PRACTICAL BEE-KEEPING

HOPKINS

PRACTICAL BEE-KEEPING

New Zealand Government Apiary, Ruakura.

WHITCOMBE'S PRACTICAL HANDBOOKS

PRACTICAL BEE-KEEPING

BEING THE

SIXTH EDITION

OF THE

AUSTRALASIAN BEE MANUAL

BY

ISAAC HOPKINS

(Former Chief Apiarist to the N.Z. Government)
Author of Government Bulletins on Bee-Culture, Nos. 5 & 18,
History of the Humble Bee in N.Z.
Hon. Life Member of South African, Queensland, and New Zealand
Bee-keepers' Associations,
Vice-President of the "Apis Club," England.

WHITCOMBE & TOMBS LIMITED

AUCKLAND, CHRISTCHURCH, DUNEDIN, WELLINGTON,
MELBOURNE AND LONDON

FOREWORD.

In reading the manuscript of the sixth edition of the "Australasian Bee Manual," one is impressed by the fact that the author's long and active connection with the business of honey production, has enabled him to see and write with great clearness on the requirements and methods of modern beekeeping. It would indeed be strange, if Mr. Hopkins, to whom the forward nature of bee-keeping in New Zealand is largely due, were not the best able to summarise the results of that development, and aid further progress by descriptions of the best working methods to be adopted.

That New Zealand has been able, in proportion to its size, to take a leading position in honey production, is largely due to the foresight and efforts of the author. He was the first to attempt commercial bee-keeping in Australasia, that is, unaccompanied by any other industry. The success attending his efforts bringing many into the business, whom he was able to guide in the right direction by supplying them with the then most up-to-date appliances used in the older countries.

His clear foresight of the requirements for the industry to develop on successful lines enabled him to make good use of his position as Government Apiarist, securing the general adoption of the standard hive, legislation preventing the use of box hives and an addition to the customs tariff of 2d. per lb. on all imported honey. These are the outstanding features that have helped in the progress of New Zealand bee-keeping.

The adoption of a specific gravity of 1·420 as a minimum standard for ripe honey is also the work of Mr. Hopkins, and has proved of immense importance in grading for export.

A life of over half a century given entirely to the progress and development of practical honey production would be productive in almost anyone, of large knowledge and experience. In the case of the author, with a vigor and mental capacity sustained far beyond the average, the fifty years of his eighty-eight years of life given up to practical apiarian development, writings and editorial work and correspondence with the leaders in the bee-keeping world, has placed him in a unique position as an instructor in bee-keeping methods.

It is pleasing to note that the Cornell University of the New York State College of Agriculture in devoting a session in discussing "the lives and work of men who have done much to make modern bee-keeping," include Isaac Hopkins as one of the seven leaders whose bee-keeping biographies have been published by the University. The other six are Francois Huber, L. L. Langstroth, Moses Quinby, Charles Dadant, Dr. C. C. Miller, and A. I. Root. This is a high but not unmerited position in the world of bee men.

The writer can sincerely recommend this book to the careful study of both those in bee-keeping, and those about to take up bee-keeping, as a means of livelihood. Its teachings are based on fifty years' experience of practical bee-keeping and a thorough knowledge of modern methods used throughout the world.

JOHN RENTOUL,

Managing Director N.Z. Co-operative Honey Producers' Association; Chairman of the Honey Export Control Board, and former President of the National Bee keepers' Association of New Zealand.

Auckland,
New Zealand.

PREFACE.

It is acknowledged throughout the bee-keeping world that New Zealand is among the most progressive countries in regard to commercial bee-keeping known at the present time, and that it produces some of the finest honey reaching the world's markets. The climate, flora, and seasons are so dissimilar in many respects to those of most other honey-producing countries that a handbook specially dealing with these peculiarities is absolutely necessary as an accurate guide for those taking up bee-keeping in New Zealand. But apart, however, from these considerations, the instructions for carrying out the various operations as detailed herein, are as suitable for the successful management of bees and the production of a maximum crop of honey in any other country as in New Zealand. In this respect, the author believes he has good grounds for stating that his past endeavours have been appreciated, seeing that his five editions of this manual have been sold out and another called for several years ago. The reason the publication of this edition has been so long delayed was owing to an unfortunate accident to the manuscript, which was dispatched to, but never reached, the publishers in London.

The practical side of modern commercial bee-keeping, together with improvements in apiary appliances, are making such rapid forward strides that no hard and fast rules can be laid down in the management of the apiary that will meet all circumstances as they arise. The fact is, we are still learning, and they are the most successful who realise this, and act accordingly. The best an instructor can do is to keep himself posted with the most forward movements throughout the bee-keeping world, and with the result of his own experience and ripe judgment impart that which has proved the most successful, as well as specifying the principles that govern all phases of bee management. It was a wise reflection of the late Mrs. L. Harrison, the clever American bee-keeper, and writer, who remarked that "Bees do nothing invariably." Such is the case, as every experienced bee-keeper will readily testify, and that being so, it follows that the successful bee-keepers are those who are skilful enough to deal with the unexpected, which, as it implies, cannot be foreshadowed in a manual.

For the reason that we have no fully established Government entomological bureau to which I could have applied for some original notes on the natural history of the hive bee, I could only touch briefly on the subject, and therefore devoted most of the volume to the practical side of bee-culture, which I trust will be found fully up to date.

I have to thank the Director of the Horticultural Division, Mr. J. A. Campbell, for kindly allowing his staff to furnish me with information asked for; also Mr. E. A. Earp, Senior Apiary Instructor, for valuable notes on the present status of New Zealand bee-keeping; and to Mr. John Rentoul, for looking through the proofs and making suggestions. Many of the illustrations were in the previous editions, but there are a number of new ones borrowed from standard bee publications, and from my photos.

I. HOPKINS.

Auckland, New Zealand.

CONTENTS.

Page

CHAPTER XIV.

Swarming.

CHAPTER XV.

Select Queen Rearing.

CHAPTER XVI.

Securing Surplus Honey.

CHAPTER XVII.

Preparation of Honey for Marketing.

LIST OF ILLUSTRATIONS.

PRACTICAL BEE-KEEPING

CHAPTER I.

INTRODUCTION.

Bee-keeping for the production of honey and beeswax on commercial lines is one of the most ancient industries of which we have any record. It was carried on extensively in those parts of Asia, Africa, and Europe, bordering on the Eastern end of the Mediterranean Sea many hundreds of years before the Christian era, and we may conclude that it was in a flourishing condition in Greece 600 years B.C., when Solon, the great Athenian legislator, instituted laws regarding the keeping of bees. The esteem in which the chief product of the honey-bee was held in those days may be judged by its name being used in combination with that of milk, the most universal of all foods, to form the Oriental metaphor denoting abundance—"a land flowing with milk and honey."

Bee-keeping in those comparatively early times was carried out in a very primitive fashion, the Asiatic hives being mostly constructed of dried clay of tubular form placed singly or in groups, while in some parts wickerwork plastered with mud or dried camel-dung, and also tubes of bark, being in use. Strange to say that after more than 3,000 years these primitive hives are still in use by natives.

Modern Art of Bee-keeping.

To the researches of Huber, and Dzierzon, in the latter part of the 18th, and early part of the 19th centuries, we are chiefly indebted for that knowledge of the physiology of the honey-bee which led to the better understanding of its management, and indirectly to the invention of the first of the modern appliances. About the year 1845 Dzierzon invented a movable-frame hive, and a few years later—1851—the Rev. L. L. Langstroth, without knowledge of the former's invention, gave us the hive which is now so popular in all bee-keeping countries, and which is a vast improvement on the Dzierzon hive. Subsequently,—in 1868—an Austrian major (von Hruschka) invented the honey extractor, the principle of which is the same as the modern improved extractors,—extracting honey from the combs by centrifugal force. The third, and in many respects the greatest invention in my opinion was that of comb-foundation impressed with the basis of worker cells. This was the work of more than one individual that eventually led up to the production by A. I. Root of full sheets of this material in 1877, which was not only an immense advance in itself, but it was the means of developing to the fullest extent the advantages of the movable-frame hive and the honey extractor. I have always considered that it is correct to date the commencement of our modern system of bee-culture in that year.

Introduction of the Honey-Bee into Australasia.

Although the author has, on previous occasions, given full particulars of the introduction of bees into this part of the world, he deems it well to briefly keep on record the dates of the introduction of the several varieties of the honey-bee (*Apis mellifica*). Previous to such introduction from the Old World there was no variety of the honey-bee in any part of Australasia.

The common, or what is generally known as the "black bee," was introduced into New South Wales from England in April, 1822, by Captain Wallace, of the ship *Isabella*, and it is pretty certain that Italian bees were landed in that State in 1862, but I have not ascertained that they were successfully established, so I conclude they were not. It is, however, indisputable that Italians brought by Mr. Chas. Fullwood from England to Queensland in 1880, were successfully established, and it has never been contradicted that it was the first successful venture to introduce this variety of the honey-bee into Australia. Victoria, South Australia, Queensland, and Tasmania were furnished at different times with their first honey-bees from the parent State.

The author had the honour, in the season of 1877-8, of being the first to introduce the Langstroth frame-hive, the improved honey extractor, and comb-foundation into Australasia; and by a series of articles in the Press drew the attention of persons interested in bee-culture to the improved system of bee management. Letters were received by me from all parts of the Australasian Colonies, asking for further information, which was subsequently supplied in the first edition of this Manual. It is correct to say then, that what is usually termed the "Modern System" of bee-keeping commenced in Australasia in 1878.

Bee-keeping in New Zealand.

New Zealand is indebted to the late Miss Bumby, sister of one of the early missionaries, for the first of the common bees, which she brought with her from England in the ship *James*. They were landed at Mangunga, Hokianga, on March 13th, 1839. Others were subsequently brought from England, and New South Wales, in the year 1842. The first Italian bees were landed in Auckland from California, to the order of Mr. J. H. Harrison, then of Coromandel, and to the author in 1880. In 1883 I imported Italians (direct from Italy), Swiss Alpine, Syrians, Holylanders, Cyprians, and Carniolan bees, also from their respective countries, which I succeeded in establishing; their comparative merits are given in Chapter II.

Climate, Flora, and Rainfall.

For carrying on commercial bee-keeping under the best conditions and at the same time raising some of the finest honey the world produces, New Zealand can scarcely be beaten. Its climate, flora, and rainfall is almost all one could wish; the mean summer temperature in the northern part of the North Island is 65·2, and the winter mean, 52·2, while in the southern part of the South Island it is 57·2 and 43·0 respectively. The mean annual rainfall is 53·63in. at the extreme north of the Dominion, and 46·43in. at the extreme south. The foregoing figures are for a five-year period. The two islands extend over about twelve degrees of south latitude, from 34 to 45 degrees, in round figures.

Most of our native flora yields nectar in great abundance, some of it very fine, but white clover is the chief source of the honey that has brought the New Zealand article into such good repute the world over. Dairying, and allied agricultural industries for which the country is so well adapted, and on which we depend for the country's welfare, accounts for our great stretches of clover pastures, which may be said to extend from one end of the Dominion to the other over all cultivatable lands. We have, like bee-keepers in other countries, occasional drawbacks in the shape of indifferent seasons when the crop of honey runs short; on the other hand, we have no wintering problem, with inevitable loss of bees, such as they have in the colder parts of the northern hemisphere. Take it all in all, there is no country in the world I would choose before New Zealand for commercial bee-keeping.

Profits of Bee-keeping in New Zealand.

Naturally, one of the first questions asked by those who contemplate taking up bee-keeping for a livelihood is, what are the annual profits that may be expected from each colony? It is easy to show what results are attained in some cases, but it would be dangerous to apply such results as a measure of success or failure to every case. So much depends upon the skill and perseverance of the apiarist, the location of the apiary, and the commercial ability brought to bear in the management, that it is necessary to be very guarded in one's reply. Under favourable conditions with regard to locality and bee forage, a reasonable sized apiary, and a skilful and persevering man in charge, an annual net profit of £1 or over may be expected per colony through a series of years, and I consider this well within the mark. As will be seen further on, our Senior Apiary Instructor's estimate is much higher, and probably, with the greatly improved condition of commercial bee-keeping in New Zealand, and the greater demand for our honey, he may be nearer the mark than my estimate. It is a rule, however, that with largely increased operations, and the establishment of out-apiaries, the average profit per hive diminishes. No doubt this may be accounted for by the inability of the apiarist to give each individual colony so large a share of attention.

The Progress of Bee-keeping in New Zealand, and Its Present Status.

I am indebted to our present Senior Apiary Instructor, Mr. E. A. Earp, for some interesting and reliable information on the above subjects, of which I have permission to make extracts for the purpose of this Manual. It is an appropriate supplement to the foregoing, and of an official nature.

New Zealand has been termed a bee-keeper's paradise. This is to some extent borne out by the equability of our climate, the vast areas of country available for commercial bee-keeping, the almost total absence of the wintering problems experienced in less favoured countries, and the present state of the business organisation of the industry. There is no part of New Zealand where a few colonies of bees cannot be kept profitably, whilst the greater part of the country adapts itself admirably to commercial bee-keeping on a large scale. The rich dairy pastures of both Islands, and localities where cattle-raising is carried on extensively, in addition to the native bush areas, afford very favourable possibilities to those who are desirous of engaging in the business.

Since the passing of the Apiaries Act in 1906 the industry has been carefully fostered by the State. Under the Act, provision is made for the appointment of Instructors and Inspectors to administer its provisions, to give instruction in general apiculture, to control disease, and to give helpful advice on the care and management of apiaries. There are now six officers engaged in the above direction, and they are kept busy throughout the year attending to the wants of bee-keepers. In addition to the above officers, the Department has organised a scheme for the employment of commercial bee-keepers as part-time inspectors.

The Apiaries Act is now working smoothly, and is considered to be the most complete in the world, as it is based on the recognition by the bee-keepers that proper control is best for the industry as a whole.

Reference to the statistics compiled by the Government Statistician indicates that the industry has undergone a remarkable expansion in production. The number of bee-keepers has declined substantially since 1916, yet the output of honey has nearly trebled, showing that the business, as was to be expected, is rapidly falling into the hands of specialists who devote their whole time to it. The undermentioned figures amply illustrate the progress made:—

Year	No. of Apiaries	No. of Hives	Honey Production During the Year	Beeswax Produced
1916	15,296	74,311	1,003,940 lbs.	31,682 lbs.
1921	8,427	85,861	2,807,346 lbs.	51,180 ,,
1923	4,895	76,573	2,980,037 lbs.	60,256 ,,
Aug. 1924	6.275	89,299	—	—
Mar. 1925	7,000	99,755	—	—

Honey Exported.

The following was furnished by the Customs Department:—"The quantity of honey exported from New Zealand since the coming into force f the Grading Regulations in 1915, to June 1924 is as follows: Quantity 3,088 tons 896 lbs., valued at £221,381."

Prior to the passing of the Apiaries Act in 1906, our young industry was in a precarious condition owing to the ravages of foul brood, but thanks to judicious legislation to control disease, and the weeding out of careless bee-keepers engendered thereby, there has been a wonderful revival as shown in the above figures. It is remarkable that while there has been a falling off in the number of bee-keepers the output of honey has nearly increased threefold, and beeswax nearly doubled, indicating that men of skill and determination are in the lead, living solely from honey production. The fact that the industry has been well-founded is a leading factor in tempting many to enter the business. Combined with this are the assistance and watchfulness of the State. Quite a number of apiaries exist in the North and South Islands containing 200 colonies upwards, and in some cases there are bee-keepers owning over 1,000 colonies. It is difficult to quote reliable estimates of income on account of the "off" seasons, but it may be said with confidence that the income from well-conducted apiaries should average between £1 5s. and £1 15s. per colony through a number of successive seasons.

For those who wish to learn the business of apiculture, the New Zealand Department of Agriculture conducts a commercial apiary. It is located at the Ruakura Farm of Instruction, Hamilton East. Cadets wishing to gain an insight into the business are taken for a six months' practical and theoretical course. At the conclusion of the course—which includes attention to the hives, lectures, and demonstrations on modern methods of apiculture—examinations are held and certificates of competency issued. The Ruakura Apiary was established in 1906, and during the seventeen years of its existence has proved valuable for training cadets, in addition to raising large numbers of queen bees for sale.

Further, it has offered facilities for carrying out experiments with regard to various phases of practical apiculture and for testing the value of apiary appliances.

Perhaps no country in the world is more fortunately placed than New Zealand in regard to standard bee-keeping equipment. To America, to which we owe the best features of modern bee-keeping we are indebted for the most popular form of hive at the present time—The Langstroth — which is practically the standard hive for the whole of Australasia. It is recommended by the Department first because it is considered to be the best of those now in use, and secondly it is in general favour in every part of the Dominion. For the above reasons alone manufacturers of hives are able to supply them cheaper on account of having to keep only one class of hive in stock. With few exceptions the 10-frame hive is used with Hoffman frames, although latterly a few of the commercial men have adopted the 12-frame hive.

In 1913 the Apiaries Act was amended and provision made for the registration of all apiaries. Every person who keeps bees and has not applied for registration is liable to penalties under the Act. The system of registration has been of great assistance in locating bee-keepers who otherwise would have escaped notice; thus a more thorough inspection is carried out when Inspectors are working in a district. Before the registration of apiaries came into force it was almost impossible to obtain accurate returns as to the growth of the industry and the number of persons keeping bees. Previously the only data compiled was that taken by the Government Statistician when a census was made every five years. In addition to registering his apiary the bee-keeper is called upon to furnish returns as to his crop of honey and beeswax. The information gleaned is useful as showing the expansion of the industry from time to time.

Advice to Beginners.

Bee-keeping is suitable to either sex, and I would strongly advise all young people contemplating taking it up as a business to engage for a full season with a successful bee-farmer, starting early in the season, and remaining till the honey is prepared for market in the following autumn. The experience gained in that time would enable the beginner to start intelligently and avoid the mistakes one may readily fall into without such experience. I offer this advice with the knowledge of the good results from taking cadets at the Government Apiaries.

If it is impossible to adopt this plan, then go cautiously to work at first, and don't lay out too much money. Three or four colonies your first season would be ample to work with, and to gain experience by. Some little increase the second season would be advisable, by the end of which sufficient knowledge of the work and your fitness for it should have been gained to enable you to intelligently decide whether to increase your apiary or not. If you decide to go into the business commercially, then it is absolutely necessary for your success that you choose a district where there is plenty of white clover grown, a dairying district for instance. Purchase your first bees from a reliable commercial bee-keeper, and if he can supply blacks or hybrids at a cheaper rate than pure Italians, take them and Italianize them later (see chapter on "Queen Rearing"), and don't stint your outlay for good bee literature, as one good wrinkle gained may be the means of saving scores of pounds.

Bee-keeping for Women.

Commercial bee-keeping is as suitable for young women as it is for the opposite sex, as proved by the number that have taken up honey-raising commercially since undergoing a season's training at the Government Apiary; up to the present time over 80 young woman cadettes have received tuition at that apiary, and no doubt many more at private apiaries. The work is not arduous, and well within the strength of the average young woman, and moreover, commercial bee-keeping is a healthy outdoor life. The following illustrations are reproductions from photos taken at the Government Apiary, and show the then manageress and a lady cadette at work. They are not in their work-a-day bee dress, for lady-like they preferred their usual costume to appear in the photos.

Fig. 1. Part view of Apiary, and first honey house.

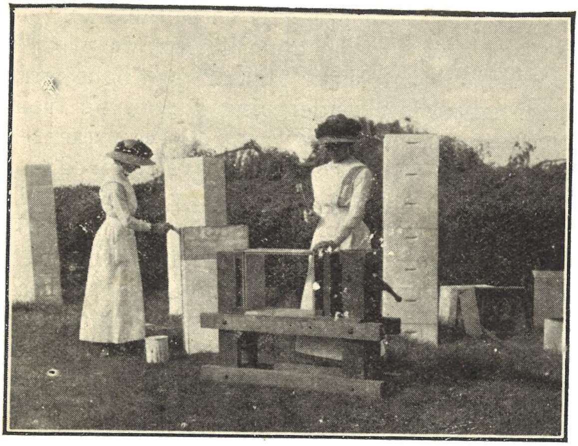


Fig. 2. Making and painting hives.

Fig. 3. Opening hive, first operation.

Fig. 4. Opening hive, second operation.

Fig. 5. Examining super comb.

Fig. 6 Brushing bees off comb.

Fig. 7. Putting on a super.

When to Start.

Spring is the best time to start, and early October for choice; do not commence in late summer or autumn unless under the guidance of an expert bee-keeper. Make your arrangements for what number of colonies you require a few weeks beforehand to reach you at the latter end of September or early October, and stipulate that the queens shall have been bred not earlier than the previous season, and that the apiary is free from disease.

CHAPTER II.

THE HONEY-BEE AND ITS VARIETIES.

There are many species of the genus Apis, or Bee, but only one which stores honey in such a manner as to be practically useful to man, and which Linnæus distinguished by the name *Apis mellifica.* The particular variety of this species known to Linnæus was the "black" or common bee. Since the beginning of the nineteenth century other varieties were observed and described by Spinola, and were at first classed as distinct species, but as the interest of the foremost bee-keepers in all countries is now chiefly centred in Italian bees, I will only briefly describe the characteristics of the other varieties with which I have had experience.

The black or common bee is inferior to the Italian in every way, proved by the fact that it is being superseded by the latter in all commercial bee-keeping countries; one of its worst features being that it is unable to defend itself against the ravages of the large wax moth—*Galleria mellonella.* Carniolan bees are prolific breeders, but too much given to swarming, and as honey gatherers far inferior to Italians. Syrians and "Holy Landers" I found much alike regarding their qualities, but again much below Italians. I soon superseded them with queens of the latter variety. Cyprians are splendid workers, but ugh! outrageously vicious, so much so indeed that after two years' experience I was compelled to destroy them, as it was simply impossible to handle them without being tortured by stings. Smoke, the usual quieter, only made them more vicious, and this was the experience of those I supplied with Cyprian queens before I discovered their vile character—I replaced them with Italian queens. I have seen Cyprians favourably mentioned in respect to handling, on one or two occasions; all I can say to this is that my Cyprian queens came direct from Cyprus, so that they were pure, and when I had them I was no novice at handling bees. Even worse in this respect was a cross strain between Cyprians and Italians that I raised; they would tackle the hot tin part of the smoker; but they were the best workers I ever had.

Italian Bees.

Take them all in all, Italian bees are undoubtedly the best, and I affirm this after an experience with all the other varieties named, and a long acquaintance with the favourite bee. They are readily improved by judicious breeding, are good honey gatherers, excellent defenders of their hives from robbers and the wax moth, and can battle against disease better than the common bee. That it is the most profitable bee to cultivate is almost the universal opinion of advanced apiarists.

Markings of Pure Italians.

It is well for the novice to be able to distinguish the difference between pure Italians and their crosses (Hybrids). Formerly, it was seldom that more than three yellow bands across the abdomen were seen on pure Italians, but of late years it has not been uncommon to see four and even five yellow bands. There should not, however, be less than three.

Referring to the illustration, A B C, Fig 8, represent the three yellow semi-transparent bands; D E, and the shaded parts of A B C, are rows of greyish hairs. The three yellow bands should, be plainly visible, though the band A, next the thorax, is sometimes very narrow, and may be overlooked at the first glance. The surest test of a pure colony, is that **all** the bees carry the three yellow bands.

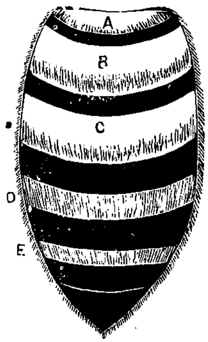


Fig. 8.
Abdomen of Italian Worker Bee.

There are light golden, and leather-coloured strains, but it is generally considered that the latter are the hardiest bees.

Hybrid Bees.

This is the name generally given to the cross between the Italian and black or common bees. Much has been said for and against hybrids, but from experience I feel satisfied that bees of the first cross between the Italians and blacks are in many cases equally as profitable as pure Italians. With regard to docility in handling, it is generally understood that hybrids are exceedingly vicious. While this may be true in some cases, I must say, after handling many thousands of hybrid colonies, that I have found very few indeed worse than some of the pure races I have had to do with. The worst bees I have noticed in this respect were nearly pure blacks, with a small dash of Italian blood in them. I advise, however, the cultivation of the pure variety.

CHAPTER III.

INMATES OF THE HIVE—THEIR NATURAL HISTORY.

Every colony of bees in a normal working condition during the swarming and surplus honey season contains bees of three different kinds, the characteristics of which are explained, and their relative sizes shown in Figs. 9, 10, and 11. First, one bee only of the peculiar form which denotes the queen or mother bee (one queen to a colony being the rule in nature); secondly, a number of large bees called drones, and thirdly, many thousands of a smaller kind known as worker bees, and which are those seen flitting about on flowers gathering nectar and pollen; neither the queen nor drones work outside the hive.

The queen is indispensable to the prosperity of the colony. She is the only perfectly developed female, and lays all the eggs, of which she can, on occasions, produce two to three thousand in twenty-four hours over a considerable period, and probably more in the height of the honey season. Without her the colony would soon dwindle down and die out, or be attacked and killed for the sake of its stores, as, after being deprived of their queen, the workers generally (unless they are in a position to rear a new one, as will be seen further on) lose the disposition to defend themselves and their home. The queen is not provided with the special organisation which enables the workers to gather honey and pollen and to secrete wax. She is furnished with a sting, which, however, she very rarely uses, except in a struggle with a rival queen. When she has been once impregnated, and has taken her place in a hive, she never leaves it except to accompany a swarm.* Her term of life under natural conditions in cool climates where she has a long rest in winter from egg-laying may reach three or even four breeding seasons, but in the mild climate of Australasia, where in most parts breeding is going on the greater part of the year, she has passed her prime before the end of her second season (see chapter on "Queen Rearing"). She can be readily distinguished from her offspring by the following description and illustration:—

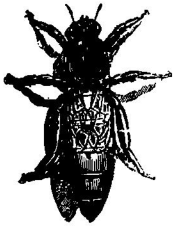


Fig. 9.
The Queen.

Fig. 10.
The Drone.

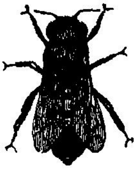


Fig. 11.
The Worker.

(Relative sizes enlarged)

Her body is not so bulky as that of a drone, though longer; it is considerably more tapering than that of either drone or worker; her wings are much shorter in proportion than those of the other bees;

*This has been disputed, but the claim that queens may leave the hive to be impregnated a second time has not been fully substantiated.

the under part of her body is of a lighter and the upper of a darker colour than the worker's; her movements are generally slow and matronly, and indeed she looks every inch a queen.

The drones, or male bees, are much stouter than either the queen or the workers, although their bodies are not so long as that of the queen. They are neither furnished with a sting nor a suitable proboscis for gathering honey, no baskets on their legs for carrying pollen, and no pouches on their abdomens for secreting wax, so that they are physically incapable of doing the ordinary work of the hive. Their office is to impregnate the young queens, but very few have the chance of doing so; those that have, die immediately afterwards, and the rest are usually destroyed by the workers at the end of the swarming season or main honey flow, having by this time become an incumbrance only.

The worker bees, the smallest in size, constitute the bulk of the population of the hive. A good-sized first swarm should contain at least twenty-five thousand, and a well-stocked hive, during the full working season, will have twice, and sometimes three times, that number of workers. They are all females, but not fully developed as regards their sexual organization—they are incapable of being impregnated by the drones; but in some rare cases their ovaries are sufficiently developed to admit of their laying eggs, which, however, as will be shown later, are unfertilized, and produce only drones. On the other hand, these workers are specially provided with the means of successfully prosecuting their useful labours. They have a wonderfully constructed tongue, or proboscis, which enables them to suck or lap up the liquid sweet from the nectaries of blossoms, and to store it in a "honey sac," which is, in fact, a first or extra stomach, from which they can again disgorge it at will into the cells of their combs. Their hinder legs are provided with a hollow, or "basket," for carrying pollen, which they are enabled, by the use of their front legs and their proboscis, to work up into little pellets, and pack in these receptacles. They have the power of secreting wax in small scales under the folds of the abdominal rings of their body, and they are furnished with a sting to protect themselves and their stores, and of which they make effective use when provoked. They perform all the work both inside and outside the hive; collect the materials for honey, bee-bread, and propolis; carry water, secrete the wax, build the combs, nurse and feed the young brood, ventilate the hive, and stand guard at the entrance when it is necessary to keep out intruders. Although division of labour is beautifully exemplified in the economy of the hive, still there are not separate classes of worker bees (as was at one time supposed) to perform the different sorts of work; on the contrary, every worker bee is capable of doing all these things, and they take their turns accordingly. "One bee in her time plays many parts." The young bees are employed on "home duty" for the first week or two; they then take their turn of outdoor work, and are gradually worn out in the service. Their term of life is short, varying from only six or seven weeks in the busiest working season to nearly as many months after that busy time is past.

Structural Organization.

In a practical work of this kind it is only necessary under the above head to touch upon the chief organs of the queen and worker bees and their functions.

Head of a Worker Bee.

Within the small limits of a bee's head there are contained several important organs, some of them of a very complex nature. These are—the compound eyes; the simple eyes, or stemmata; the mouth and its appendages; and the antennæ. The following engraving shows a front view (on a greatly magnified scale) of a worker bee's head:—

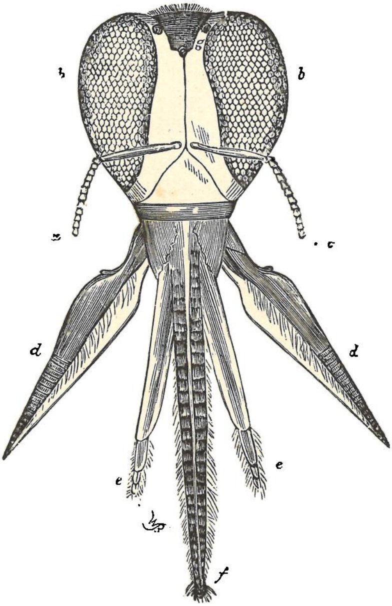


Fig. 12. Head of Worker Bee.
a. Antennæ; *b*. Compound eyes; *c*. Jaws; *d*. Maxillæ; *e*. Lateral palpi; *f*. Ligula, or tongue; *g*. Stemmata.

The Compound Eyes are shown at *b b*, at right and left at top, and the simple eyes between them.

Each compound eye is composed of something like 3,500 hexagonal convexities, or facets, which according to Cheshire are about one-thousandth of an inch in diameter and are independent instruments of vision. The compound eyes are believed to be used chiefly for distant vision, and the simple eyes for objects near at hand.

The Antennæ (*a*) are wonderful structures under the microscope. That they are organs of touch—"feelers"—there can be no doubt, and that they also perform the functions of hearing and smelling, although an open question at present, is generally believed by naturalists.

The Mouth Parts consist of several organs, as shown in the figure, the chief of which is the tongue. The end of this organ at (*f*) is covered with whorls of hair, and is furnished with a spoon-shaped hollow on the under side, opening into a capillary tube on the upper side, into which the liquid passes when the bee is sipping. Herman Muller, in his great work on "The Fertilization of Flowers," beautifully describes the process of the bee gathering nectar. He says:—

"When the bee is sucking honey which is only just within her reach, all the movable joints of its suction apparatus, cardines, the chitinous retractors at the base of the mentum, laminæ (maxillæ), labial palpi, and tongue, are fully extended, except that the two proximal joints of the labial palpi are closely applied to the tongue below, and the laminæ to the mentum and hinder part of the tongue above. But as soon as the whorls of hair at the point of the tongue are wet with honey, the bees, by rotating the retractors, draw back the mentum, and with it the tongue, so far that the laminæ now reach as far forward as the labial palpi; and now labial palpi and laminæ together, lying close upon the tongue, and overlapping at their sides, form a tube, out of which only a part of the tongue protrudes. But almost simultaneously with these movements, the bee draws back the basal part of its tongue into the hollow end of the mentum, and so draws the tip of the tongue, moist with honey, into the tube, where the honey is sucked in by an enlargement of the foregut, known as the sucking stomach, whose action is signified externally by a swelling of the abdomen.''

Doubts have been expressed as to whether the bee empties the contents of its honey sac into the cells through its proboscis or simply through its mouth; but the statement of Muller, that when gathering pollen from some kinds of flowers the bee ejects a little honey on the anthers through its suction tube —which in another part of his work he calls the ''proboscis'' for shortness—would incline us to suppose that the honey may be ejected into the cells in the same manner.

The maxillæ, or so-called lower jaws, form the under sheath of the ligula and palpi when at rest, and the whole organ is then folded under the lower part of the head.

The Sting of the Worker.

The sting of the worker bee is a very complicated organ, as will be seen by a study of the following engraving, taken from Root's ''A B C of Bee Culture.''

In the general view of the sting, *I* is the double gland which secretes the poison; *A*, the cylindrical reservoir in which the poison is collected from the glands, and from which it is transmitted through hollows in the spears or lancets to the wound; *B*, the two barbed lancets; and *D*, the third spear or awl, usually styled the sheath, in which the other two partly slide when at work. In the cross section (greatly enlarged) of the lancets, at the point *D*, it will be seen how the two hollow lancets, *A* and *B*, slide on ribs or guides in the concave side of the so-called sheath, *D*. They have tubes, *F* and *G*, through which, as well as through the tube *E*, formed between the three parts of the sting, the poisonous fluid is transmitted. There is a hollow, *C*, in the awl or sheath, *D*, but it is only for strength and lightness, and is not open either above or below. In the barbed lancets, the end of one of which is shown, greatly magnified, there are grooves, *G*, to fit on the ribs of the sheath, and the poison, which is conveyed down the hollow tube inside of each, finds vent by small side openings to the barbs at *H H*. It appears that when the wound is first pierced by the smooth and highly polished point of the awl, *D*, a sliding motion is communicated to the barbed lancets by the muscles shown at *J* and *K*, and the poison is **pumped** into the wound through the centre cavity, *E*; the barbed lancets are then driven in by alternate motions, and at the same time the centre cavity is closed by valves at the root of the sting, and the poison is forced through the tubes in the hollow lancets, and through the side openings near the barbs, and having once penetrated any tough material, such as the human flesh, cannot be withdrawn by a direct pull. The bee if left to itself will work in a circle in its endeavour to withdraw the sting, but if it be abruptly shaken or brushed off, the whole sting is torn out of its body and left behind. In that case the muscles will continue to work and to force poison into the wound for some time, if the sting be not carefully extracted, which should be done without squeezing the poison reservoir at its base. The injury occasioned to a bee by the tearing out of its sting must be very severe, and it has been generally supposed that they die immediately afterwards. The late Sir John Lubbock (Lord Avebury), however, in his work on "Ants,

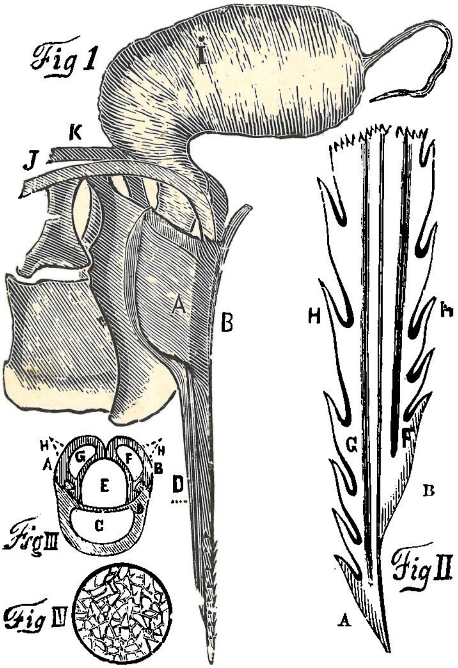


Fig. 13. Sting.

I. Worker sting, magnified; II. Barbed Lancet; III. Cross section of Lancet; IV. Drop of poison, crystallised.

Bees, and Wasps," says: "Though bees that have stung and lost their sting always perish, they do not die immediately, and in the meantime they show little sign of suffering from the terrible injury." He mentions having seen a bee after losing its sting, remain twenty minutes on the floor-board, enter the hive, return in an hour, feed quietly on some honey, and again return to the hive.

It is said:—"1. The poison of the hymenoptera is always acid. 2. It is composed of a mixture of two liquids, one strongly acid, the other feebly alkaline, and acts only when both liquids are present. 3. These are produced by two special glands that may be called the acid gland and the alkaline gland. 4. These two glands both expel their contents at the base of the throat from which the sting darts out."

The Honey Sac.

This is merely a widening of the œsophagus, forming a first stomach, in the anterior part of the abdomen, a sort of ante-chamber to the true stomach, which is very different in shape, and which is followed by the intestines leading to the anus, or vent. Everything passing from the mouth to the stomach must go through the honey sac, but the bee has the power of retaining the nectar in this sac, and afterwards disgorging it through the mouth, without letting it enter the true stomach at all. Connected with the œsophagus, in front of the honey sac, there are important glands in the head and in the front part of the abdomen, which secrete the so-called salivary juice, which, as Professor Cook states, "aids in kneading wax, etc., as already described. It also probably aids in modifying the sugar while the nectar is in the bee's stomach." This would account partly for the difference observable between honey and other merely saccharine matter.

Reproductive Organs of the Queen.

The most important organs of the queen bee—themselves forming perhaps one of the most wonderful objects of nature, and of which the very accurate knowledge which we now possess, owing to the patient researches of many naturalists, has done more than aught else for the progress of scientific bee-culture—are her ovaries and the parts attached thereto, which are illustrated in the following engraving.

The two fig-shaped bodies are the ovaries, which are multitubular, there being more than a hundred tubes (called the ovigian tubes) in the two ovaries of a queen bee. In these tubes the eggs grow and develop until they are fit to be deposited. Each ovary has a separate oviduct at bottom, through which the eggs pass for some distance, until the two join in one common oviduct leading to the vulva, or vent, through which the eggs are ultimately deposited. A little below the junction of the passages from the two ovaries, and on the outside of the common oviduct, is a small globular body, shown on the right hand side in the engraving. This is a hollow vessel, called the spermatheca, of which much has to be said. More than two hundred years ago Swammerdam published an excellent illustration of the ovaries of a queen bee, showing the spermatheca, but he conjectured that it secreted a fluid for sticking the eggs to the bottom of the cells in the comb. In his time but little was known of what went on within the hive. It was no doubt assumed by many that every single egg laid by the queen required to be fertilised by a separate act of the drone, while Swammerdam himself conceived the idea that no copulation was necessary, but that some gaseous emanations from the body of the drone produced fecundation by penetrating the body of the queen. About a hundred years later great advances were made in the knowledge of the physiology of the bee.

It is said that Jansha, apiarist to the Empress Maria Theresa of Austria, discovered the fact that young queens have to leave the hive to meet the drones; but it is to the labours of Huber in 1787 and following years, and communicated in his letters addressed to Bonnet in the years 1789 to 1791, that we owe the

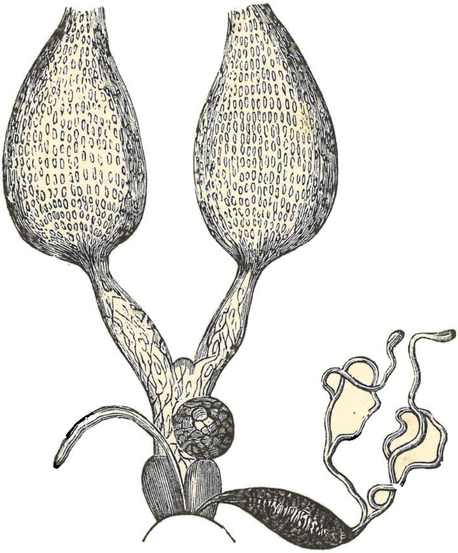


*Fig. 14. Ovaries of Queen.

first knowledge of the following main facts:—1. That the queen bee is truly oviparous; that what she deposits is a true egg, which takes three days to produce a living maggot or larva—(even the great Bonnet was inclined up to that time to believe that a minute worm, and not an egg, was produced by the queen). 2. That the queen must be impregnated by the drone in order to become fertile. 3. That

*The illustration must not be accepted as an exact representation of the ovaries, but near enough for the purpose.

copulation is accomplished outside the hive and while on the wing high in the air. 4. That one impregnation was sufficient to fertilise all the eggs laid by the queen subsequently for two years at least, perhaps for life. 5. But that if the act of impregnation was delayed beyond the twenty-first day of the queen's life, her eggs would afterwards produce only drones. Huber also proved that queens could be reared from the larvæ of worker eggs, and also that in some rare cases workers were able to lay eggs, which, however, could only produce drones. He investigated other matters of the greatest importance to the science of bee-culture, and was gratefully designated "The Prince of Apiculturists" by Langstroth. He failed, however, to discover the secrets of the spermatheca, and remained under the false impression that the fertilization of the eggs took place in the ovaries and that there were two kinds of eggs, one sort to produce workers and queens, the other to produce drones, and that they occupied separate portions of the ovaries. His contemporary, Schirach, who also contributed much to apiarian science, supposed that one branch of the ovaries contained the one kind and the second branch the other kind of fertilized eggs. In this state the science remained for some sixty years. Langstroth said it is now ascertained that Posel, in a work published in Munich in 1784—therefore previous to the experiments of Huber—"describes the spermatheca and its contents and the use of the latter in impregnating the passing egg"; and also that "years ago the celebrated surgeon John Hunter and others supposed that there must be a permanent receptacle for the male sperm opening into the oviduct." Nothing certain was known, however, until 1845, when the brilliant discoveries of Dzierzon led to the promulgation of the theory which bears his name, and especially to the doctrine of

Parthenogenesis.

The late Professor Cook, himself an eminent entomologist, and the author of a notable work on practical bee-keeping, said:—"This strange anomaly—development of the eggs without impregnation—was discovered and proved by Dzierzon in 1845. Dr. Dzierzon, who as a student of practical and scientific apiculture must rank with the great Huber, is a Roman Catholic priest of Carlsmarkt, Germany. This doctrine—called Parthenogenesis, which means produced from a virgin—is still doubted by some quite able bee-keepers, though the proofs are irrefragable."

It is not necessary to go into all the details of observations and experiments by which the case has been proved; I shall therefore only add the thirteen "propositions" of the Dzierzon theory, which are generally accepted in almost every particular, and which have been discussed by the Baron von Berlepsch, in his excellent work on the subject:—

"1. A colony of bees, in its normal condition, consists of three characteristically different kinds of individuals—the queen, the workers, and (at certain periods) the drones.

"2. In the normal condition of a colony, the queen is the only perfect female present in the hive, and lays all the eggs found therein. These eggs are male and female. From the former proceed the drones; from the latter, if laid in narrow cells, proceed the workers, or undeveloped females; and from them also, if laid in wider, acorn-shaped, and vertically suspended, so-called royal cells, lavishly supplied with a peculiar pabulum or jelly, proceed the queens.

"3. *The queen possesses the ability to lay male or female eggs at pleasure, as the particular cells she is at the time supplying may require.

"4. In order to become qualified to lay both male and female eggs, the queen must be fecundated by a drone, or male bee.

"5. The fecundation of the queen is always effected outside of the hive, in the open air, and while on the wing. Consequently, in order to become fully fertile, that is, capable of laying both male and female eggs, the queen must leave her hive at least once.

"6. In the act of copulation, the genitalia of the drone enter the vulva of the queen, are there retained, and the drone simultaneously perishes.

"7. The fecundation of the queen, once accomplished, is efficacious during her life, or so long as she remains healthy and vigorous; and when once become fertile, she never afterwards leaves her hive, except when accompanying a swarm.

"8. The ovaries of the queen are not impregnated in copulation; but a small vesicle, or sac, which is situated near the termination of the oviduct, and communicating therewith, becomes charged with the semen of the drone.

"9. All eggs germinated in the ovary of the queen develop as males, unless impregnated by the male sperm when passing the mouth of the seminal sac or spermatheca when descending the oviduct. If they be thus impregnated on their downward passage (which impregnation the queen can effect or omit at her pleasure) they develop as females.

"10. If a queen remain unfecundated she ordinarily does not lay eggs. Still exceptional cases do sometimes occur, and the eggs then laid produce drones only.

*This is now questioned by eminent authorities. It is believed that the smaller size of the cell in worker comb through pressure on the abdomen of the queen brings in play muscular action involuntarily, which causes the laying of worker eggs.

"11. If, in consequence of superannuation, the contents of the spermatheca of a fecundated queen become exhausted; or, if from enervation or accident, she loses the power of using the muscles connected with that organ, so as to be unable to impregnate the passing egg, she will thenceforward lay drone eggs only, if she lay at all.

"12. As some unfecundated queens occasionally lay drone eggs, so also in queenless colonies, no longer having the requisite means of securing a queen, common workers are sometimes found that lay eggs, from which drones only proceed. These workers are likewise unfecundated, and the eggs are uniformly laid by some individual bee, regarded and treated more or less by her companions as their queen.

"13. So long as a fertile queen is present in the hive, the bees do not tolerate a fertile worker. Nor do they tolerate one while cherishing the hope of being able to rear a queen. In rare instances, however, exceptional cases occur. Fertile workers are sometimes found in the hive immediately after the death or removal of the queen, and even in the presence of a young queen, so long as she has not herself become fertile."

Development from Egg to Bee.

The egg, when laid, is attached to the bottom of the cell at one end by some glutinous substance with which it is coated. When greatly magnified it appears covered with a sort of delicate network, which is, in fact, its shell, and it has a yolk and surrounding white, or albumen, like all eggs of birds or reptiles. When deposited in a worker cell, it remains unchanged in outward appearance for three days, when the larva first appears as a minute worm, and goes through the stages of development shown in the following figure; the numbers underneath denoting the age, in days, from the laying of the egg.*

1 3 4 5 7 15 18

Fig. 15. From the egg to the bee.

The larva, when it emerges from the egg, is fed by the workers, which act as nurses, with a mixture of bee-bread, honey, and water, the two first-mentioned materials having undergone a partial digestion in the stomachs of the bees, and been converted into a species of chyle. Whether the water is mixed with the food so prepared, or is required for the process of digestion to prepare it, certain it is that during the breeding time great numbers of bees are to be seen imbibing water, and bringing it to the hive. This process of feeding the larvæ continues five days for the workers and six and a half days for the drones, and the cells are then capped with a mixture of wax and pollen, which forms a safe covering for the cells, but is sufficiently porous to admit the air necessary for the life of the larva and pupa, or nymph, during its period of metamorphosis. As soon as the cell is closed, the grub begins to spin a web or cocoon around itself; this spinning goes on for thirty-six hours, when the cocoon is complete, and then ensues a period of rest,

*For the great changes going on within the egg during the three days before it hatches into the grub stage, I would refer the reader to the interesting and valuable work on "The Embryology of the Honey-Bee," by James Allen Nelson, Ph.D. (Oxford University Press).

or apparent rest, and subsequent metamorphosis, during which time a wonderful transformation is going on from hour to hour. This includes the pupa or nymph period, and lasts altogether thirteen days for workers and fourteen and a half for drones; and at length, on the twenty-second day from the laying of the egg in the former, or on the twenty-fifth day in the latter case, the fully formed bee cuts through the capping of the cell with its mandibles, and emerges complete in every respect, and

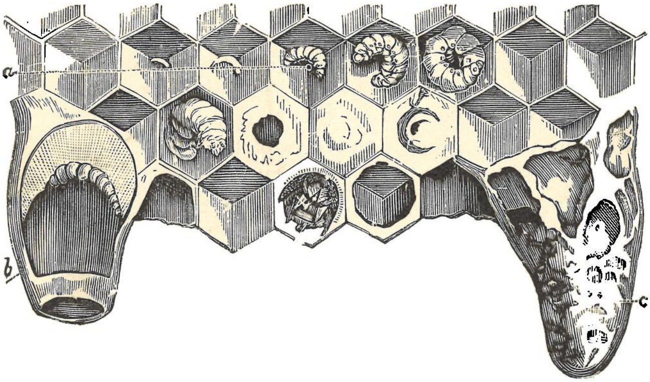


Fig. 16. Worker bee, larvæ and Queen cells—After Cheshire.

ready, **without any previous training, education, or experience,** to fulfil its functions, to execute all the delicate operations, and to observe those rules of conduct which appear to us (and justly) to be such marvels of intelligence, ingenuity, dexterity and even foresight.

The cells in which eggs are laid to ultimately develop into queens differ widely from those of the workers and drones: in the natural state, they are only built in the swarming season, or in cases where the colony has become queenless; in the former case the cells are laid out for the purpose as a rule on the under side or on the edges of the comb, as shown in the accompanying figure, which exhibits, on an enlarged scale, the top view of a number of worker cells, with the egg and larva in the different stages of development up to the time of capping the cells (in the line marked *a*); a section of a queen cell (*b*), showing the larva and a supply of the royal jelly, and a similar one completed and closed (at *c*).

The material of which these cells are composed is not pure wax; there is much pollen mixed with it. The outside surface is uneven and indented like the sides of a thimble. The number built at one time varies much, according to circumstances—sometimes only two or three, but ordinarily not less than five, and sometimes more than a dozen. They are built to hang as nearly vertical as possible, the broader end uppermost, and gradually narrowing towards the point below. The queen lays her egg in the cell when it is about half built; after three days, as in the case of workers and drones, the larva is hatched; the workers then feed the larva for five days with an abundance of so-called "royal jelly," which appears to be much the same as that fed to worker larvæ, only perhaps more carefully prepared. This food is deposited in a considerable quantity in the queen cell before it is closed (see *b* in last figure). The queen larva takes only one day to spin its cocoon, as it only covers the upper half of the body. This fact was observed by Huber.

The transformations of the queen larva are completed in seven days from the closing of the cell, so that on the sixteenth day from the laying of the egg (five days less than the period for the worker and eight days less than for the drone) the queen is due to emerge a perfect insect in structure. It must, however, be understood that in each case the state of the weather, good or bad, may make a difference of a few hours in the time of emerging from their cells.

Chapter IV.

WHAT BEES COLLECT, AND WHAT THEY PRODUCE.

Bees **collect** three different sorts of raw materials, all of vegetable origin: (1) the sweet liquids secreted by plants in the nectaries of their blossoms, or exuded on parts of their leafy structure; (2) the pollen, or fecundating dust of plants; (3) resinous matter exuded on various parts of some trees and plants. They **produce**, on the other hand, honey, wax, bee-bread, and propolis. This distinction must be borne in mind if we wish to be precise both in our ideas and our mode of expression.

Honey.

The raw material of the honey is entirely a vegetable production; it is excreted or thrown off by the plant, from the superfluity of its saccharine juices, which, when subjected to chemical analysis, are found to consist of nearly the same constituents as all sugars, starch, gum, and other non-nitrogenous vegetable secretions, namely, of carbon, oxygen, and hydrogen, the two latter in the proportions required to form water. This nectar, therefore, does not contain any of the nitrogenous or of the mineral substances furnished by the soil, which require to be returned to it, in some degree at least, by the use of manures. Liebig and other chemists have proved that all the elements of the non-nitrogenous vegetable substances are derived from the atmosphere and from rain-water; it is clear, therefore, that no quantity of honey produced in any district can tend to impoverish the soil from which the nectar is collected.*

While lying in the nectaries of blossoms, and being collected by the bee, or afterwards when being stored in the honey-comb, it may by accident take up some particles of pollen, which will account for the fact that minute grains of that substance are generally discovered in honey when examined with the microscope. In its passage through the honey-sac of the bee, and in the act of being stored in the cells of the comb, the raw juice goes through a process of ripening, which deprives it of much of its superfluous watery particles (see Chapter XVII), and while in the honey-sac it is also probably in some way chemically affected by the juices from the salivary glands of the bee.

New Zealand Standard for Honey.

In the new Regulations under the Sale of Food and Drugs Act, published by the New Zealand Department of Health, dated 30th June, 1924, the following standard for honey has been set:—

Honey shall be the nectar and saccharine exudations of plants gathered, modified, and stored by the honey-bee; it shall contain not more than 20 parts per centum of water, not less than sixty parts per centum of reducing-sugars, and it shall not yield more than three-fourths of one part per centum of ash. It shall not contain added sugar or glucose, artificial sweetening-substance, added colouring-matter, or any other foreign substance.

---

*This matter is fully dealt with in another chapter.

Under this heading it will be instructive to whom it may concern to learn the result of an analysis of a sample of honey sent by the author in July, 1908, to the Bureau of Chemistry, United States of America, which Dr. Phillips kindly attended to:

Washington, D.C., Nov., 1908.

"I transmit the analytical results of two samples of honey received by you from the New Zealand Department of Agriculture. Both are from the Ruakura Apiary, No. 7 is marked Clover with a slight mixture of Dandelion. The result of analysis is as follows:

Polarizations.	
Direct Immediate at 20°	–17.40
Direct Constant at 20°	–18.40
Direct Birotation	1.00
Direct at 87°	+7.00
Invert at 20°	–21.34
Invert at 87°	+5.28
Difference	26.62
Moisture	17.52
Reducing Sugar	78.00%
Sucrose	0.00%
Ash	0.21%
Dextrin	0.40%

(As both samples were similar it is only necessary to give one analysis.—I.H.).

Respectfully,
(signed) H. W. WILEY,
Chief."

In a subsequent letter from Dr. Phillips he praised the honey and remarked on the low percentage of moisture in both samples.

Honey Dew.

There is a saccharine substance sometimes gathered in considerable quantity by bees in countries of the Northern Hemisphere termed "honey dew." It is quite distinct from, and much inferior to, ordinary honey. Different opinions have been expressed as to its origin, some holding that it is entirely a vegetable product, while others claim that the larger proportion is an excretion from certain insects. Dr. E. F. Phillips, who has had special opportunities for studying the matter, says:

"Honey dew is a general term, including sweet substances from several sources. There are many plants which have nectaries outside the flower which secrete honey dew and which is gathered by bees. Among these may be mentioned hau (*Paritium tiliaccum*), of Hawaii, cotton, some of the acacias, and conifers. It is a mistake, however, to assume that this is a characteristic of the majority of plants from which honey dew is gathered, for the greater part of honey dew is not a plant secretion, but an insect product."

The black birch (*Betula nigra*) I understand is a good example in this respect.

The United States Government has formulated an official standard for honey, and any product not coming up to the test, whether stored by bees or not, must not be sold as honey. Honey dew is below the standard, though it is used for manufacturing purposes in America. In some bee-keeping countries honey dew is gathered in large quantities, and occasions heavy loss to bee-keepers, but fortunately we are free from the pest in New Zealand, though no doubt a little may be seen occasionally, but not enough to give trouble or I would have heard of it.

Adulteration of Honey.

At one time, subsequent to the introduction of the modern system of bee-culture, and when the consumption of honey had largely increased, the world's markets were flooded with spurious honey, chiefly from American packing houses, the adulterant consisting almost wholly of glucose, American bee-keepers being as great sufferers through the fraud as any one. Thanks, however, to the pure food laws now in force in America, and in other countries, including New Zealand and Australia, there is practically no "manufactured" honey put on the markets at the present time.

Beeswax.

Until Huber's time it was generally understood that wax was gathered from certain flowers, and it is a curious fact that I have come across people in this enlightened age who concluded that pellets of pollen seen on the bee's leg was wax. Beeswax, as most people know, is secreted by the bees, and the proof of this can be seen at any time when comb building is going on by exudation of wax scales from the under portion of the wax worker's abdomen, as in Fig. 17.

It has been pointed out that, while honey and sugar contain by weight about eight pounds of oxygen to one of carbon and hydrogen, the wax contains only one pound of the first to more than sixteen of the two latter; and that, as the combustion of oxygen is the great source of animal heat, the great quantity consumed in the conversion of honey into wax "must aid in generating the extraordinary heat which enables the bees to mould the softened wax into such exquisitely delicate and beautiful forms." The force of this observation will be seen when we recollect that wax requires a temperature of about 145° to melt it, though it may be moulded, by pressure, at 100° or less. Is it not probable that the way, in which it has been said that "bee-bread assists the bee in producing the wax," as Langstroth expresses it, is that its nitro-

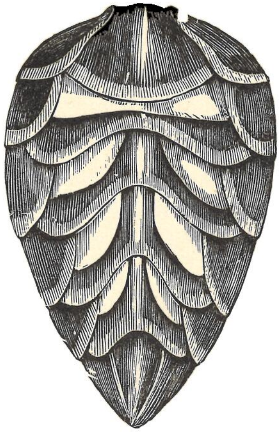


Fig. 17. Under side of abdomen of worker bee, showing wax pockets and wax scales.

genous qualities serve to keep up the bodily strength of the insect during the exhausting work of secreting the wax and building the comb? This appears to be Professor Cook's view. At all events, it is now well known that the wax is exuded from the body of the worker bee, and formed in thin flakes in what are termed the wax pockets, of which four may be observed in the foregoing engraving, on each side of the centre line on the under-part of the abdomen, and which are, in fact, the folds of the shell-like plates covering the abdominal rings.

The wax can only be secreted when the temperature of the hive is above a certain point, and during the time of secretion the bees appear to hang in clusters or festoons, in a state of absolute repose. In the height of the honey season, or so long as new comb is required, this secretion goes on night and day. The constituents of wax, according to the analysis of Hess, are:—

Oxygen	7.50
Carbon	79.30
Hydrogen	13.20
	100.00

On the authority of Langstroth, that careful experiments had proved that from thirteen to twenty pounds of honey are required to make one pound of wax, this was for a long time accepted as a well-ascertained fact, but it is now believed on the strength of further experiments that from eight to twenty pounds of honey is nearer the mark; the fact is, it is still an open question, and we may leave it at that.

Adulterated Beeswax.

Formerly a good deal of adulteration was carried on by one or two parties in New Zealand, but the fact of one person who was caught at the game getting six months' imprisonment for the fraud seemed to have effectually put a stop to the business. The usual adulterants which are so difficult to detect by the novice are the ordinary paraffins and ceresins, and for these the simplest way of detecting them is by the alcohol test. Too much reliance, however, must not be placed in it as it is quite possible that something else might be added to make the test unreliable.

Into a clear glass bottle pour a little clean water, then drop in a small piece of beeswax of known purity, the wax, being lighter than the water, will float. Now pour in gradually pure alcohol till the wax slowly sinks to and touches the bottom, but no more. Then drop in a piece of the suspected article: if it does not sink slowly like the wax there will be every reason for believing it to be adulterated. When there is more than 5 per cent. of either of the two adulterants present the stuff will float, while the pure beeswax lies at the bottom of the liquid. Should the suspected article not prove equal to the test it will be wise to have a chemical test made.

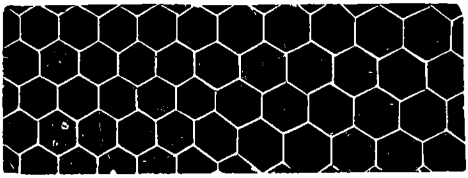


Fig. 18. Worker cells. Drone cells.
(Natural size.)

Comb.

Wax, after being produced by the bees, is formed by the workers into comb, which consists of hexagonal-shaped cells of two sizes—one for the deposit by the queen of the worker eggs, the other for the same purpose, for drone eggs; and these are known to apiarists by the names of "worker" and "drone" comb (Fig. 18). Both kinds are used by the workers for the storage of honey.

The bees, when given the opportunity to build their own combs entirely, invariably build what our modern commercial bee-keepers consider an excess of drone comb, in which subsequently drones (nonproducers) are bred in numbers beyond the actual requirements of a colony of bees. No doubt that when bees are living under natural conditions in the forests with their nests far apart an abundance of drones are required to avoid missing the young queen when on her wedding flight in the air. (See chapter on "Comb-foundation.") The worker cells measure about five to the lineal inch and the drone cells about four. When used for breeding purposes

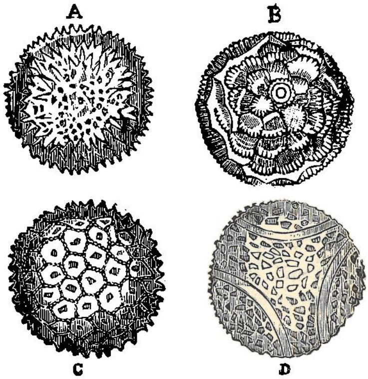


Fig. 19. Pollen grains, magnified.

the former are slightly under half an inch in depth, and the latter five-eighths of an inch, but when used for the storage of honey they vary in depth according to the space available.

Pollen.

Pollen is the dust-like particles of farinaceous matter which constitutes the fecundating principle of the stamens of flowers and blossoms of all kinds. The manner in which it is collected by the field bees has already been described.

It is of the greatest importance in the economy of the hive, as, after being mixed with a little honey, stored in the cells, it subsequently passes through the stomach of the nurse bees in its process of being converted into chyle food for feeding the larvæ, what is usually termed bee-bread. Pollen is indispensable to the nourishment of young bees, and without which, as has been proved, even when substitutes, such as pea flour and other like substances have been provided, brood cannot be raised. It is very rich in nitrogenous matter, which is necessary for the formation and maintenance of muscular tissue, and therefore to the development of the young bees.

It may here be observed that an obscure malady that now and again attacks the bees in Australia, notably in Victoria, causing great loss, has been attributed to scarcity of pollen in the years when the malady appears, though it is still more or less an open question. Fortunately we are not troubled in New Zealand with a dearth of pollen, rather the reverse, and our complaint often is that we get too much of it, frequently clogging several combs in a hive, making them useless for breeding purposes, or for the storage of honey.

To Rid Combs of Surplus Pollen.

In early spring, when overhauling the hives, take out all the combs clogged with old pollen and place them flatly in a large tub or tank one above the other, weight them down and cover with water; let them remain over night. Next morning hang them by their frames against the wall of an outhouse, and syringe well with a garden syringe or a fine spray from a hose, then hang them up where they will dry before use. A little salt in the water will act as a mild disinfectant, and sweeten the combs.

Propolis.

This is a substance used by the bees for glueing things together, and for stopping up all crevices in their hives. In order to make it they gather the resinous matter which exudes from some trees; or when this is scarce, they will take varnish, or even tar, whenever they can find it. They carry this substance home in their pollen baskets, and use it, mixed with wax, wherever they want to fasten any loose parts, or to fill up joints to exclude enemies or air. They make a very liberal use of it at the end of the honey season. It is also used for other purposes by them, as the following anecdote will testify:—

"A snail having crept into one of M. Reaumer's hives early one morning, after crawling about for some time, adhered, by means of its own slime, to one of the glass panes. The bees having discovered the snail, surrounded it, and formed a border of propolis round the verge of its shell, and fastened it so securely to the glass that it became immovable." —Bevan.

I saw where the bees had fastened and hermetically sealed a snail to the inside bottom of a box hive I transferred at the Thames.

CHAPTER V.

THE APIARY.

When the object is to take up honey-raising on a commercial scale as a business proposition, the first consideration should be the location of the home apiary, where most of the work of the out-apiaries will be conducted. As this is to be a permanent site, careful attention should be given to the principal bee flora of the surrounding country, and as clover honey is in the greatest demand, and brings the highest price, it follows that a central site in clover country, if obtainable, should be chosen, provided it is not fully stocked with sheep. Dairying country is to be preferred, and beware of cropping country. Good roads are essential for rapid work to and from out-apiaries in the busy season. Flowing uncontaminated water near large apiaries is a great boon, as bees use up much water in the breeding season, and foul water lowers their health.

Area of Site, Contour of Ground, and Shelter.

In estimating the area required for an apiary of say from 75 to 100 colonies, together with the necessary buildings for carrying on the bulk of the work, to include extracting house and comb room, large storage shed, garage for motor truck, and dwelling-house with garden, and a roadway into the apiary, one acre would not be too much, but sufficient to locate the bees and buildings well clear of the dwelling. For convenience, and for rapid work, the site should be level and open, that is, clear of trees, fruit trees for instance, and everything that would tend to impede speedy movement, but a gentle slope toward the north or north-east is not objectionable. If a little below the general level of the surrounding country, all the better, providing it has good drainage, to prevent excessive dampness, as there would be less trouble to provide shelter than if exposed on high ground, and the bees flying home heavily laden would be less liable to be blown down in high winds.

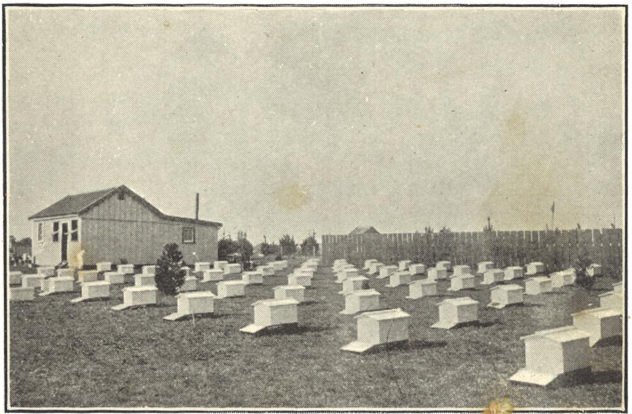


Fig. 20. N.Z. Government Apiary, Ruakura, 1906, when first established by the author. Note the temporary boarded shelter fence with tops of shelter trees at back.

Shelter.

Next to selecting a good site, shelter is the most important matter for consideration; I have no hesitation in declaring that a well-sheltered apiary will yield double the profit of one under the same conditions otherwise, but exposed, to say nothing of the convenience to the apiarist. When well sheltered, work can go on among the bees at almost all times except when raining, whereas without shelter the hives cannot be opened without loss in anything beyond a gentle zephyr. The contour of the ground may help, but in any case the site should be surrounded by a durable live hedge that can be kept by trimming at about eight or nine feet high, which is quite high enough to shelter a large apiary. Bees can fly against a fairly strong wind when in full flight, but in nearing their home they naturally slacken their flight; this is the time, when their hives are in an exposed position, that the greatest loss occurs— they are blown to the ground, never to rise again.

For a real good permanent shelter hedge for an apiary I cannot recommend anything better or equal to the giant-growing privet (*Ligustrum sinense*), and for temporary quick-growing shelter, *Cytissus proliferus,* commonly but erroneously called "tree-lucerne," the botanical name of which is *Medicago arborea.* The privet is thoroughly hardy, is not weakened by trimming, and keeps free from disease. Tagasaste grows rapidly in the Auckland province, but I am informed by a leading bee-keeper in the South Island that it does not do well where cold, bleak winds abound. As it is only intended for a temporary hedge it does not matter so long as it gives some little shelter.

Cultivation.

Giant Privet.

The following is reprinted from my Government Bulletin No. 18:—

"For permanency and general utility this plant can be thoroughly recommended as a shelter-hedge. It is of close upright growth, extremely hardy, and adapts itself well to a wide variety of soils and

Fig. 21. N.Z. Government Apiary, Ruakura, 1923, on same site as Fig. 20.
Note the permanent giant privet hedge at back of building.

situations. It is not advisable, however, to employ any of the Ligustrum as hedge-plants too near a garden plot, as their surface roots extend several yards from the base on either side, and extract all virtue from the soil. This fault can be obviated to a great extent by cutting ditches at a little distance from the plants on either side. Assuming that this space is of no consequence, then the privet may be advantageously employed for shelter purposes. For a single row a width of 3 ft. should be deeply dug, and if the ground be poor a liberal dressing of bonedust given. Select strong two or three-year-old plants, and set out at 18 in. apart along the centre of the prepared ground. To induce a good base it is well to clip the plants fairly hard back at the time of planting; in following seasons the sides may be lightly clipped, and the tops of those unduly high reduced to a general level. With fair treatment four seasons of growth should produce a hedge from 6 ft. to 8 ft. high. As there are many different species of Ligustrum in cultivation, care should be taken to get the best for hedges—that is, the one under notice."

Tagasaste.

If space allows, a temporary hedge of tagasaste should be grown about six feet outside the privet hedge; this would afford very good shelter in the second season's growth, two or three years before the privet is sufficiently high to be of good service. Tagasaste also affords excellent bee forage during winter and early spring, when nectar is scarce. A temporary brushwood fence or pailings on the prevailing windward side, as shown in Fig. 20, will afford some protection while the permanent hedge is growing.

To obtain the best results the seed should be sown in early spring, and to assist germination it should be first steeped in very hot water (not boiling) to which a little washing soda is added—pouring on the water and letting it stand till quite cold will suffice to soften the seed, and, after straining, the addition of a little dry sand will separate it nicely for sowing.

Fig. 22. Tagasaste hedge, three years old.

It is important that seeds treated in this manner should be sown immediately.

The ground should be thoroughly worked (as for onions), and if, as is to be recommended, a double row is contemplated, the width of the prepared bed should be not less than 4 ft. Sow the seeds three in a place at a distance of 3 ft. apart and 1 ft. from edge of bed on either side, alternating the second row with the first—this gives a distance of 2 ft.

between the rows. Thin out the plants as they advance, to the strongest in each place.

Water.

A good supply of clean water near the apiary is indispensable; bees require a great deal during the breeding season, and the best source of supply is a clear running stream, but where this is not available the next best is in well-constructed troughs placed under shade near the apiary. Thin floats of some kind should be put in for the bees to alight on, and the troughs should be shallow with a plug at the end to let the water out, as it must be renewed often to keep the bees in a healthy condition. It has been claimed, and I think with good reason, that stagnant water lowers the health of the bees and renders them prone to disease. Unless there is an ample supply of water near at hand, bees are likely to become a nuisance to neighbours by congregating about horse troughs and cattle-drinking places. This must be avoided.

Distance from Roads.

To avoid trouble and possibly damages, no bees should be kept near main roads or by-roads where there is horse or cattle traffic. Whether large, small, or out-apiaries are to be established, they should not be nearer a main road than from 130 to 150 yards, the latter in preference, and 75 yards from a by-road. The danger of bees stinging animals and human beings or causing horses to stampede is at swarming time, and also in the case of robbing, especially just after the close of the surplus honey season. Although, as a rule, swarms headed by a laying queen settle near at hand, and without much delay, now and again one may remain in the air for some time and settle a couple of hundred yards from the apiary. When headed by a virgin queen there is no knowing where the swarm will settle, and when swarming bees fly over horses or cattle there is bound to be serious trouble, hence the reason for providing a good distance between traffic roads and apiaries to prevent the owner being mulcted in damages.

Arrangement of Hives.

There is no general rule recognized in the arrangement of hives in an apiary—it is simply a matter for the bee-keeper to decide for himself as to what he considers best. There are two systems in vogue, the "clump," in which two, three, or more hives are placed together facing different ways as in Fig. 21, the Government Apiary (but the clumps there are arranged for a special purpose, to give each cadet so many colonies to care for), and the straight row plan, as in Figs. 20 and 23. The latter scheme is the one generally adopted by extensive apiarists, and the one I recommend as having the fewer faults. The position of the hives in each row, as can be seen, alternate with those in the front and back rows, so that in working at any hive one is free from the flight of the bees to any other hive (see Figs. 20 and 23). The area of these sites not being limited, and the intention being to limit the number of colonies to 100 in each case, the hives were placed eight feet apart in the rows, and the rows ten feet apart, reckoning in each case from centre to centre of hives. Although these spaces may seem extravagant from a commercial point of view they should not be reduced much. At the least there should be four clear feet between the walls of the hives in the row and at least six clear feet between the rows to allow the apiary-barrow to turn, and a lawn-mower or scythe to be used to keep down weeds and grass around the hives. It is reasonable to suppose a few landmarks about an apiary, such as shrubs, assist young bees in their first flights to locate their hives, and in each apiary I have established a few have been planted and kept trimmed to about seven feet in height, as seen in Fig. 21.

Keeping Hives Clear of Weeds and Grass.

It not only looks untidy, but it is very unprofitable, and I might say cruel, to allow the entrances of hives to become obstructed by long grass and weeds. Bees on their homeward flight, heavily laden, fly very swiftly till nearing their hive, when they must of necessity slacken to make a good landing; but if their flight is suddenly checked at this time by some obstruction they fall to the ground, in most cases never to rise again. It might appear a formidable job to keep several hundred hives distributed in a number of out-apiaries clear of long grass and weeds, but being most essential to the profitable working of such hives, it must be done at all hazards. If in spring, when grass and weeds are just beginning to make fresh growth, the ground around each hive for twelve inches or so is turned over with a spade, and a good sprinkling of cheap agricultural salt is spread over it, the hives will be kept clear all the season.

Number of Colonies in One Apiary.

As there are several factors to be considered in connection with this question, it is impossible to formulate a general rule that shall be applicable in all cases. Some districts in New Zealand would profitably carry up to 150 colonies provided there

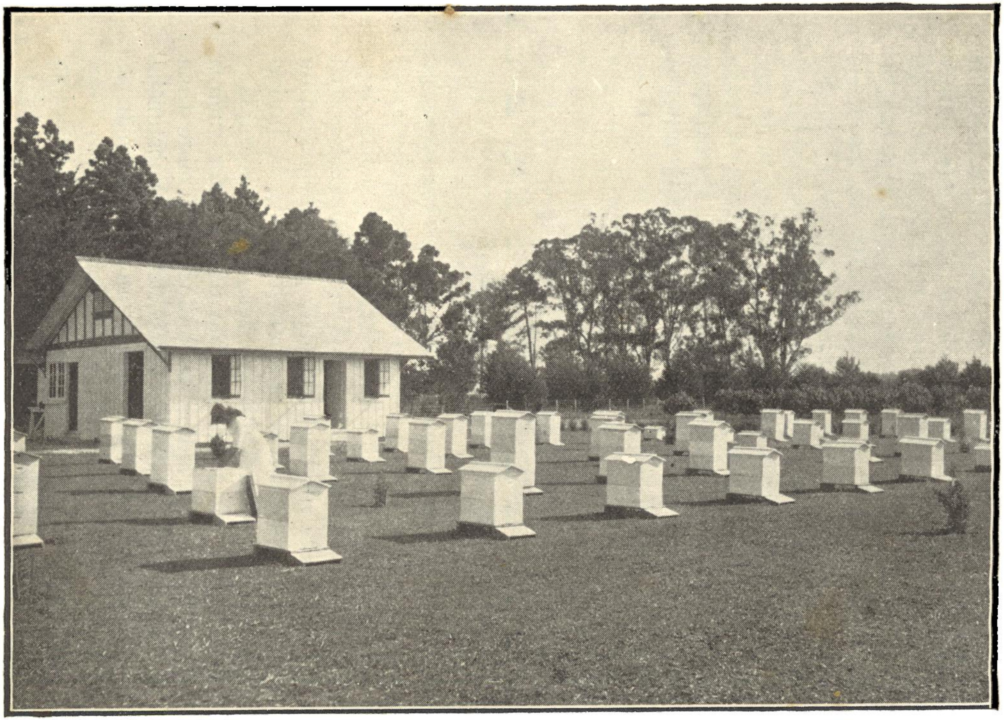


Fig. 23. Educational apiary with apiary building, established by the author for the Dilworth Trust Board, Papatoetoe.

is no other large apiary much within three miles in a straight line; but if the neighbouring apiary is one's own it would not matter so much. Other districts might not carry more than from 50 to 75 colonies, but I consider, generally speaking, that in an average good clover district 100 in the home apiary, and 75 in out-apiaries, would be about the maximum number of colonies to run profitably. It is, however, worth considering whether it is not better to reasonably overstock apiaries already established rather than start a new one. My estimate is based upon a skilled and persevering apiarist being in charge.

Chapter VI.

APIARY BUILDINGS.

Where extensive honey production is being carried out on modern lines, and motor vehicles for rapid communication with out-apiaries have come into general use, it has been found more economical and satisfactory to establish a central plant for executing most of the work, rather than it should be undertaken at the several out-apiaries. The home apiary is of course the most suitable position for such a plant, and the building or buildings if more than one, for the plant, should be erected in a substantial manner, especially the flooring and its supports, as it should be capable of supporting heavy weights. The hygienic arrangement of the whole building, and particularly the extracting room, should receive first attention; cleanliness should be the dominant feature throughout. Supposing there is only to be one building, this would embrace extracting and honey store rooms, queen rearing and comb rooms, and workshop; the latter also answering as a spare hive store room in winter, all sections being divided from each other.

The extracting room, where all the honey is exposed for a time, should be closely partitioned off from all other sections of the building, otherwise it would be impossible to keep the honey and appliances free from dust, and the room as clean as it should be. It should be just large enough to comfortably contain the extractor, honey tanks, uncapping arrangements, and ample room for two operators to work, and some for boxes of combs for extracting. Comparing notes with a leading New Zealand commercial bee-keeper on the subject, we both agreed that the dimensions of the extracting room should not exceed about 16ft. x 14ft., for if larger there will be more space than is actually required and so become a storeroom as well, which must be avoided. I have erected four different apiary buildings in which the extracting rooms measured 16ft. x 14ft., and I found that space to be ample for all purposes. There is no need for greater space even for power plants, as the engines should be outside the room as in Figs. 25 and 29, and only the belt to the extractor from an overhead shaft within the room.

Doors, Windows and Ventilation.

The most essential feature needed in an apiary building is that as far as possible it shall be bee-proof, especially in the section devoted to the extracting and storage of honey. A loosely constructed building where it is practically impossible to prevent bees from entering freely at times of extracting, and in the worst robbing season, is not only a positive nuisance, but is dangerous, inasmuch that it is likely to be the means of setting up robbing among the colonies. In a properly constructed building there would be no place for bees to enter except by the doors when those engaged in the apiary were going in and out, and when carried in with the honey for extracting. There is something to be said about the doors when dealing with ventilation.

With regard to the windows, the construction of which has given me more concern to get the most efficient and convenient design possible than any other part of the building, the objects should be to obtain all the ventilation possible in hot weather without giving an opportunity for a bee to enter, to be able to close them in stormy weather, and perhaps the most important feature of all, to enable one to get rid of the bees quickly that have obtained entrance. In my first honey house, erected in 1882, I had the windows made to revolve on their pivoted sides; this scheme answered the purpose of getting rid of the bees quickly, but did not allow of ventilation, as they had to be kept closed most of the time. This was the case with the windows of the extracting house at the Government apiary erected in 1906, but subsequently I figured out the scheme shown in Fig. 24., which was incorporated in the plan of the house I had built for the Dilworth Trust Board's apiary at Papatoetoe, and which answered admirably. There need be little explanation, as the diagram explains itself, and as it is drawn to scale by the architect there should be no difficulty in a builder following it. The outer glass sash can be opened at right angles, or closed at will, while the inner screen sash when closed prevents bees entering the room, and one can get rid of bees clinging to it in less than a second by simply turning the sash round. The use of "Porter" bee escapes at the top of screen sashes is next to useless; cone escapes are better, but the upright revolving screen is best of all.

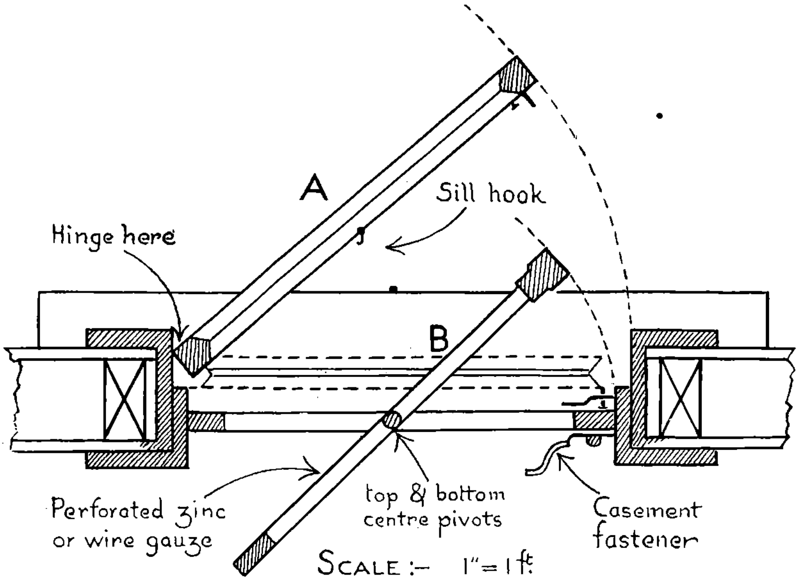


Fig. 24. Plan of honey house window.
A, Outer glass sash ; B, inner revolving wire gauze screen.

Doors leading to the extracting and honey store rooms, also to the queen-rearing room, and others giving entrance and exit to the building, should be double—that is, there should be a screen door as well as the ordinary door to each.

With regard to ventilation, there can hardly be too much facility for this in such a building, provided it is under control so that much or little can be given as required. The screen windows and doors will allow of ample ventilation provided the house is well furnished with windows as in Fig. 29.

The interior of the extracting, honey store, queen-rearing, and comb rooms should be close lined, and ceiled, with a ventilator in the ceiling of the extracting room that could be closed if necessary. The whole of the doors, if they can be made bee-proof,

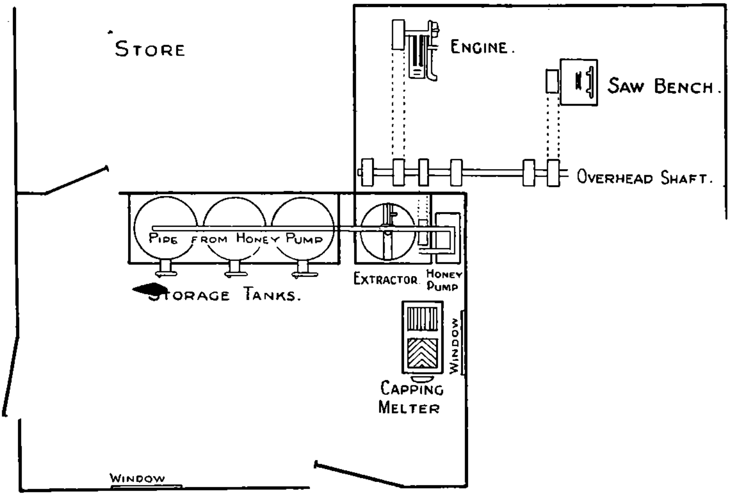


Fig. 25. Plan of power extracting house.

would be better to slide on account of saving room, but to make the comb room moth proof it would be best to have a shut-to door with a strip of felt tacked round the edge.

A garage for the motor truck is necessary, but this should be clear away from the main building in case of fire, and would be better built of concrete.

The owner of the House and Extracting plant represented in Fig 25, kindly furnished me with the following note:

"Extracting room is 20 ft. by 16 ft., but 16 ft. by 14 ft. is ample for most bee-keepers, as it is liable to become a store room as well as an extracting room when much larger. The belt from engine is led through an aperture in wall direct, or from an overhead shaft from which a belt can also operate a circular saw bench, etc., in the work shop, which, and the honey store room can be of any size required." Windows are not shown. Cost of engine and plant about £50.

The following figures illustrate the plan of some of the apiary buildings in use at the present time in New Zealand, and a ground plan of one suggested by the author with detailed particulars of same.

Some Particulars of Mr. H. E. Lloyd's Apiary Building and Electric Power Plant, Figs. 26 and 27.

Mr. H. E. Lloyd, of Manaia, Taranaki, in response to my request to furnish me with some particulars of his electric plant for publication in this work, very kindly favoured me with photos (see Figs. 26 and 27) and the following items:—

"The entire building is 75 x 21 feet, of which 55 ft. has a wooden floor raised about four feet from the ground; the other 20 ft. is floored with concrete at the ground level, thereby allowing my Ford lorry to be driven into the extracting house, and to bring the lorry platform level with the wood floor, thus saving lifting, and preventing robbing. The honey tanks are on the lower portion of the building in order that the honey may flow into them from the extractor by gravitation. You will notice the extractor stands on a wooden platform. I would advise having it placed on solid concrete to avoid vibration. I favour the motor being placed on floor as shown, with overhead drive to extractor."

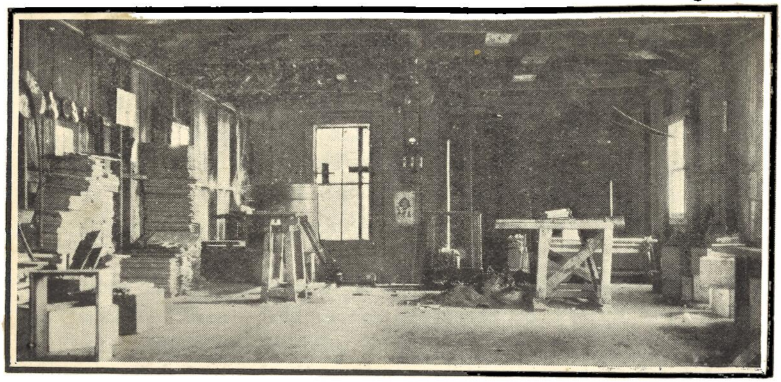


Fig. 26. Part of interior of Mr. H. E. Lloyd's extracting and general workroom.

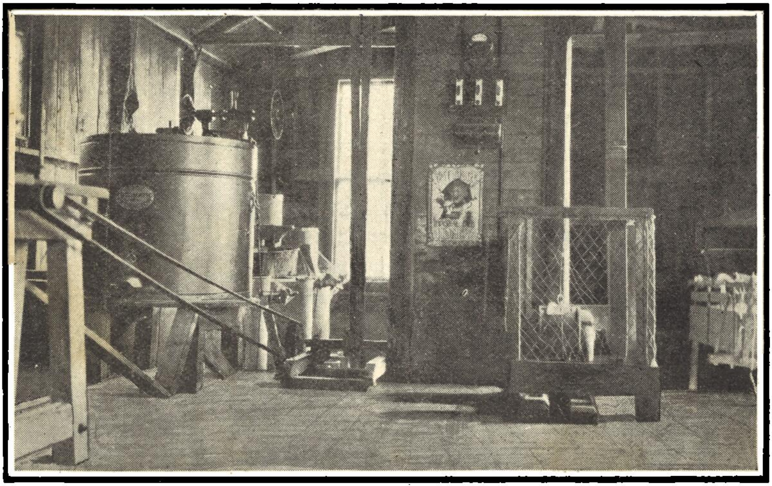


Fig. 27. A close-up view of Mr. Lloyd's electric plant.

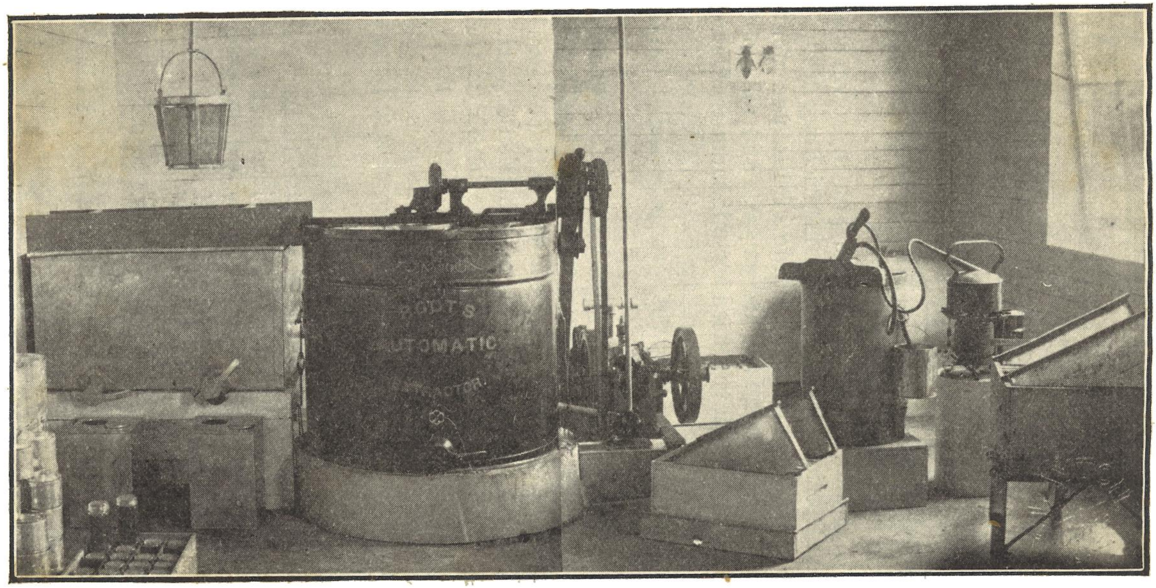


Fig. 28. The oil-engine power extracting plant run by Mr. R. Gibb of Menzies Ferry, Southland, until recently, when he installed an electric plant.

The following are answers to further questions I subsequently sent to Mr. Lloyd:—

"(1) A 3-horse-power electric motor is quite sufficient to deal with any number of colonies up to 1000.

"(2) I can only give you what it cost me four years ago to install mine (1920, I.H.), £75—motor, shaft, pulleys, and belting.

"(3) Again, I can only give you my own costs as the electric companies vary in price per unit. I have to pay a minimum charge of 10s. per month whether the power is in use or not, and only once in the four years have I used the minimum allowance. Advantages over an oil engine plant are cleanliness, quietness, and breakdowns are practically impossible.

"(4) I use the power for the manufacturing of absolutely all requirements needed in bee-keeping from the flat; the bench near the extractor is the one used for all this. It has a combination of various size saws, and a buzzer. The large bench on right of Fig. 26 is a firewood saw.

"(5) The belt from pulley to ceiling is the only way to obtain a drive below surface of saw bench."

A Correction.

"In my first letter I advised motor to be placed on floor, and to drive upward, but since then I have concluded it would be much better if things were reversed, by motor on top, and shaft set below floor, thus obtaining an upward drive on all machinery, while saving the trouble of climbing to oil."

The Author's Idea of a Complete Apiary Building.

Fig. 29 represents what I consider a fairly complete building under one roof suitable for a power

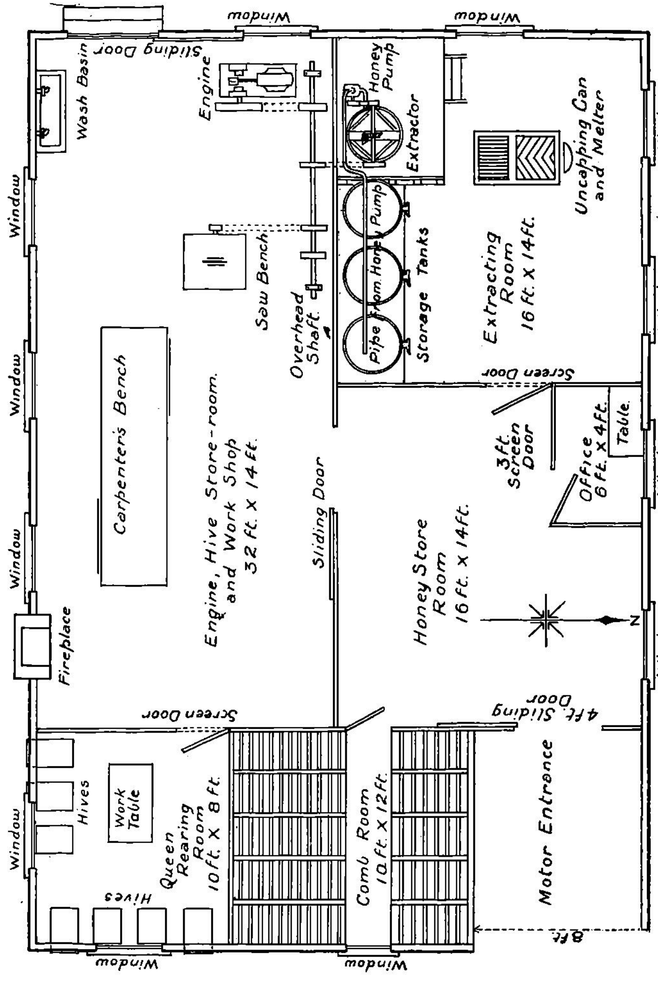


Fig. 29. The author's idea of a complete modern apiary building under one roof.

plant, and the necessary equipment for running from 600 to 800 colonies, and by a slight enlargement for over 1000 colonies. The dimensions and particulars of the different sections of the building are given in diagram. The height of flooring from ground is that of a Ford one-ton motor lorry platform, 2ft. 10in., and the motor lorry entrance allows of 2ft. 6in. play. The building is suitable for either an oil-engine or an electric plant.

The height of extractor and tank platforms is the same, viz., 1ft. 6in. from floor; this will allow about five inches play between the taps of the tanks and the top of a 60lb. honey tin. If a Beuhne heater and a Benton clarifier be used, which, from reports received of the results of the use of each, I feel certain will in time come to be largely utilised, they could be erected on the tank platform, the honey being pumped direct into the heater. Tanks would scarcely be needed, however, but both platforms need extra strong supports built up from the ground, and the extractor platform in any case should be separate from the other and well braced to prevent as much as possible vibration, which would be very considerable if the platform is not rigid. The extracting, queen rearing, and comb rooms should be close lined and ceiled, and the door of the comb room made smoke tight, the studs of the building suggested being 10ft. Some arrangement for heating the extracting and queen rearing rooms if required would, I think, make the building pretty complete. The spare comb room of the size given with six tiers is calculated to hold well on for 2,000 combs, three-quarters of an inch between them.

Of course, the sketch is simply meant as a guide to those about to build as to what is required, and it should be remembered that the time is past when any old building would do for the apiary, and although economy should always be kept in view, it will not pay to be niggardly over such a building and have it incomplete.

The First Apiary Building at the Ruakura Farm of Instruction.

For bee-keepers in a small way, up to but not exceeding 100 colonies, a description of the above, which was erected with the utmost economy, will prove useful. In the matter of economy, it was my object at the time to give a lead to bee-keepers in the erection of the least expensive form of an efficient sanitary honey house. Most of our bee-keepers were in a small way at that time (1905), and it served its purpose very well as it should do now under the same circumstances.

On each side of the extractor platform is a shallow honey tank (4 4, 4 4), and when one was full the extractor was moved to discharge into the other. The tanks being shallow, it did not take long for the scum to rise to the surface to be skimmed off. But of course the internal fittings can be made to suit the ideas of the bee-keeper interested.

The particulars of the timber required for building shown in plan and elevation as specified by the architect are as follows:—

Blocks, 4in. by 4in. sawn, or 6in. by 4in. split: 18, about 2ft. long.

Ground and sleeper plates, 4in. by 3in.: 3, 16ft.; 3, 11ft. Platform, 3, 6ft.; 3, 10ft.

Floor-joists, 6in. by 2in.: 19, 14ft.

Plates, 3in. by 2in.: 4, 26ft. (or 4, 16ft.; 4, 11ft.); 4, 14ft.; 4, 9ft. raking-plates.

Studs, 3in. by 2in.: 22, 8ft.; 2, 9ft.; 5, 10ft.; 3, 12ft.

Rails, 3in. by 2in.: 4, 16ft.; 4, 11ft.; 4, 14ft.

Braces, 4in. by 1in.: 5, 16ft.

Rafters, 3in. by 2in.: 28, 9ft.

Collars, 3in. by 2in.: 6, 13ft.

Ridge, 8in. by 1in.: 1, 16ft.; 1, 12ft.

Purlins, 3in. by 2in.: 8, 16ft.; 8, 12ft.

Fascias, barge, and covers, 8in. by 1in.: 2, 16ft.; 2, 12ft.; 8, 10ft.

Soffits, 8in. by $\frac{3}{4}$in.: 2, 16ft.; 2, 12ft.; 4, 10ft.

Vertical boarding, 12in. by 1in.: 50, 9ft.; 4, 10ft.; 8, 11ft.; 8, 12ft.; 4, 13ft.

Covers, $2\frac{1}{4}$in. by $\frac{3}{4}$in.: 50, 9ft.; 4, 10ft.; 8, 11ft.; 8, 12ft.; 4, 13ft.

Flooring, P., T. and G., 6in. by 1in.: 500ft. B.M. to cut 14ft. lengths.

Lining and ledged doors, P., T. and G., and B., 6in. by 1in.: 300ft. B.M. to cut 14ft. lengths.

Lining of ceiling, P., T. and G., and B., 6in. by $\frac{3}{4}$in.: 300ft. B.M. to cut 14ft. lengths.

Sills, doors and windows, 6in. by 2in.: 1, 17ft.; 1, 6ft.

Steps to platform, strings, 6in. by 3in.: 1, 10ft.

Steps to platform, steps, 8in. by $1\frac{1}{2}$in.: 4, 2ft.

Sashes, glazed, 3: 5ft. 6in. by 2ft. 10in. (nine-light).

3rd October, 1905.

Subsequently, a lean-to the length of the building, 12ft. wide, was added in which was the comb room and workshop, and instead of a fire-place and chimney an American stove was put in. The only alteration I would now make if erecting such a house would be to have 10ft. studs instead of 8ft. Such a house is so simple to erect that any man handy with tools would have no difficulty in building it.

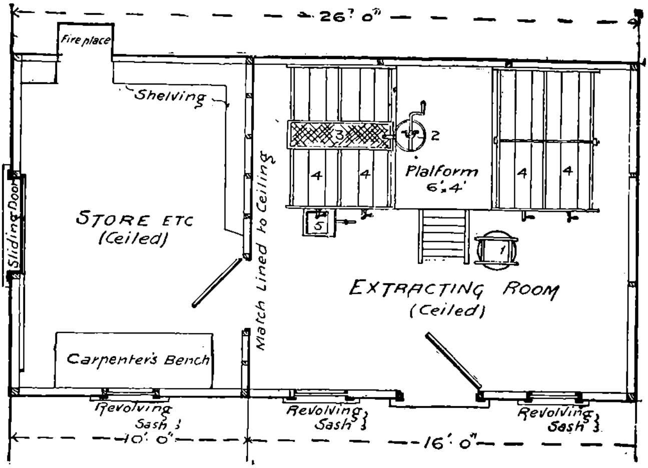


Fig. 30. Ground plan of first apiary building at Ruakura Government Farm.

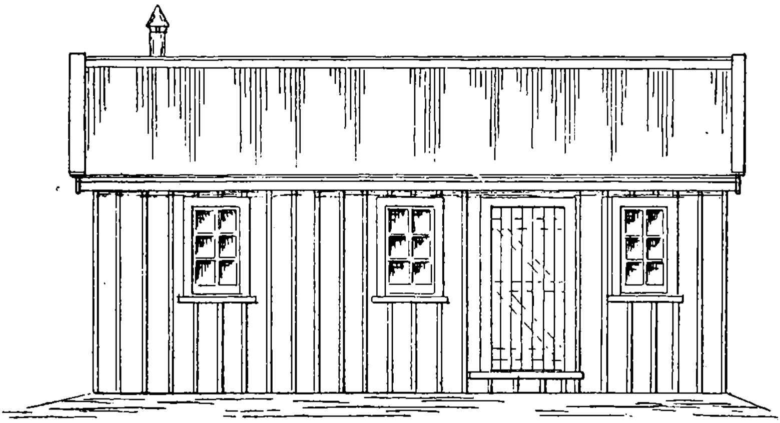


Fig. 31. Front elevation of apiary building (Fig. 30).

CHAPTER VII.

HIVES, FRAMES, AND SECTION BOXES.

The three principal factors that have contributed to the great advance bee-keeping has made during the past sixty years are the movable-comb hive, comb-foundation, and the honey extractor. They are in fact the complement of each other, for without either one the industry could not have progressed as it has done. To the Rev. L. L. Langstroth we are indebted for the present form of the movable-comb hive, which he gave to the world in 1851. His priority has been disputed with regard to the frame hive, and rightly so, but the defect in all such previous hives that to a large extent destroyed their usefulness was the absence of the three-eighths of an inch bee space between all parts of the frames and the hive, which is the feature of all hives built on the Langstroth principle, and which Langstroth devised. Therefore he made the movable-comb hive thoroughly practicable and deserves the credit of inventing the complete movable frame hive as we have it to-day. Although hives of other dimensions than the one he advocated are in use, they are few in comparison with the "Langstroth," and it would be no exaggeration to say that the latter is the world's standard hive in its ten-frame form.

The Langstroth Standard Hive.

America, to which country we are indebted for the most of our improved apiary appliances, launches out every now and again into some new form of hive and frame, that is, in dimensions. The craze for the new idea lasts long enough to tempt many beginners to take it up, when lo! another change takes place, and so it has gone on to my knowledge for the past fifty years. We have as the standard hive in New Zealand the ten-frame Langstroth, although there are a number of twelve-frame Langstroth hives in the Taranaki province, but few elsewhere. My object is to warn beginners not to be led into the mistake of taking up any other form

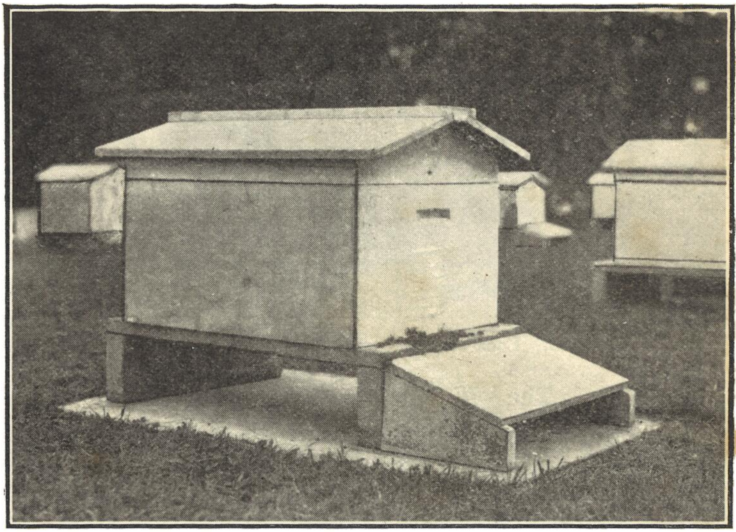


Fig. 32. Langstroth single-storey hive, as introduced and made by the author.

of hive than the standard of the country. The author had the privilege of introducing the Langstroth hive into New Zealand and Australia in 1878, where in 1883 it was officially adopted as the standard, and has remained so in both countries ever since. Our hives and frames are interchangeable throughout the country, and on that account can be manufactured and sold cheaper than if several sizes had to be kept in stock.

The original hives as made by the author were constructed out of one-inch timber planed on outside, the sides were housed into the ends, and measured 20¼ inches in length, by 16 inches in width outside, and 10 inches deep.

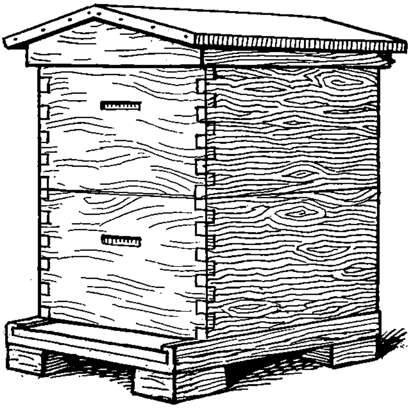


Fig. 33. Lock-cornered two-storey Langstroth hive.

The "Modified Dadant" Hive.

This hive has received a good deal of notice during the last year or two in America and elsewhere, and although, as I have already intimated, I do not for a moment suggest that anyone in this country should depart from the standard Langstroth, a word or two concerning it will not be out of place. As the size of the frame governs the size of hive it is only necessary to give the former. The length of the frame is the same as that of the Langstroth, but the depth is that of the Quinby frame, 11¼ inches outside. The hive can take ten frames and a division board.

Dadant in his latest work, "The Honey Bee," when dealing with his original and the modified one, says: "Yet the Langstroth being the standard frame of America, we hesitate to advise any apiarist to change from this size."

Shallow Extracting Supers.

Some years ago a few of our bee-keepers adopted these supers, but on recent enquiry I find there are

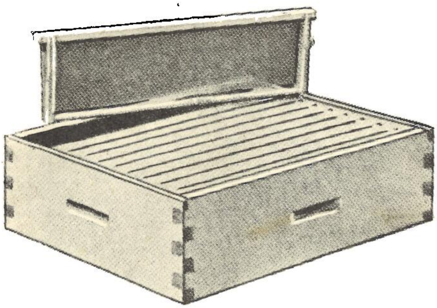


Fig. 34. Shallow extracting super.

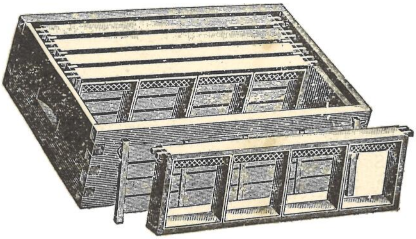


Fig. 35. Half-storey super for raising section honey, with fence separators.

only a comparatively very small number in use in New Zealand at the present time. This is not surprising, seeing that the cost for bodies and frames to accomplish the same amount of work as the full stories would be very nearly double, and then neither bodies nor frames would be interchangeable with the brood chamber bodies, therefore it is wise to keep to the one size body and frame throughout when raising extracted honey. The depth of super is 5 11-16ths inches, taking frames 5$\frac{3}{8}$in. deep, while that of the section super is 4$\frac{3}{4}$in. deep, with frames holding the popular 4$\frac{1}{4}$ x 4$\frac{1}{4}$ x 1$\frac{7}{8}$ section boxes; in other respects both supers are the same size as the main body of the hive. The nucleus hive, Fig. 36,

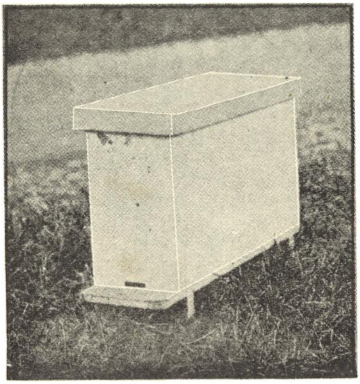


Fig. 36. Three-frame nucleus hive for queen rearing.

which I strongly recommend for queen rearing purposes, takes three Langstroth frames, and should be a full 4$\frac{3}{4}$ inches inside width to allow of an introducing queen cage being inserted between them.

Making Hives.

Those who contemplate making their own hives should understand that unless they are made very accurately out of well-seasoned timber trouble is certain to follow. Each part should be cut true like a piece of cabinet furniture or the frames will not fit properly, and any jolting of the hive, or jerking of the frames in removing or replacing them, will set up stinging. Those in a small way will find it more satisfactory to purchase their hives in the flat from the manufacturer, and put them together and paint them themselves; no advice in this respect is required by those in a large way.

A Cheap Form of Langstroth Hive.

When travelling among bee-keepers in all parts of the Dominion, I found many box-hive bee-keepers in the backblocks, a long way from the regular lines of traffic, who were ready to take up bee-keeping on proper lines, but could not afford the expense of getting hives from the manufacturers, the carriage being so costly. It was then I discovered that petrol cases were the exact size of a Langstroth hive when laid on their side, and that with a hammer, saw, a few nails, and a little labour, they could be converted into serviceable Langstroth frame hives at a trifling cost. Shortly after, the following directions for converting the cases were given in my Bulletin on Bee Culture, published by the Department of Agriculture, and I have good reason to know that a large number of such hives were subsequently made and used in the backblocks. There is just one thing I may mention, that the motor spirit cases are not so substantial as they were.

Secure a complete and sound petrol case, and carefully knock off one of the broad sides; nail on the original cover, which will now form one of the sides. If the sides of the case are not level all round, build them up level with fillets of wood. The inside depth should be ten inches. Next nail on at each end, half an inch below the inside upper edges of the case, to suspend the frames from, a fillet of wood $\frac{3}{8}$in. thick by $\frac{3}{4}$in. wide, and the length of the inside end of the case. The frames when suspended from these should be a clear $\frac{3}{8}$in. off the bottom of the hive. An entrance $\frac{3}{8}$in. wide by 6in. long should be cut out of the lower part of one end of the case,

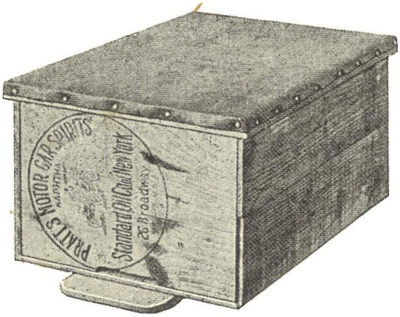


Fig. 37. Motor-spirit case hive, closed.

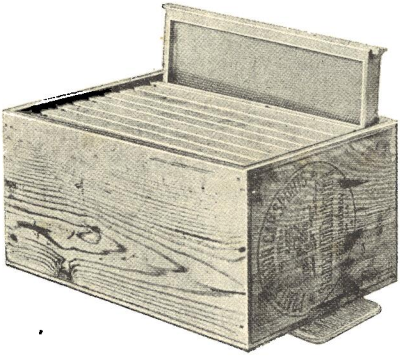


Fig. 38. Motor-spirit case hive, open.

and a small alighting board be nailed on underneath, projecting from 2in. to 3in. in front. A loose bottom board can be arranged if thought desirable.

Top or surplus honey-boxes can be made in the same way, but will not require a bottom. With regard to comb-foundation, see Chapter VIII.

I strongly recommend the purchasing of "Hoffman self-spacing frames" from the manufacturers, as they need to be very accurately made, and are difficult to make by hand. If, however, it is desired to construct frames it is not so difficult to make loose-hanging ones; the following are the dimensions:—

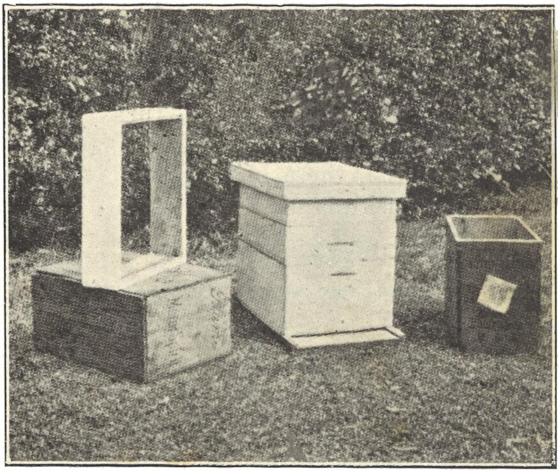


Fig. 39. An improved spirit case hive.

Cut the top bar 15-16in. wide by $\frac{3}{4}$in. deep and $18\frac{3}{4}$in. long. Shoulders should be cut out on ends $\frac{7}{8}$in. long, leaving a thickness of $\frac{1}{4}$in. to rest on the fillets. The ends should be $8\frac{1}{2}$in. long, the same width as the top bar, and $\frac{3}{8}$in. thick; bottom bar $17\frac{1}{2}$in. long, $\frac{3}{4}$in. wide, and $\frac{1}{4}$in. thick. There are ten frames to each hive.

The cover can be made from the side knocked off, and should have small fillets, 1in. wide, nailed on right round the edge, to overlap the body. Cover the top with rubberoid or other waterproof material, and let it overlap the edges. (See Fig. 37.) A capital waterproof covering can be made by first giving the wood a good coat of thick paint, and, while wet, laying on open cheese-cloth (not butter-cloth), letting it overlap the edges, and painting over it. The paint on the wood will ooze through the cloth, and the covering will last for years—no tacks are needed. Light-coloured paint is best, as with this the hive will keep cooler when exposed to the sun than if painted a dark colour.

The spirit-case hive shown in Fig. 39 was made at the Government Apiary, Ruakura, under the supervision of Mr. A. B. Trythall, the manager, and is very substantial, there being a double thickness of timber at the sides.

Hive Cramp.

One of the handiest appliances one can have in an apiary when putting and nailing parts of hives together is a hive cramp (Fig. 40). Some kind of appliance of this nature is needed to clamp the parts together true and firmly while nailing them, and the one illustrated does this, and forms a good solid platform for nailing. My first one was made in 1878, and was used during the whole of my hive-making career. Any handy man (and all commercial bee-keepers are by nature handy men) can make such a cramp.

Four pieces of 6in. x 2in. timber 3ft. long are required for uprights, and two 4in. x 3in., 5ft. 6in. long, to form the platform, and to which the uprights are bolted, there being 16in. between the top of the uprights and top of platform; both are halved into each other. Two pieces 4in. x 3in., 4ft. 6in. long, are halved in, and nailed or bolted, to bottom of uprights as shown. The two parts of the framework are held parallel to each other by 6in. x 1in. spreaders let in flush in the platform, the outside edges of the latter measuring exactly the depth of a hive, and 16in. below the upper ends of uprights. Two ⅝in. iron screw bolts run through the double parts of uprights and horizontal pieces with washer and nut screwed up together hold all firmly.

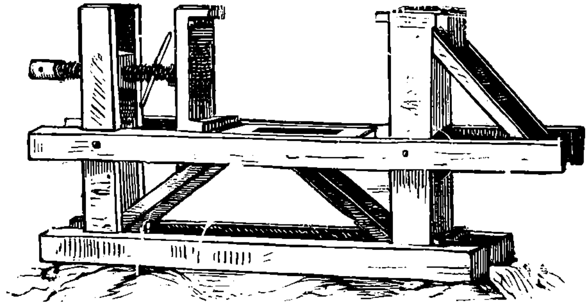


Fig. 40. Hive cramp.

Two jaws are required, one movable and the other stationary, the latter being the two uprights to the left of the worker, but on the right of the illustration. The movable jaw is made of a piece of 9in. x 2in. board, 16in. long, and to each of the jaws are screwed two 1½in. square battens, at top and bottom. The screw is an ordinary carpenter's wooden bench-screw worked between the uprights by fastening the screw-block between them, while the end of the screw is fastened to the jaw in the usual manner. In use the parts of a hive are placed in position between the jaws and screwed together and nailed.

Frames.

Little need be said regarding these other than that those in universal use at the present time are the "Root-Hoffman self-spacing" frames, which should be obtained in all cases from the manufacturers, as they are very difficult to make without proper machinery.

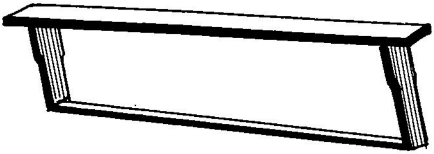


Fig. 41. Shallow extracting frame.

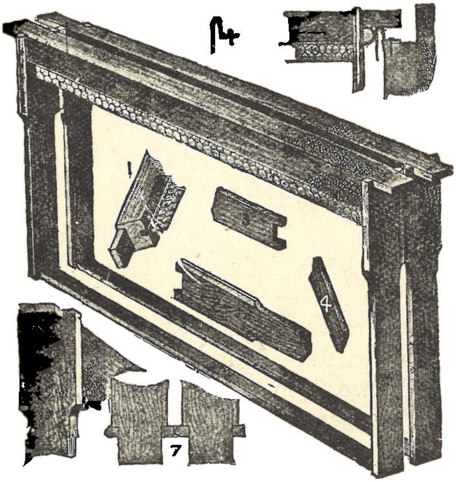


Fig. 42. Full-depth Root-Hoffman frame.

Section Boxes.

Section boxes holding one pound of comb-honey when full are the most popular among both producers and consumers, and there are a good number of the latter in some parts of the Dominion, though the great majority prefer extracted honey. The section boxes in general use in New Zealand have the split top as in Fig. 43, to slip the comb-foundation in. The boxes when received from the manufacturers are in the flat as in Fig. 44, and require care in folding. My method when using

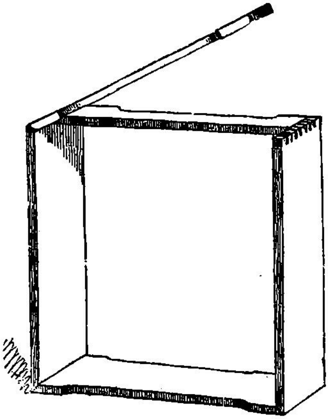


Fig. 43. One-piece section.

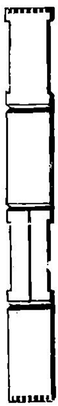


Fig. 44.

Section box in the flat.

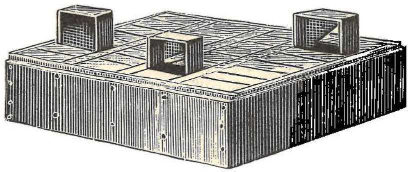


Fig. 45. Section case.

large numbers was to take as large a bundle as I could grip, held as tight as possible, and plunge them under warm water; when the air bubbles from the joints ceased rising I took them from the water, and after standing in the bundle for a short time they fold easily, and without risk of breaking. Half of the top is folded down, the edge of the foundation inserted, and the other half closed, when it is ready to put in the frame, of which there are seven to the half-storey, each taking four boxes, as in Fig. 35.

Separators.

These are made of tin or thin veneer; the latter is shown in Fig. 35, and usually termed "fence" separators. Their use is necessary between each two frames of boxes to prevent the bees building the combs beyond the edges of the boxes and frames. Fence separators are undoubtedly the best in spring, as the coldness of tin tends to prevent the bees entering the section supers as early as they might.

CHAPTER VIII.

COMB-FOUNDATION.

Of equal importance I consider to the invention of the movable-frame hive, was that of turning out full-depth sheets of comb-foundation by A. I. Root and another in 1877. In fact, the full advantage of the use of the former could not have been obtained without the latter; it took, however, some 32 years from the time the first crude foundation was made in narrow strips, until it was manufactured in a more perfect form, and in full sheets, as we have it now.

Comb-foundation is simply a thin sheet of beeswax upon which the basis of worker cells, with a small portion of the side walls, are impressed, and upon this foundation the bees construct the complete comb. Beeswax being an expensive article, quite a number of cheap substitutes have been tried, such as paraffin, ceresin, and other mixtures; also stiff paper, thin calico, and thin veneer of wood coated with beeswax have been tried and failed, as well as the aluminium foundation, from which so much was expected; nothing but pure beeswax has yet been discovered suitable for the purpose.

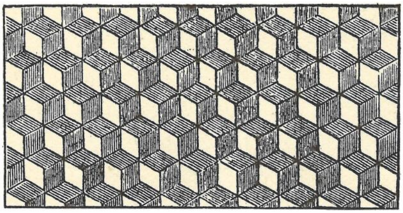


Fig. 46. Comb-foundation.

Manufacturing Comb-foundation.

Formerly, the process of manufacturing comb-foundation consisted in melting the wax in a deep boiler to a few degrees beyond the average melting point, which ranges from a degree or two below 145° F. to the same above. Into this a thin board was dipped after being taken out of water, when a thin sheet of wax was peeled off each side of the board, the sheets being afterward put through the embossing rollers to impress the cell bases. It was a slow and messy job as I know, having made 75 tons by that method, but it was the only way of making foundation at that time, and the finished article had to be handled very carefully after the sheets were cold, as they became as brittle almost as glass. As manufactured now, it is far superior in every way to the old style; it is cleaner, more

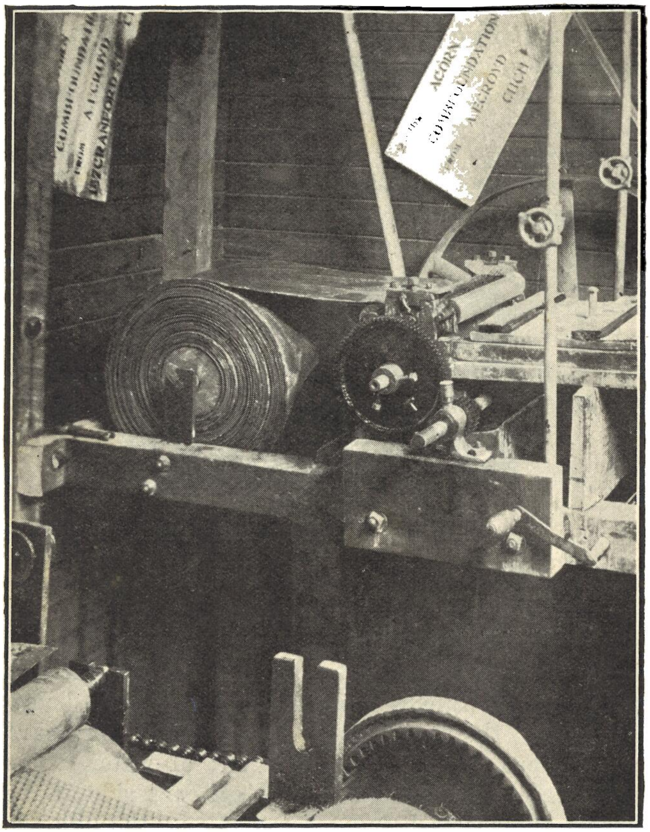


Fig. 47. Sheeted wax passing between plain rollers preparatory to going through the embossing rollers.

pliable in cold weather, and it is more economical, there being more sheets to the pound. The two illustrations, Figs. 47 and 48, represent an up-to-date manufacturing plant owned by Mr. A. Eckroyd, of Christchurch, and his method of manufacture is briefly as follows:—The blocks of wax as received

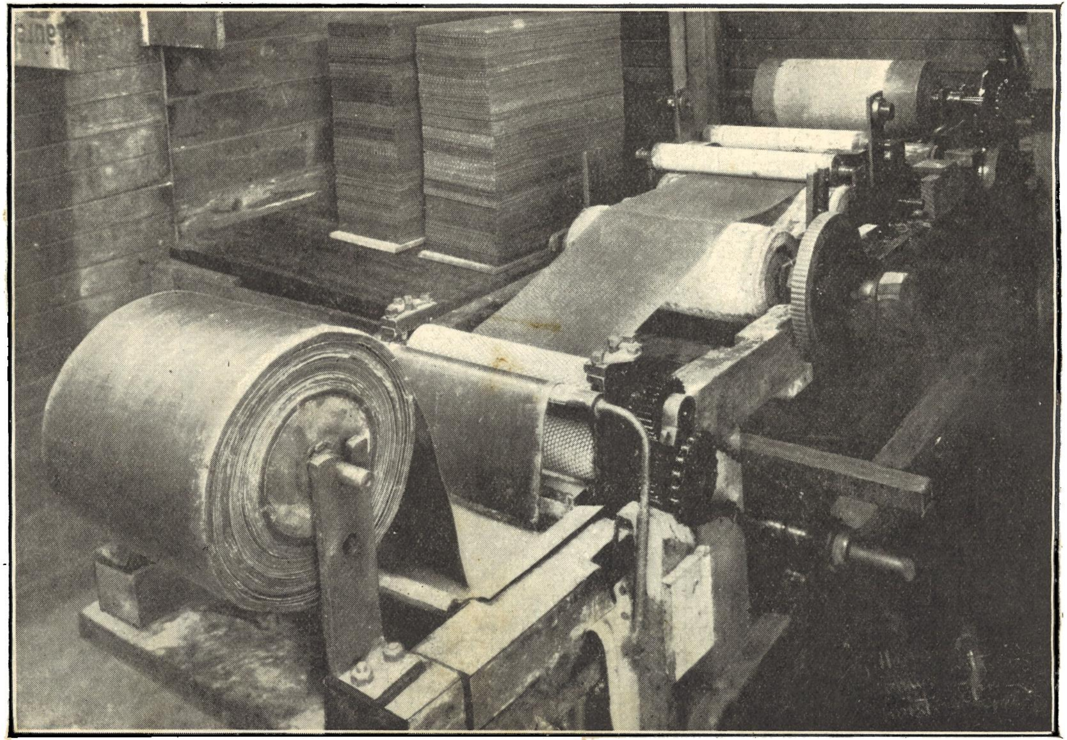


Fig. 48. Prepared sheet of wax passing between the embossing rollers in the final process of manufacturing comb-foundation.

are examined and graded ready for clarifying; no matter how clean the wax may appear, it goes through a grading process previous to being dumped into a specially constructed melting vat, where the wax is melted under a high pressure of steam till the desired temperature is reached. The steam is then turned off and the vat covered. Owing to the vat having an insulated wall, the wax remains in a melted condition for several days, during which a complete clarification takes place; it is then run off into convenient blocks which are allowed to cool slowly, to anneal thoroughly. The blocks are then reheated and passed between plain rollers (Fig. 47), and wound as a thin wide ribbon automatically on to bobbins, each containing about 200 feet.

The full bobbins are next passed on and placed in bearings at the end of the embossing machine (Fig. 48), and the sheet fed through the embossing rollers, passes over other plain rollers to where the complete comb-foundation is automatically cut into correct lengths and stacked, a very interesting process.

The Super Foundation Mills at the "Acorn" Works are somewhat similar in construction and operation to the Brood Mills, with additional automatic gear which feeds tissue paper in between the sheets of foundation as they leave the embossing mill.

Comb-foundation for Brood and Extracting Frames.

Comb-foundation is made of different weight, for use in above frames; there is medium and light weight, the former running eight full Langstroth frame sheets to the pound, and the latter nine and a half sheets. The medium weight is generally used in brood and extracting frames of full depth, and the lighter weight in half-storey extracting frames.

For use in section boxes a still lighter weight is made, little more than half that of the medium foundation, so that there shall be no suspicion of a thick midrib of wax when consuming section honey.

Comb-foundation and Disease.

It was very generally believed at one time that comb-foundation, made commercially from beeswax from all sources, was a fruitful medium for con-

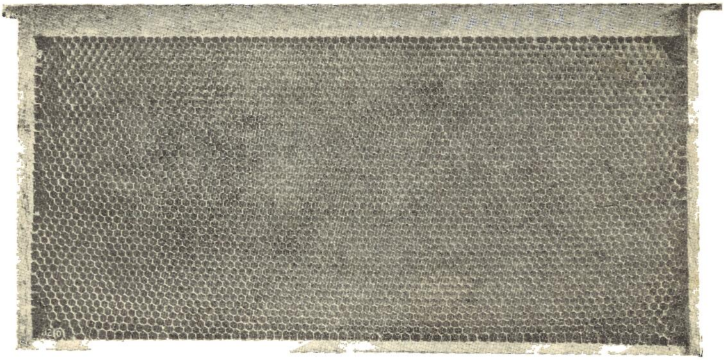


Fig. 49. A frame of worker-comb built on comb-foundation, as near perfect as possible

veying foul brood. My experience was entirely against this proposition from the first outcry, for when the first commercial apiaries were established at Matamata I had over 10,000 combs in use, the foundation of which was made from wax bought in all parts of New Zealand, and imported from England and Australia, yet there was never a sign of disease in the apiaries, nor had I ever seen foul brood until after I left for Auckland, where there was plenty of it. Again, Mr. G. V. Westbrooke, Apiary Instructor at that time, in accordance with instructions, officially carried out decisive experiments some few years ago in the Waikato to ascertain something definite on the matter. He selected very badly diseased combs, melted them up into wax on the spot, made it up into comb-foundation, and gave it to colonies which he had treated and isolated on one of the islands in the Hauraki Gulf. All the work was done by himself so that there should be no mistake, and the result was that no sign of disease appeared in the combs. The melting of the combs into wax appears sufficient to sterilize the latter and render it free from disease germs.

Fig. 50. Wax tube.

This is very useful for waxing comb-foundation in frames. Plunge the tube into melted wax, place thumb over vent and withdraw. Run the tube along the groove after the foundation is in place. Take care the wax is not too hot or it will melt the foundation.

Wiring Frames.

In order to strengthen the full combs, and to prevent the comb foundation from sagging, the frames are first wired, and then the wire is embedded in the foundation before use. The frames as formerly supplied have the end bars pierced with four holes at equal distance apart (Fig. 52), and the top bars grooved (double grooves). But as now sent out in New Zealand they are only bored for three horizontal wires instead of four, and instead of the wedge with two grooves in the top bar for fastening the upper edge of the foundation, the majority of our bee-keepers prefer one groove only, and to fasten the foundation with melted wax in the groove instead of a wedge. If the frames with wedge have to be boiled it is almost impossible to use the wedge again, hence the reason for the change.

Number 30 tinned wire is used, and after the frames are put together they are wired by threading the wire through the top holes and down through the others in one length, winding the end round a small tack driven in at the lower end. Take up the slack of the wire nice and tight, and fasten the upper end round a small tack and cut off. Unless the spool on which the wire is wound is steadied in some way the coils are likely to unwind too fast and kink; if a small spike that just fits the hole

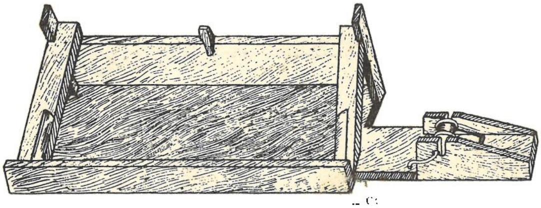


Fig. 51. Finlay frame-wir... device.

in the spool is put through and driven into the work bench, sloping slightly a... y from the workman, the unwinding is then better under control.

When, however, there are many frames to deal with, it will pay to construct an appliance similar to that shown in Fig. 51 to hold the frame and regulate the unwinding of the wire, while leaving both hands free for the work. Lay the frame with the top bar at bottom of the device; the end bars will then rest between the top projections, while the bottom bar will fall upon the peg in centre at top. By springing the bottom bar inwards, and pressing it downwards, the frame will be held firmly and securely. In the projection at the right of the illustration is a sawcut into which a small crank made out of a $\frac{3}{8}$in. bolt, 8 in. long, and bent at one end into a crank handle, is dropped in after passing through a half-pound spool of wire. The centre of the bolt is hammered flat before being driven through the spool, the better to hold the latter firmly. A common mouse-trap spring is fastened to the board, so that it presses on the spool to prevent running backward. The wire from

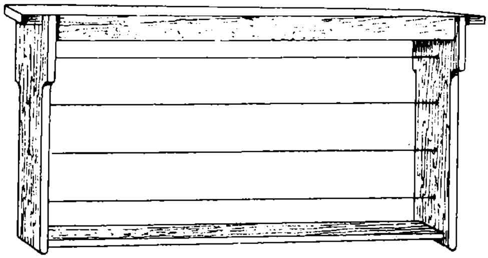


Fig. 52. Wired frame.

the reel is then passed through the hole nearest the top bar, and in and out through the others and fastened round a tack after passing through the last hole near the bottom bar. The slack wire is now taken up with the left hand while holding a winding pressure of the spool-crank with the right. When tight enough to "sing," reach over with the left hand and pull wire up between frame and spool and take a couple of turns round a tack driven in above the hole near the top bar and cut off. Do not make wires too tight to cut into the wood of frame.

Fastening Comb-foundation in Frames.

The top bar of a frame has two grooves, a large one in the centre, and a narrower one alongside, the former for the foundation, and the other for the wedge supplied with the frames. See that the edge of the foundation is perfectly straight and slip it into the groove, making sure that it is well down in it, then put in the wedge, which should be pressed down level. Sometimes the wedge gets warped out of the straight and cannot be pressed into the groove securely. In such case break off about an inch of the wedge, then break the remainder into three parts; it will work all right then.

Embedding the Wire in Comb-foundation.

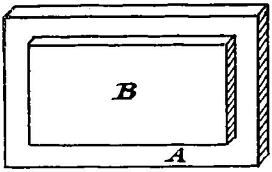


Fig. 53. Wiring board.

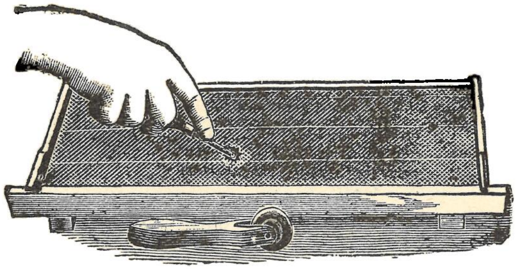


Fig. 54. Spur wire embedder in use.

There are two methods for accomplishing this, by hand and by electricity; the former is a comparatively slow process suitable for where there is little to be done, but on a large scale the use of electricity is essential for rapid work. To embed by hand, cut an inch board (*A* in Fig. 53) a little larger than the size of the frame; on this screw another piece, *B*, three-eighths of an inch thick, cut slightly smaller than the inside of the frame, letting the grain of each board cross that of the other, which will prevent twisting. Lay the frame of foundation, wires uppermost, on the board *B*, the frame itself resting on the lower board *A*; the wires can then be embedded with the embedder as shown, which is provided with teeth set like those of a saw. The foundation should, of course, be warm enough to be pliable.

Electric Embedding.

Two simple forms of electric embedders are depicted in Fig. 55, portrayed and described in Bulletin No. 92, British Columbia, recently published. It says: "Nothing has been found better for this purpose than to heat the wires by electricity and allow them to sink into the wax without destroying a single cell or weakening the foundation in any way. The illustration (Fig. 55) shows an embedding board made for use with current from an electric light socket, together with a transformer for reducing the current to the right voltage. The board is made of $\frac{3}{4}$-inch material, and is cut to fit loosely inside a standard Langstroth frame, leaving about $\frac{1}{2}$-inch for play at the ends. The foot-rests are of the same material and width projecting $\frac{3}{4}$ inch beyond the board. To the one on the left is attached two strips of $\frac{1}{2}$-inch copper, with screw-stems and nuts soldered on to them, which can be obtained from a worn-out dry cell battery. These copper strips, or contact points, are fastened directly opposite where the ends of the wires in the frame will come in contact with them. The transformer is made with an ordinary quart Mason jar three-quarters filled with water, to which is added half a teaspoonful of common salt, a few yards of electric light cord, with plug at one end for light socket, and two pieces of heavy copper wire. Unwrap one end of the double cord and attach direct to one of the contacts on the embedding board. Make a break in the other wire at some convenient place to stand the quart jar, and at the ends of the break fasten the two

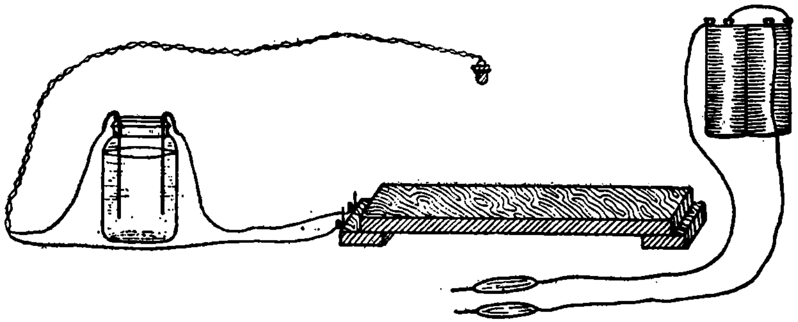


Fig. 55. Electric embedder.

Left: A simple home-made electric embedder and transformer capable of embedding 300 frames of foundation an hour. Right: Two dry-cell batteries for embedding one wire at the time where no electric current is available.

pieces of heavy wire, bending them with a hook to hang over the edge of the jar into the water, and connect the remaining edge of the wire with the other contact on the board.

The current will not flow through the resistance of the fresh water, but will begin to do so as soon as a little salt is added; about half a teaspoonful being generally sufficient for ordinary light current, and can be regulated by adding salt or more fresh water to an exact degree. It is advisable to start with a cool current until experience is acquired and faster work desired, when the addition of a little more salt will "speed her up."

Placing the Foundation.

The frame of foundation, with wires uppermost, is laid on the board, and keeping a downward pressure with the hands on the ends of the bars, to press the wires on to the foundation, it is slid to the left, where the copper strips come in contact with the frame-wire ends. A slight buzzing will indicate when contact is made, and the four wires will sink into the wax. To break contact, do not lift the frame, as the hot wires may leave the wax, but slide back to first position, allowing a second for wires and wax to cool before lifting. Three hundred frames an hour can be embedded perfectly in this way as soon as practice allows for speed.

The Dry-cell Embedder.

Where the electric light or other current is not available, an equally good job of embedding can be done with the use of an electric battery, though, of course, not so quickly; a couple of dry cells, a yard of double light cord, and two stiff points being all the equipment required. The wires are connected as shown in the illustration, two heavy pieces flattened to a chisel-point being attached to the ends for pressure points. A good hand grip for these points can be made by sawing a couple of short lengths from an old broom handle and boring them through with a gimlet to fit tightly over the copper points. Only one wire at a time is embedded with this, but the result is all that could be desired. It is understood that as many frames as are required are completed as far as possible with each of these appliances before moving on to the next, for not much time would be saved if each frame was done separately. These appliances would not greatly benefit the owner of one or two colonies, but no bee-keeper with ten colonies or more can afford to be without a set if he values his time and appreciates fine work. One pound of wire will wire about 300 frames, four strands to the frame.

Chapter IX.

THE HONEY EXTRACTOR, AND EXTRACTING APPLIANCES.

As with all apiary appliances, improvements are constantly being made in the construction of honey extractors. After the original crude extractor invented by Major von Hruschka, of Dolo, Italy, in 1868, came Root's two-comb fixed-basket extractor, then Cowan's reversible basket extractor, which was a very great improvement on the previous ones. The four-comb reversible was the next in order, with a few six-comb, all worked by hand. Now we have four, six, and eight-comb reversible extractors worked by oil-engines, and some by electricity, both powers being in use in New Zealand. The latest improvement in extractors in America enable the operator to reverse the baskets without stopping the machine, thus saving a vast amount of time and trouble to commercial apiarists on a large scale, which means extra profits (see Fig. 58).

Four-comb hand-power honey extractors are largely in use at the present time in New Zealand, but are rapidly giving place to power extractors by extensive commercial bee-keepers, as more economical in every way. Six and eight-comb extractors are very expensive, but will no doubt come into use here before long, especially where all

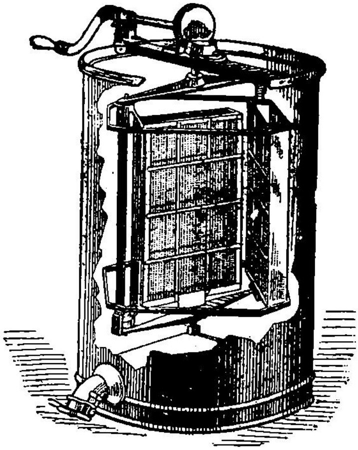


Fig. 56. Two-comb reversible extractor.

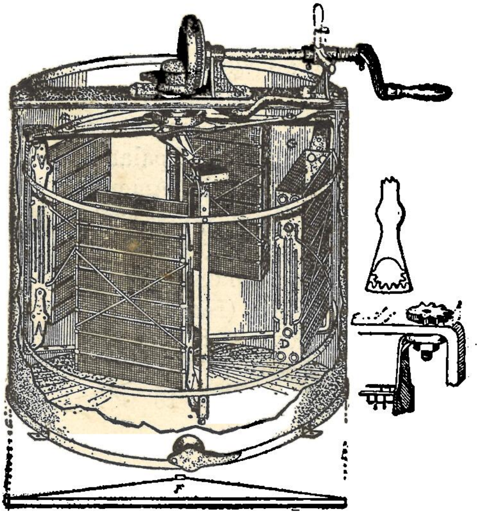
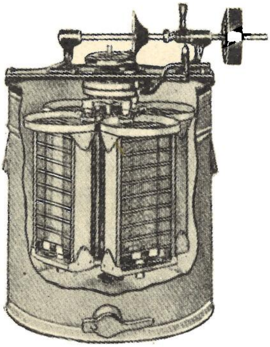


Fig. 57. Four-frame hand-power reversible extractor.

the extracting from a number of out-apiaries is done at a central and stationary plant. The latest improved extractors, by which it is claimed that



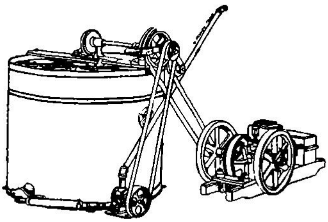


Fig. 59.
Power extractor and honey pump.

Fig. 58. Buckeye full-speed reversing extractor.

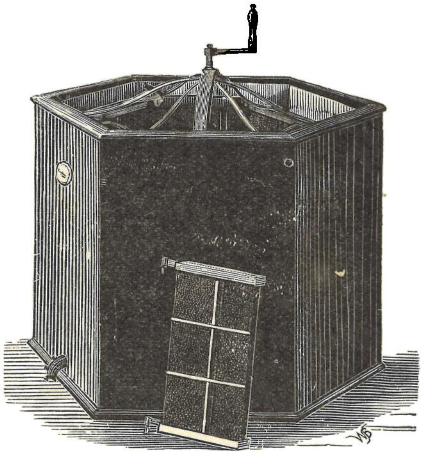


Fig. 60. Original six-comb extractor.

the honey in both sides of a comb can be extracted at one time, is an English invention (see Fig. 61 and advt. at end of manual).

A very great advantage connected with a power-driven extractor is, that a honey pump can be worked at the same time with the same power, to convey the honey as it leaves the extractor to a tank (see Fig. 59). It may be worth mentioning that six-comb reversible extractors were in use in New Zealand almost as early as in America. The one shown in Fig. 60 was made in Auckland in 1883 for the author to his design, and subsequently quite a number came into use. They were made of stout timber lined with tinned steel, but driving direct from the spindle did not answer, for once it got going with six heavy combs one had to let go till it stopped. After side-gearing was substituted it went all right.

Where full-depth Langstroth frames are used the extractor baskets need not be wider than 9⅝ inches, but if using half-depth extracting frames, baskets 12½ inches wide will take two frames.

The Radial Honey Extractor.

This extractor, which has been brought prominently forward during the past eighteen months by the proprietor and patentee, Mr. Herrod-Hempsall, the former editor and proprietor of the "British Bee Journal," is built and run on quite a different principle to the ordinary reversible comb machines. As will be seen in Fig. 61, the combs, instead of being in baskets in the ordinary position, radiate from the centre, and are minus the baskets, and in this position are fixed. The great feature claimed for this extractor is that the

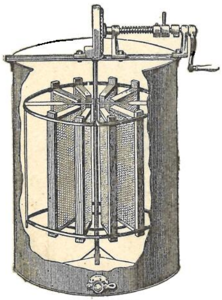


Fig. 61.
Radial Honey-extractor.

honey in both sides of the combs is extracted at the same time. The departure from the ordinary extractors is so radical in structure and principle that I asked the distributing agent for some particulars about it, and received an encouraging report of a large power-driven one in use at St. Mary's Abbey, Buckfast, Devon, extracting from upwards of 30 combs, both sides at once (see advt. at end of book). There is also a very favourable notice of the radial extractor in the "American Bee Journal" for February, 1925, which warrants me bringing the machine forward in this edition of the manual.

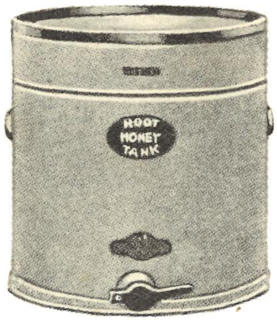


Fig. 62. 90 gallon honey tank.

Honey Tanks.

Each bee-keeper by the time he needs a honey tank will have decided upon the form and size that will suit him best, but a few hints may assist in forming a satisfactory decision. Regarding the material, galvanized metal has been objected to, but as no injury to honey has been noticed, it is now largely used in honey tanks. Medium-size tanks seem to be preferable to large ones. By a medium-size tank I mean one holding about 2,000 lbs. of honey; the one illustrated (copied from Root's 1924 catalogue) represents a smaller one, holding, if we reckon about 14lbs. of honey to the gallon, 1,260lbs. The particulars as to size and material of which the tanks are made are given as follow:—They are made of galvanized steel, the 90-gallon size of 24-gauge, and the 140-gallon (1,260lbs.) of 22-gauge. The dimensions of the former are: diameter 29in., height 31in, and of the latter, diameter 37½in, height 32in. Such honey tanks are probably as good, and as handy as can be used, but if the method of rapidly clarifying honey ready for tinning after leaving the extractor, which I have suggested in Chapter XVI, is adopted, there will be little need of tanks, or probably not more than one.

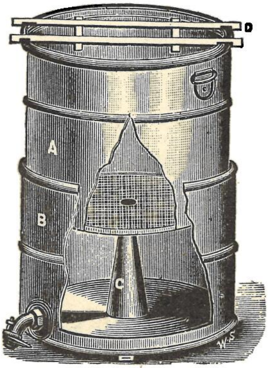


Fig. 63. Dadant uncapping can.

Uncapping Appliances and Cappings Melters.

Where the operations are on a limited scale of say under 40 colonies, run for extracted honey, all that will be needed is an uncapping can (Fig. 63) or some such appliance to hold and drain the cappings of honey, an uncapping knife, a strainer, and a small tank.

The Dadant uncapping can, as will be seen, is made in two parts; at the bottom of the upper part is a strainer on which the cappings fall, and through which the honey from the cappings drains, to be eventually run off by the honey gate. While the Dadant can is suitable for bee-keepers in a small way, and was extensively used at one time, with the enlargement of operations in commercial

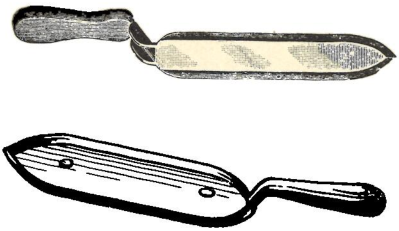


Fig. 64.
Root, and Bingham uncapping knives.

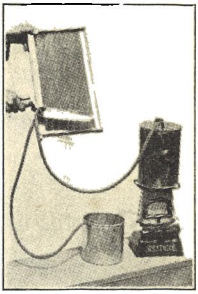


Fig. 65.
Steam-knife outfit.

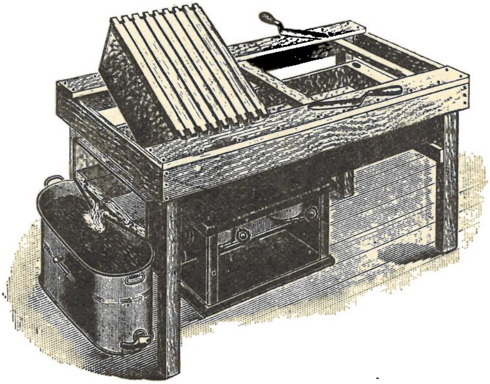


Fig. 66. Lewis cappings melter. (Water-jacketed.)

apiaries and the enormous increase in the quantity of cappings to be dealt with, it was found absolutely necessary to adopt some method whereby they could be got rid of at once, hence the invention of the "cappings melter," which by the aid of heat in some form, melt the cappings as they drop from the knife and both wax and honey run at once into the separator, as shown in Fig. 66. Three well-known New Zealand apiarists, Messrs F. C. Baines, Y. H. Benton, and C. Smedley, set their wits to work, and each brought out a machine, all being highly spoken of by those who have used them. They are dealt with in another chapter. Capping melters similar to the Lewis melter are much in favour among our extensive bee-keepers, the principle of which is a ridged metal bottom at the uncapping end, above a water jacket, which can be heated to the required temperature of melting wax (145° F. average) by a lamp, steam, or hot water circulation. It is a curious fact that more than thirty years ago the present chief apiarist of Victoria, Australia—Mr. R. F. Beuhne—invented a ridged metal cappings melter, diagrams of which he submitted to me at the time. His idea appears to have been adopted in other parts of the world, including New Zealand.

Uncapping Knives.

Some form of knife is essential for shaving the caps off the honey-cells previous to extracting the honey; the two illustrated in Fig. 64 are in universal use as being best adapted for the purpose. Although cold knives may answer where there is little uncapping to be done, where the operations are on a large scale, heated knives are necessary for rapid work, and the saving of time in the busy honey season means larger monetary gains. To heat the ordinary knives a convenient plan is to have an open can (similar to the one shown on the floor in Fig. 65) a little deeper than the blade of the knives, and with three sleeves or narrow pockets round the inner side of the can to hold the knives. The can is filled with water and set over a lamp; two knives are necessary for changing for one operator, and three knives for two operators. Care must be taken when using water-heated knives to wipe them dry each time before uncapping the combs.

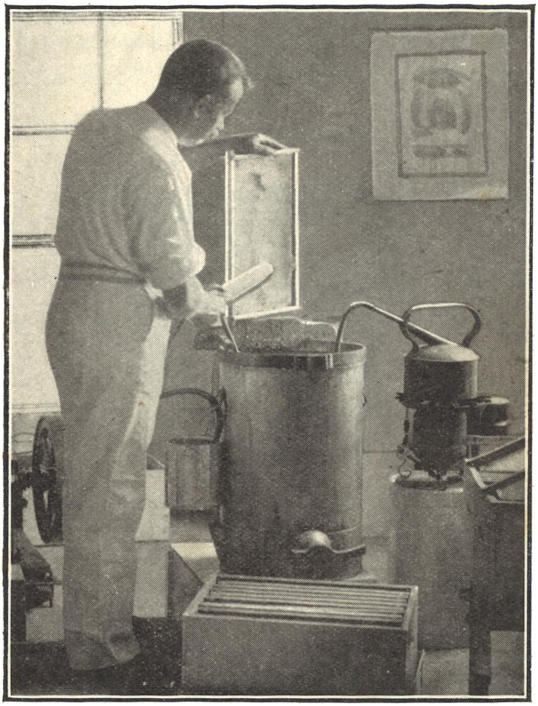


Fig. 67. Steam uncapping knife in use at Mr. R. Gibb's Apiary, Southland.

Steam Heated Knives.

The steam uncapping knife (Fig. 67) is now chiefly used in commercial apiaries, and few who have used it would care to go back to the water-heated knife, although I and my assistants have done excellent work with the latter. The rubber tubes conveying the steam and the resultant water should be of the lightest suitable material or the work will be very heavy on the wrist. Owing to not being able to procure light tubing, both my assistant and myself on one occasion had to fall back upon water-heated knives. The outfit can be obtained from our hive manufacturers and their agents.

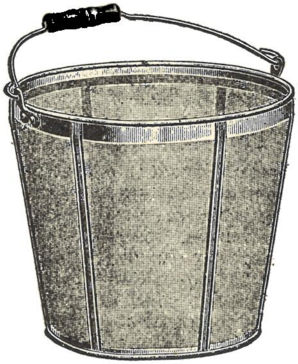


Fig. 68. Alexander honey-strainer.

Honey Strainers.

Some kind of strainer is necessary to strain the honey after leaving the extractor, and before it enters the tank. The Alexander strainer is a popular one and largely in use by commercial bee-keepers; it is strongly made of finely-meshed brass wire cloth, but it needs, to make it more useful, a movable shallow coarser strainer let into the top to catch pieces of wax, bees, etc., to prevent the finer one getting clogged too readily. It can be suspended from a hook or collar over the honey tank. Other forms of strainers can, of course, be made, but avoid all sorts of cloth strainers if you value your peace of mind, and save all the strainings for making mead and vinegar.

The further process of dealing with honey after leaving the extractor, to bring it to the highest condition for marketing, is explained in Chapter XVIII.

Chapter X.

HANDLING BEES.

The best that any writer can do on this subject is to give a few hints, for no amount of book teaching will do as much to give confidence to the novice as a few minutes in the presence of an experienced apiarist when going through his hives. I therefore advise all beginners who cannot go for a season's tuition at an established commercial apiary, to visit one as often as possible in the honey season to gain a knowledge of how to handle bees and work the hives; experienced bee-keepers are very liberal and readily give information to beginners.

There are certain rules to be observed to secure tolerable freedom from stings:—(1) Avoid jarring the hive or frames; if anything is difficult to move, such as the cover, or a frame, quietly prise it apart without jarring. (2) Never stand in the line of flight to a hive, and do all the manipulations from the sides, never in front. (3) A novice should never handle bees on dull, showery days, nor after sundown. (4) Never strike at a bee, but if timid and unprotected by a veil, bow the head slightly and walk away. After confidence has been gained by experience, a person may take liberties, but it is better to be cautious at the commencement.

Bee Veils and Smokers.

A good bee veil fixed over a stiff-brimmed hat of some kind is a necessity, as it protects the face and gives the wearer greater confidence. They can be made of book muslin, with or without Brussels net in front, tarlatan, or mosquito netting, but should be large enough to stand out from the face, and come well down the shoulders, where it can be

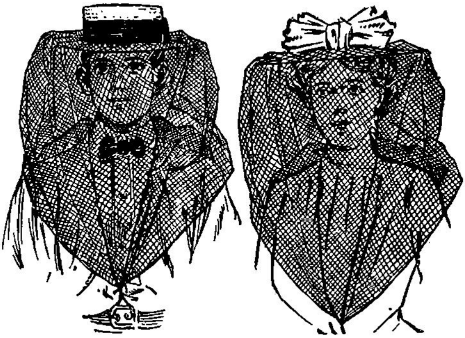


Fig. 69. Bee veils.

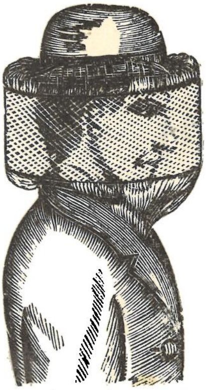


Fig. 70. Wire-cloth bee veil.

tucked in under the waistcoat. It improves a veil to face it with open silk netting or queen-cage wire cloth, to allow the warm breath to escape readily.

Smoker.

A good smoker is absolutely necessary in handling bees, for pungent smoke in small doses is harmless, and the best bee quietener we have, a puff or two blown in at the entrance previous to opening a hive, is sufficient to frighten the inmates and drive them to their honey to take in a full load ready to take flight if necessary, and in that condition the bees can be handled with safety, providing the foregoing rules are observed.

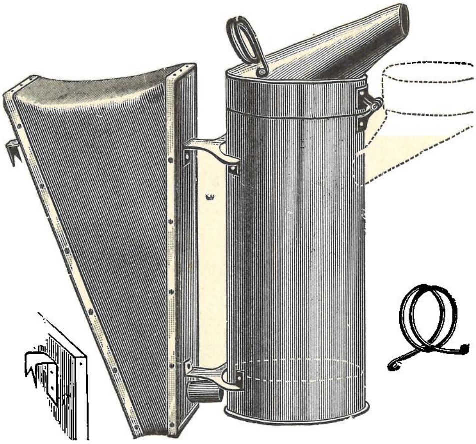


Fig. 71. Standard smoker.

Fig. 72. Breech-loading smoker.

Fuel for Smokers.

Though dry rotten wood makes excellent fuel, giving out dense smoke, it is not always readily procurable, but old dry sacking is much more easily obtained, speaking generally. This latter when quite dry should be cut into strips the depth of the smoker in width, and rolled up loosely, and if the ends of the rolls are dipped in a solution of saltpetre and dried, they will ignite readily from a spark. A number of rolls should always be on hand.

Gloves.

No experienced commercial bee-keeper would dream of wearing gloves while handling bees, but those who only keep a colony or two as a hobby, and are timid of stings, may find them useful. Rubber, and oiled cotton gloves can be obtained from bee-keeping supply firms, and the best for the purpose are those which leave the ends of the fingers free.

Stings and Remedies.

When a person takes up bee-keeping and intends to carry it out properly, he or she must make up their mind to put up with stings occasionally. It is impossible to work among bees without being stung now and again. Though very painful to beginners sometimes, and the occasional cause of much inconvenience, they are rarely dangerous to human beings. The effect in some cases is to bring out a rash over the body, and in others, violent vomiting. In the latter case, place a strong mustard plaster between cloths on the pit of the stomach.

I have known of one or two cases during my fifty years' experience with bees, when there was a partial collapse after being stung, but the administration of a fairly strong dose of brandy brought them round, without any painful after-effects. I believe in such cases a strong stimulant is the best remedy that can be applied.

Beginners who suffer at first may console themselves with the fact that the more they are stung the less effect the poison will have on them; that is to say, the system becomes more immune to the poison as time goes on. I am often asked for the best remedy to allay the pain and swelling, which with beginners almost invariably follow a sting, but have always to plead ignorance, for I do not know of any good remedy. I have tried everything that has been recommended, with the hope that I might discover something to benefit others, but without success. Bathing the wound with very hot water is perhaps as good as anything. The sting being barbed cannot readily be withdrawn from any tenacious substance, like the human flesh, but is, with the poison bag attached, left in the wound, and the best way of removing it is to scrape it out with the finger, or thumb nail, so as to avoid pressing the poison bag.

How to Open a Hive.

Light the smoker and get it well going; then don the bee veil; blow a few puffs of smoke into the entrance of the hive, and wait a short time; then blow in another puff or two. The cover can now be removed, and as one corner of the mat is lifted blow a little smoke under it (see Figs. 3-4). By this time the bees are under control, and the mat can be removed altogether. Keep your smoker by you, and if bees get in the way, or "boil" up over the frames, give a little more smoke. The smoker will keep alight if stood on end, and to put it out, plug up the nozzle with a piece of cork or bunch of grass.

When the hives are made properly there is always a little play on one side of the frames when they are pressed together to allow the first one to be easily removed. A "hive-tool" like that in Fig. 74

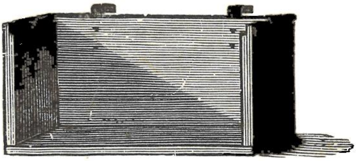


Fig. 73. Comb holder.

is handy for lifting the first frame, and it also answers as a scraper. In fact, something of the kind is needed all the time one is at an open hive. A small screwdriver also makes a good hive tool, but the one illustrated is in the form of a scraper as

Fig. 74. Hive tool.

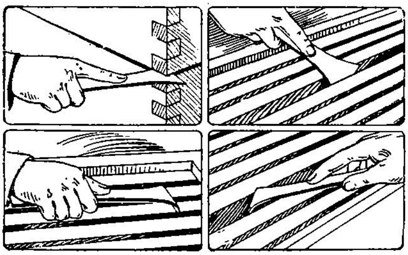


Fig. 75. Hive tool in use.

well as a lever—a scraper is often needed. Some kind of comb holder in which one or two combs with their adhering bees may be placed temporarily while manipulating a colony is very handy and easily made out of light timber, as in Fig. 73.

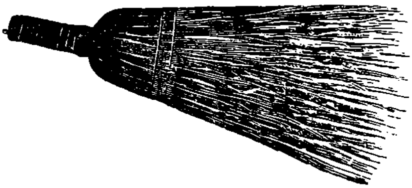


Fig. 76. Bee brush.

Another indispensable appliance is a brush of some kind for brushing the bees off the combs when removing them from the hives, and the kind shown in Fig. 76 is about the best for the purpose.

This is a sort of whisk broom especially made for brushing bees. The strands are thinned out and are longer than ordinary hand brooms so as to afford a soft, pliable, easy sweep of the combs.

Handling Frames.

Beginners need to be very careful in handling new combs heavy with brood or honey, as if not handled the right way they are likely to fall out of their frames. By studying the three illustrations, and practising with an empty frame for a short time, the difficulty can be soon overcome. It is practically always necessary to examine both sides of the comb when a frame is removed from a hive. Fig. 77 shows a frame of comb just lifted from a hive; Fig. 78 shows the first action in reversing the frame to examine the opposite side of comb. The left hand is lowered and the frame swung round at the same time, when, by raising the left hand again the reverse side of the comb is brought into view of the manipulator without disturbing the bees or putting strain on the comb. By reversing the process the frame of comb is brought back to its original position.

Fig. 77. First position in handling frames.

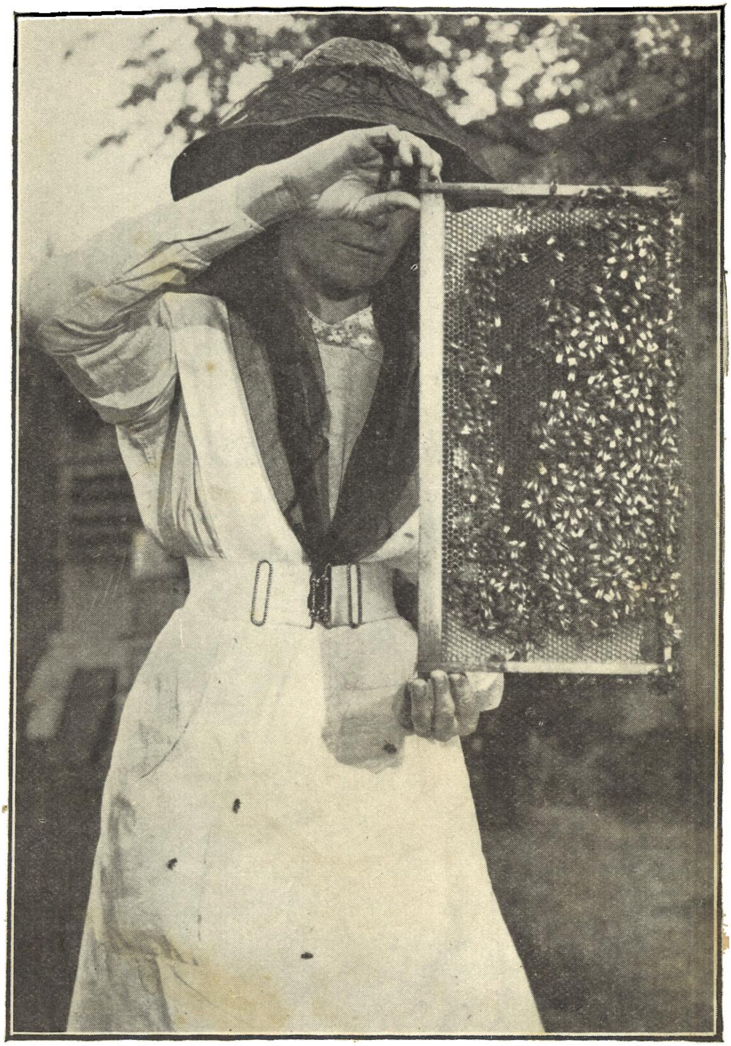


Fig. 78. Second position in handling frames.

Fig. 79. Third position in handling frames.

Chapter XI.

TRANSFERRING BEES FROM BOXES TO FRAME HIVES.

Were it not that this Manual is sure to be read by box-hive bee-keepers in countries where such hives are not yet illegal, and where they are likely to be used for some time to come, there would be no need for this chapter. New Zealand was the first country to do away with, or make it punishable to use, box-hives and the sulphur-pit system; other countries are following suit, and it is to be hoped it will not be long before similar regulations will be in force in all countries.

Driving Bees from Boxes.

The best time to transfer bees is on a fine day during the honey season; the frame hive to which the bees are to be transferred should be located in its permanent position, the frames furnished with full sheets of foundation, or strips if the bees are to be "McEvoy'd," and the front of the hive raised off the bottom board a couple of inches or so, by stones or wood at each corner. A mat should cover the frames and a sack be laid across the alighting board to prevent the bees falling to the ground when dumped down near the entrance. A box about the same size as the one the bees are in should be ready and the smoker going.

Blow a few puffs of dense smoke into the box, and put on a bee veil. In about two minutes give the bees some more smoke, then turn the box upside down, and put the mouth of the empty box over the bees, and drum away with two sticks on the lower box, on the sides running nearest parallel with the combs. To prevent the top box from shifting, a long towel or sheet of some kind can be tied round the junction of the two boxes. In a short time the bees will begin to ascend, but the drumming may have to be kept up for from fifteen to twenty minutes before all the bees are in the top box. Set the one the bees are in down near the permanent hive, and carefully look among the old combs to see whether the queen is still there. As a rule she is among the first third to leave, but occasionally she is among the very last.

The bees clustered in the box are practically in the same condition as a swarm, and may now be dumped down on the sack in front of the new hive, close to the entrance; after the bees are all in, lower the hive on to the bottom board, and allow from six to eight inches of entrance space. The box of old combs should be taken away clear of all bees and be dealt with at once. The honey can be made use of, and the brood combs be burned with the box or melted into wax. Should the weather after transferring be against the bees gathering nectar, feed them with sugar syrup (see Chapter XVII).

Chapter XII.

SPRING MANAGEMENT.

It is a common-place saying among experienced bee-keepers that spring management of bees should commence in the autumn. Paradoxical as it may seem, the observation is quite correct, for the condition of the colonies for making forward progress in early spring (when it is most essential) or otherwise, depends upon the autumn management, and the condition they were in when fixed up for winter, which is fully explained in Chapter XVII.

In the latitude of Auckland and most parts of the North Island south of Auckland, increased breeding commences in healthy colonies of normal strength at the end of July, so that by the fourth week in August the new season's bees will be on the wing, and taking their place as nurses, while the old bees from the previous season are dying off rapidly. Some allowance must be made for difference in time of season between the North Island, and from North Canterbury southward, which on an average is from two to three weeks later in the south.

Spring Examination.

This should take place during the first half of August to ascertain the exact condition of each colony, to be noted in the field-book, the quantity of food, and to clean the bottom boards. Colonies in normal healthy condition will have patches of sealed brood in the centre combs; any that are backward in this respect, mark the hives for examination again in a fortnight or so, and if there is no improvement renew their queens at once if there are any spare ones on hand, or unite them with other colonies to save the bees.

Removal of Spare Top Boxes.

Top boxes that have remained on the hives since autumn and not fully occupied should now be removed, the object being to leave as little cold space in the hives as possible, as warmth and food are the two essential requisites from now forward to encourage breeding. At the same time there should be no overcrowding of the bees by forcing them into too small a space. It frequently happens when top boxes have been left on too long over a small colony that the bees forsake the lower box and take possession of the upper one, as the warmest part of the hive. In such cases it is only necessary to remove the lower box altogether and replace it with the upper one; what brood there is in the hive will be in the top box.

During the autumn and winter more or less grime accumulates on the bottom boards that needs clearing away. Lift the hive on to a spare bottom board and give the permanent one a good scraping with a hive tool or a three-cornered scraper, and return the hive. This is the best time of the year for amateurs to detect symptoms of disease, as described in Chapter XIX on Diseases of Bees, therefore examine each brood comb closely, and if disease be discovered mark the colony for treatment later on. See that the food is ample, and close down.

Spring Feeding.

Only in exceptional cases of prolonged bad weather should spring feeding be needed in New Zealand, for if the minimum amount of food (40lbs.), as advised, be left in the hives in late autumn when fixing the bees up for winter, with what nectar can be gathered in average winter seasons, it will carry them through till the main flow commences in the latter part of November. The most critical time is in the second half of October, as there is naturally a dearth of nectar at that time, and if a spell of bad weather cut off what nectar might be gathered, and with breeding practically at its maximum, the food supply would diminish very quickly and the colony be reduced to starvation in a few days. At such times close attention to the food should be given, and if short, feed at once; the formula for making syrup is given in Chapter XVII.

Division-boards and Their Use.

Division-boards are very useful for contracting the ordinary space in a hive to accommodate a small colony where it is considered worth while to continue it as a separate colony on account of its queen; in

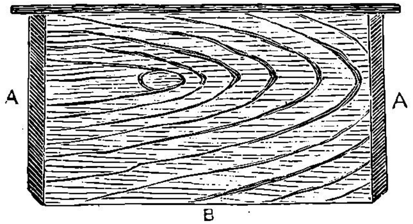


Fig. 80. Division-board. AA, bevelled ends.

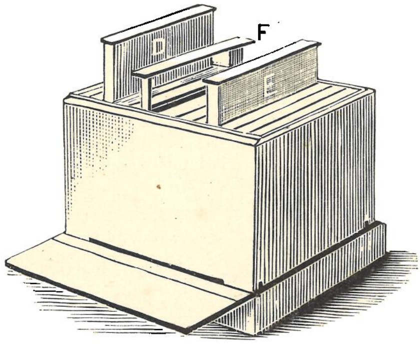


Fig. 81. Division-boards in use.

fact, they serve to convert a full body into a nucleus hive. They can be readily made out of a 9 x 1 inch board, cut to the exact length of the interior of the hive, and a quarter inch top bar nailed to one edge to suspend them from the rabbets. The method of using the boards is shown in Fig. 81.

Uniting.

Except in the case noted above, all colonies below the normal standard of strength, or that are not advancing in their strength of workers, should be united to other colonies at the first opportunity.

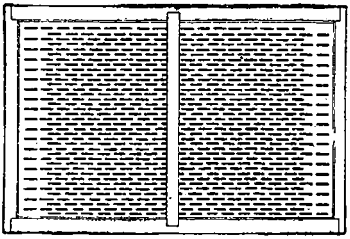


Fig. 82.
Zinc queen-excluder.

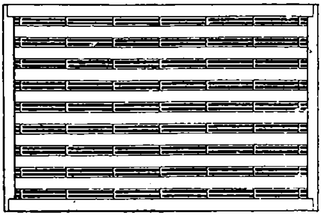


Fig. 83.
Wood and wire excluder.

Having decided upon the colony to which the other is to be united, have the smoker going about sundown when the flying bees are all in, blow a couple of puffs of smoke into the entrance of the chosen colony, remove the cover and mat, and place a queen-

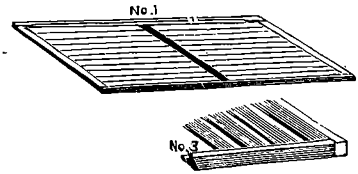


Fig. 84. Wire excluder.

excluder on the frames, and cover temporarily with the mat. Next blow a couple of puffs of smoke in the entrance of the other hive (which we may presume is a single-storey hive) and carry it bodily and place it above the excluder on the first hive after removing the mat, and close down after giving the colony a little more smoke to equalize the odour of both lots of bees. It is better to remove the queen of the weak colony early in the day of uniting, as the bees will not then be so likely to disagree. Watch the hive for a while, and if there are any signs of fighting, give the bees a good dose of smoke, and they will soon cease.

Wire excluders of different patterns can be obtained, and although a little more expensive than ordinary ones, are to be preferred on account of their allowing freer ventilation. In the case of no ordinary excluder being handy when about to unite two colonies, a good substitute can be made out of a sheet of stiff brown paper cut to fit the top of the frames, and perforated well with a three-inch nail. In 36 hours or so the excluder can be removed, by which time both lots of bees will have settled down peaceably to work. Except in the case of saving a valuable queen, it does not pay to mess about with a weak colony in spring; where the queen is worth saving the colony can be gradually built up by giving it a frame of emerging brood occasionally, otherwise uniting it with another colony is the most profitable plan.

As the season advances the colonies should be getting stronger in worker bees, and toward the end of September drones make their appearance, a sure indication of the approach of the swarming season. In the meantime, if swarming is to be kept down, drone traps should be placed at the entrances of such hives from which unwanted drones are flying, the drone comb cut out, and a piece of worker comb or comb-foundation fitted in its place. Colonies that are droneless are not so likely to swarm as those with drones flying. For a good class of queen and drone trap, see chapter on "Queen Rearing." Two or three drone traps can be made to serve a considerable sized apiary by changing them from hive to hive. Entrance guards like those shown in Figs. 86 and 87 may be made useful, on a pinch, for catching drones

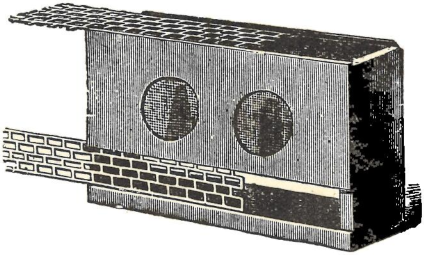


Fig. 85. Drone-trap.

where time is not of very much importance to the bee-keeper, as the scheme needs the attendance of some one to destroy them. Drones invariably fly out of their hives soon after midday, and return

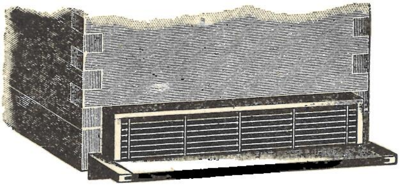


Fig. 86. Wire entrance-guard.

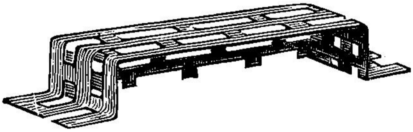


Fig. 87. Excluder zinc entrance-guard.

about two o'clock. If a guard be set in front of the hive after the drones are flying, they will congregate in front of the guard on their return and can there be killed.

Early Queens.

When it is desired to raise queens as early as possible, the colonies selected for raising drones and queens may be forced on ahead by a little stimulative feeding, and giving them a frame or two of emerging brood. I do not think, however, that generally speaking there is much to be gained by this forcing, as we are so liable to get stormy weather in October, and early November, that success in raising extra early queens is very problematical. It is most aggravating, after one has started a big batch of fine cells, to have them torn down through a spell of bad weather intervening during the process; that was my misfortune on several occasions when trying to raise extra early queens. In any case, however, the colonies chosen for drone breeding should be pushed on during September in the manner described, so that their drones may be flying early in October, and when they are due to emerge in the course of a week or so the first stage of queen rearing may commence (see chapter on "Queen Rearing"), but fine settled weather, and a reasonable flow of nectar or feeding, is indispensable for success. During the latter half of October and beginning of November there is often a dearth of nectar, so that when queen rearing this should be noted.

Chapter XIII.

OUT-APIARIES AND THEIR MANAGEMENT.

Beginners who have decided to take up bee-keeping as a business and to devote the whole of their time to honey raising on an extensive scale must look forward to establishing several out-apiaries, the number depending upon their skill and capacity for work. For instance, two brothers in the Taranaki province ran 700 colonies last season in 17 apiaries, and their output of honey was 43 tons. This, no doubt, was an exceptional case, but it serves to show what can be done; the season was 1923-4.

Distance Apart.

The profitable distance apart for out-apiaries, or, in fact, apiaries in general, with the view to not encroaching too much within the area of bees' flight from each apiary, will depend much upon the richness of the bee flora in the district, and the dependance that can be placed on its uniform yield of nectar. For instance, white clover—if we have a fair amount of rain in August and September, and warm sunshine weather following in October and November, yields an abundance of nectar, but the reverse when these conditions are absent; so that both conditions must be taken into consideration before deciding. From three to four miles apart would be a good average distance; an extra mile or so would make very little difference in time with a decent motor vehicle in use.

Tenure of Sites.

Undoubtedly the freehold tenure is by far the best for many reasons, and if in a good permanent clover district should be secured if possible. Security of tenure encourages improvements, better fixtures, better methods, permanency of operations, and adds considerably to the value of the whole as a going concern in case of realisation. The next best tenure, if one cannot afford to buy the freehold right out, is a renewable lease with a purchasing clause.

Locomotion.

A motor vehicle of some kind is indispensable for working out-apiaries. A good engine and chassis, with a convertible body with platform to carry passengers or goods as required by simply changing the bodies, would fill the bill exactly. A light trailer would be handy to save changing the bodies occasionally when there is only a light load to draw.

Arrangement of Hives at Out-apiaries.

If the hives are arranged in straight rows with ample space between them to run the motor lorry, much time and labour will be saved, as the honey from the hives can be loaded direct on to the lorry, and thus save the need of a barrow. In such case, if the area of the site will allow it, a space of twelve feet would not be too much between the rows.

Swarm Control.

The season that calls for the most strenuous work at out-apiaries is spring, and the most anxious time is the commencement of the swarming period when one is endeavouring to control swarming. The three chief requisites in this respect are young queens, ample working room, and adequate ventilation; these are specially dealt with elsewhere.

Extracting.

It is now generally agreed among commercial apiarists that it is more convenient and profitable to do all the extracting and other work at a central plant, which is usually at the home apiary, rather than at each out-apiary. The use of motor vehicles in place of horse traction has enabled commercial bee-keepers to concentrate their work, and to afford a more complete plant than would be possible otherwise. There is one important matter to consider, that is, where disease exists in any out-apiary the combs should not be carted about, or to the central plant, but be dealt with at the hospital apiary where the diseased colony, or colonies, should be moved to, and treated at the first opportunity.

Accommodation at Out-apiaries.

That some kind of small building at each out-apiary would be of great convenience is admitted, but the question of expense comes in. In this connection it might be advisable to put up a small removable shed in one of the most distant apiaries that would serve all the purposes needed for several of the adjoining out-apiaries, thus saving motoring to the home apiary occasionally.

Hive on Scales.

It would be of great utility in saving time and trouble on visits to out-apiaries, especially in spring, if one had the means of conveniently weighing a hive containing a colony in good average condition. The records would be valuable in indicating at once the condition of the food supply in the hives, whether it is diminishing or gaining, or whether it is necessary to open some of them for examination. A tripod and spring-balance that could be carried round on the motor would answer the purpose, and would not be expensive.

SOME NOTES FROM "OUT-APIARIES" BY DADANT.

When editing the bee columns of the "N.Z. Fruit-grower and Apiarist," I arranged a symposium on the management of out-apiaries, and obtained details of the working methods of eighteen of our most experienced out-apiarists, the summary of which is embodied in the foregoing, and it is interesting to find that they practically coincide with the advice given by M. D. Dadant in his book. Dadant runs 13 out-apiaries as well as his home apiary.

Locomotion.

On this question Dadant says:—"The automobile has done more than any other one thing to revolutionise out-apiary bee-keeping. It furnishes a quick mode of travel from one apiary to another, and removes the danger of stings to horses when used in the apiary." He thinks a light car or converted machine the most economical up to a system of four apiaries, and for five or more a light ton truck is best. Trailers are used by some bee-keepers in cases of emergency in removing bees from one apiary to another.

Swarm Control.

According to the author six conditions are necessary to control swarming. They are: "A minimum of drone comb, ample breeding room, plenty of super room for honey, ample ventilation, and young queens." With regard to ventilation, Dadant says:—There is nothing which will more quickly induce bees to cluster out, sulk, and get the swarming fever than a total disregard to ventilation. He recommends a full width entrance, then adding to the ventilation by raising the body of the hive from its bottom board, and in the height of the honey flow giving a two-inch entrance in front, the full width, or one inch all round the body.

Closely connected with this matter is the use of queen excluders, on which the author remarks: "Many bee-keepers running for extracted honey use queen-excluders. There are two objections to their use. In the first place they hinder to some extent the free passage of the bees into the supers above. In the second place they restrict the queen and are apt to induce swarming."

Young Queens.

On this question Dadant is in agreement with our own out-apiarists, that young queens are desirable for controlling swarming queens less than two years old.

Extracting.

He favours a central extracting plant in preference to doing the work at each apiary, although he is mindful of spreading foul brood by the central scheme. Taken as a whole, our out-apiarists are not behind in their scheme of work of that of more experienced men.

Chapter XIV.

SWARMING.

Natural Swarming.

It has already been stated that in normal healthy colonies breeding commences to increase at the latter part of July (a little earlier in the extreme north, and later in the extreme south of New Zealand). The increase at first is gradual, but as the season advances with a rising temperature, and the usual flow of nectar from spring forage, it develops very rapidly in September, and eventually brings about the natural instinct of the bee, the desire to form a new colony, hence we expect the earliest swarms in October. It is often stated that an over-crowded hive is the usual cause of swarming, and there can be no doubt that is the case during the swarming season, generally speaking, but sometimes in the early part of the season a colony will develop the "swarming fever" and send out a swarm when there is still plenty of working room in the hive. It seems to be a case in accord with the axiom promulgated by the late Mrs. Harrison, an American bee-keeper, that "bees do nothing invariably." The swarming season in New Zealand extends from early October to end of December, and sometimes swarming will occur in January, but these latter are usually forced swarms, from over-crowding, or defective ventilation.

Preparation for Swarming.

The first intimation of the near approach of the swarming season is the appearance of drones, for as a rule, however much we may try to prevent the breeding of drones, the bees will manage to breed board, and in the height of the honey flow giving a two-inch entrance in front, the full width, or one inch all round the body.

Closely connected with this matter is the use of queen excluders, on which the author remarks: "Many bee-keepers running for extracted honey use queen-excluders. There are two objections to their use. In the first place they hinder to some extent the free passage of the bees into the supers above. In the second place they restrict the queen and are apt to induce swarming."

Young Queens.

On this question Dadant is in agreement with our own out-apiarists, that young queens are desirable for controlling swarming queens less than two years old.

Extracting.

He favours a central extracting plant in preference to doing the work at each apiary, although he is mindful of spreading foul brood by the central scheme. Taken as a whole, our out-apiarists are not behind in their scheme of work of that of more experienced men.

Chapter XIV.

SWARMING.

Natural Swarming.

It has already been stated that in normal healthy colonies breeding commences to increase at the latter part of July (a little earlier in the extreme north, and later in the extreme south of New Zealand). The increase at first is gradual, but as the season advances with a rising temperature, and the usual flow of nectar from spring forage, it develops very rapidly in September, and eventually brings about the natural instinct of the bee, the desire to form a new colony, hence we expect the earliest swarms in October. It is often stated that an over-crowded hive is the usual cause of swarming, and there can be no doubt that is the case during the swarming season, generally speaking, but sometimes in the early part of the season a colony will develop the "swarming fever" and send out a swarm when there is still plenty of working room in the hive. It seems to be a case in accord with the axiom promulgated by the late Mrs. Harrison, an American bee-keeper, that "bees do nothing invariably." The swarming season in New Zealand extends from early October to end of December, and sometimes swarming will occur in January, but these latter are usually forced swarms, from over-crowding, or defective ventilation.

Preparation for Swarming.

The first intimation of the near approach of the swarming season is the appearance of drones, for as a rule, however much we may try to prevent the breeding of drones, the bees will manage to breed a few somewhere, and when seen flying from a hive about midday it is a sure sign that the colony will soon, if not already begun, build queen cells, which is the first procedure toward swarming. In spring swarming there is invariably a preponderance of such cells built; as a rule there may be any number from half a dozen to a dozen or more, although only one or two might be needed by the bees; the only reasonable explanation for building so many is to have some embryo queens in reserve in case of accidents.

Issue of the First Swarm.

If there is no interference with the cells in which larvæ have developed from the eggs, the commencement of the third or pupa stage will take place on the eighth day from the laying of the eggs, when the foremost cells will be capped or sealed, and on the next morning, the weather being favourable, the first swarm will issue, usually about the middle of the forenoon, thus (except for the embryo queens in their cells) leaving the colony queenless for seven days. First swarms with their old queens, after a short flight to and fro, settle on some convenient spot (that is, convenient for the bees, but often very inconvenient for the bee-keeper) near, or within the apiary, to allow the queen to get rid of her eggs, so 'tis said, to prepare for a long flight. If there are any shrubs or trees near at hand, the bees are likely to cluster on a branch, and in about half an hour from issuing, forming a compact bunch for taking.

Swarm Box.

Beginners will find it interesting and instructive to ascertain the weight of their first few natural swarms, as it will enable them later on to estimate on seeing a cluster the weight of the swarm. A box 14in. square and 12in. deep, made of ⅝in. timber, forms a light and handy swarm box that will hold a large swarm. It should have a hinged lid, and a hasp for securing the lid. On the bottom of the box, which when in use will be the top, tack a leather loop to form a handle for carrying the box. Bore a 1½in. hole on each side of the box, and cover with wire cloth to allow of ventilation. Weigh it and mark the weight plainly on the box. It is then only a matter of finding the gross weight of box and swarm and deducting that of the former, to get the correct weight of swarm. A 5lb. swarm is a fair-sized one, and if purchasing one it should not weigh less, or one might be buying an after swarm with a virgin queen, which might prove a failure with a beginner. A 7lb. swarm is a very large one, and can only come from a very strong two or three-storey colony where swarming has been delayed.

Number of Bees to 1 lb.

It may be well to give the latest decision on this question. The number has been variously estimated at different times, but we may accept the following as the consensus of opinion of those who have experimented. Bees in a normal condition number about 5,100 to the lb., but when loaded with honey, as they are when swarming, about 4,300; so that a 5lb. swarm contains between 21,000 and 22,000 bees.

Taking the Swarm.

Swarms occasionally settle in such curious places that one must use his judgment as to the best way of taking them in such cases. I will take an ordinary case of a swarm settled on a convenient branch of a shrub or tree. Spread a sack beneath the cluster, hold the swarm box close up under the bees, give the branch a good jar with one hand, when most or all the bees will fall into the box. Close the lid and place the box lid downward on the sack. In a few seconds prop up the body of the box from the lid about an inch, so the bees can go in and out. If the sun is likely to shine on the box, lay a folded sack on it, and leave the swarm till just before sundown before hiving it.

Hiving the Swarm.

A swarm in the hands of an experienced bee-keeper may be hived at once before it has time to cluster in the swarm box, but many of the bees may rise and go back to where it was clustered. When once the bees are clustered in the swarm box, and they are disturbed again to hive them before later on in the day, the chances are they will decamp, but if left where taken until dusk there is little risk. The hive should be prepared and set in its permanent position, a sack spread in front close up to the entrance, and the front of the hive propped up about an inch to form a large entrance. Next close the swarm box, carry it to the hive, and dump the bees down on the sack near to the entrance. In a short time all the bees will be in the hive, when it can be lowered on to the bottom board, leaving a fairly wide entrance. In very warm weather, with a powerful sun, it is best to throw a folded sack over the cover to keep the hive cool for a few days.

After-swarms.

I have already explained that a number of young queens are bred by the bees prior to swarming, and that the old queen leaves with the swarm eight days before the first of the embryo queens have reached maturity. Now, in almost all cases of the earliest swarming the colonies are strong enough to throw off one or more after-swarms, which, however, are much weaker in themselves than the prime swarm, and greatly weaken the parent colony. After-swarming should be prevented in all cases.

Prevention of After-swarms.

Under normal conditions the first young queen emerges eight days after the first swarm issued, and would lead off a second or after-swarm on the following day unless prevented. Five days after the swarm comes off go through the hive, examine all the brood combs very carefully, and cut out all queen cells but one; as there is then only one queen to come to maturity she is forced to take charge of the colony instead of leading off a swarm. The reason for waiting until the fifth day before cutting out the surplus queen cells is that before that time the bees could convert some of the worker larvæ into queens, but on the fifth day they would be too old.

There are, however, exceptions to the foregoing. When bad weather has kept back the first swarm from issuing, the period between the first and second swarms may be much shorter, but I have stated the case under normal conditions.

Returning Swarms.

As I have already remarked, we cannot always prevent swarming, do what we may, and when it occurs during a good flow of nectar, or when we do not want increase, swarming is a nuisance. If it is known from which hive the swarm issued we may get over the trouble to a large extent by returning it. Take the swarm in the way described and hive it immediately alongside the parent hive. Next morning go through the latter and cut out all queen cells. Be sure not to miss any. Then place the swarm with its hive as a top box on the original hive, and close down.

Fig. 88. A fine queen cell (magnified).

Artificial Swarming, or Dividing for Increase.

There are different methods for securing increase by dividing, but only different in a few details in reaching the same end. To obtain the best results select queen rearing should be started in advance, so as to have young queens or ripe queen cells to introduce to the divided and queenless half. If any of the best colonies have commenced preparations for swarming by building queen cells, such extra cells as can be spared may be used for dividing.

Characteristics of Good Queen Cells.

It is well to explain to beginners how to choose their queen cells with the object of obtaining the best queens, and which to discard. As a general rule, there are fewer poor queen cells built by the bees under the impulse of natural swarming than when forced, and this applies especially when queen rearing late in the season.

The best queen cells are broad at the base, a good length, tapering symmetrically to a blunt point, and well crinkled. Poor cells, on the other hand, are short and dumpy, not shapely, and poorly crinkled; in all cases these latter should be destroyed. Figure 88 represents a good standard queen cell.

Dividing.

As already stated, there are several ways of making increase by dividing, but I favour the Alexander plan, which has always given me satisfaction. The following is the substance of the plan as practised by myself:—

When a colony is in a condition to prepare to swarm naturally, remove the hive temporarily from its stand, and in its place put a body of hive furnished with frames of empty comb or foundation. Remove one frame from the centre and in its place insert a frame of brood, with bees and queen, from the removed hive, taking care that no queen cells have been started on the comb, but if so, destroy them. Place a queen-excluder over the frames, and the original hive above the excluder. Then examine the combs in this part of the hive, and if queen cells have been started, and the colony is worth breeding from, take note of the number of cells and whether any are capped over. If uncapped, they may be set down at under eight days old, in which case the colony may be divided in five days by removing the upper box with bees and combs to a new stand, and all but one of the queen cells be removed and made use of for other divisions. In meantime they can be preserved in queen nursery cages till required. Should the queen cells be sealed, the same process should be gone through at once or swarming may result.

If the combs are free of queen cells, or any queen cells built are destroyed, look through the combs again in five days, and destroy all cells built in meantime; the box can then remain for another five days before removal, when either a young queen or an approved ripe queen cell may be introduced a few hours after placing the box with bees on a new stand as a separate colony. If the removal is done quietly in the evening after the bees are all in, the queen cell, or queen, can be introduced next morning, and fewer bees will return to the old stand. By this plan there is no risk of losing swarms, no time is lost, especially if a young laying queen can be given to the divided half, and an increase of 100 per cent. is made with little trouble.

The explanation of Fig 88a is, that a swarm issued from one of the hives at the Government Apiary, Ruakura Farm of Instruction, and the young lady (an apiary cadet), while watching to see where the bees were going to settle suddenly found them clustering on the front of herself. With commendable presence of mind she remained quite still until the whole swarm had settled, when she quietly walked to a hive prepared for the bees, and shook them off in front of it without any inconvenience to herself.

Fig. 88A. A large swarm of bees clustered in a handy place for hiving it.

Swarm Control.

Swarm control, which, apart from artificial swarming for increase, really means the prevention of natural swarming, has engaged the attention of the world's most advanced bee-keepers since the commencement of modern bee-keeping, and although we have made some little advance, we appear to be about as far off as ever we were from a satisfactory solution. Those who have had the opportunity of consulting as many modern works as I have on the subject, must have come to the same conclusion, viz., that there is not, nor can there be, any infallible method for obtaining complete control over natural swarming while the nature of the bee remains as it is to-day, that is to say, with profit to the honey producer. The various schemes that have been tried are legion, and if any were of benefit the manipulations required would be impossible to carry out on a large scale. To sum up the matter, the very best we can do is to check swarming by judicious breeding, by providing ample working room during the swarming season, by strict attention to all that is needed for abundant ventilation of the hives, and not forgetting the value of young queens in this connection.

Demaree Method of Swarm Control.

The Demaree plan of swarm control has had an extensive trial in New Zealand, and been well spoken of, and I have little doubt that it is one of the best schemes for the object aimed at yet put forward. The following was published in the "American Bee Journal," as the original Demaree method:—

"As I have already intimated, my plan of preventing swarming, and entirely preventing increase, is accomplished by one single manipulation right at the commencement of swarming. Only one hive and its outfit is used for each colony. Any system that requires a divided condition of the colony, using two or more hives, is not worthy of a thought.

"In my practice I begin with the strongest colonies and transfer the combs containing brood from the brood-chamber to an upper storey above the queen excluder. One comb containing some unsealed brood and eggs is left in the brood-chamber as a start for the queen. I fill out the brood-chamber with empty combs, and I have a full outfit for my apiary. But full frames of foundation may be used in the absence of drawn combs.

"When the manipulation is complete the colony has all of its brood with the queen, only its condition is altered. The queen has a new brood nest below the excluder, while the combs of brood are in the centre of the super, with the sides filled out with empty combs above the queen-excluder.

"In 21 days all the brood will be hatched out above the excluder, and the bees will begin to hatch in the hatcher-out below the excluder, and so a continuous succession of young bees is well sustained.

"If my object is to take the honey with the extractor, I tier up with a surplus of extracting combs as fast as the large colony needs the room to store surplus. Usually the combs above the excluder will be filled with honey by the time all the bees are hatched out, and no system is as sure to give one set of combs full of honey for the extractor in the very poorest seasons; and if the season is propitious, the yield will be enormous under proper management.

"The great economy of this system is, all the colonies will produce as nearly alike as can well be—a condition of things that never occurs in any apiary swayed by the swarming impulse. If my object is fancy comb honey, I tier the section cases on the super that contains the brood, and push the bees to start all the combs they can; at the close of the season I extract the honey from the combs in the super, and feed it back to properly prepared colonies to have the partly-filled sections completed. The nicest honey in sections that I ever produced was obtained in this way.

"The system above described works perfectly if applied immediately after a swarm issues. The only difference in the manipulation in this case is that no brood or eggs are left in the brood-nest, where the swarm is hived back."

A modification of the above system is now usually adopted, by transferring the brood from the brood chamber to a second storey above the queen-excluder instead of to the first.

Chapter XV.

SELECT QUEEN REARING.

There is no branch of commercial bee-keeping deserving of more strict attention on the part of the bee-keeper as a means of improving his bees, than that of select queen rearing. It is only in the judicious selection of their breeding stock, season after season, that bee-keepers can hope to make the continuous progress that is possible, and which their interests demand. The improvement of his bees should be the constant aim of each bee-keeper; he should never be satisfied with those he has, but be always striving after a better strain. That it is possible to improve the hive-bee by breeding out inferior characteristics, and breeding in more desirable ones, and so to produce a strain of a higher standard, has been proved over and over again, and no commercial bee-keeper can afford to neglect this part of his business.

Choice of Breeding Queens.

Given an apiary say of fifty colonies where there has been no attempt to select the breeding stock, and consequently, indiscriminate breeding of queens has been going on, there will be found a vast difference in the characteristics of various colonies. Some may prove 50 or more per cent. more profitable in their honey-gathering qualities than others, while they may differ quite as much in their propensity to swarm, and in their temper. Now, it is quite possible by taking over the control of queen breeding from the bees, and by judicious selection of breeding stock season after season, to bring all the colonies to a fairly uniform standard in four or five years, as I proved at the State queen rearing apiary, Waerenga.

The colonies chosen for breeding stock each season should be those that have given the most surplus honey, been the least inclined to swarm after the main honey flow has started, the gentlest bees, and the best defenders of their hives. Any of these qualities lacking at the start should be gradually bred into them. Remember that infinitely better work can be accomplished in the way of improving one's bees by the judicious selection of breeding stock in one's own apiary, than can be done by continually bringing in unknown breeding stock from outside. Even when but a few colonies are kept as a hobby, the rearing of a few queens will be found a most interesting study.

Where extensive commercial bee-keeping is carried on through a number of out-apiaries, and the queens are periodically superseded, there should be one of the staff (necessarily a capable man for the purpose) in charge of the queen rearing section of the business, whose duty it would be to select the breeding stock, raise the queens, and conduct the periodical supersedure.

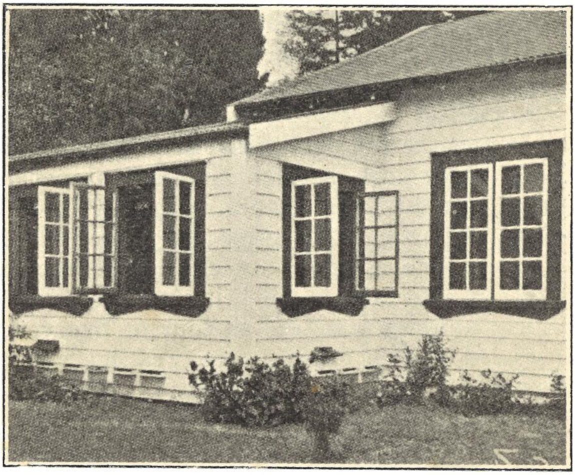


Fig. 89. Queen rearing room, projecting from rear of Extracting Apiary Building, at Ruakura State Apiary. (See Fig. 21).

In such cases a queen rearing room, capable of being heated when necessary, is absolutely essential. It could be part of the honey and extracting house provided there is a separate door from the outside, and a screen door between the room and the inner part of the house. There should also be room for three or more breeding colonies having the entrances to the hives through the wall, as at the Ruakura apiary (see illustration). With such an arrangement the transference of larva, and other delicate work in connection with queen rearing, could be carried out to the very best advantage in all weathers.

The Best Season for Raising Queens.

I have always maintained, and have proved in practice, that the season for raising the very best queens is in spring, during the height of the swarming period, that is, in most parts of New Zealand, in October, November, and the first half of December, preferably during the two former months. The impulse to raise queens to swarm is then strongest in the bees, and the drones are at their best, therefore it is reasonable to conclude that, other things being equal, the best queens should be obtained at that period. There are some experienced bee-keepers in New Zealand who believe that as good queens can be raised in autumn as at any time; this view of the matter is against nature as I see it; for instance, the period during which the bees have a natural desire to swarm, and therefore to raise queens, is past, and still more important is the fact that the drones are old and out of season, being killed off as of no further use.

In my early days of the queen breeding I bred queens in late summer on several occasions, and found quite a number turn drone layers the following spring after laying worker eggs previously. This could only be accounted for by the young queens being fecundated by old drones devoid of sufficient spermatozoa to fertilize but a few worker eggs, hence they soon turned drone layers. Jay Smith, the well-known American queen breeder, also claims the swarming season the best for raising queens. He also says that as good queens can be raised in a simple way as by more elaborate methods, with which I quite agree.

Raising Select Drones.

In select queen rearing, it is just as important to choose one or two of the best colonies for raising drones as it is queens. We can go a long way in checking the breeding of undesirable drones by furnishing the frames with full sheets of worker comb-foundation reaching from top to bottom bars, and can facilitate the breeding of select drones by giving the chosen colonies a good supply of drone comb, in which the queen will readily deposit eggs. What is needed is that there shall be plenty of select drones flying in the mating season, and few others.

Raising Drone Comb.

This is readily done during the main honey flow by removing one or more of the combs containing honey from the top box, and inserting in their places frames containing a narrow strip of comb-foundation. The bees will at once build the frames full of drone-comb, and may store honey in part, and breed in part. They can be removed till the brood dies, and then be given back to the bees to clean. Any quantity of good drone comb can be secured in this way for future use.

Raising Queen Cells.

The raising of queen cells is the starting point in queen rearing, and whether the bee-keeper assists the bees in this work by supplying artificial "cell cups," and transferring selected larvæ to them or not, he is dependent upon the bees to bring the young queens to maturity. To ensure this he takes advantage of the natural instinct of the bee, which at once sets about raising another queen when deprived of the reigning one, and in this way he forces the colony by making it queenless to start queen cells.

By supplying it with selected eggs or larvæ, and taking away all others, the bees are compelled to raise queens from these, so that the bee-keeper has almost complete control over their work, and by adopting certain methods he can encourage the bees to build more cells than would be built under natural conditions.

There are two methods for raising queen cells, one commonly known as the "Doolittle" plan, and the other as the "Alley" plan. The former may be described as an artificial scheme, while the latter is more in accordance with nature. The Doolittle plan being more economical when raising queens in large numbers, is generally adopted by commercial queen breeders and large commercial honey raisers. It, however, requires much more skill to avoid mishaps, with the result of poor queens, than does the Alley plan; that is a very good reason why there should be a specialist at the work in extensive commercial apiaries. There is, however, a plan now being carried out by a number of New Zealand bee-keepers, by which the cells containing the selected larvæ are transferred without interfering with the latter, a plan to be recommended—explained further on.

The "Doolittle" Plan.

The late Mr. G. M. Doolittle (after whom the plan is named), if not the first to make artificial cell cups, was the first to perfect and make commercial use of them. A smooth, round, pointed stick is used similar to Fig. 90, shaped to the size at its point of the base of a natural queen cell. This is first dipped into water, then into melted wax to about half an inch deep; when cool, the same process should be repeated several times, but less in depth each time, the object being to secure a thick base, hence the several dips. After the last dip, and before cooling, the cup is thrust into the wood base (see Fig. 90, *B*) and is then ready for the grafting process. (Cell cups, wood bases, transferring needles,

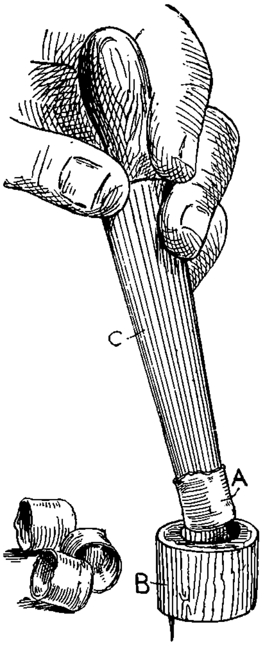


Fig. 90. Queen cell dipping stick.

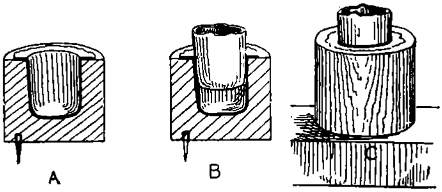


Fig. 91.
A, B, cross sections of wood base with cell-cup ; C, cell-cup and base complete.

Fig. 92.
Completed queen cell in wood base.

and all appliances used in queen rearing can be obtained from hive manufacturers.)

The late E. L. Pratt (Swarthmore) devised a die by which, by compression, he could punch out better cell cups than by dipping, and at the rate of 2,000 an hour.

Royal Jelly.

As it is necessary to have some royal jelly on hand before grafting can be undertaken, and as this can only be secured from a natural built cell, see that such cells are available; if not, remove the queen from one of the colonies and there will soon be some. The largest amount of jelly from a cell is to be secured just before it is ready to seal, on the sixth or seventh day from the egg being laid. Very little jelly is required in each cell; one well-furnished

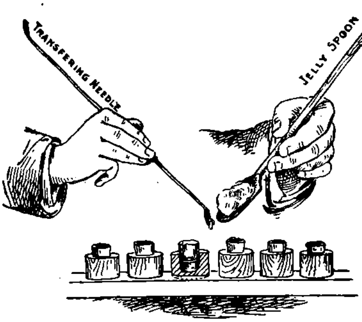


Fig. 93.
Furnishing cups with royal jelly.

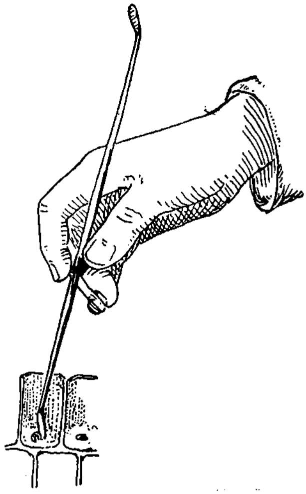


Fig. 94. Transferring larvæ.

natural cell will contain enough to graft nearly twenty cell cups. It is best to stir the jelly just before removing it from the cell.

Special tools are required for the delicate operation of grafting, and although they can be constructed out of quills, it is best to purchase from bee supply dealers those made specially for the purpose. Take care that the whole operation is carried out in a warm room, as the slightest chill to the jelly, or larvæ, would be fatal to the latter; 75° F. or over is a suitable temperature. Having furnished the cell cups with jelly, the next process is to procure the comb (already spotted) containing newly-hatched larvæ from the breeding queen, to be transferred (see Fig. 94). Each cup is given a larva to rest on the royal jelly, and when all are finished the wood base of each cell cup is spiked to the underside of a frame bar, as in Fig. 95. For convenience of handling it is best to have movable bars in the frames to which the cells are to be attached (see Fig. 95).

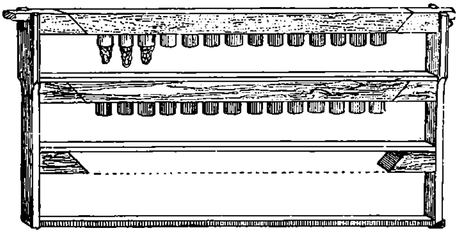


Fig. 95. Frame of cell cups with removable bars.

Finishing the Cells.

Formerly the "swarm box" system was greatly in vogue in getting the cells cared for and finished, which, briefly, was this: A nucleus hive large enough to hold five frames, but only three were used; the inter-spaces were for the queen cells. Enough bees were shaken into the box to form a small nucleus colony, two bars of grafted cells were given and the box closed, the bees being left to complete the cells. In my earliest days of queen rearing (1879 on) I realized that the best queens were those in which the cells were raised and cared for in strong colonies, where there were a host of nurse bees, and this was confirmed in my trials of the swarm-box plan at the Government apiary, which was soon discarded. The baby nuclei with its handful of bees to care for the young queens was another huge mistake; to get first-class queens there must be an abundance of bees in the process from first to last.

The system now found to be successful and economical is to deprive a colony of its queen about twenty-four hours before the cells are ready, enough time to make the bees anxious to raise another, then give them the frame of cells. Be it understood that in all operations in queen rearing, if there is a check in the flow of nectar, and consequently no honey being brought in, the bees must be fed or failure is practically certain.

Conditions being favourable, the cells will be cared for at once and royal jelly added. The cells being accepted and lengthened, they can either be left in the same hive to finish or, which is more economical, be transferred to the upper storey of a strong colony after the queen has been confined to the lower one by a queen-excluder over the frames. The queen removed from the cell-starting colony can then be returned, or instead, a fresh batch of furnished cell cups may be given. A couple or three days after the cells are capped they should be transferred to protective nursery cages. There are several kinds of cages, but the best I consider for wood-based cells is the modified Alley nursery cage (Fig. 108). The nursery frame with its cages and cells should be placed in the upper storey of a strong colony till the queens emerge, or the cells may be made use of before they mature; but more concerning that later.

Transferring Worker Cells Containing Larvæ to Wood Bases.

Some five years ago the late Mr. Stephen Anthony, of Coromandel, brought under the notice of Mr. G. V.

Westbrooke, apiary instructor and grader, an instrument he obtained from Switzerland (Fig. 96) with which the worker cells containing selected larvæ for queen rearing can be cut out of the comb and transferred to wood bases, thus avoiding the risk of injury attached to transferring larvæ only.

Mr. Westbrooke gave the instrument and system a thorough test, and reported that he transferred twelve cells to wood bases with the instrument, and also twelve larvæ into Doolittle cell cups in the

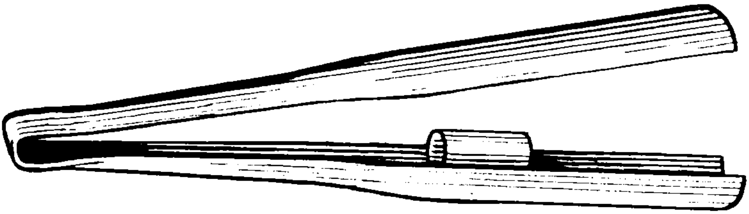


Fig. 96. Swiss cell transferrer.

ordinary way. Two of the former wood bases with cells fell down, but all the others were accepted, whereas only six of the latter were successful. The instrument is made of thin sheet brass, 8in. long by $\frac{5}{8}$in. wide, folded in two in its length, and made springy; for 1$\frac{5}{8}$in. the two parts are nearly flat; the remainder of its length the two parts are curved into a semicircle. On the inside of one arm 1$\frac{1}{4}$in. from the end, is soldered a small tube to act as a guide to both arms when pressed together, which then forms a circle $\frac{3}{8}$in. in diameter. The cutting ends should be sharp, and be kept bright with fine emery cloth.

In use, the cells containing the larvæ should first be pared down with a sharp moderately warmed knife to half their natural depth, the knife having been dipped into a little warm diluted honey. The transferrer should also be dipped, and be pressed into the comb with a slight twirling motion, when the cell will be extracted from the comb without disturbing the larva. A little melted wax having been put in the wood base, the cell is dropped into it; the length of the untrimmed underside of the cell prevents the grub coming in contact with the hot wax.

The Barbeau Method.

Mr. E. Barbeau, of St. Eustach, Quebec, follows the same practice, but with a different transferrer. His instrument is a small brass tube with a $\frac{3}{8}$in. opening 2in. long, filed sharp at one end to press into the comb. A wooden punch or rammer forms part of the transferrer. The cells are pared down, the tube pushed into the comb around the cell to be transferred, and withdrawn with the cell, which is then pushed out with the rammer into the cell-base.

Mr. Y. H. Benton's Experience.

Mr. Benton, whose judgment of things apicultural can be relied upon, was one of, if not the first in New Zealand to recognize the good points in "cell transferring," and to adopt the Barbeau method as soon as it was made known in this country. After making an improvement on Barbeau's cell bases, and proving the method superior to that of the ordinary transferrence of larvæ, he finally adopted the system in preference to all others, and has carried it out exclusively for the past three years. Not only has he been converted to the system, but a number of others to whom he has supplied transferrers have adopted it. The only objection that has been advanced against it is, that pop-holes are made in the comb from which the cells are taken, but that is a very trivial matter when compared with the advantages gained. The cell bases used by Mr. Benton are hollow, so that the cells can be pushed through to their required position without trouble. His latest improved bases are constructed out of the metal ends of spools on which photo-

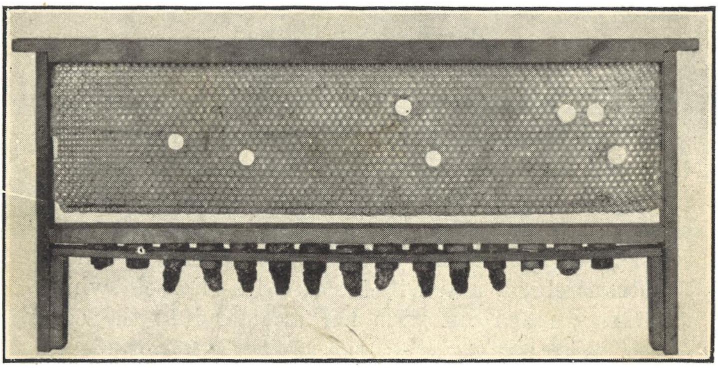


Fig. 97. A frame of transferred cells on the Barbeau system, raised by Mr. Y. H. Benton. See pop-holes.

graphic films are wound; they certainly take up less room than the wood bases, and are very handy.

The "Alley" Plan.

The late Mr. Henry Alley, whom the plan is named after, commenced queen rearing in 1863, and followed it up until his death some years ago. His system of raising queens right from the eggs in cells built entirely by the bees comes the nearest to nature of any plan, and is undoubtedly the best for beginners, and those in a small way of bee-keeping. The operation is straightforward, requires no delicate manipulation, and an amateur can raise as fine queens by the Alley method as the most experienced bee-keeper can by any plan.

In the queen rearing season (already explained) place an empty clean comb in the centre of the brood combs (one that has not been bred in is to be preferred) of a colony chosen for breeding stock.

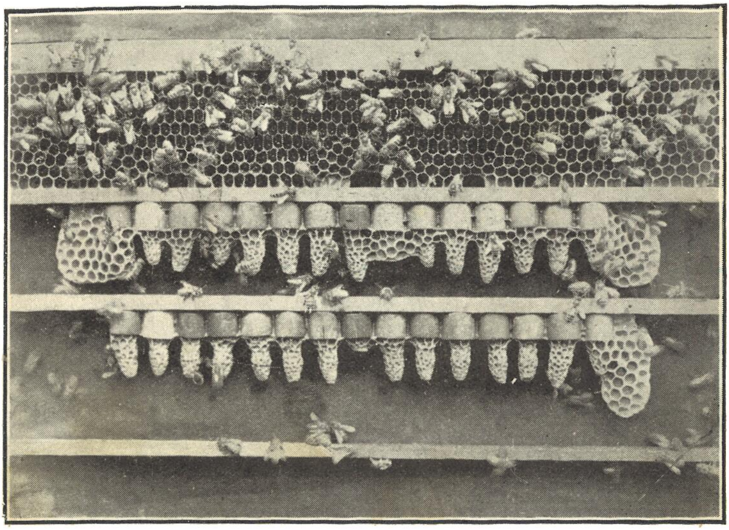


Fig. 98. A frame of queen cells with wood bases.

On the third day after there is likely to be plenty of eggs in it, and ready for the next operation. Before removing the comb take away the queen and all unsealed brood from the colony selected for cell building, which should also be a strong one; the removed queen with the frame she is on and the adhering bees, together with a frame of unsealed brood, and one of honey, can be made into a nucleus colony, or the queen with some bees and food may be caged for a day or two and the other brood combs be distributed among the other colonies. The cell-building colony being deprived of its queen, and the wherewithal to raise another, are in the condition to start queen rearing at once from the selected eggs provided for the purpose. In order to give

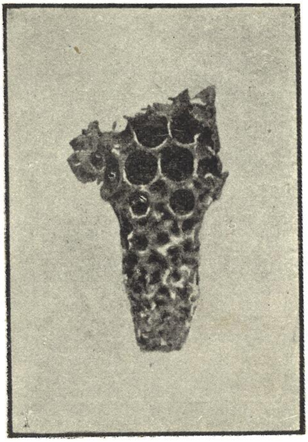


Fig. 99. A perfectly formed queen cell.

facilities for the building of a goodly number of cells the comb may be cut as shown in Figs. 100-101, but see that there are eggs along the cut edges.

Mark the date and age of eggs on the frame, as well as in the field book, and in four or five days after the first cell is sealed they may be all cut out and put in nursery cages until the queens emerge, or the cells may be given to nucleus colonies on the thirteenth or fourteenth day from the laying of the egg.

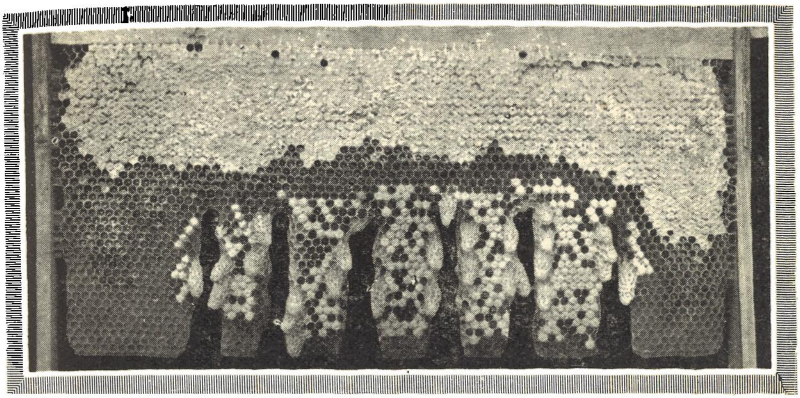


Fig. 100. Queen cells built on the "Alley" plan.

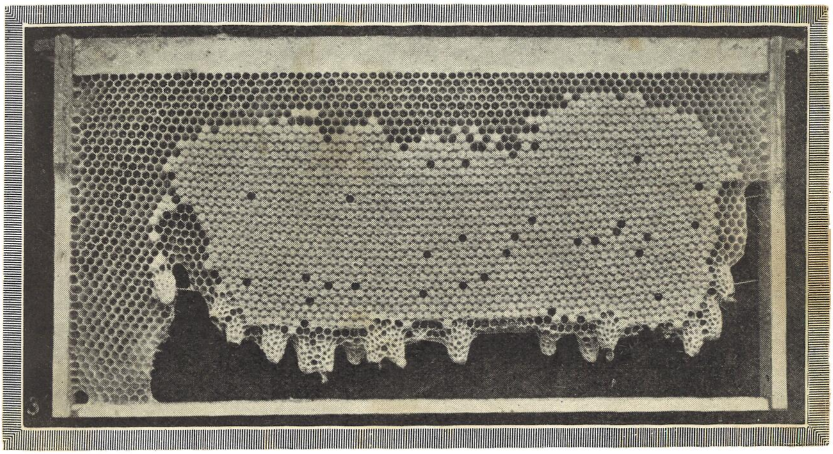


Fig. 101. Queen cells raised on the "Alley" plan.

The Flat-comb Method of Raising Queen Cells.

In a leading American standard work on Bee-Culture what I am about to describe has been credited to me as "the Hopkins method"; all that

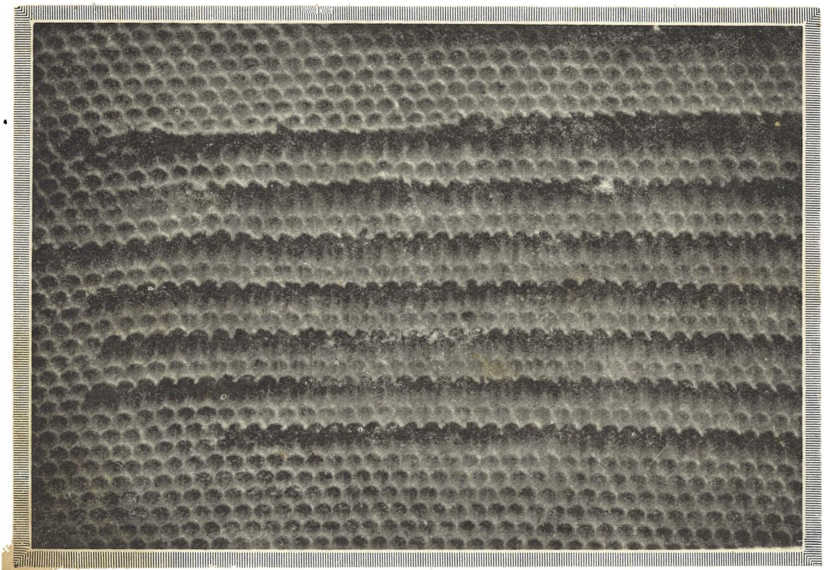


Fig. 102. Prepared comb, for flat comb method.

I can claim is being the first to bring it under the notice of Australasian and United States bee-keepers. It originated, I believe, in Austria. In my first test I secured 60 fine queen cells, and in the second 80 (see Fig. 103), nearly all of which were made use of at the Government Apiary where the tests were carried out.

Preparing the Comb.

A comb of selected eggs is secured in the usual way (already explained). Lay it flat on a bench, then run a thin-bladed knife, previously dipped in

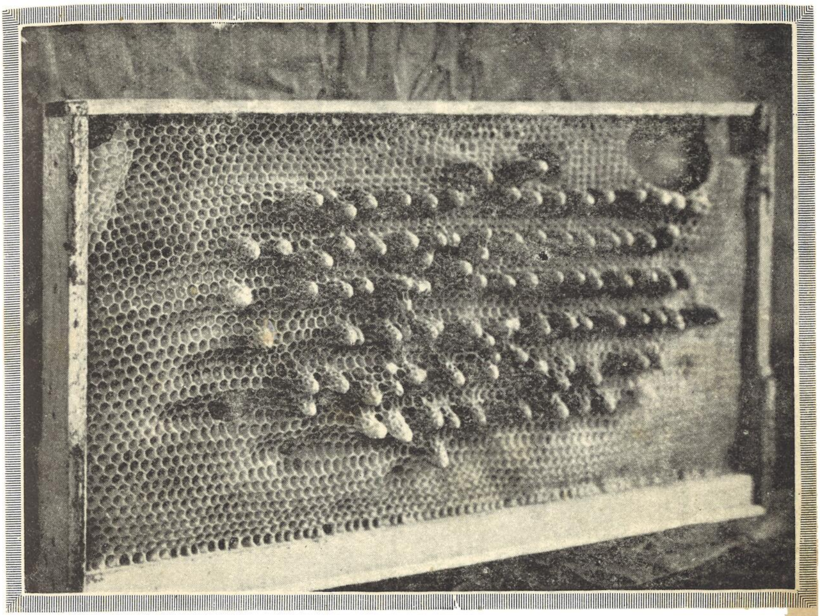


Fig. 103. Comb of eighty good queen cells.

warm thinly-diluted honey, along each side of every fourth row of cells containing eggs or young larvæ, cutting down to the midrib only. Scoop out the three intermediate rows of cell with a broad-bladed bradawl, and kill two out of every three eggs or larvæ along the standing rows, as well as all between the rows. Prepare a strong two-storey colony for cell building in the manner previously described, place an empty half-storey body immediately above the brood chamber, an empty frame laid flat on the brood frames, and the prepared comb (prepared side downward) laid flat on the empty frame with a light piece of muslin or calico spread over the upper side of comb, and the upper storey replaced. The cells shown in Fig. 103 are not depicted to the best advantage, being much foreshortened in the picture; they were an excellent lot, and produced splendid queens. In very hot weather it may be well to tack thin splints of wood across the frame between one or two of the rows of cells to prevent the comb sagging. In connection with the foregoing I received the following from Dr. E. F. Phillips after submitting the plan to him: "The plan of rearing queen cells in quantity which you describe in your manual and about which you wrote October 23rd, 1909, seems an excellent one. I described the method last winter at the New York Bee-keeper's Association, and a number have tried it with marked success."

Number of Cells a Colony can Properly Care For.

It has been frequently stated that from twelve to fifteen cells are as many as a colony should be allowed to attend to in order to produce first-class queens. I long ago concluded from experience that a strong two-storey colony can well care for as many as it builds, as a rule, be it fifteen or fifty, during the swarming season. The main factor in this connection is to have an abundance of nurse bees in the cell building hives, and one can be assured of good queens regardless of the number of cells built.

Swarm Cells.

There was a great outcry a few years ago against the use of swarm cells, that is, spare cells raised by bees preparatory to swarming; it was declared by some bee-keepers without sufficient thought that the propensity to swarm would be intensified in the

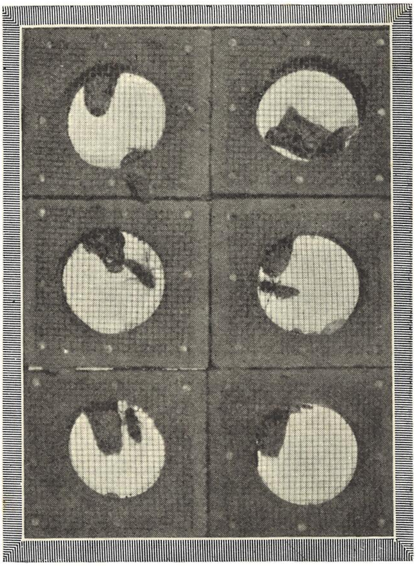


Fig. 104. Alley nursery cages with emerged queens.

bees from such queens. This, however, was considered a fallacy by many experienced bee-keepers, who, on the contrary, declared that the very best queens were bred under the swarming impulse. Of course, one would exercise the same discrimination with regard to the choice of such cells as one would in the choice of breeding stock.

Queen Cell Nurseries.

The modified Alley queen cage and nursery suitable for wood-based cells is shown in Figs. 106 and 108, but for cells built on the Alley plan the original cage and nursery are more suitable, Figs. 104-105.

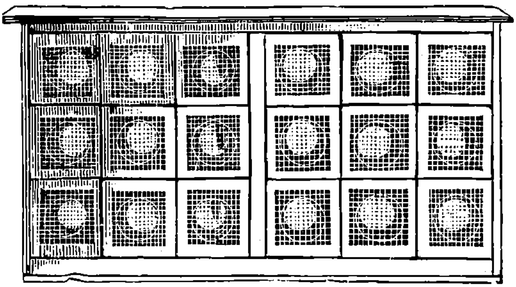


Fig. 105. Alley queen nursery, complete in frame.

The cages can be easily made out of a smooth batten seven-eighths of an inch thick, $2\frac{7}{16}$in. wide, and each cage, being $2\frac{11}{16}$ in. long, they can be cut off the batten after all are bored. The large central hole

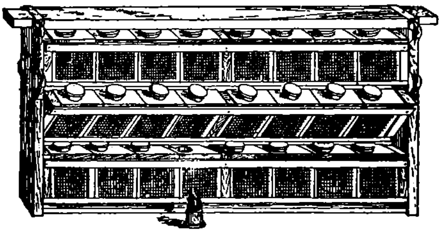


Fig. 106. Nursery for wood-based cells.

is $1\frac{1}{2}$in. in diameter, and the two smaller ones on the edge are $\frac{11}{16}$ in. and $\frac{5}{8}$in. in diameter and bored through to the central hole; the latter is then covered with wire cloth on each side to make the cage complete.

The queen cell is placed in the larger hole on the edge, and candy food in the smaller one. The frame with cells should be suspended in the centre of an upper storey of a hive till the cells are required or the queens emerge. The same cages can be used to introduce the young queens.

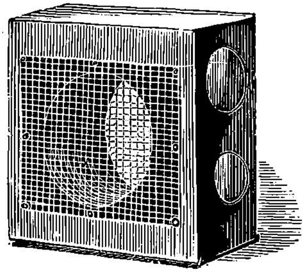


Fig. 107.
Alley nursery cage.

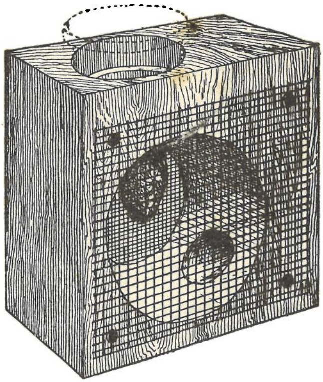


Fig. 108.
Nursery cage for wood-based cells.

The nursery cage (Fig. 108) has a large opening at the top to receive the wood base of the cell; the small hole in the lower right-hand corner is filled with queen-cage candy for food for the queen after she emerges from her cell.

The "nursery for wood-based cells," it will be seen, has three nursery-cage holders, each containing eight cages, the holders being pivoted to the frame at each end so that they can be tilted for putting in or removing the cages.

Benton Queen cell Nursery.

This nursery (Fig. 109) is, I consider, worthy of special notice by extensive queen breeders, and the following notes from the inventor explain its principle and its working.

An appliance which permits one to inspect, put in, or take out cells or virgin queens whenever and as often as one likes without in any way interfering with or opening up the colony of bees, which supplies

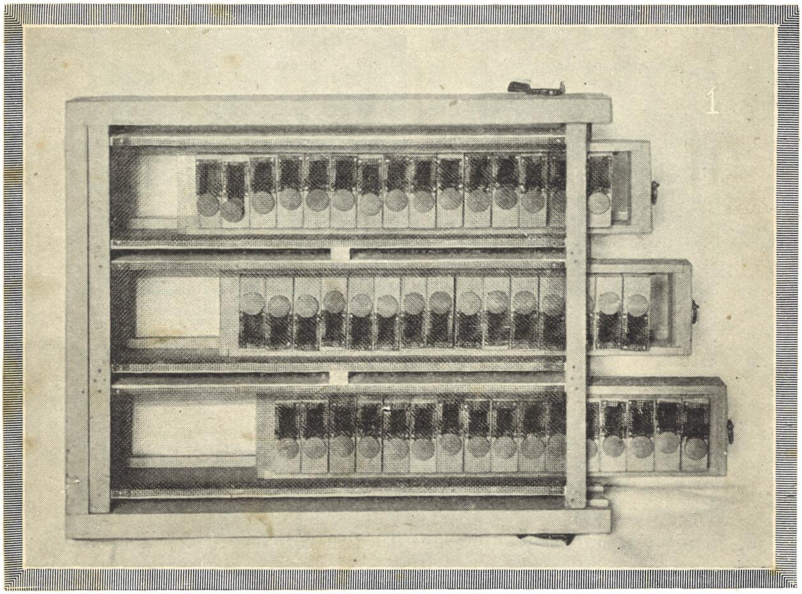


Fig. 109. Benton queen cell nursery.

the necessary heat in a natural manner, must, I think, be regarded as a big advance in present-day methods of caring for cells.

The illustration shows the appliance in detail, the exterior of which is similar to a half-storey body. Three separate compartments are arranged, each covered top and bottom with wire gauze. Into these compartments drawers slide, containing combined nursery and introducing cages, as shown. Each drawer holds 16 of these cages, of which more anon.

One end of this appliance opens on a hinge, exposing to view the ends of the drawers. To put a batch of cells into the nursery occupies a very few minutes. One simply goes to the back of the hive, pulls out a drawer, inserts the cells into the cages, and closes the appliance again.

Between these compartments, and on either side of them, are interstices through which the bees pass unchecked from one hive body to the other, hence the storing of honey will go on as usual in the supers above, with very little, if any, inconvenience to the workers. The nursery-introducing cage shown in the photo is perfect in every detail, both as a nursery and introducing cage, but any kind of nursery-introducing cages may be used.

The advantages of the appliance may be summarised as follows:—

1. It affords better facilities for handling cells and virgin queens than an artificially-heated incubator.

2. Cells can be put in or inspected, and virgin queens, when emerged, can be taken out in a minute or two and without the use of smoke.

3. The bees in the hive upon which the nursery is placed are not in any way disturbed when putting cells in or taking queens out.

4. It accommodates 48 cells, each in an approved nursery-introducing cage, at one time.

5. It gives greater facilities for handling the cells expeditiously, and thus there is no risk of the cells being chilled.

6. As there are no bees adhering to the nursery cages, consequently there are none to brush off, as is usual with other nurseries.

7. The appliance saves time, trouble, labour, and allows one to avoid many of the risks incurred in handling cells, while providing a nursery for queens.

Forming Nucleus Colonies for Queen Cells.

Nucleus hives have already been described in Chapter VII, and here once more I would strongly impress upon queen breeders the necessity of not stinting the bees at any stage throughout the whole process of raising and caring for queens. Nothing less than a three-frame hive (the frames being the same size as those used throughout the apiary) fairly well stocked with bees, should be approved as a nucleus colony.

Whatever number of queen cells are to be made use of, the same number of nucleus hives will be required—a piece of perforated zinc or wire cloth should be tacked over each entrance, and there should be some spare frames of empty combs or foundation at hand. A strong two-storey colony will make five nucleus colonies, and leave sufficient bees with the old queen to make another. When the embryo queens are thirteen days old from the egg the cells are ready to be given to nuclei.

With the cells and some cell protectors (Fig. 110) ready, select a colony to break up and find the queen, placing her with the frame she is on in an empty hive or comb holder for the time being. Now, put one frame of brood (as much sealed brood as possible) with the adhering bees into a nucleus hive, and another also with adhering bees containing honey and some pollen if possible, and also an empty comb or frame of foundation.

Place a queen cell in protector (Fig. 110) and fasten it on to the centre comb by pushing its projecting end through the comb. Sometimes the bees will tear down the cell, hence the need for protection. All being finished, put on the cover and do the rest in same way.

The bees are now fastened in by the wire cloth over the entrance, and the hives should at once be

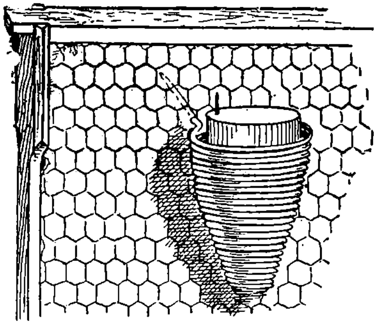


Fig. 110. Queen cell protector.

placed in a cool, dark situation until sunset on the following day, when they may be put in their permanent position and the entrances be opened. Unless the bees are confined for a time, the majority would return, and the nucleus hives be deserted. Nucleus hives are best set apart some distance from the main apiary, and from each other.

Emerging and Mating of Young Queens.

The normal time for a queen to come to maturity and emerge from her birth cell is on the sixteenth day from the laying of the egg, but it is liable to vary according to the weather. If very fine weather has prevailed for some time, she may emerge late on the fifteenth day; on the other hand, in unfavourable weather she may be delayed till the seventeenth day before coming forth. As a rule, when five days old and the weather favourable, the young queen takes her wedding flight to meet the drone, usually about midday, and here it should be observed that there should be plenty of select drones flying and all others, so far as possible, be suppressed. Should there be other than the desired drones flying and their breeding cannot always be prevented in a large apiary where there is so much to attend to, a drone trap

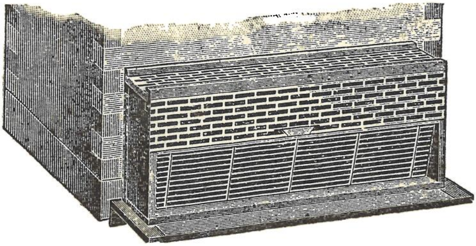


Fig. 111. Queen and drone trap.

(Fig. 111) placed at the entrance of hives where there are such drones a few days before the queens are due to take their wedding flight will catch most of them. A couple of drone traps will serve a large apiary by shifting them about.

Introducing Queens.

As a rule it is not difficult to introduce an alien queen to a colony, be she a virgin or laying, so long as certain rules are observed. The ordinary conditions to ensure safety are—that the colony must first be made queenless, that is, the old queen must be removed. In the next place the new one, when first placed in the hive, should be protected in such a way that while the bees can see and even feel her with their antennæ, they are prevented from stinging her, as they might do if not protected. And lastly, the colony should be fed if there is no honey being gathered while the queen is being introduced. There are exceptions to the second clause. In the busy season, when honey is coming in rapidly, if the queens can be changed without much disturbance of the hive, the new one is likely to be accepted just as readily if she is turned loose on the frames as she would be were she protected for a day or

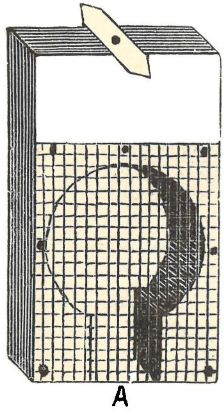


Fig. 112.
Original Alley introducing cage.

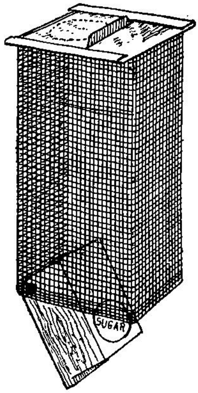


Fig. 113.
Titoff introducing cage.

two. I have often introduced them in this manner with success. On the other hand, I have had great difficulty with some colonies when trying to get them to accept a queen when introduced in the usual way.

Introducing Cages.

An introducing cage, while affording protection to the queen for the time being, should also allow her being seen by the bees and getting into touch with her with their antennæ, and be provided with a place for food. The Alley, and modified Alley nursery cages (Figs. 107-108) can also be used as introducing cages, while Figs. 112 and 113 represent two useful ones.

A number of Alley cages can be very readily and quickly made out of a smooth batten 2in. wide by ½in. thick, and any length. Bore a 1¼in. hole every three inches along the centre of the batten before cutting it into three-inch lengths, the circumference of the hole being exactly half an inch from one end of the cage. Cut out the notch *A* large enough to admit the queen, and to hold a supply of candy for food; cover the hole on both sides with queen-cage wire cloth, tack a piece of tin on upper end as shown in Fig. 112 for suspending the cage between the frames when introducing a queen.

Candy.

Crush up some loaf sugar very fine; if a good deal of candy is needed, as when commercial queen rearing, a good coffee mill is best for this work. The sugar should be like flour; beware of buying ground sugar, as there is frequently starch or some foreign matter mixed with it that is death to bees. Warm some honey, but be sure it comes from a clean hive, and mix a little (it requires very little) with the ground sugar. Knead it well and add more sugar until the ball becomes firm but moist; when the ball of candy is left on a board for twenty-four hours it should only flatten out a little—it is then right. It will do for nursery, introducing, and shipping cages.

The colony, cage and candy being ready, cage the queen with as little handling as possible, plug up the entrance with candy and suspend the cage between two of the centre combs, using as little smoke as possible, and close down. In twenty-four hours or so the bees will have eaten their way to the queen through the candy and be ready to accept her as the head of the colony.

It has frequently been advised to de-queen a colony a day or more before introducing a new one. I have never found it necessary to do so, and have invariably introduced the new queen immediately after removing the old one with the best results. Experience engenders a kind of instinct when one is

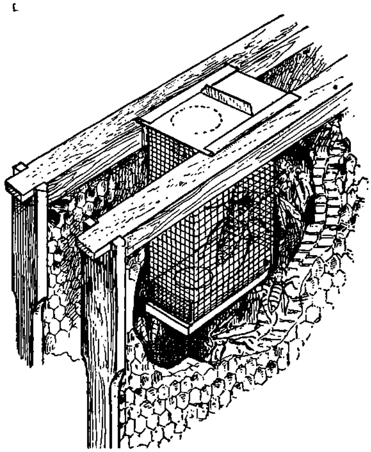


Fig. 114. Titoff's introducing cage in use.

conscious without direct thought of what one may successfully accomplish under the conditions prevailing at the moment. For instance, I, with my assistant, have taken as many as thirty laying queens from as many nuclei, and immediately after run in at the entrances with a puff of smoke a virgin queen to each with complete success. Success in such cases entirely depends upon the weather for some time previous, and flow of nectar, both of which must be favourable.

Balling Queens.

Do not be too eager to discover whether the queen has been released from the cage or not, as this means the disturbance of the colony more or less, and may result in the balling of her, especially if she has only just left the cage. Allow at least four days to elapse from the introduction before disturbing the colony. By that time if she is a fertile queen there is likely to be eggs in the combs. That is sufficient; don't bother to look for the queen; if a virgin queen, allow time for her to have made her wedding flight and started to lay, say, when she is eight or nine days old. To the uninitiated, "balling" the queen means the worker bees clustering round the queen in a ball often as large as an egg, with the seeming intent to kill her for some reason, and it is more likely to take place with a newly introduced queen if the colony is disturbed too soon. To release a balled queen, blow dense smoke on the ball until she can be rescued, or throw the ball into a basin of water, when she will be quickly released, to do what you will with.

Supersedure of Queens.

An injured or aged queen unable to keep up the strength of her colony is soon detected by the workers, with the result that sooner or later she is deposed and a young one purposely bred by the bees installed in her place. It is not uncommon, however, when such occurs to find mother and daughter discharging their functions amicably together for a time. It is claimed that supersedure cells produce the finest of queens, but the difficulty is to know when such is taking place, and really whether they are better than ordinary swarm-cells. What is of more importance at the present time among the largest honey producers is the advantages of periodical supersedure by the apiarist apart from the bees.

Systematic Re-queening.

As part of the modern system of bee-culture it has been found more profitable for commercial bee-keepers to re-queen their colonies periodically rather than trust to the bees superseding their queens. In climates such as that of New Zealand, where breeding over the greater part of the country rarely ceases, and in the very coldest parts but a very short time, queens soon reach and pass their prime, when they become unprofitable to keep. The consensus of opinion among the leading bee-keepers of America at the present time is in favour of re-queening annually, and that is favoured by the majority of our commercial bee-keepers. Where queens have exceptional good qualities it is wise to retain them as breeders during the early part of the second season.

Season for Re-queening.

When editing the bee columns of the "N.Z. Fruit-grower and Apiarist," I conducted a symposium on the above subject, and obtained the opinion of a number of our leading commercial bee-keepers as to the best month for re-queening. The opinions varied between November, if possible to have queens ready at that time, and February, at the close of the honey season. Personally, I favour the latter month, as the young queen will be certain to breed up well right into our winter months, and thus enable the colony to come out strong with young vigorous workers in spring.

Laying Workers.

Occasionally, when from some cause a colony has become queenless, and there are no eggs or young larvæ in the combs wherewith a queen could be raised, one or more workers may commence egg-laying, and such eggs will produce drones, but no workers (see propositions 12 and 13 in the Dzierzon theory of parthenogenesis). The presence of a laying worker in a hive may be detected by more than one egg in a cell, often three or more, and it means that if left to itself the colony would die out. The best thing to do is to unite it to a colony in normal condition.

Clipping the Queen's Wing.

This is practised by some bee-keepers to prevent the queen from taking flight with a swarm. Should a swarm issue, the queen, being unable to fly, cannot get further than the alighting board, and the bees, missing their leader, will return to their hive. If the bee-keeper is on hand to secure the queen, cage her and cut out all queen cells, then return her; swarming will be prevented for some time, perhaps for the season.

In every case when a queen is purchased the wing should be clipped to prevent subsequent misunderstanding. It sometimes happens that a short time after a queen has been accepted the bees for some reason will supersede her, raising another queen from her eggs, the young one not being distinguishable from her mother. If the new queen should get cross-mated her bees will be hybrids, and the bee-keeper, not knowing the queen he introduced has been superseded, naturally accuses the queen-breeder of fraud in sending him a cross-mated instead of a pure queen. Now, by clipping the wing it can be seen at once if the original still reigns.

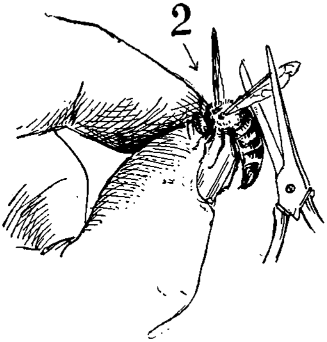


Fig. 115. Clipping wings.

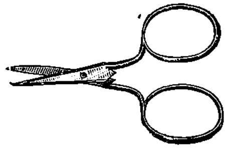


Fig. 116. Surgery scissors.

How to Clip.

The chief point to be observed is to hold the queen in such a position that while the wing on one side can be readily clipped the legs shall be free from the scissors as in Fig. 115. Where a good deal of clipping has to be done a pair of small surgery scissors will be found the most useful (Fig. 116).

Chapter XVI.

SECURING SURPLUS HONEY.

The main flow of nectar in the Auckland province usually commences at the latter part of November, with a range of a week or so earlier or later according to the temperature of the atmosphere chiefly, and in order to take advantage of the flow from the start, all manipulations of the bees, such as artificial swarming, etc., should have been finished before that time. All disturbance of hives and colonies during a flow checks the storage of nectar considerably, so that no manipulation should take place while the flow is on unless absolutely necessary.

The Most Profitable Honey to Raise.

There are two conditions of honey suitable for marketing, comb honey in one-pound section boxes, and honey extracted from the combs, put up in tins or glass containers. Although in some respects, for economic reasons, it is best for beginners, who have had no training, to raise comb honey for their first season, but if their intention is to make a business of bee-keeping then the sooner they secure the proper plant and start raising extracted honey the better for their pockets.

In the first place, there is a very limited demand for comb honey. It is very fragile and readily damaged in transit, it is more expensive and troublesome to raise as compared with the extracted article, swarming is more difficult to keep down, and finally, nearly or quite double the quantity of extracted to that of comb honey can be raised with less trouble under the same conditions, and it can be kept any length of time without deterioration. On the other hand section honey is very liable to granulate in the comb, and in that condition is unsaleable. For the sake of economy I always advise beginners to commence by raising comb honey in sections, as there is no expensive plant needed, and they can feel their way meantime at little cost as to whether they are suited for bee-keeping or not, or whether it is worth while to extend their operations. If their decision favours the latter, then by all means get the plant and raise extracted honey.

Putting on Supers or Top Boxes.

A comparatively few of our bee-keepers raising extracted honey favour the use of shallow (half-storey) supers, but the great majority use the ordinary full-depth bodies, which is by far the most economical plan (see chapter on "Hives"). If, in the ordinary course of things, it is found necessary to domicile the colonies in the brood chambers at the early spring overhaul to encourage brood rearing, the first supers should not be put on until nearly the whole of the frames are well covered with bees and plenty of young bees emerging every day. The general temperature of the atmosphere will have risen considerably by that time, but care should be taken to cover the frames of the super with at least two close-fitting stout warm mats to conserve the natural heat of the bees. To encourage the bees to start work in the super, two frames containing capped brood may be transferred from the brood chamber to the centre of the super and re-transferred later on if considered necessary. The probability is that by the time the main flow of nectar sets in there will be a considerable amount of brood, both capped and uncapped, in the super, and some unoccupied combs at the sides of the brood chamber. These should change places, putting the brood below, and the empty combs above. The tendency of prolific queens to desert the brood chamber and take charge of supers intended by the bee-keeper for the storage of surplus honey is very strong, with the result that much extra labour is thrown upon him in counteracting the evil of breeding in the supers.

The Use and Abuse of Queen-Excluders.

Queen-excluders are most useful apiary appliances and no apiary is complete without them, but for the purpose of confining a queen to the brood chamber during the surplus honey season, I have no hesitation in condemning their use. It is certainly of great advantage to have all our surplus honey combs free from brood, but if we have to pay too dearly for the advantage there can be no gain. To the hobbyist, with a few colonies, who is not particular about the amount of honey he secures, or as regards swarming, used in the manner stated, excluders would save him a good deal of trouble; but the man after the maximum crop of honey would encounter a great evil with a resulting small crop. My first thorough trial of excluders for keeping queens out of supers was in 1883 and following seasons, and the result was I condemned them for that purpose. Subsequently, I tried them above the second storey frames, and although an improvement, I found in the height of the main flow, which occurs during our hottest weather, they were almost, or quite, as great an evil as when on the lower frames. Most of the world's foremost bee-keepers are against their use, and the evil would be accentuated in the case of out-apiaries. The following, published in previous editions of this book, conveys the reasons for my objections:—

"The most important point to observe during the [illegible] season in working to secure a maximum crop of honey is to keep down swarming, and the main factors to this end, as I have previously stated, are ample ventilation of the hives, and adequate working room for the bees. When either or both these conditions are absent, swarming is bound to take place.

The free ventilation of a hive containing a strong colony is not so easily secured in the height of the honey season, even under the best conditions, that we can afford to take liberties with it; and when the ventilating-space between the lower and upper boxes is more than half cut off by a queen-excluder, the interior becomes almost unbearable on hot days. The results under such circumstances are that a very large force of bees that should be out working are employed fanning, both inside and out, and often a considerable part of the colony will be hanging outside the hive in enforced idleness until it is ready to swarm.

"Another evil caused by queen-excluders, and tending to the same end—swarming—is that during a brisk honey flow the bees will not readily travel through them to deposit their loads of surplus honey in the supers, but do store large quantities in the breeding-combs, and thus block the breeding space. This is bad enough at any time, but the evil is accentuated when it occurs in the latter part of the season. A good queen gets the credit of laying about three thousand eggs per day: supposing she is blocked for a few days, and loses the opportunity of laying, say, from two to three thousand eggs each day, the colony would quickly dwindle down, especially as the average life of the bee in the honey season is only about six weeks.

"For my part I care not where the queen lays—the more bees the more honey. If she lays in [illegible] of the super combs it can be readily rectified now and again by putting the brood below, and side combs of honey from the lower box above; some of the emerging brood also may be placed at the side of the upper box to give plenty of room below. I have seen excluders on in the latter part of the season, the queens idle for want of room, and very little brood in the hives, just at a time when it is of very great importance that there should be plenty of young bees emerging.''

Additional Supers.

When the main flow is well started and honey coming in freely, an additional super will soon be needed on each hive, and care should be taken that it be given before they become over-crowded, or swarming will be induced, and swarming during the flow must be kept down at all cost. Pay strict attention to the ventilation, and if necessary prop the hive up an inch or so all round. When adding a super always put it next above the brood chamber, under others already on, and all brood in the first super should be transferred to the brood chamber, and when that is full the balance can be put in the new super. At least two full-depth supers are needed in ordinary seasons, and frequently three when honey is coming in very freely, and being stored faster than it is being sealed or capped. Do not attempt to extract from combs till all or nearly all the cells are sealed, but there is nothing to be gained by leaving it on the hive after the honey is capped, although some think it does improve. All that seems possible to me is that it may become slightly denser if left for a considerable time in the hive; the caps of the cells being porous, some of the moisture in the honey may evaporate, but it would be so infinitesimal that it could make no appreciable difference to the honey, and the cost of such procedure would be considerably over that of extracting as soon as sealed.

Conveying Combs from Hive to Extractor.

A good roomy platform wheelbarrow, well made of light, tough timber, is a most necessary appliance in the home apiary, and for that matter could be conveyed to out-apiaries on the lorry when required. Long cases in which to suspend the frames of honey are better than bodies of hives to bring them from out-apiaries, and good canvas waterproof covers are needed to keep out dust, bees, and rain. Drip-pans constructed of stout galvanized iron to catch honey leaking from the combs, and broken combs, placed

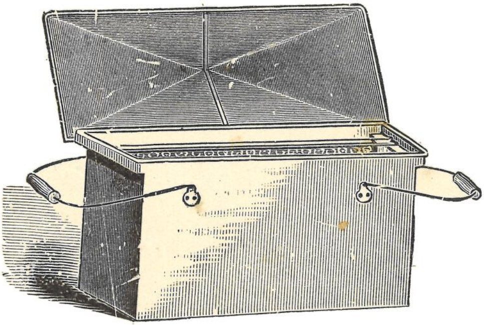


Fig. 117. Comb basket.

under cases or hive bodies as the combs are being conveyed from out-apiaries, saves what otherwise would be waste of honey.

Marking Frames.

Where the least symptoms of disease exist, the frames from the diseased colonies should be marked so that they may be returned to same hives after extraction, or, better still, such colonies should be removed and be dealt with at an hospital apiary, where a two-frame extractor would be handy (see chapter on "Bee Diseases").

Comb Basket.

Comb baskets, such as that shown in Fig. 117, are very useful in small apiaries for carrying combs from the hives to the honey house free from bees, and back to the hives after extraction. They are also useful as drip-pans. A convenient size holds from six to eight frames, which are suspended in the basket as in a hive, with two inches free from bottom.

Extracting.

I have proved to my entire satisfaction that the difference between "ripe" and "unripe" honey is a matter of the quantity of moisture in it, that in the latter being in excess, and that it can be reduced, and therefore ripened, as well outside as within the hive by careful bee-keepers, with much profit. But as all conditions of bee-keepers have to be considered, I advise allowing the honey to ripen within the hive, and not to remove the combs for extracting until they are at least nearly all sealed over. When extracting heavy combs of honey, the extractor should be revolved at a moderate speed till one side is partially extracted, then reverse to avoid damage to the combs. After extraction hang the combs in the body of a hive over a drip-pan till they are returned to their hive. By keeping the extractor going as soon as there are combs ready, it will help greatly to prevent swarming.

Heat in the Extracting Room.

If the honey is to mature in tanks after extraction some means should be adopted to heat the extracting room on cold nights, which we often get in New Zealand. During extracting time the temperature of the room should not fall below 75° F., and if up to 80° all the better.

Working for Comb Honey.

The same method is pursued right up to the time of putting on the top as when working for extracted honey, but instead of using full-depth supers, half-stories furnished with one pound sections, as explained in a previous chapter, should be employed. Beginners frequently complain of the difficulty in getting bees to start work in the sections in the spring. This unwillingness to enter the sections boxes in the early season on the part of the bees is readily explained. The bees cannot build out comb until there is a fairly high temperature to enable them to secrete and manipulate the wax. About the time the top boxes are put on the weather is frequently very changeable with cold nights, and entirely against wax working, especially when the bees are necessarily split up into small clusters as they must be in section boxes. The weather must be settled and fairly warm before the work can commence.

"Bait" Sections.

"Bait" sections are partly worked sections held over from the previous season, and are very useful for placing in the centre of the first boxes put on. No doubt they afford some enticement to the bees to start work in the sections a little earlier than they would otherwise; in any case the frames should be covered snugly with mats to retain the heat of the hive.

After the bees get fairly started in the first top box, place the second half-storey underneath, and take care to remove the sections as they are finished without waiting for the whole of them to be ready for removal, and replace them with empty sections. Remember that it is more difficult to keep down swarming when working for comb, than when running the hives for extracted honey. Give ample working room immediately above the brood chamber and plenty of ventilation from below.

See that the whole of the cells are capped over before removing the sections, and when they have been removed, scrape the boxes free from propolis, and allow them to remain in storeroom for a couple of days to harden before crating them for market.

A brush for brushing bees off the combs is an indispensable appliance in an apiary, and the best, in my opinion, is that known as the "Cogshall" brush (see Fig. 76).

Chapter XVII.

PREPARATION OF HONEY FOR MARKETING

With the advent of modern commercial bee-culture, and as a natural sequence the rapid decline of the box-hive and sulphur pit system of bee-keeping, came, as a matter of course, a great improvement in honey placed upon the market. Instead of the noxious mixture of sulphured honey, bee-grubs, and wax frequently seen on sale formerly, consumers can now rely upon getting the pure article as stored by the bees, while retaining its original aromatic flavour. Improvement is still going on, and I have no hesitation in saying that in this respect New Zealand leads the bee-keeping world.

The two outstanding requirements to bring honey into perfect condition for marketing, whatever grade it may be, and to obtain the highest points in its class, are that it is not below the minimum density for ripe honey, and that it is free from scum. The condition the combs containing the honey should be in before extraction of the latter has already been dealt with, but as a minimum density for ripe honey, obtained by the hydrometer test, of 1,420 specific gravity has been adopted by the official grader, under which density honey is turned down, it behoves every New Zealand bee-keeper to ascertain the density of his honey before sending it to the grading store, and to avoid sending in any below the above specific gravity.

Moisture in Honey.

All honey in its natural condition contains more or less moisture, ranging when first stored in moist weather from considerably over 20 per cent. down to about 13 per cent. in exceptionally dry weather, though the latter low percentage is seldom reached. The average per centum of moisture content in well-ripened New Zealand honey is between 16½ and 17½ per cent. Fifty-one samples of honey from all parts of New Zealand, officially gathered and tested by the Health Department, gave the average moisture content as 16⅓ per cent., exceptionally low. When there is more than 20 per cent. of moisture present, honey will not keep long under household use before fermentation sets in, and even at 20 per cent. it is not likely to remain free for any length of time.

Fermentation in Honey.

Formerly, when a considerable quantity of honey from different parts of New Zealand was passing through my hands (much of it in liquid, and soft granulated condition), I had parcels occasionally that set up fermentation in my store, causing much loss. It was clearly evident that such honey was unripe when received, and after much thought I concluded that the cause of unripeness was excess of moisture therein. If this were correct, then the simplest method of ascertaining when honey contains excess of moisture would be by the use of the hydrometer in determining the minimum density, or specific gravity, of honey that would keep for an indefinite period free from fermentation. When in the Government service I had an opportunity of carrying out some 250 tests, extending over more than six years, with the result that I finally concluded the specific gravity minimum for ripe honey to be 1·420, below which an excess of moisture begins. Official tests made in Wellington favour the above, and British Columbia has, after official tests, adopted that standard, it being also our Grader's official standard, he being convinced after more than ten years' experience of grading that excess of moisture is the chief cause of fermentation of honey. There may be other factors unknown at present so far as I am aware that help to bring about fermentation, but excess of moisture is all that need concern bee-keepers.

Using the Hydrometer.

There are different makes of hydrometers in use, but the one I have always used is "Twaddel's No. 4," shown in Fig. 118, which denotes a range of specific gravity from 1·360 to 1·510. This, together with a small test glass as shown, and a thermometer, is all that is needed, costing but a few shillings. The spindle is graded for liquids at a temperature of 60 degrees Fahr., but if, as is nearly always the case in summer when testing is going on, the temperature of the honey exceeds 60 degrees, allowance must be made on the hydrometer scale. The following scale of allowance for varying temperatures was worked out by our present official honey grader, Mr. G. V. Westbrooke:—

Supposing at a temperature of 60 degrees F. a given sample of honey is found to be 1·420 specific gravity, at 70 degrees F. the hydrometer would indicate 1·415 sp. gr.; at 80 degrees F. it would indicate 1·410; and at 90 degrees F. it would indicate 1·405 sp. gr., this being the highest temperature at which reliable tests can be made.

Note.—Each degree of this hydrometer is equal to 5 degrees specific gravity; for example, 84 degrees Twaddel is equal to 1·420 sp. gr. as 84 x 5=420 1,000 for water=1·420 true specific gravity.

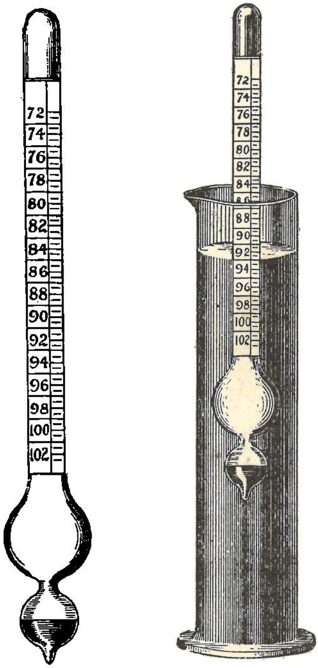


Fig. 118. Twaddel's hydrometer No. 4.

Clarifying Honey.

Honey as it runs from the extractor into the strainer invariably contains more or less pollen grains and minute particles of wax (comb), much of which cannot be strained out however fine the strainer-gauze may be, for where honey can pass through so will the above extraneous matter. In days gone by little or no attention was given to this matter by the majority of bee-keepers beyond the straining, with the result that after tinning the honey the pollen grains, wax, and air bubbles rose to the surface, forming an unsightly scum, often from a quarter to half an inch deep, which was the cause of many complaints. In order to get over this difficulty I had shallow tanks made holding 25cwt. of honey in each, but only 20 inches deep; the extracting room being kept warm and dry, the foreign matter gradually rose to the surface and was skimmed off every day, usually taking three to four days to bring the honey into first-class condition for tinning. It was a slow process, but answered the purpose in those days (1883 onwards) when the average output of honey from the majority of apiaries was less than one-tenth of what it is now. That the utmost care is needed in this respect at the present time is evidenced by the fact that in the Grading Regulations there is a possibility of losing 10 points if there is "scum" on the tinned honey, which is a serious matter.

Rapid Clarification.

Now that in our large commercial apiaries tons of honey are raised where cwts. were raised before, the saving of time in each operation is of vital importance to the profitable working of such as a whole. We cannot afford to wait for three or four days for honey to clear, as an immense number of storage tanks would be needed; therefore, much thought during late years has been given to devising some means to clarify honey rapidly. There is only one way in which this can be done, and that is by thinning it by heat, but the difficulty has been to find the best method of applying heat without detriment to the honey. Steam, and hot-water pipe coils in the bottom of the extractor or the tanks, has been suggested, but neither appears to be satisfactory, and after much enquiry I feel confident in recommending the use of the "Beuhne Heater" and the "Benton Clarifier" (see Figs. 119 and 120) in combination.

The "Beuhne Heater."

This instrument is named after the inventor, Mr. F. R. Beuhne, Chief Apiarist to the Government of Victoria, to whom I am indebted for the photo and particulars of the instrument. It is very highly spoken of by those who have used it, and Messrs. Pender Bros., of Maitland, N.S.W., who are the manufacturing agents of the heater, in response to my enquiry inform me that for "the rapid method of dealing with honey after leaving the extractor and before tinning, the Beuhne honey heater is the most efficient to raise the temperature of honey and so cause the impurities to rise quickly to the surface, and does not injure the honey in any way. Without the use of a separator, honey passing directly into a tank from the heater is ready for tinning in one hour."

With regard to this last statement, even one hour saved is of much consequence where power extractors are in use, and if the honey can be tinned right away, completely clarified as fast as it can pass through the clarifier from the heater, then the use of the former is warranted.

The Beuhne heater, as made by Pender Bros., is constructed of tinned copper, the lower part forming a water chamber or tank, over which a series of shallow channels or races can be seen. When in operation the honey from the extractor falls into

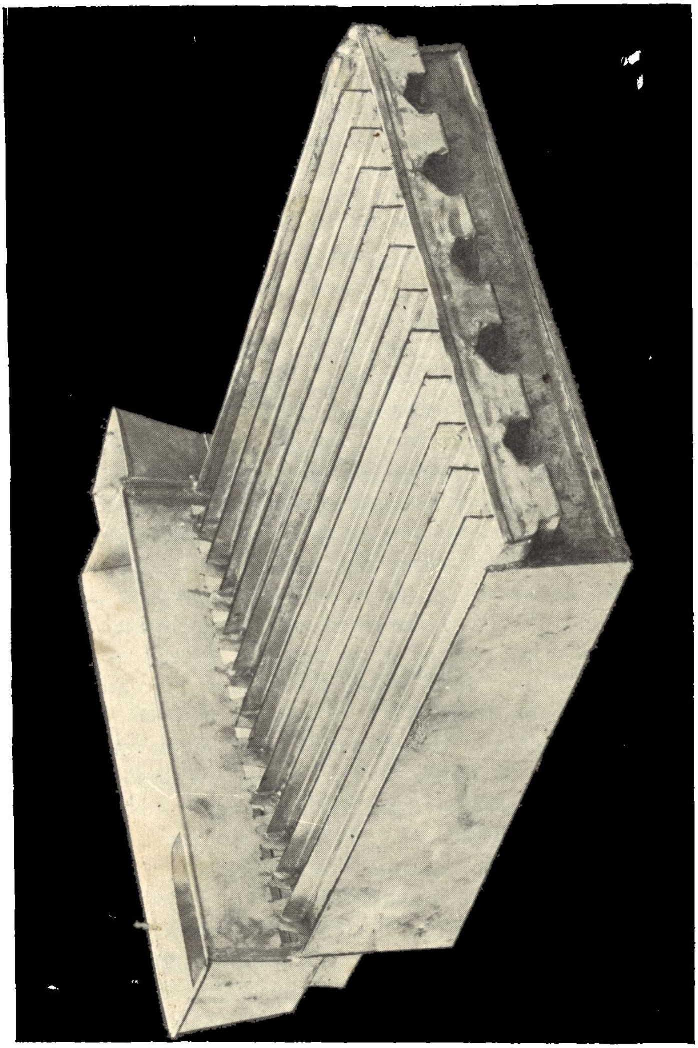


Fig. 119. Beuhne honey heater.

the trough at the head of the machine, in which it spreads in a thin layer, and so flows along each of the races over the heated chamber into a honey tank or clarifier as the case may be. It will be seen that the upper part of the heater is on a slight incline to facilitate the flow of honey. The illustration shows a heater with twelve races, but Mr. Beuhne writes me that for extensive operations he recommends heaters with sixteen races, and I find the price of the larger heaters is not much more than the smaller ones.

Generating the Heat.

As already explained, the lower part of the heater is a chamber in which the heat is generated, what may be termed a water tank, and Mr. Beuhne informs me that, "as a heating medium I have used the Blue Flame Stove, a steam chest inside the water tank, and finally hot water circulation, which last named is the most satisfactory, being the simplest and most direct method of heating without the objectionable fumes of a stove and the risk of fire."

Caution Regarding Heat.

In Australia honey is mostly put up for market in liquid form, and therefore requires much heat in the first place to keep it in that condition for some time. The temperature aimed at is 160 degrees F. before bottling the honey, which, according to reports, has no harmful effect upon it, whereas such a high temperature would have a very baneful effect on New Zealand honey, destroying much of its aromatic flavour. The difference, I suppose, can only be attributed to difference in the source of the honey, that in Australia being chiefly the eucalypts, and in New Zealand, clover. A high temperature, especially if sustained for a while, or the honey is reduced from a firm granulated condition, has the effect of producing an objectionable coarse grain in New Zealand honey on re-granulation. All that is required is sufficient heat to reduce the honey to a thinness that will allow pollen grains, wax, and air bubbles to rise to the surface quickly to be skimmed off, and when this is attained the sooner the honey cools again the sooner it will granulate, and no honey is passed by the grader for exportation unless firmly granulated.

The heat necessary for the purpose should not exceed 120 degrees F., that is, the honey should not exceed that temperature after passing over the heater and entering the clarifier. The heater and clarifier can be erected on the tank platform as suggested in the description of the author's idea of a complete apiary building.

The "Benton Clarifier."

This, I think, can be claimed as the best form of honey clarifier yet put forward, and what is to the point, those who have it in use speak very highly of its efficiency. The illustration, Fig. 120, shows its construction, with the exception that in the diagram I have suggested a movable gate at the lower part of the first division which can be opened or closed from the top so that the flow of honey between the first and second compartments may be checked until the first is nearly full, and so retain much of the scum in the first.

The diagram originally sent me by Mr. Benton represented a clarifier 4ft. 6in. high, 2ft. wide, and 3ft. long, capable, as Mr. Benton said, of clarifying five tons of honey per day. It is not likely that such a large instrument would be required, for working in conjunction with a Beuhne heater honey could be tinned in first-class condition as fast as it could

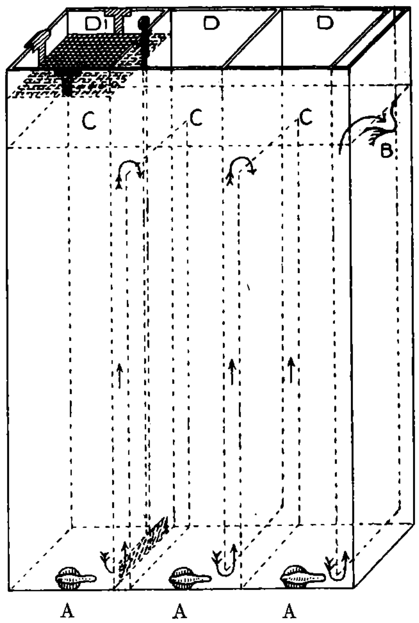


Fig. 120. Benton honey clarifier.

A, A, A, honey gates for emptying the clarifier at the finish of each extracting. B, outlet for clarified honey. C, level of honey for skimming. D1, D, D, separate compartments. D1, into which the honey from the heater flows has a movable strainer to catch pieces of comb or bees. The arrows show the direction in which the honey flows.

go through the clarifier, therefore one about 30in. high, 18in. wide, and 30in. long should be large enough to serve the purpose of any extensive honey producer.

Chapter XVIII.

AUTUMN AND WINTER MANAGEMENT.

The closing of the main flow of nectar, that is, the closing of the surplus honey season, in New Zealand varies in date somewhat according to latitude and the particular kind of flora of the district. As the two Islands extend over nearly 16 degrees of latitude, it will be readily understood why it varies, but we may reckon the extreme variation to extend from the end of the third week in February to the end of the first week in March. A notable feature in New Zealand bee-keeping, and one of the utmost importance to commercial bee-keepers, is that as a rule, with very rare exceptions, we can depend upon a good autumn flow of nectar, sufficient to keep up breeding and a little for winter stores, though this latter must not be entirely depended upon; the winter supply must be allowed independent of this.

Taking the Last Surplus Honey.

The last of the season's surplus honey should always be taken before the actual close of the season if possible, to save trouble from robbers, which are very active at this time. The novice may readily gauge the near approach of the end of the season by the slaughter of the drones, and the inactivity of the field bees after midday. What little nectar has been secreted during the night is gathered or dispersed before noon of the following day, hence the field bees are forced into idleness from their legitimate work, and become robbers of their own kind if the opportunity offers.

With regard to section honey, unless certain steps are taken one is liable to have an unnecessary number of unfinished sections to hold over to the following season. Where there are several colonies raising section honey the surplus boxes containing sections should be examined in the last week in January, not later; all finished sections should then be removed, and the most forward of the unfinished ones be placed in the centre frames. Any vacancies should be filled with fresh sections placed in the outside frames. Another examination should take place during the first week in February, all finished sections removed, and the most backward of the unfinished ones be collected and given to the strongest colonies to finish as they can. By working in this manner there will be but few to hold over through the winter.

Use of Bee Escapes.

If the removal of the last of the surplus honey has been delayed till robbers are troublesome, then nothing can be better to circumvent the latter than the use of bee escapes (see Fig. 121). These are made of tin and so constructed that bees can pass down through them but cannot return. The complete escape (Fig. 122), as used and supplied by hive manufacturers, is an improved one. The frame with centre batten is made of ⅜in. timber, and the tin escape itself is let into the latter as shown in illustration. The outside frame should fit the walls of the hive exactly, leaving no space for the bees to return when once they go through the escape, and the space on each side of the centre batten should be covered with wire cloth to allow of ventilation to the super above it when in use. To remove a super while robbers are about, place an escape immediately below it, and in the course of a few hours it will be clear of bees, and can then be removed to the honey house without attracting robber bees. The best plan is to put on the escapes late in the afternoon, when the supers will be ready for removal early next morning. There must be no brood in the supers to be removed, or failure

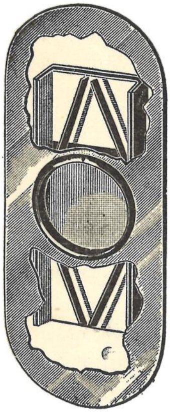


Fig. 121.
Section of double
Porter bee escape.

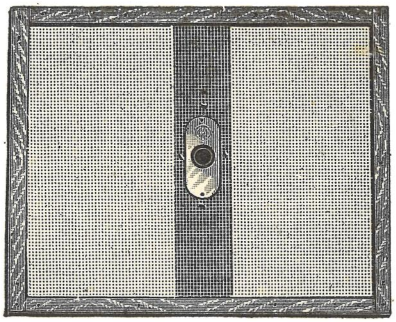


Fig. 122.
Bee escape complete.

is likely to result, as the nurse bees will not leave the brood. If the escapes are put on in the day time in hot sunny weather, throw a folded sack over the cover, or take some means to shade the hive from the sun's rays.

Autumn Breeding.

Given a queen in her prime, and the usual autumn flow of nectar, which I have never known to entirely fail in New Zealand, we may be assured of breeding going on satisfactorily right into the winter months, and in many parts of the country little patches of brood may be found in the two centre combs of brood chamber during those months. The advantage of late breeding is to insure having plenty of young bees in the spring to do the arduous work of field bees when breeding is on the increase again. A queen on the down grade, that is, past her prime, will cease breeding early in autumn, with the result that there are only old bees left to go into winter quarters, and the certain prospect of the colony dying out during the winter or early spring. By superseding queens in February as previously suggested, one may be sure of ample autumn breeding, and providing the food supply does not fail, there will be strong colonies to meet the strenuous work connected with early and increased breeding at the close of winter.

Autumn Uniting.

No attempt should be made to carry weak colonies through the winter except by experienced bee-keepers, and then only for some special purpose, such as nuclei with young queens as a stand-by in cases of emergency, and in the home apiary where they can be constantly under the bee-keeper's eye. Weak colonies in the hands of novices are always a source of danger from robbing after the close of the season, and should be united with others as directed in "Spring Management," and the sooner in autumn the better.

Robbing.

Immediately after the close of the main flow of nectar, when the bulk of the field bees are idle, and for the following six weeks, is the worst period for robbing during the whole year, and no opportunity should be given to marauding bees to get away with a load of stolen sweets, as that is the way in which robbing is invariably started. Avoid opening hives, but if it is absolutely necessary to open one, do it early in the morning, and get through as quickly as possible. Robbing never occurs while there is sufficient nectar to be gathered to keep the field bees busy; it is only during a dearth, and at the close of the season, that it takes place if there is the slightest opportunity afforded. It may of course occur in winter or spring, but there is not so much risk at these times. Ordinary precautions, however, should be observed at all times, more especially at out-apiaries.

To Detect Robber Bees.

Robber bees "on the prowl" may be seen examining the joints of the lower hive, supers, and covers, and dodging about on the wing in front of the hives, every now and again making a feint to alight near the entrance, but quickly dodging back again on the approach of a "sentinel." Hives containing small colonies should have their entrances contracted a little while robbers are about.

Precautions.

The first six weeks after the end of the season is the worst for robbing. No saccharine matter of any kind should be left where bees can get at it, and the honey house should be kept clear of bees at this time. The advantage of having a bee-tight honey house will then be appreciated. Robbing may easily be prevented, but when once it gets in full swing it requires all one's ingenuity to stop it, and an apiary may be ruined before it can be mastered. The bees at such times become demoralised, and will sting any animal that approaches within a hundred yards of the apiary.

To Stop Robbing.

It is easy to detect open robbing, but there is sometimes a quiet tranquil kind of robbing going on without the violence associated with the former, but which is nevertheless quite as dangerous, and more difficult to detect. It occurs chiefly in the colder weather of winter and early spring. At first there is nothing abnormal about the hive to be seen, the bees seem to be going in and out as usual, but an experienced apiarist might notice that the bees are rather more active than those in the other hives. Later on, minute portions of wax will be seen at the entrance, which is really portions of the cappings of the honey cells. By this time the condition of the robbed colony is hopeless; it will be queenless, the queen probably having been killed, and all the honey robbed out, when the best that can be done if there are a good few bees still in the hive is to put it over a queen-excluder on another hive, that is, unite it with another colony.

At the beginning of an attack of ordinary robbing the following may be sufficient to check and stop it: Place a wet cloth, or bunch of wet grass, across the entrance to the hive, and give a douch of water from a watering pot through a fine rose held breast high over the bees flying in front of the hive. The cloth or grass should be removed occasionally to allow bees to come out, but none to go in for a while. A cloth well moistened with diluted carbolic acid and tacked in front of the hive will also scare robber bees away in the first stage of robbing, but should it be a severe case it would be best to close the hive, allowing ample ventilation, and to place it in a dark cool spot till the following evening, when it should be set on a new stand some distance from its former position, and the bees liberated. Another method sometimes practised is to change places with a strong colony; it strengthens the robbed colony, and the robbers get a hot reception at the changed hive.

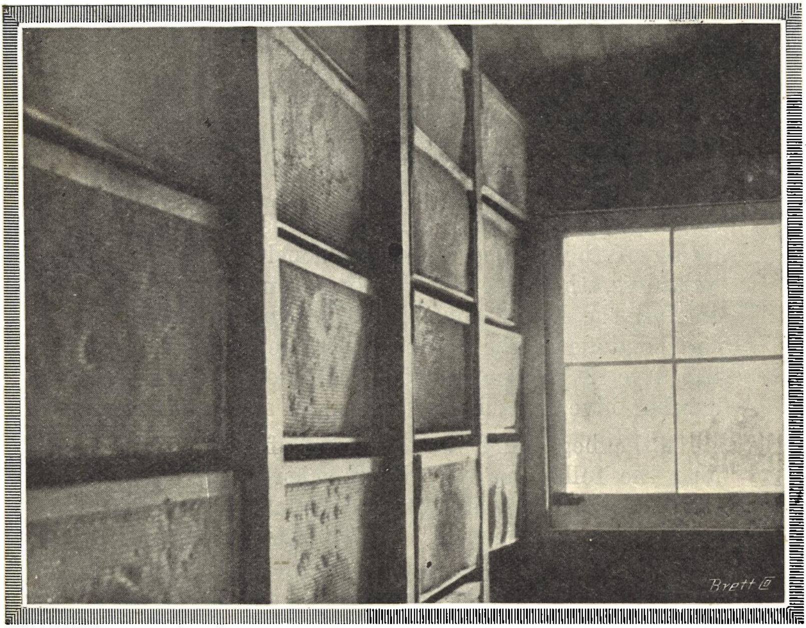


Fig. 123. A section of the original comb-room at Ruakura Apiary.

Storage of Spare Combs and Appliances.

After the close of the surplus honey season, and the last extracting finished, a number of combs will fall out of use from each hive, and the question of their safe storage from the wax moth through the winter and early spring following is important. I have explained in the chapter on "Enemies of Bees" the destructive nature of the moth, and as each fully worked out comb is worth 1s. 9d. without the frame it will be realised how necessary it is to provide moth-proof storage for spare combs, and where, if necessary, they can be fumigated. An ideal storage room would be one built of concrete or some fire-proof material quite apart from other buildings, smoke-proof, but capable of being well ventilated while moth-proof. I would have had such a room built at the Ruakura Government apiary, but was restricted in the outlay, and had to partition off part of the apiary workshop for a comb-storage room (see Figs. 29 and 123).

This was 12ft. wide, 9ft. deep, 6ft. high, and close lined throughout, with a 2ft. passage down the centre; capable of storing 900 combs about one inch apart. The method of suspending the combs, as shown in illustration, was in fixing 3in. x 2in. uprights along each side of the passage way, and one-inch battens from the uprights to the walls.

Fumigating Combs.

Combs should be stored in a moth-proof place immediately they drop out of use or moth eggs may be layed in them to develop into the destructive grubs a little later on, when least expected. If only a few combs are to be cared for, they may be suspended in bodies of hives an inch apart, and the bodies piled on each other with strips of paper pasted round the junctions.

There are two substances used in the fumigation of combs, sulphur and carbon bisulphide. The latter needs very great care in using it, as it is highly inflammable, that is, the gas generated by evaporation, and is a deadly poison. It has an advantage over sulphur insomuch that it will kill eggs as well as the grubs. I would recommend its use in a separate concrete comb-room, but not otherwise. Dry powdered sulphur when used with ordinary care is not dangerous. My method is to obtain plenty of live charcoal by burning chunks of hard wood, which is put in an old iron saucepan or a similar iron vessel, to be placed as high as possible in the comb-room on something that will not burn, then throw on the powdered sulphur and clear out quick and shut the door for two days. The fumes are heavier than the atmosphere, hence the reason for burning the sulphur high up.

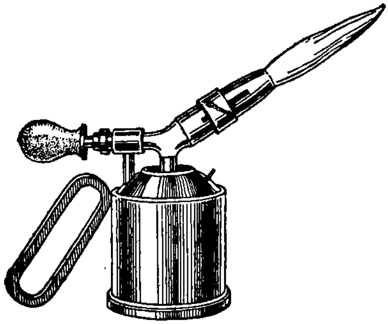


Fig. 124. Blow lamp.

Disinfecting Hives.

Hives and other material falling out of use in the autumn should be thoroughly disinfected before being stored away, and as the spores of foul brood can withstand the strongest of our ordinary liquid disinfectants without destruction they are useless for the purpose. Powerful heat is the best disinfectant for the destruction of spores, and the handiest way of administering it is by the aid of a painter's blow-lamp. If the inside of the hives is slightly singed there will be no risk of any spores adhering thereto surviving that ordeal. Any needed repairs, painting, and making up new material can be done after the bees are fixed in their winter quarters.

Preparing for Winter.

It almost seems out of place to speak of preparing for winter in connection with bee-culture in New Zealand, where the average temperature and climate suggests almost perpetual summer when compared with the severe winters of some of the chief bee-keeping countries of the Northern Hemisphere. There is, however, a short period of about three months, when in the Southern parts the bees are comparatively quiet, and it is advisable during that time not to meddle with the hives at all unless something unusual occurs.

Winter Food Supply.

This is a very important matter, and should be seen to early in April, or about a month before finally fixing up the hives for wintering, so that if there is a deficiency of food it may be made good beforehand, and while the weather is warm. The minimum quantity of food at the beginning of May in each hive should not be less than 40lbs., and if there is 10lbs. more so much the better, as it will be more on the safe side should the early spring following prove stormy. Ordinarily 40lbs. of food, with what the bees can gather in fine weather during the winter and early spring months is sufficient to carry a colony through till the late spring flow commences, but the margin of safety is none too great, so that a little more is advisable as a surplus is not wasted by the bees. The weight of honey in a hive at any given time may be gauged very accurately by reckoning a Langstroth frame of sealed honey to weigh six pounds, as near enough; if, then, the honey in different frames is estimated on that basis we get the quantity very closely. Should the food supply threaten to be short when the hives are examined in early April, it will be wise to feed at once to make up the quantity.

Food and Feeders.

Sealed honey is, of course, the best food to give provided it comes from your own apiary, and you

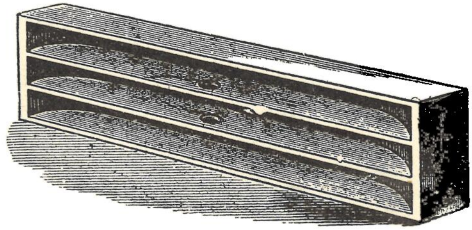


Fig. 125. Simplicity feeder.

know it to have been taken from a colony free from disease, otherwise give sugar syrup made from the best cane sugar in the following proportions of sugar and water: To each three pounds of sugar add one pint of water, stir well over a slow fire till it comes to the boil, remove from fire and when cool the syrup is ready for feeding.

With regard to feeders, there have been several kinds introduced at different times, but only three out of them that have been largely adopted, viz., the Simplicity, Division-board, and Miller feeders, shown in Figs. 125, 126, and 127. The Simplicity is the smallest, and is sometimes used for feeding small quantities of syrup for stimulating purposes when queen breeding; it is placed in an empty half-storey above the brood chamber, and the mat arranged so the bees may have access to it. The Miller feeder is usually made in a large size for holding an extra

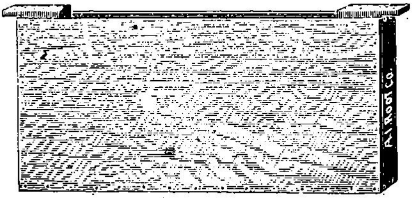


Fig. 126. Division-board feeder.

quantity of syrup when it is necessary to feed rapidly in late autumn and early spring; in the latter case when the weather is cold it is wise to feed the syrup lukewarm. This feeder is placed

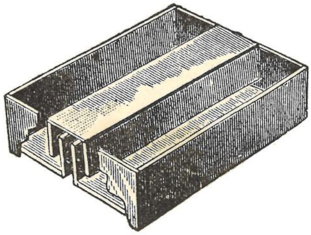


Fig. 127. Miller feeder.

immediately above the frames and under the mat. The most popular feeder, however, is the Division-board feeder, as it holds a good quantity of syrup, and can be suspended in the hive like a frame, where it is easily accessible to the bees.

Final Overhaul.

By the end of the second week in May the bees should be snug in their winter quarters. Nothing is to be gained by leaving the final overhaul till later, as the weather in New Zealand usually breaks for winter about the end of the third week. Granted that the food supply has been attended to, and all the colonies in good order, then all top boxes not fully occupied by bees should be removed, taking care not to overcrowd them in too limited space. I have invariably found that where autumn breeding has been satisfactory the lower and at least one top box would be fairly crowded with bees at the commencement of winter, and often a second top box would be needed for some time to accommodate all the bees. I do not remember wintering bees in the Auckland province in less than two-storey hives.

Mats.

I am aware that some bee-keepers consider mats in hives with flat covers are superfluous, but I certainly cannot agree with their conclusions. Mats of a moisture-absorbing nature over the frames in winter are very necessary to prevent moisture settling on the combs and causing mould and soured food. Bees give off a good deal of moisture, and when confined to their hives in wet wintry weather, and unable to drive off the excess moisture, good absorbing mats over the frames are then most valuable. Half-worn clean sacking is the cheapest and best material I know for mats, and there should not be less than two well-fitting mats over the frames of each hive when closing them down for winter. There should also be a supply of spare mats on hand to take the place of any that may become damp.

Covers.

The covers of hives as now supplied by manufacturers are usually covered with leak-proof material, such as thin metal or rubberoid, but when not so covered and the bare wood is exposed to the sun, they will develop sun-cracks sooner or later, however well they may be painted, and consequently leak, and a leaky cover is an abomination. In such cases painting alone is not sufficient, but if an extra thick coat is given, and a layer of thin butter-cloth (not calico) spread over the paint, while wet, and another coat of paint over the cloth, the cover will remain leak-proof for many years.

Moving Bees.

Unless necessity compels the moving of bees at other times, the end of June, through July, and the first half of August, is the best period for carrying out that work, as there are fewer bees and less brood in the hives at that time than at any other during the year, and the moving does not interfere with preparations for the main flow of nectar. If possible the moving should be finished by the first week in August, as breeding is then commencing to increase, and brood is the first to suffer from confinement of the bees when continued over a day or two. The above period is the best for stocking new out-apiaries, the site having been prepared beforehand. The necessary preparations of the hives for moving bees without loss depends upon the time the bees are to be confined, and how they are to travel. If for a long distance, and the confinement is to extend over two or three days or more, some care is needed in packing both the interior and exterior of the hives. The interior packing should be done a day or so before the final packing is done.

Interior Packing.

There must be no overcrowding of the bees, but if the colony can be conveniently domiciled in a one-storey hive so much the better, and there should be little or no unsealed brood, and but little sealed brood with the bees. The combs are the better for having been bred in, they are then tougher than before, and can then stand rougher usage. With regard to food, on no account put heavy frames of honey in the hives, as such combs, through the additional heat engendered by the confined bees, are certain to break down, and probably destroy the colony. The necessary quantity of food should be distributed through several tough combs. The Hoffman self-spacing frames, such as are in general use, do not need special packing, as they remain firm of themselves.

Exterior Packing.

To ensure safety of the bees when travelling long distances, a shilling or two spent on each colony to secure the same is a mere nothing to the satisfaction it affords. The chief considerations are that the bees cannot escape from the hives even under rough usage, and that the ventilation is ample. The illustration (Fig. 128) shows the exterior packing I have invariably used in packing bees to travel long distances successfully; in fact, I never had a mishap with that method, even on a six weeks' voyage to the South Sea Islands. As will be seen, two frames of 4in. x $\frac{3}{4}$in. battens are made the exact size of the outside dimensions of the hive; the centre part of the frames is covered with ordinary queen-cage wire cloth, which allows of free ventilation through both. Four short battens of 2in. x $\frac{5}{8}$in. timber, the full length between the upper and lower frames, are nailed or screwed to both to secure them.

The evening before removal, after the bees are all in, place a frame, level side upward, alongside each hive, and have the second frame ready to place on top, level side downward. If the hives are gently lifted on to the frames not a bee will be disturbed, and for this reason it is best to have an assistant to help lift the hives. The next thing is to remove

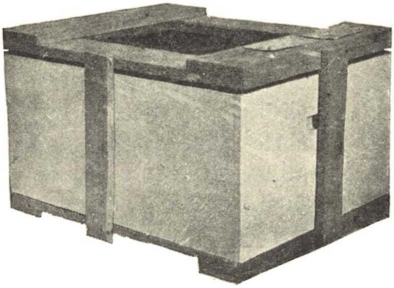


Fig. 128. Hive packed for long distance travel.

the cover and mat and put on the upper frame; the side battens can either be nailed on at once or be left till the following morning, placing the hive covers over the frames in case of rain during the night. When packing colonies in two-storey hives all that is necessary is to make the four side battens longer.

When the bees are to travel by road, see that there is a good thick layer of straw, or better still, fern if procurable (as it is more springy), for the hives to stand on, and the direction of the comb frames of the hives should be across the waggon, but when travelling by train they should point the long way of the train. When bees are to be confined for more than 24 hours, some water must be given in warm weather, which can be supplied by wet flannel laid on the wire cloth of the frames, to be kept moist.

To move bees a short distance no elaborate packing is required; all that is necessary is to secure the hive to the bottom board and arrange for plenty of ventilation, and move them the same night. If the new site is within 3½ miles in a direct line, and there are, say, ten or a dozen colonies to be moved, leave one on the old site for a day or two to catch any returning bees.

Winter Ventilation.

This is a question not fully understood by many bee-keepers, especially by beginners, many of whom imagine that it is the proper thing to contract the entrances to hives in winter to a small opening with the view of preventing the ingress of cold air. This is a mistake; insufficient means for adequate ventilation in the winter not only causes more work for the bees to remedy the evil, but results in most cases in mouldy combs. Hives containing colonies of normal strength should have fairly wide entrances right through the winter, for all the ventilation conducted by the bees is done through the entrance, the fresh air drawn in on one side and the exhausted air driven out on the other. This was fully demonstrated in a series of experiments conducted by the late Rev. J. R. Madan and the author at the author's apiary in 1888, and extending night and day over a period of three months.

CHAPTER XIX.

DISEASES AND ENEMIES OF BEES.

Diseases.

The hive-bee (*Apis mellifica*), like all other animals, especially those under domestication, is subject to several diseases, some fortunately of minor importance. The most injurious are those which attack and destroy the brood, thus preventing the normal development of young bees, and the inevitable result of which, when allowed to run their course, is the rapid decline and ultimate extermination of the colonies affected.

The most pernicious of bee diseases is what we know as "foul brood," a germ disease of a very infectious nature, and only too familiar to the majority of bee-keepers. It is, without doubt, the greatest drawback to successful bee-culture known at the present time, and seems to be prevalent in all countries where bee-culture is followed.

There are two forms of foul brood, one formerly known as "American" foul brood, and the other as "European" foul brood, but the former is now distinguished as *Bacillus larvæ*, and the latter as *Bacillus pluton*. There is, however, another but very much milder form of brood disease known as "Sac-brood," and so far as is known does little harm. Of adult diseases there is one which we term "paralysis," but of which we know little, and another that in Britain has proved of a most serious nature, formerly known, when it was an obscure disease, as "Isle of Wight disease," from it having first been detected on that island. The symptoms of these several diseases are explained further on.

Foul Brood (*Bacillus larvæ*).

Although from the early eighties until near the close of 1907, New Zealand bee-keepers had suffered severely from disease among their bees, and believed the disease to be foul brood, no one could say

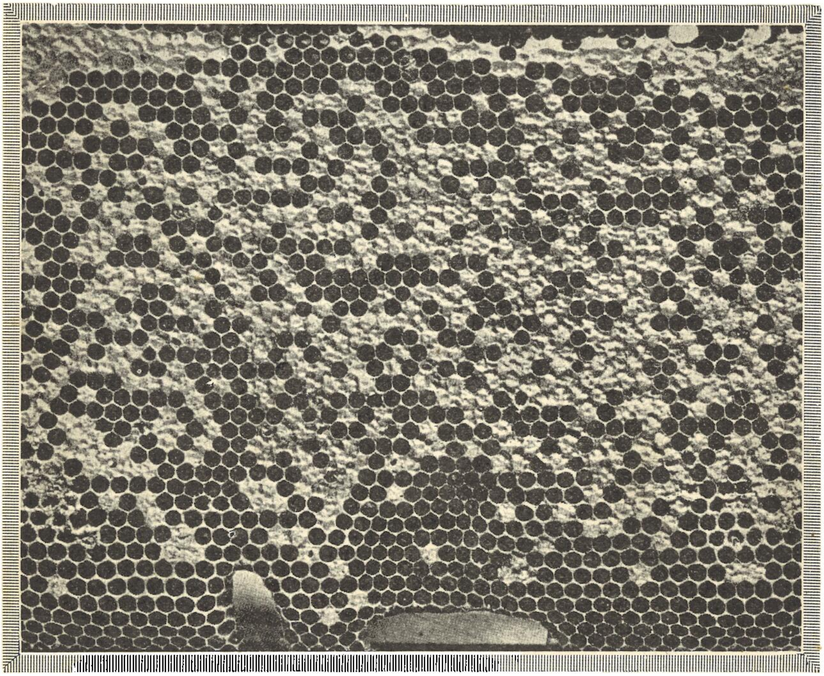


Fig. 129. Portion of diseased comb in an advanced stage.

positively what it was or whether there was more than one disease present, or knew what treatment to follow. In order to set this matter at rest, I sent on August 2nd, 1907, six typical specimens of diseased combs, three from each end of New Zealand

(I was then in the Government service and sent the combs officially), to Dr. E. F. Phillips, in charge of Apiculture in the United States, for examination, and on the 23rd of the following November I received his report upon them, which was to the following effect: "That after a close investigation of the specimens, and making pure cultures from each and feeding them to healthy colonies, the same disease was produced that was present in the specimens, viz., 'American' foul brood (*Bacillus larvæ*). You are then able to say distinctly that 'American' foul brood exists in New Zealand, and that it is caused by *Bacillus larvæ.*"

Fortunately, subsequent experience has proved that up to the present we have only the one form of foul brood in New Zealand, and though bad enough in itself, it is the least difficult to deal with.

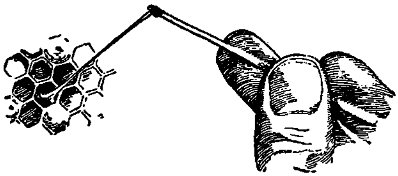


Fig. 130. Ropiness of American foul brood. (After Dr. Phillips.)

Symptoms.

Healthy brood in the larvæ stage—that is, before it is sealed or capped—presents a clear pearly whiteness, but when attacked, which is usually, as Dr. Phillips remarks, "about the time of capping," changes to a light buff, then to brown. It is, however, when the brood has been capped that the novice is better able to detect the presence of disease.

In the early stage of an attack a capped cell here and there appears somewhat different from the surrounding healthy brood. Instead of the cappings or seals being bright, full, and of convex form, characteristic of healthy brood, they are of a dull blackish-brown colour, and flat or sunken, an indication that the cells contain dead pupæ. The disease rapidly spreads to surrounding cells and combs, if allowed to take its course, till finally no brood can emerge, and the colony succumbs. On opening some of the cells a thin glue-like, pale coffee-coloured mass will be noticed, which on the insertion of a splinter of wood adheres to the point, and can be drawn rope-like for some little distance out of the cells. (See Fig 130). This is one of the most distinctive features of foul brood prevalent in New Zealand, and where present is considered conclusive evidence of the disease. Later on this glue-like substance dries up into a black scale-like body, which may be discerned adhering to the lower wall of the cell.

Other symptoms are "pin-holes" and ragged perforations in the cappings of the cells, and a very disagreeable smell resembling that of heated glue or tainted meat, which may be sometimes, though rarely, detected at some yards away from a badly infected hive in close weather. The characteristic odour cannot easily be detected in the earliest stages, even when an infected comb is placed close to the nose, but some slight difference can be noticed between that and healthy comb at all times.

Symptoms of European Foul brood (*Bacillus pluton*).

Although this form of foul brood has never been present in New Zealand, nor as far as I know in Australia, it is well that we should be acquainted with its symptoms so as to deal with it at once should the disease appear. The following is taken from Circular No. 79, issued by the Bureau of Entomology, Washington, D.C.:—

"Adult bees in infected colonies are not very active, but do succeed in cleaning out some of the dried scales. This disease attacks larvæ earlier than does American foul brood (Bacillus larvæ), and a comparatively small percentage of the diseased brood is ever capped; the diseased larvæ, which are capped over, have sunken and perforated cappings. The larvæ when first attacked show a small yellow spot on the body near the head, and move uneasily in the cell; when death occurs they turn yellow, then brown, and finally almost black. Decaying larvæ which have died of this disease do not usually stretch out in a long thread when a small stick is inserted and slowly removed; but occasionally there is a very slight 'ropiness,' but this is never very marked. The thoroughly dried larvæ form irregular scales which are not strongly adherent to the lower side wall of the cell. There is very little odour from decaying larvæ which have died from this disease, and when an odour is noticeable it is not the 'glue-pot' odour of American foul brood, but more nearly resembles that of soured dead brood. This disease attacks drone and queen larvæ very soon after the colony is infected. It is, as a rule, much more infectious than American foul brood and spreads more rapidly. On the other hand, it sometimes occurs that the disease will disappear of its own accord, a thing which the author never knew to occur in a genuine case of American foul brood. European foul brood is most destructive during the spring and early summer, often almost disappearing in late summer and autumn.''

Treatment of American Foul brood.

Time and experience have so convincingly proved that treatment by drugs (so prominent at one time) utterly failed to make any inroads on the disease that it would be waste of time to discuss the matter here. We have in the McEvoy treatment, when properly carried out, an effective cure, which has already been tried and proved in thousands of cases in New Zealand, and that is the one I advocate.

Where the disease is so far advanced as to have left few bees in the colony, then it will be safest to destroy everything that has been in contact with it by fire. ''Tinkering'' with such a colony would be both useless and dangerous.

Treatment may be successfully undertaken at any time when honey is being freely stored and comb-building can be carried on. When going through the hives in spring, make a note of those showing signs of diseased combs (which are readily detected at that time) for treatment later on, and be very careful that robbing is not started. When the honey season has set in (about mid-November), keeping the bees busy, treatment should begin. All operations in this connection should be carried out in the evening, when the bees are quiet. During the first stage of treatment block the entrances to adjacent hives temporarily to prevent flying diseased bees entering them.

Prepare a clean hive and bottom board with narrow starters of comb-foundation in the frames. Remove the infected hive and stand to one side, and put the prepared one in its place; prop up the front about an inch, lay a sack near the entrance, and shake and brush the bees as quietly as possible close to the entrance, and when finished remove every vestige of the infected hive away where the bees cannot get at it. The combs, if not too badly infected, may be melted into wax, or, if insufficient in quantity for that purpose, they, with their frames, had better be burned right away and the ashes buried. The hive, bottom board, and cover, if sound and worth saving, should be cleaned and thoroughly disinfected.

Hospital Apiary.

Commercial bee-keepers now find it safest and best to set apart a small plot of ground in an isolated position from all their apiaries as an "hospital apiary," to which diseased colonies may be at once removed and be treated at the proper time. This is a very important move in dealing with disease. As soon as an infected colony is discovered it should be sent to the hospital apiary to be treated, and when this has been done it should be taken to one of the permanent apiaries.

(A recent discovery of enormous importance to the bee-keeping world in the matter of saving diseased combs by disinfection is referred to further on.)

On the evening of the fourth day following, the necessary number of frames for the hive should be furnished with full sheets of comb-foundation, to be exchanged with those the bees have been working on. This can be done by removing the frames one at a time, shaking the bees back into the hive, and inserting the others. The comb built on the starters during the four days may be cut out and melted up, and the frames disinfected.

The theory of this treatment is that during their four days' comb-building the bees use up all the infected honey contained in their honey-sacs when taken from their old hive, so that when shifted again at the end of four days they start clean.

When there are several colonies in an apiary affected with disease, or one here and there in different parts of it, it may be taken for granted that nothing less than the treatment of the whole of the colonies at the same time will be effective. To do otherwise will be to expend time and labour with no good results.

It has been reported more than once that success has been achieved, and time and labour saved, by putting the bees in the first place directly on to full sheets of foundation instead of starters. My opinion is, that such treatment is very risky, and I cannot recommend anything less than the full remedy as described.

Feeding and Disinfecting.

In all cases when treatment is going on and honey is not being stored freely, feed sugar-syrup liberally after shifting the bees on the fourth day. Mix half a pint of water with each two pounds of sugar used, stir well, and bring to the boil; when cool it is ready. Always feed within the hive and in the evening.

Be sure to remove out of the way of the bees, and disinfect or burn, everything used during the operations of treatment; and a solution of a good disinfectant should be kept for disinfecting the hands, knives, etc., after handling an infected colony. Directions are given on the bottles, and the solution should not harm the skin. Also dig the ground over around the diseased hive stand.

After-inspection.

In from three to four weeks, when the new brood begins to emerge, keep a look-out for any suspicious-looking brood cells, and if any are seen cut them out at once, together with the adjoining cells. If suspicious cells recur treat again fully. "Eternal vigilance" should be the watchword of every bee-keeper who hopes to keep down disease.

To Prevent Swarming Out.

On rare occasions colonies swarm out during treatment, but this is not likely to occur when honey is gathered freely. It can be guarded against by caging the queen for a few days, or, better still, by giving a wide entrance and placing queen-excluding zinc across.

Saving Healthy Brood.

When several colonies are to be treated and there is a large quantity of healthy brood in the combs, put a queen-excluding zinc honey-board over the frames of one of the least affected hives, and put all the healthy brood above this to emerge. When this has been accomplished remove everything and treat the colony in the manner advised. The zinc prevents the queen making use of the affected combs while the brood is emerging.

Autumn Treatment.

When it is desired to treat colonies in the autumn, after brood-rearing has nearly ceased, just put the bees into clean hives provided with ample winter stores in the shape of frames of honey, with no empty cells, from clean colonies. The disease is not likely to reappear.

Young Queens.

There can be little doubt that bees from young vigorous queens can better cope with disease than those bred from aged and weak mothers. It is therefore advisable to change the queens at the time of or shortly after treatment if those in the affected hives are not up to the mark; in any case, it is profitable to do so if young queens can be obtained.

OTHER DISEASES.

The following description of symptoms of other diseases than foul brood, which so far have given but very little trouble in New Zealand, is taken partly from "The Bacteria of the Apiary," published in 1906 by the United States Department of Agriculture:

Sac-brood.

This disease, according to Root, comes and goes, and is only mildly infectious, and until Dr. G. F. White carried out exhaustive research in connection therewith, was generally known as "Pickle-brood," the symptoms of which were published in my Bulletin No. 18, as follows:—

"There is a diseased condition of the brood called by bee-keepers 'pickle-brood,' but practically nothing is known of its cause. It is characterised by a swollen watery appearance of the larvæ, usually accompanied by black colour of the head. The larvæ usually lie on their backs in the cell, and the head points upward. The colour gradually changes from light yellow to brown after the larva dies. There is no ropiness, and the only odour is that of sour decaying matter, not at all like that of American foul brood. In case the larvæ are capped over, the cappings do not become dark, as in the case of the contagious diseases, but they may be punctured. So far no cause can be given for this disease, and whether or not it is contagious is a disputed point. Usually no treatment is necessary beyond feeding during a dearth of honey, but in very rare cases when the majority of larvæ in a comb are dead from this cause the frame should be removed and a clean comb put in its place, to make it unnecessary for the bees to clean out so much dead brood.''

Palsy or Paralysis.

This is an obscure disease that occasionally attacks bees, but in most cases does little harm. Drs. Phillips and White, in their Bulletin No. 98, after investigation, state: ''But little is definitely known about paralysis of bees. The disease has not been demonstrated to be infectious. Many suppositions have been made by different writers as to the cause of the trouble, but nothing satisfactory has been produced to prove the cause.'' If I may venture an opinion, I believe a contributing cause, and probably the chief one, to be a low condition of the health of the bees attacked, and the best remedy to be the supersedure of the queens by young and robust ones. Now and again a case is reported in New Zealand, but as we so seldom hear of the trouble we may conclude that it is not severe.

Power of Resistance in Spores of *Bacillus Larvæ.*

In order to impress upon the minds of bee-keepers how careful they should be in dealing with diseased combs, especially those containing scales of dead larvæ, which contain the seeds or spores of the disease, I may quote the following from Bulletin No. 18:—

"In Bulletin No. 75, Part IV., just issued by the United States Department of Agriculture, the author, G. F. White, Ph.D., expert in bacteriology, says, 'The spores of this bacillus (*Bacillus larvæ*) are very resistant to heat and other disinfectants. They resist the boiling temperature of water for fifteen minutes. In 5 per cent. of carbolic acid they were not killed in two months' time. Likewise it has been demonstrated that the spores of *Bacillus larvæ*, when taken from the scales of American foul brood, resist the action of mercuric chloride (corrosive sublimate), 1:1,000 aqueous solution, for two months. Having such facts before us, we can better judge the methods for treatment."

Acarine Disease.

This disease will be more familiar to most bee-keepers under the name of "Isle of Wight" disease, by which it was known until 1921, when the discovery of Dr. John Rennie, D.Sc., was officially published in the "Transactions of the Royal Society of Edinburgh," since when it has been known as Acarine disease, from the fact that the contributing cause has been proved to be a mite, of the order Acarina. The disease first came under notice in the Isle of Wight (hence its popular name) in 1904, from whence it rapidly spread over the whole of England, Scotland, and Wales, with most disastrous effects, so much so that in or about 1911 the then Minister of Agriculture and Fisheries declared that the losses through the disease amounted to more than £1,000,000.

Official investigations were made in 1907, 1909, and in 1912, to discover the cause of the disease, and the final outcome of these was that the causal agent was the protozoan, *Nosema apis.* There was still a doubt as to whether the true causal agent had been found, and in 1916 the magnificent generosity of Mr. A. H. Wood, of Aberdeen, who gave a sum of £500 a year for five years, enabled Dr. Rennie to carry out his investigations, which have resulted in the discovery of the mite, the real causal agent of the disease, and which has been fitly named *Tarsonemus woodii.*

Dr. Rennie is still carrying on his investigations with the view of discovering means to combat the disease, and has already done much in that direction. In his latest "Memoir No. 6," he says: "In Acarine Disease the thoracic breathing tubes of the hive bee are infested with mites, which pass through the whole of the growth stages from egg to adult in this situation. The mites are true parasites, members of the Family Tarsonemidæ. All types of adult bees are liable to be affected—worker, drone, and queen. The mites feed, breathe and breed in the region indicated, and the result of their secure establishment is the eventual disablement of the affected bees. This is primarily due to a continuous loss of blood, on which the mites feed." Although the mite has been discovered in bees in other countries in Europe, there does not appear to have been any serious, if any, trouble caused by them outside of Britain. Our Legislative Regulations will prevent any bees being landed in New Zealand from that part of the world, so that we are not likely to import Acarine Disease.

SAVING DISEASED COMBS.

The Hutzelman Treatment.

Probably the greatest financial loss a bee-keeper suffers in his encounter with fool brood is the destruction of fully built out combs in the treatment of a colony. The bees in most cases may be saved, but whether or not the loss of bees can soon be made good without much trouble or expense, the removal of the combs means considerable money outlay for comb-foundation. Then again, the frames are frequently destroyed with the combs; therefore, taking into consideration the first cost of a sheet of foundation and frame, with carriage, together with the time and labour of the bees, the value of a fully worked comb and its frame is, I reckon, little if any short of two shillings (Root puts the value at half a dollar). The Hutzelman treatment of such combs has proved beyond doubt that they can be thoroughly disinfected at very little cost so as to be used again without the slightest risk of their conveying disease.

Dr. J. C. Hutzelman, M.D., of Glendale, Ohio, carried out experiments in 1921 with a view of discovering some means of clearing diseased combs of the bacteria and spores of American foul brood, and eventually concluded that formalin would sterilize the combs provided it was mixed with some substance which would penetrate the wax of the comb, propolis, pollen, and the dried scales carrying the spores of disease. He found that pure alcohol was suitable, and with 20 per cent. of formalin added to it he accomplished what he was striving after. Experiments were carried out subsequently by the A. I. Root Company, and at the Bureau of Entomology, Washington, D.C., with perfect satisfaction. The greatest test, however, and a decisive one, was undertaken at the apiary of Mr. O. E. Barber, at Ashtabula, Ohio, when 50 colonies were treated in May of last year, and when independently examined in September not a diseased cell was discovered in all the combs which previous to treatment were rotten with American foul brood.

"Gleanings" for November, 1923, contains a full account of the treatment of 6,000 combs, and the completely successful result. Previous to treatment, as the report says, "many of the combs were almost completely filled with American foul brood scales and many fairly rotten were thus treated and given back to the bees without a single recurrence of the disease." We may therefore accept the remedy for saving the combs as a decided success. The same article gives the cost of treatment per comb in this case, at "less than three cents," or, say, three half-pence.

With regard to cost of the mixture, it may here be mentioned that none but pure alcohol will do; the cheaper denaturalized article contains so much poisonous matter that condemns it for this purpose. The A. I. Root Company advertise the solution ready for use in drums at from one dollar fifty cents to one dollar seventy-five cents per gallon, according to quality. The cost of pure alcohol, duty paid, in New Zealand at the present time is 80/- per gallon, and formalin 12/6, so that the remedy is absolutely prohibitive unless the Government can see its way either to import or allow bee-keepers to import the mixture free of duty. (I am informed that it is likely a wholesale New Zealand drug firm can probably supply formalin-alcohol 20 per cent. at a cheap rate).

ENEMIES.

The list of enemies of the bee usually set down in bee books published in the Northern Hemisphere includes ants, bee moths, some kinds of birds, mice, toads, and wasps.

Ants.

New Zealand is singularly free from the larger kinds of ants. In some parts of Australia they are troublesome more or less, but it is not difficult to deal with them. The best plan is to seek out and destroy their nests. Kerosene, or bisulphide of carbon, poured into holes made in the nests with an iron rod or crowbar, will destroy them. If the bisulphide is used, care must be taken with it, as it is very explosive; kerosene is the safest to use, and I believe quite as effective as the other.

Birds.

Now and again some of our birds help themselves to a dainty meal off hive-bees. I have occasionally seen kingfishers at this work, and have frequently had to drive sparrows away from near the entrances of hives where they have been catching bees. I don't think much damage is at present done by birds, and it is to be hoped that it will not increase in the future.

With regard to the other animals mentioned, I am not aware that they may be reckoned among the enemies in this part of the world. Mice, and even rats, do sometimes get into hives, but this can only occur where there is a very careless bee-keeper, and nothing further need be said about it.

Wax Moths.

These are the greatest enemies of careless bee-keepers, apart from bee disease, but I have yet to learn that they do any damage in New Zealand where careful bee-keepers are concerned. We know of two that have appeared in this country; so far as I am aware the small one *Ailbraca grissella,* may be indigenous to the country—I certainly saw it when I started bee-keeping fifty years ago at the Thames. The larger and most destructive one, *Galleria melloncila,* was first seen in the Taranaki province in 1904, when grubs of the moth were sent

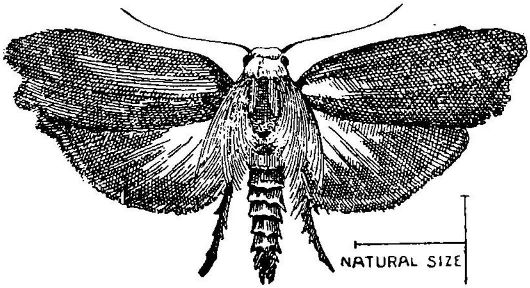


Fig. 131. Large wax moth (enlarged).
(*Galleria mellonella.*)

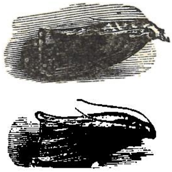


Fig. 132.
Male and
female of
lesser moth.
(*Achræa grissella.*)

to me for identification. Subsequently (in February, 1905) I paid a visit to the apiary from which the grubs were sent, and the accompanying reproduction of the original photo was taken. I found moths and grubs in several apiaries within a radius of a few miles, and as the bees in the district were mostly blacks I advised the introduction of Italians, which are proof against moths. Since then I have not heard of any further trouble from that or from any other district concerning the large moth. There can be little doubt about their having been imported with bees from Australia, the moth having appeared there in 1880, and believed to have been imported with bees from Italy. A warning to bee-keepers how careful they should be in procuring bees from other countries, and that they don't import more than they bargained for. In January, 1888, my third lot of Italian queens (one dozen in all) arrived from Italy direct, each queen with perhaps 100 workers and a piece of comb in a separate box about eight inches square. On opening the first box in my workroom I received quite a shock when I discovered the large wax moth in all stages, millions of them, and not a bee alive. My assistant made a big fire at once, and

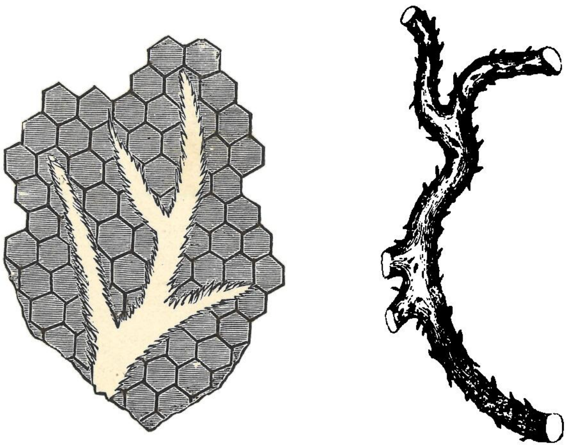


Fig. 133. Silken tubes in comb.

as all the boxes were in like condition, they, with their contents, were immediately burned, a loss of £12 worth. Had the boxes been opened without great care, moths would have escaped to cause very serious damage at that time.

It is the larvæ or grubs of the moth that destroy the combs, burrowing through them under the protection of strong silken galleries (Fig. 133), which they spin around themselves as they advance, till eventually, if not disturbed, they completely ruin the combs, which fall to the floor of the hive a mass of web and cocoons. In the climate of Sydney, New South Wales, the moth has four broods in one season, and considering the enormous number of

Fig. 134. Comb badly attacked by large wax moth. (Original photo taken at apiary mentioned.)

eggs laid in each brood, they would soon overrun a country when once they gained a footing.

The average length of the grub is one inch, and "when first hatched is pale yellow with a slightly darker head, and of a greyish flesh colour with a reddish brown head when full grown. The length of the moth is about three-quarters of an inch, has reddish brown-grey forewings, which are lighter in colour towards the outer or hinder margins."

Remedy.

The remedy against all insect pests is to keep Italian bees and to keep all colonies strong, with a good open space around each hive free from weeds and long grass.

CHAPTER XX.

RENDERING OLD AND BROKEN COMBS INTO COMMERCIAL BEESWAX.

Among small bee-keepers, and they are in the great majority, a very large quantity of old and broken combs in the aggregate, that might be converted into good commercial wax, is wasted annually through the want of some simple and inexpensive means of conversion. I have had scores of enquiries on the matter, and could only suggest doing what I did myself in early days, viz.: Procure a sound motor spirit tin, cut out the top, turn down the edge, and put a wire handle to it; cut a 9 x 1 inch board nine inches long, and bore a number of $\frac{3}{8}$in. holes in it. Next make some bags out of paper-hanger's scrim, about six inches square, press the comb into tight balls and put into bags, and these into the tin. When half full or less, fill up to within six inches of top with water, and set tin on a fire out in the open, and boil well. In meantime nail a short length of 3 x 1in. batten on to the wall of an outhouse, and make a lever and short fulcrum out of 3 x 2in. scantling. After a good boil, place the tin near the batten, put the perforated board in the tin, and get the lever to work as in Fig. 135. Skim off the wax that floats to the top while keeping the pressure on, and pour it into another tin containing very hot water, then release the pressure a little to allow the water to penetrate the bags again; do this two or three times, skimming after each pressure, and boil again if necessary. To cleanse the wax, melt it again in a good volume of boiling water and let it cool gradually; the longer it takes to cool the cleaner will be the wax, as the impurities

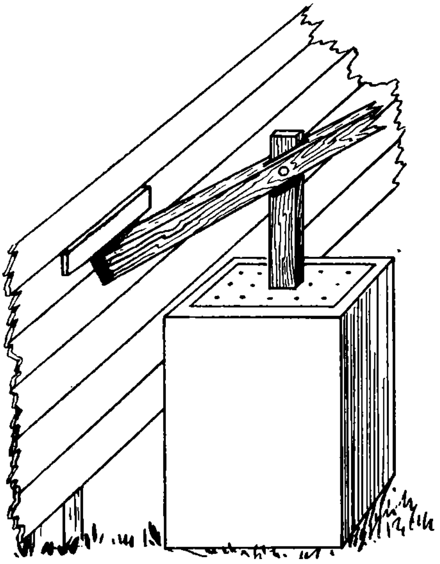


Fig. 135. Home-made wax press.

sink to the bottom of the cake and can be scraped off.

After the first couple of years, if it is the intention of the beginner to become a commercial bee-keeper, and therefore to enlarge his operations, it will pay him to get the proper utensils for dealing with cappings and broken combs. The illustration, Fig. 136, represents a Root steam press and uncapping can combined. *H* is the boiler, which should be two-thirds filled with water, and then the can set on a fire after removing the screw and perforated can from inside. A scrim bag about ten inches deep, and three-fourths the diameter of the can, should be nearly filled with comb, well pressed in, and the top of the bag folded over, and placed in the can. By providing an extra follower or two of boards, two,

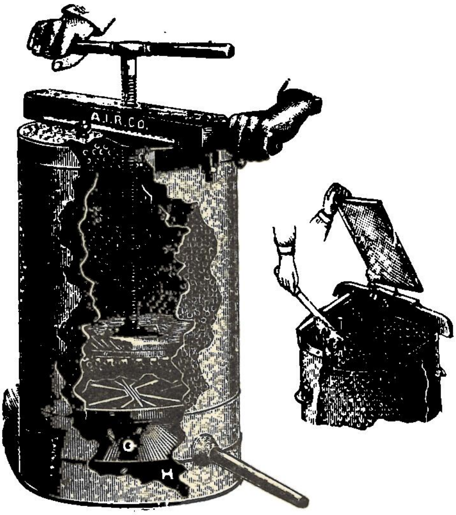


Fig. 136. Root steam wax press and uncapping can.

or even three, such bags of comb may be pressed at one time—a follower over each bag. The steam from the boiler *H* will ascend around the false bottom *G* through the comb, but no pressure must be put on until the wax ceases running from the spout. After pressing, loosen and take out the screw while the bags are well shaken up, then put in the screw again, and repeat the process until no more wax can be pressed out.

The Root-Hatch wax press (Fig. 137) is favoured by most extensive bee-keepers. It differs from the German steam press, in that the comb is first heated in a boiler with water which is kept over a good fire. Paperhanger's scrim is laid in the press basket, about one gallon at the time of the melted combs,

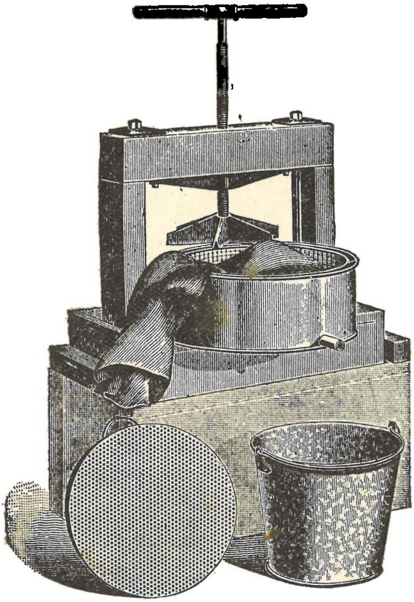


Fig. 137. Root-Hatch wax press.

and hot water is dipped from the boiler and put into the scrim, the follower is placed on top, and the whole screwed down. The wax and water runs from the spout shown, into a tin or bucket placed to receive them; the cake of wax floats on top when cool.

Iron boilers should never be used for melting or cleaning wax with hot water, as the iron and water combined turns the wax a dull dark colour; copper is best. I believe for extensive commercial bee-keepers with much old combs to deal with, the Hatch press and system is the most speedy and best.

The Solar Wax Extractor.

My first experience with the Solar Wax Extractor, some thirty-three years ago, and after, gave me a very poor impression of them, and in the fourth edition of this Manual I condemned them. Further experience, however, with an improved pattern to those I first used has entirely altered my opinion, and I can now speak of them in the highest terms. My first extractors were too deep as I afterwards discovered; the heat, or a good part of it, was no doubt wasted instead of being concentrated on the combs.

In 1906 I had one constructed on the "Boardman" pattern, Fig. 138, which worked splendidly. It was at work at the International Exhibition Apiary at Christchurch, New Zealand. It stood in the open without any special shelter, and the inside temperature, as tested frequently, went over 220° Fahr., and on one occasion I found it reached 231½° Fahr., or 19½° above boiling point. The refuse from old combs came out of the extractor quite dry without a particle of wax in it, while the wax was of a nice bright colour. I had two others made for the Government Apiaries, and they gave every satisfaction during my time.

The following are the particulars of their construction:—The dimensions outside are—length, 5ft. 3in.; width, 2ft. 8in.; depth of main part of body, 4½in.; wax-receptacle at lower part of body, width 9in., depth 8in. The sash should be double glass with one inch air-space between them. The wheel on which the extractor is mounted was 4ft. 6in. in diameter, and worked on an axle about 2ft. long driven into a block of wood in the ground. The body of the solar wax extractor is lined with black sheet iron turned up at the sides, and fitting loosely

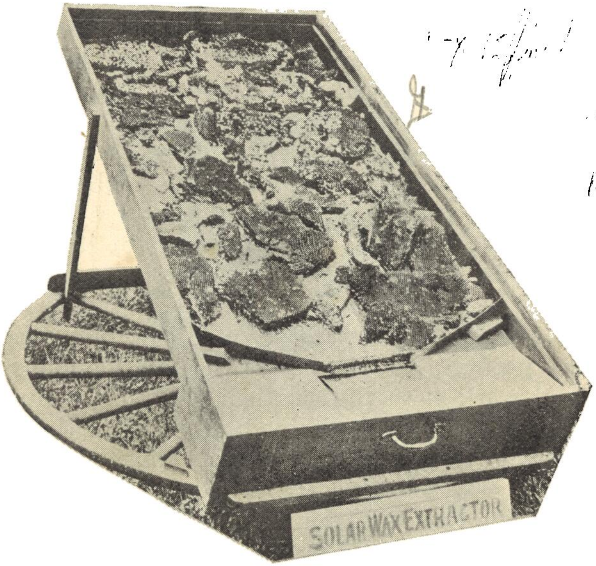


Fig. 138. Solar wax extractor, with sash removed.

in the extractor. A long tin divided into three compartments fits in the lower part for catching the wax as it runs from the combs. The tin and the divisions should run smaller at bottom than at the top, to facilitate turning out the cakes of wax, and the tops of the two divisions should be $\frac{3}{4}$in. below the top of the tin. The middle compartment will then retain any dirt or foreign matter running in with the wax, while the clean wax will flow over into the outside compartments.

The woodwork of the Extractor must be substantial and well put together to stand the great heat, and it is well to have the edge of the sash bound with 1½ inch angle iron. The depth inside from the lower sheet of glass to the iron lining should not exceed from 2½ to 3 inches.

If in a warm corner of the apiary and well sheltered, the Extractor will work at almost all times when the sun is shining. Such an appliance will soon pay for itself in a fair-sized apiary, for every particle of comb can be put in at once and converted into good commercial beeswax, instead of being wasted. Mounting the Extractor on a wheel is for convenience of turning it to the sun.

New Zealand Wax Extractors.

We are certainly not devoid of talent in New Zealand in the matter of wax extractors of original designs. There is the "Benton," and the "Smedley," extractors, which are original throughout in their construction, and the "Baines" and "Bartlett-Miller" machines, which I understand have some features of an Australian cappings reducer. Be that as it may, I have had some very good reports of the efficiency of the first three; of the latter I have not received any report, and am not aware whether it has been made since Mr. Bartlett-Miller's death.

The Benton reducer is made of tinned steel and the coil of piping of copper, which latter is also tinned. The screen shown at the upper part of Fig. 139 fits below the coil when in action, and heat is conveyed to the latter by steam from a boiler. There is an interstice of one-eighth of an inch between each round of the coil, so that when in action the cappings falling on the heated coil, pass between, and fall on the screen, where the slumgum is retained, and the clear honey and wax fall into the receiver. The capacity of such a machine 18 inches in diameter, Mr. Benton informs me, is the reduction of cappings from 300 combs per hour, and of broken-

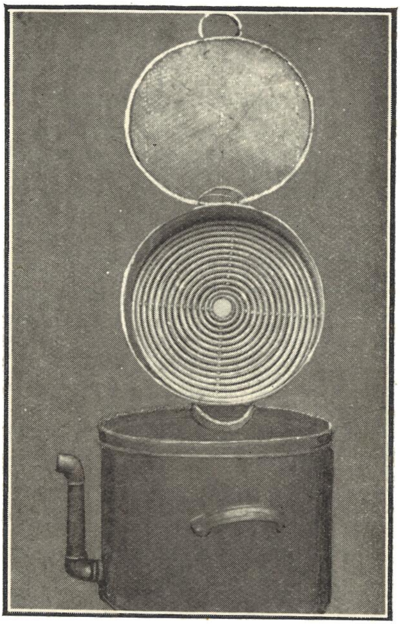


Fig. 139. The Benton cappings and comb reducer.

up combs 60 per hour, provided they are not old and black brood combs. The temperature of the honey leaving the coil is 150° F., and is quickly reduced in the receiver, and Mr. Benton further informs me that neither the flavour or colour of the honey is altered.

Regarding the Smedley reducer, Fig. 140, it is rather difficult to explain this machine clearly without the parts being separated; one needs to see it at work to get a clear understanding of its utility. The hopper, that is, the visible part of the illustra-

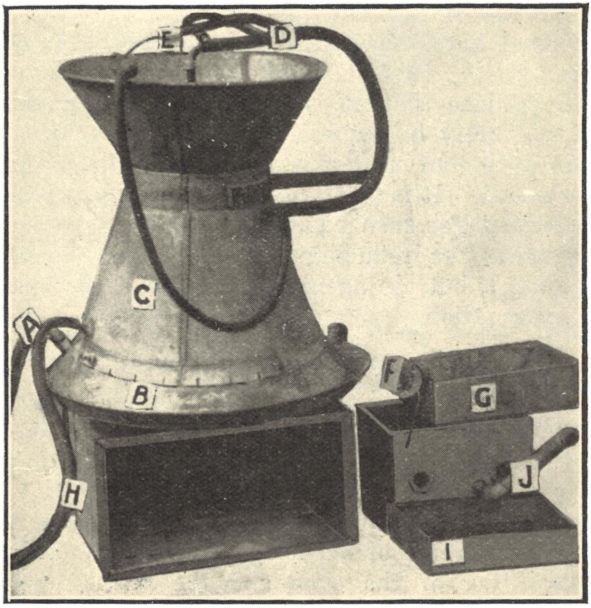


Fig. 140. The Smedley cappings and combs reducer.

tion, marked *C*, is double jacketed, and heated by steam, and inside the hopper is a tall cone (presumably heated in the same way), with a space between them. The cappings or combs are fed into the top of the hopper and reduced as they descend into the channel, from which they flow into a separator. A very ingenious arrangement for getting rid of the slumgum as it flows from the machine has been invented by Mr. Smedley to prevent it getting into the honey. It is in the shape of a roller at the mouth of the outlet, against which the honey and wax flows, and passes into the receiver; the slumgum is retained, when one turn of the roller deposits it into a receptacle by itself. As already stated, both of the foregoing reducers have been highly spoken of by those who have used them.

The Baines reducer is a very popular machine, and is largely in use in New Zealand. I have no photo of it, but no doubt most of our bee-keepers have seen it. It is primarily intended as a cappings reducer, and as such I have used it, but whether it is suitable for reducing old and tough combs I cannot say, but the agents for its sale could supply the information.

An Electric Cappings Melter.

What promises to be an important departure in cappings melters, has been invented by Mr. W. B. Bray, of Barry's Bay, Canterbury, who has had the affair in use for the past two seasons. It consists of an electric oven, and in his address at the recent Conference of Bee-keepers, Mr. Bray outlined the working of the oven and the results, which were published in the "New Zealand Fruitgrower and Apiarist." He said: "The cappings were placed in the oven on cheesecloth, which is supported on wire-mesh trays which, in turn, were supported on ridges, so that the melted honey, which came away, was caught in a receptacle underneath. The wax melted last, and the slumgum was left on the cheesecloth. The maximum heat required was not sufficient to melt the solder used on the trays, but was quite sufficient to do the work to reduce the cappings of three-quarters of a ton of honey in six hours at a cost of one shilling. With the exception of one hour's work in loading and unloading the oven, the process was effected without the attendance of the bee-keeper or anyone else. Two 600 watts heat elements were used; the voltage was 230.'' The result of treating cappings by this method, that instead second grade honey (from the cappings) he got the price of fancy grade honey. When asked the probable cost of such an oven, Mr. Bray gave as a rough estimate of £3 10s. Mr. Bray's invention was considered of very great value to bee-keeping.

Personally, I feel convinced that electricity will supersede oil-engines in the honey house and apiary workshop.

Chapter XXI.

BEE FLORA IN NEW ZEALAND, INDIGENOUS AND EXOTIC.

NATIVE.

1. Rewa-rewa	Honeysuckle, *Knightia excelsa.*
2. Pohutukawa	Christmas tree, *Metrosideros tomentosa.*
3. Rata ..	Oak-elm, *Metrosideros robusta.*
4. Hinau ..	*Elaeocarpus hinau.*
5. Kahikatea	White pine, *Podocarpus dacrydioides.*
6. Matai ..	Black pine, *Podocarpus spicata.*
7. Miro ..	*Podocarpus ferruginea.*
8. Puriri ..	New Zealand oak, or teak, *Vitex littoralis.*
9. Kohekohe	Cedar, *Hartighsea spectabilis.*
10. Tawai ..	*Leiospermum racemosum.*
11. Kowai ..	*Edwardsia microphylla.*
12. Nikau ..	Native palm, *Areca sapida.*

In the bush are also generally found the native fuchsia, wild clematis, rata creeper (white and red), karaka (laurel, *corinocarpus*), koromiko (*veronica*), and many other flowering shrubs or creepers; in the open, both on hillsides and swampy places, cabbage trees (*Cordyline Australis* and *Dracœna Australis*), and the New Zealand flax (*Phormium tenax*), and in the fernlands generally, manuka (tea-tree, *Leptospermum scoparium*), rawiri (*Leptospermum ericoides*), tutu (*Coriaria sarmentosa*), fuchsia (*Fuchsia excorticata*), silver birch or red birch (*Anothofagus menziesii*), and kie-kie (*Freyunctia banksii*).

Some of our forest trees yield excellent honey in great quantities, while that of others, although admirable for manufacturing purposes, is not in great demand, and the value is low, and much of it is too dense to extract from the combs in the ordinary way. By the way, some of the latter resemble both in appearance and flavour the celebrated Scotch heather honey which, owing to its ranking with us as an inferior grade, our bee-keepers endeavour to avoid its vicinity when establishing apiaries. I am aware that our Scotch bee-keeping friends will deem this rank heresy, but nevertheless, having had the opportunity of comparing both together, and exhibiting them at the Christchurch Exhibition, I speak of what I know. The samples of heather honey sent me by one of the then leaders of British bee-keeping had taken prizes at shows.

Plants Yielding Deleterious Nectar.

This chapter would not be complete without some reference being made to two plants indigenous to New Zealand that yields deleterious nectar, the native names of which are Pukapuka, Wharangatiwiti, blooming in early spring; and Waioriki, flowering in early autumn. The former is to be found on the edge of the bush, and the latter in swampy districts in the north of New Zealand, the Pukapuka growing from 8 to 20 feet high, and the Waioriki from 6 to 12 inches high, and known as the native butter-cup. It is reassuring to consumers of honey to know that there is absolutely no risk whatever of even the ripened honey from either plants reaching the markets under well-known brands. The risk of discomfort lies in eating newly gathered unripe honey from bee nests in bush adjacent to such plants. Neither plants blossom during the season when surplus honey is secured by commercial bee-keepers; in any case the risk of discomfort is almost negligible, as for instance, I have eaten honey from all sources during the past fifty years without discomfort, and I have not known of any established bee-keeper to suffer. New Zealand is not singular in this respect as every country has one or more such plants chiefly among the heathworts. It is a singular fact that whatever the substance is that is the cause of suffering analysts have failed to discover it; according to the Maoris it is of a volatile nature, and no doubt evaporates while they are looking for it.

IMPORTED FLORA.

White and Alsike Clovers.

Of all the nectar-yielding flora imported into New Zealand, white clover stands first in the estimation of our commercial bee-keepers, and taking all things into consideration white clover honey suits the taste of the majority of people in all lands, therefore is in greatest demand, and consequently fetches the highest price on the world's markets. Alsike clover may, I think, rank next to white clover as a valuable honey plant. Root says that "a field of twenty acres of alsike will take care of fifty colonies of bees very well, provided it is supplemented by white clover in the vicinity.'' The honey from alsike differs little from that of white clover. I have myself seen no end of bees working on it and sending forth that loud hum characteristic of bees when they are ''up to their eyes'' in nectar.

Sweet Clover, Annual and Biennial.

With regard to sweet clover, known also as Bokhara clover, this is a biennial flowering plant, of which I obtained seed from Root, and grew plants from them in 1880, and although they were good nectar-yielding plants I had no opportunity of growing them on a large scale. Some years ago Prof. H. D. Hughes, of Iowa State College, discovered an annual variety, which was given the name of ''Hubam'' clover; it is very highly spoken of as a honey and fodder plant. Our esteemed fellow bee-keeper, Mr. E. G. Ward, of Canterbury, has grown large areas of it, and speaks very highly of its nectar-yielding qualities.

Regarding lucerne, of which I was hoping much from a bee-keeping point of view some years ago when farmers commenced to cultivate it largely, so far it seems to be as disappointing here as it is in America, yielding abundance of nectar in some localities, and none in others. I have watched it closely on the Ruakura farm and never saw a hive-bee working on the blossoms, although there were plenty on a patch of alsike in the midst of it. Fruit trees, willows, and poplars afford good spring forage, especially the two latter when the weather is fine at blossoming time; but I have only known of one occasion when fruit trees yielded nectar heavily, and that was at Frimley orchard, near Hastings, Hawke's Bay. I arrived there on one occasion just as the peach trees had gone out of blossom, and the hives in an apiary alongside the orchard were so crammed with honey gathered from them that the owner had to extract it, in fact, I helped him. Regarding the honey, one would naturally expect, as I did, that peach honey would be excellent, but as a matter of fact it has a most objectionable flavour, and I think it was the worst I ever tasted. Frimley orchard, I may state, had miles and miles of peach trees at that time. As a rule the amount of nectar gathered from fruit trees does not amount to much.

Of the eucalypti (natives of Australia) introduced into New Zealand, I am only acquainted with two varieties grown in this country with regard to their nectar-yielding qualities, viz., the blue and red gums (E. globulus and E. rostrata). They are excellent nectar yielders, but they do not blossom every year, and the resulting honey is not so much favoured overseas as the New Zealand article.

Does it Pay to Cultivate for Bees?

No, it will not pay to grow a crop of any known plant specially for bees, but if it can serve other purposes as well, such as the clovers, well and good, not otherwise.

Flight of Bees.

It is generally understood that the usual range of a worker bee's flight is from 1½ miles to 2 miles in all directions from the apiary, although bees are known to go much further when pasturage is scarce within that distance.

Of course the greater the flight the less honey is stored; so that the apiarist will understand how necessary it is, where practicable, to have good and abundant pasturage near the apiary. It was Langstroth's opinion that "although bees will fly in search of food over three miles, still if it is not within a circle of two in every direction from the apiary they will be able to store but little surplus honey."

Chapter XXII.

BY-PRODUCTS OF AN APIARY.

Honey-Mead.

I have made honey-mead from various recipes, with and without herbs and other ingredients, but in making both mead and vinegar at the State apiaries I adopted the most simple methods in order that they might be readily followed by all classes of bee-keepers. The ingredients in both cases are simply honey and water in different proportions. When properly made, honey-mead at three years old is hardly distinguishable from first-class sherry, either in taste, colour, or aroma. Those who have had the opportunity of tasting mead and vinegar made at the State apiaries, when on exhibit at the winter shows, will have appreciated these by-products.

Suitable casks should be procured; I find spirit (whisky and brandy) casks the best, procurable from wine and spirit merchants, but beware of beer-casks for mead. One cask should have the head out for fermenting purposes. Whatever quantity of mead is to be made, the cask or casks it is to be put into after the ferment should be of a size that they will be full, leaving no space for air. In all cases, both for vinegar and mead, use rain-water if possible, as being freer from minerals than well or spring water.

To each gallon of water there should be added 4½lb. of honey; but as in the case of washings it would be impossible to estimate the amount, we can bring a hydrometer into use—costing about 5/- or 6/- each. The specific gravity of the mixture is as near 1·115 as is required, so that when testing the liquid, if under that, add more honey, and if over add more water. Put the mixture into the cask with the head out, add a little yeast, and cover the top of the cask with a clean sack. Where yeast cannot be readily obtained I may state that the liquid will commence to ferment in the course of a few days, but the yeast expedites it. If it is intended to fill, say, an 18-gallon cask, 20 or 21 gallons of the liquid should be set to ferment. December, January and February are the best months for making mead and vinegar. The mead is best made under cover, but vinegar can be made outside.

After fermentation commences, skim the liquid every day and then stir it well. It will be found that the scum gradually changes from a dirty brown to snowy-white colour. At this time the ferment should be slight, and the liquid can then be transferred to its cask. A small calico bag filled with sand should be placed over the bunghole. This will allow the gas generated to escape from the cask without allowing the air to enter. If these instructions are followed there will be more liquid than will fill the cask; the extra amount should be kept in a jar or bottles to use for filling up the cask now and again—keep the cask full. After about four weeks or so the sand bags may be removed, and the cask be securely bunged, but a spile hole should be first bored near the bunghole, and a spile inserted. The spile (about the size of a meat skewer) should be removed for a second or so every day for a while to allow the carbonic acid gas to escape. It can now remain undisturbed until the following August, when the liquid should be refined and transferred to a clean cask.

It should here be mentioned that Twaddel's No. 1 hydrometer, registering from 0 to 24, is the one to use for light liquids such as mead and vinegar, and No. 4 for honey.

Refining Mead.

Cut into very fine shreds some isinglass in the proportion of about 1oz. to 30 gallons of mead, and allow it to soak in some mead for two or three days, adding two teaspoonfuls of tartaric acid. When in a jelly rub the isinglass through a fine sieve until the whole is in liquid form; this is very important. Draw off from the cask, or casks, sufficient to allow of the refining mixture being added to fill them; bung up and leave the casks undisturbed for from fourteen to seventeen days, when the mead should be carefully siphoned off and be put into a clean spirit cask. A rubber tube makes an efficient siphon, but great care should be taken that the tube does not reach the bottom of the cask. Tie the tube to a stick, so that when the end of the latter is lowered gently to the bottom the end of the former is 3in. off the bottom. The mead can now remain to mature, and if not quite clear it can be further refined the following winter. Mead improves with age.

From an analysis, the mead at the Ruakura Apiary, at three years old, gave—Specific gravity, 0·9800; absolute alcohol in weight, 13·15 per cent.;

ditto in volume, 16·24 per cent.; proof spirit, 28·46 per cent.

Honey Vinegar.

This is made and fermented in a similar manner to mead, but the proportions of honey and water are different. To each gallon of water 1½ lbs. of honey are required, giving a specific gravity of 1·040 or about. Skim as for mead, and when fermentation has nearly ceased transfer to casks. In the case of mead we exclude the air, but in making vinegar we need a free circulation of air to oxidize the liquid and help the formation of acetic acid. A 1in. hole should be bored in each end of the cask on the upper edge, in a line with the bunghole; these holes, and also the bunghole, should be covered with cheese-cloth to exclude flies, but otherwise must be left open. The following winter it will be strong enough when properly made to be drawn off and put into whole casks to mature. Honey-vinegar has an excellent flavour, quite different from the ordinary article, and has a ready sale.

It is recommended, in most recipes, to add about 10 per cent. of matured vinegar (roughly, one and a-half pints to the gallon) after the first, or alcoholic fermentation has ceased, to force on the acetic acid production. Such procedure saves time, but is expensive when matured vinegar has to be purchased, while such addition is not needed to produce first-class honey vinegar.

Caution: If mead and vinegar are both made, take care to use separate utensils for each. Paint the hoops of the vinegar casks as a protection from the acid which attacks them.

Honey Beer.

In five gallons of water mix half pound of hops and two ounces of ginger, well bruised with a hammer; add two and a half pounds of liquid honey to gallon. Stir well in clean boiler over brisk fire till the liquid boils; boil for one hour (stirring occasionally) or until the hops cease to swim on the surface. Remove from fire, and let remain undisturbed until the hops and sediment has settled to or near the bottom. Strain well through suitable material into an open vessel that will allow of skimming, and place in a warm situation covered to keep out dirt and flies. In from 24 to 36 hours fermentation will set in, and will continue from 10 to 14 days, according to the temperatures. Skim every day and stir the liquid after; when fermentation has nearly ceased and little or no movement is observed, the liquid may be bottled, taking care that the bottles are clean, the liquid well strained (four folds of buttercloth makes a good strainer), and the bottles corked securely and tied in by wire or strong twine. Keep the bottled beer in a dry, cool place, and it will be ready for use in a couple of weeks, but is better if kept for a month. A bottle of fresh brewer's wort added while boiling improves it.

Chapter XXIII.

HIVE-BEES IN RELATION TO FRUITGROWING

Their Value to Orchardists.

It is but a very short time since the majority of fruitgrowers little understood the value of the hive-bee in the orchard; on the contrary, commercial fruitgrowers were inordinately prejudiced against them, believing that they did much harm, and therefore did much to discourage and prevent apiaries being established near their orchards. In fact, in a celebrated fruitgrowing district in California, the orchardists actually drove the bee-keepers out of the locality, only to, some years later, when they found their crops of fruit had fallen off, and the fruit had deteriorated, invite them back and pay their expenses. Fortunately the schoolmaster has been abroad since then, and the majority of orchardists are better acquainted with the subject than they were, but there are still some who are doubtful as to the immense value of bees in the orchard.

The following is the substance of an address delivered by the author before a meeting of fruitgrowers at Auckland:—

Self and Cross-Fertilization.

There are some varieties of fruit blossoms capable of self-fertilization by their own pollen, while others again are sterile in this respect, and require the pollen to be conveyed from the anthers of some other blossoms of the same species to their own stigmas, before fruit will be produced—that is termed cross-fertilization. In the former case the result is invariably little and poor fruit, but entirely different when cross-fertilization takes place (see illustrations).

Even with blossoms capable of self-fertilization, Nature, as it were, seems to have placed obstacles in the way to prevent it.

The late Mr. F. R. Cheshire refers to this in his "Bees and Bee-keeping" as follows:—"An examination of most blooms will show that the essential organs before referred to (anthers and pistils) are so placed that an accidental or unaided transfer of pollen to stigma is unlikely, and where this arrangement of parts is not found it frequently occurs that the anthers ripen and dehisce (open) much before, or not until some time after the stigma has so matured as to be ready for pollination. In the former case, as we may observe in the common garden nasturtium (Tropaeolum majus), the pollen is all carried away by insects by the time the stigma presents itself, so that if fertilization be effected it must be through the bringing of pollen from some other blooms still shedding it."

The wonderful mechanism developed by double-sex flowers to insure their cross-fertilization is shown in the following familiar and interesting illustrations.

In the common sage (Salvia officinalis) both the stamens and the pistil are of very peculiar form, and the latter is not fully developed and ready to be fecundated until after the anthers of the same blossom have shed their pollen. The shape of the flower, and the mode in which the bee enters it, are shown in Fig. 141, in which the tip of the still undeveloped pistil is seen just over the back of the bee, which is forcing its way down to the nectary through the stamens—not visible.

The anthers are shown in the next figure, but on an enlarged scale.

The anther-cells, instead of being close together, are at the two ends of a long connective, which is attached by a sort of pivot joint at about one-third of its length to the stalk of the stamen. The lower anther-cells contain very little pollen, sometimes none at all, while the upper ones are fully developed,

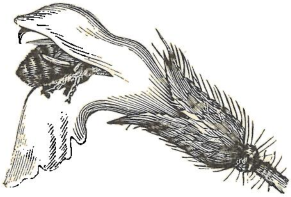


Fig. 141. *Salvia officinalis.* Young flower visited by a bee.

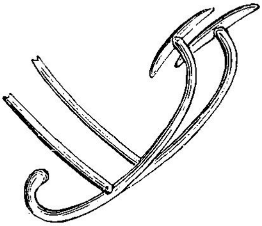


Fig. 142. Stamens and Anthers.

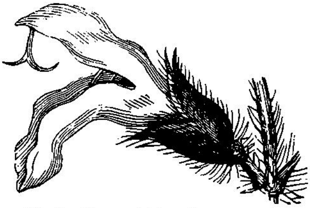
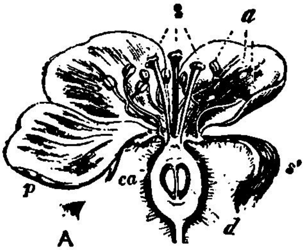


Fig. 143. *Salvia officinalis.* Older flower, with pistil developed.

as shown in Fig. 143. When the bee thrusts its head into the tube, it presses against the lower cells and pushes them back; the connectives revolve on their axis, and the upper anther-cells are brought down on the bee's back, the hairs of which brush off the pollen, which the bee carries away, and as soon as it meets with an older blossom, in which the pistil is fully developed, as seen in Fig. 143, it is evident that upon entering the tube of this blossom the pollen already on the bee's back must be rubbed against the stigma, and the cross-fertilization be thus effected.

Results of Imperfect Fertilization.

In this connection Cheshire says: "The apple is called by botanists a pseudo-syncarpous fruit, because it may be regarded as five fruits gathered into a unit by an envelope formed by a development of the calyx. If an apple be cut across we see five compartments or dissepiments in the core (see Fig. 145b., each one of which should contain pips or seeds. The bloom which preceded the fruit had five stigmas (see Fig. 144a), three of which are shown in section.



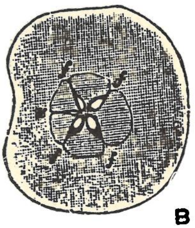
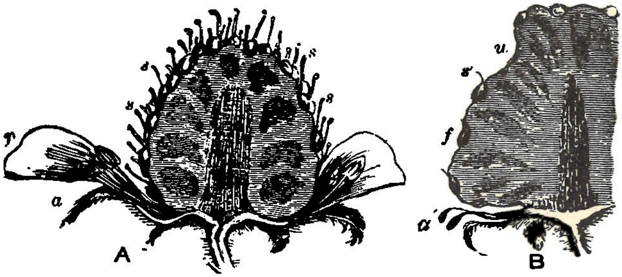


Fig. 144. Apple blossom. Fig. 145. Section of fruit.

A : Blossom (natural size). *s*, stigmas ; *a*, anthers ; *p*, petal ; *ca*, calyx ; *s*, sepal ; *d*, dissepiment.
B : Section through partly developed fruit. *f*, *f*, fertilized carpels ; *u*, unfertilized ditto.

and each one of which communicated with a dissepiment or partition, and required an independent fertilization. Bees seeking honey would, by getting their breasts (furnished as they are with abundance of long webbed hairs) thoroughly dusted with apple pollen, and flitting to a bloom whose stigma had reached the receptive condition, bring about fertilization. It would, however, frequently happen that three or four of the stigmata only would be pollinated. In this case an apple, though an imperfect one (see Fig. 145b) would be produced. Trees agitated by the winds frequently drop a number of their fruits, hence known as "windfalls," but the actual cause of this dropping is in by far the largest number of instances defective fertilization.

I had two hundred apples, that had dropped during a gale, gathered promiscuously for a lecture illustration, and the cause of falling in every case but eight was traceable to imperfect fertilization. Such fruits are readily recognised by being deformed, a part failing to grow (see Fig. 145) from the want of perfect fertilization. Cutting one such apple



Figs. 146 and 147. Strawberry, partly and full grown.

A : Earlier stage. *a*, anther ; *s,s*, stigmas ; *p*, petal.
B : Section of mature strawberry. *a*, withered anther ; *f*, fertilised achenium (popularly termed seed) ; *u*, unfertilized ditto ; *s* withered stigma.

across, no seed will be found opposite the undeveloped part. These facts taken together show conclusively how completely our fruit crop is dependent upon insect agencies, and amongst these the hive-bee takes the most important place.

In the case of the strawberry—and the same applies to the raspberry and other berry fruits—each little achenia (popularly known as seed) dotting its surface possesses a style and stigma (see Fig. 146). The stigma of each of the achenia must be fertilized to produce a perfect fruit; otherwise, if this is but partially accomplished, the part unfertilized remains undeveloped—hard, shrunken, and green—when the fertilized portion is fully ripe (see Fig. 147). Almost any dish of strawberries will furnish such examples.

Hive Bees in the Orchard.

Several years ago I communicated with the late Prof. A. J. Cook, the well-known American entomologist, and Horticultural Commissioner for the State of California, than whom there was no person living better qualified to give an opinion on the value of the bee as an agent in cross-pollination. His reply indicates the questions sent. He said: "Bees never harm blossoms, but are always a help. Bees are a tremendous aid through pollination. Many of our best fruits must be cross-pollinated to produce. Many pears, apples, and plums, etc., are utterly sterile to their own pollen. Bees are alone numerous enough to effect this valuable service. I am sure that it is an incontrovertible fact that bees as the great agents in pollination are far more valuable to the world than for the honey they produce. The best orchardists (in California) now arrange with apiarists to bring their bees to the orchards; they find they must have bees."

Conclusive evidence in this respect came under my own observation. In the winter of 1882 I started a bee-farm at Matamata, and had about one hundred colonies of bees when the fruit-blooming season came on. The apiary was located close to a mixed orchard of large trees, covering some ten acres. The nearest bush was about five miles distant, and, the orchard being in an open plain, there was no shelter for wild bees nearer than the bush, so that it is not at all likely the orchard was visited by many bees. I was informed that, though the trees blossomed abundantly each season, the trees bore very little fruit, that the whole ten acres did not supply fruit enough for the station. The result in that and subsequent seasons, by the aid of my bees, was that the trees had to be propped up in all directions to keep them from breaking down under the weight of fruit.

At a meeting of the National Federation of Fruit-growers, held in London some years ago, Mr. C. H. Hooper, M.R.A.C., of Wye College, gave particulars and results of 300 experiments he had conducted in order to get information on self and cross pollination in the orchards. Without giving details, it will be sufficient to say that the results were entirely in favour of the latter, and that from careful observation last year he estimates that 80 per cent. of the pollination of the hardy fruits is due to hive-bees, and the remaining 20 per cent. to humble and other wild bees, and insects.

Mr. E. R. Root, editor of "Gleanings," having occasion to "deliver a talk on the relation of bees to horticulture, at the Ontario Agricultural College, Canada, made the statement that bees produce annually £4,000,000 worth of honey (in the United States, America), but that their economic importance to the fruitgrower and consumers of fruit in this country could be measured by five times that (£20,000,000) in the production of more and better fruit, and better crops. After concluding the talk, he asked the College botanist if this statement, in his opinion, was too strong. He promptly replied 'it was not.' "

Pollenising Agents in New Zealand.

All writers emphasise the fact that hive-bees are the earliest and most numerous cross-fertilizing agents about when fruit trees are in blossom. If this is the case in the Old World, where there are other agents, how much more valuable to fruit-growers must this bee prove in New Zealand, where there are practically no other agents about at that time?

Shelter.

To get the best results, the orchard should be well sheltered, and the bees in, or closely adjacent to it, so that in boisterous weather, as often happens, when the trees are in blossom, the bees can take every advantage of fine spells, which they cannot do if they have far to fly.

Spraying Fruit Trees Out of Season.

I understand from those well up on the subject that it is wrong in principle to spray fruit trees for codlin moth with the usual poisonous mixtures while in blossom. This I do know, that to do so not only destroys the fructifying pollen grains, but also kills the bees which visit the flowers, and thus prevents cross-fertilization. In some of the American States there are laws which make it penal to do so. I am informed that it is not frequently done in New Zealand, and I am pleased to hear it.

Former Prejudice Against Bees.

It evidently arose through bees being seen sucking the juices from ripe fruit, and it got abroad that the hive-bee destroyed ripe grapes and other delicate fruits. It has, however, been abundantly proved that bees cannot puncture sound grapes, or any other sound fruit, but during a dearth of honey they will suck the juice from ripe grapes and other fruits after they have been punctured by some other animal, or have burst through over-ripeness. Sound grapes, smeared with honey, have been put into a hive containing a starving colony of bees: the honey has quickly vanished, but not a grape has been injured. Bunches of sound grapes have been left in four or five hives at a time, directly in contact with the bees, and after three weeks every grape was perfectly intact, but glued to the combs. (See "Langstroth on the Honey Bee," page 507.)

Conclusion.

The following from Herman Muller's great work on "The Fertilization of Flowers" has always appealed to me, and, I think, is a fitting conclusion: "Bees, which not only feed on the produce of flowers, but nourish their young also thereon, are in such intimate and lifelong relations with flowers that they show more adaptation to a floral diet, and are more important for the fertilization of our flowers, and have therefore led to more adaptive modifications in these flowers, than all the foregoing orders (of insects) put together. . . . Bees, as the most skilful and diligent visitors, have played the chief part in the evolution of flowers; we owe to them the most numerous, the most varied, and most specialised forms. Flowers adapted to bees probably surpass all others together in variety of colour. The most specialised, and especially the gregarious, bees have produced great differentiations in colour, which enable them on their journeys to keep to a single species of flower. While those flowers which are fitted for a miscellaneous lot of short-lipped insects usually exhibit similar colours (especially white or yellow) over a range of several allied species, the most closely allied species growing in the same locality, when adapted for bees, are usually of different colours, and can thereby be recognised at a glance (e.g., Trifolium Lamium, Tenerium, Pedicularis)."

Chapter XXIV.

APICULTURE IN RELATION TO AGRICULTURE.

The benefits derived by both agriculturists and horticulturists from the labours of the bee are now very generally understood and acknowledged; but still cases have sometimes occurred, though rarely, of farmers objecting to the vicinity of an apiary, and complaining of bees as "trespassers," instead of welcoming them as benefactors.

Are Bees Trespassers?

It is not, perhaps, surprising that at first a man should imagine he was being injured in consequence of bees gathering honey on his land, to be stored up elsewhere, and for the use of other parties; he might argue that the honey belonged by right to him, and even jump at the conclusion that there was so much of the substance of the soil taken away every year, and that his land must therefore become impoverished. It is true that if he possessed such an amount of knowledge as might be expected to belong to an intelligent agriculturist, working upon rational principles, he should be able, upon reflection, to see that such ideas were entirely groundless. Nevertheless, the complaint is sometimes made, in a more or less vague manner, by persons who ought to know better; and even bee-keepers appear to have occasionally adopted an apologetic tone, arguing that "bees do more good than harm," instead of having taken the much higher and only true stand by asserting that bees, while conferring great benefits on agriculture, do no harm whatever, and that the presence of an apiary on or close to his land can be nothing but an advantage to the agriculturist.

Beneficial Influence of Bees on Agriculture.

The value of the intervention of bees in the cross-fertilization of plants is dwelt upon in Chapter III., "Australasian Bee Manual," third edition, and the reader is referred for further information to the works of the late Lord Avebury, better known as Sir John Lubbock, and of Darwin. The latter, in his work on "Cross and Self Fertilization of Plants," gives the strongest evidence as to the beneficial influence of bees upon clover crops. At page 169, when speaking of the natural order of leguminous plants, to which the clovers belong, he says: " The cross-seedlings have an enormous advantage over the self-fertilized ones when grown together in close competition;" and in Chapter X., page 361, he gives the following details of some experiments, which show the importance of the part played by bees in the process of cross-fertilization:—

Trifolium repens (White Clover).—Several plants were protected from insects, and the seeds from ten flower-heads on these plants and from ten heads on other plants growing outside the net (which I saw visited by bees) were counted, and the seeds from the latter plants were very nearly ten times as numerous as those from the protected plants. The experiment was repeated in the following year, and twenty protected heads now yielded only a single abortive seed, whilst twenty heads on the plants outside the net (which I saw visited by bees) yielded 2,290 seeds, as calculated by weighing all the seeds and counting the number in a weight of two grains.

Trifolium pratense (Purple Clover).—One hundred flower-heads on plants protected by a net did not produce a single seed, whilst one hundred on plants growing outside (which were visited by bees) yielded 68 grains' weight of seed; and as eighty seeds weighed 2 grains, the hundred heads must have yielded 2,720 seeds.

Here we have satisfactory proof that the effect of cross-fertilization brought about by bees upon the clovers and other plants growing in meadows and pasture-lands is the certain production of a large number of vigorous seeds, as compared with the chance only of a few and weak seeds if self-fertilization were to be depended upon. In the case of meadow-cultivation it enables the farmer to raise seed for his own use or for sale, instead of having to purchase it, while at the same time the nutritious quality of the hay is, as we shall see further on, improved during the process of ripening the seed. In the case of pasture-lands, such of those vigorous seeds as are allowed to come to maturity and to fall in the field will send up plants of stronger growth to take the place of others that may have died out, or to fill up hitherto unoccupied spaces, thus tending to cause a constant renewal and strengthening of the pasture. The agriculturist himself should be the best judge of the value of such effects.

The beneficial effect of the bees' visits to fruit trees has been well illustrated by Mr. Cheshire in the pages of the "British Bee Journal," and by Professor Cook in his articles upon "Honey Bees and Horticulture" in the "American Apiculturist." In fact, even those who complain of bees cannot deny the services they render; what they contest is the assertion that bees do no harm.

Can Bees Harm the Soil or the Crops?

is then, the question to be considered. The agriculturist may say, "Granting that the visits of the bees may be serviceable to me in the fertilization of my fruit or my clover, how will you prove that I am not obliged to pay too high a price for such services?" For the answer to such a question one must fall back upon the researches of the agricultural chemist, which will furnish satisfactory evidence to establish the two following facts: First, that saccharine matter, even when assimilated and retained within the body of a plant, is not one of the secretions of vegetable life which can in any way tend to exhaust the soil, being made up of constituents which are furnished everywhere in superabundance by the atmosphere and rain water, and not containing any of the mineral or organic substances supplied by the soil or by the manures used in agriculture; and, secondly, that in the form in which it is appropriated by bees, either from the nectaries of flowers or as honeydew from the leaves, it no longer constitutes a part of the plant, but is in fact an excrement, thrown off as superfluous, which if not collected by the bee and by its means made available for the use of man would either be devoured by other insects which do not store honey, or be resolved into its original elements and dissipated in the air.

The foregoing statements can be supported by reference to authorities which can leaye no doubt as to their correctness—namely, Sir Humphry Davy in his "Elements of Agricultural Chemistry," written more than ninety years ago, and Professor Liebig in his "Chemistry in its Application to Agriculture and Physiology," written some ten years later, and the English version of which is edited by Dr. Lyon Playfair and Professor Gregory. These works, which may be said to form the foundation of a rational system of agriculture, were written with that object alone in view, and the passages about to be quoted were not intended to support any theory in favour of bee-culture or otherwise; they deal simply with scientific truths which the layman can safely follow and accept as true upon such undeniable authority, although he may be incapable himself of following up the processes which have led to their discovery or which prove their correctness.

Saccharine Matter of Plants not Derived from the Soil.

Liebig, when describing the chemical processes connected with the nutrition of plants, informs us (at page 4*) that—

"There are two great classes into which all vegetable products may be arranged. The first of these contain nitrogen; in the last this element is absent. The compounds destitute of nitrogen may be divided into those in which oxygen forms a constituent (starch, lignine, etc.) and those into which it does not enter (oils of turpentine, lemon, etc.)."

And, at page 141, that—

"Sugar and starch do not contain nitrogen; they exist in the plants in a free state, and are never combined with salts or with alkaline bases. They are compounds formed from the carbon of the carbonic acid and the elements of water (oxygen and hydrogen)."

---

* The edition to which reference is made is the fourth, published in 1847.

Sir Humphry Davy had already stated that, according to the latest experiments of Gay Lussac and Thenard, sugar consists of 42·47 per cent. of carbon and 57·23 per cent. of water and its constituents. Now, Liebig in several parts of his work shows that the carbon in sugar and all vegetable products is obtained from carbonic acid in the atmosphere; and that "plants do not exhaust the carbon of the soil in the normal condition of their growth; on the contrary, they add to its quantity."

Derived from the Atmosphere and Rain-water.

The same authority shows that the oxygen and hydrogen in these products are derived from the atmosphere and from rain-water; and that it is only the products containing nitrogen (such as gluten or albumen in the seeds or grains), and those containing mineral matter (silex, lime, aluminium, etc.) which take away from the soil those substances that are required to be returned to it in the shape of manures. The saccharine matter, once it is secreted by the plant and separated from it, is even useless as a manure. Liebig says on this head, page 21—

"The most important function in the life of plants, or, in other words, in their assimilation of carbon, is the separation—we might almost say the generation—of oxygen. No matter can be considered as nutritious or as necessary to the growth of plants which possesses a composition either similar to or identical with theirs, because the assimilation of such a substance could be effected without the exercise of this function. The reverse is the case in the nutrition of animals. Hence such substances as sugar, starch, and gum, themselves the products of plants, cannot be adapted for assimilation; and this is rendered certain by the experiments of vegetable physiologists, who have shown that aqueous solutions of these bodies are imbibed by the roots of plants and carried to all parts of their structure, but are not assimilated; they cannot, therefore, be employed in their nutrition."

Nectar of Plants Attract Insects.

The secretion of saccharine matter in the nectaries of flowers is shown to be one of the normal functions of the plant, taking place at the season when it is desirable to attract the visits of insects for the purposes of its fertilization. It may, then, be fairly asserted that the insect, when it carries off the honey from any blossom it has visited, is merely taking with it the fee or reward brought about in the evolution of the plant.

Sometimes Thrown Off as Superfluous.

There are, however, occasions when considerable quantities of such matter are thrown off or exuded by the leaves, which effect is taken to indicate an abnormal or unhealthy condition of the plant. At pages 106 and 107 of Liebig's book (speaking of an experiment made to induce the rising sap of a maple tree to dissolve raw sugar applied through a hole cut in the bark), he shows that—

"When a sufficient quantity of nitrogen is not present to aid in the assimilation of the substances destitute of it, these substances will be separated as excrements from the bark, roots, leaves and branches."

In a note to this last paragraph we are told that—

"Langlois has lately observed, during the dry summer of 1842, that the leaves of the linden-tree became covered with a thick and sweet liquid in such quantities that for several hours of the day it ran off the leaves like drops of rain. Many kilograms might have been collected from a moderate-sized linden-tree."

And further on, at page 141, he says—

"In a hot summer, when the deficiency of moisture prevents the absorption of alkalies, we observe the leaves of the lime-tree, and of other trees, covered with a thick liquid containing a large quantity of sugar; the carbon of the sugar must, without doubt, be obtained from the carbonic acid of the air. The generation of the sugar takes place in the leaves, and all the constituents of the leaves, including the alkalies and alkaline earths, must participate in effecting its formation. Sugar does not exude from the leaves in moist seasons, and this leads us to conjecture that the carbon which appeared as sugar in the former case would have been applied in the formation of other constituents of the tree in the event of its having had a free and unimpeded circulation."

These quotations will probably be considered sufficient to justify the assertion that the gathering of the honey from plants can in no possible way tend to exhaust the soil or affect its fertility. There is no difference of opinion among scientific men as to the sources from which the saccharine matter of plants is derived. Since Liebig first put forward his views on that subject, as well as with regard to the sources from which plants derive their nitrogen, the principles of agricultural chemistry have been studied by the most eminent chemists, some of whom combated the views of Liebig on this latter point (the source of nitrogen and its compounds), and Liebig himself seems to have modified his views on that point; but there has been no difference of opinion about the saccharine matter, as to which

Liebig's doctrine will be found given unaltered in the latest colonial work on the subject, MacIvor's "Chemistry of Agriculture," published at Melbourne a few years ago.

Superfluous Nectar Evaporated if not Gathered or Eaten by Stock.

That the nutritive quality of the plants in any growing crop is not diminished by the abstraction of honey from their blossoms would appear to be evident from the fact already referred to, that those plants have actually thrown off the honey from the superfluity of their saccharine juices as a matter which they could no longer assimilate. There would appear, on the other hand, to be good reason to believe that the plants themselves become daily more nutritive during the period of their giving off honey —that is, from the time of flowering to that of ripening their seeds. This is a point upon which, I believe, all agricultural chemists are not quite agreed, but the testimony of Sir H. Davy is very strong in favour of it. In the appendix to his work already quoted, he gives the results of experiments made conjointly by himself and Mr. Sinclair, the gardener to the Duke of Bedford, upon nearly a hundred different varieties of grasses and clovers. These were grown carefully in small plots of ground as nearly as possible equal in size and quality; equal weights of the dried produce of each, cut at different periods, especially at the time of flowering and at that of ripened seeds, were "acted upon by hot water till all their soluble parts were dissolved; the solution was then evaporated to dryness by a gentle heat in a proper stove, and the matter obtained carefully weighed, and the dry extract, supposed to contain the nutritive matter of the plants, was sent for chemical analysis.'' Sir H. Davy adds his opinion that this ''mode of determining the nutritive power of grasses is sufficiently accurate for all the purposes of agricultural investigation.'' Further on he reports, ''In comparing the compositions of the soluble products afforded by different crops from the same grass, I found, in all the trials I made, the largest quantity of truly nutritive matter in the crop cut when the seed was ripe, and the least bitter extract and saline matter and the most saccharine matter, in proportion to the other ingredients, in the crop cut at the time of flowering.'' In the instance which he then gives, as an example, the crop cut when the seed had ripened showed 9 per cent. less of sugar, but 18 per cent. more of mucilage and what he terms ''truly nutritive matter,'' than the crop cut at the time of flowering. From this it would follow that during the time a plant is in blossom and throwing off a superfluity of saccharine matter in the shape of honey the assimilation of true nutritive matter in the plant itself is progressing most favourably. In any case it is clear that the honey, being once exuded, may be taken away by bees or any other insects without any injury to the plant, by which it certainly cannot be again taken up, but must be evaporated if left exposed to the sun's heat.

Question as to Grazing Stock.

There is, however, a plea put in by the agriculturist on behalf of his grazing stock, and one which he generally seems to consider unanswerable. He says: ''Even if it be admitted that the removal of the honey from my farm is neither exhausting to the soil nor injurious to the plants of the standing crop, still it is so much fattening matter which might be consumed by my stock if it had not been pilfered by the bees.''

Now, it may at once be admitted that honey consists to a great extent of fattening-matter, though it may be allowable to doubt whether in that particular form it is exactly suitable as food for grazing cattle. Although it is quite true that the saccharine matter assimilated in the body of a plant tends to the formation of fat in the animal which eats and digests that plant, still one may question the propriety of feeding the same animal on pure honey or sugar. We may, however, waive that view of the subject, as we shall shortly see that it is only a question of such homœopathically small doses as would not be likely to interfere with the digestion of the most delicate grazing animal, any more than they would considerably increase its weight. Admitting, therefore, that every pound of honey of which the grazing stock are deprived by bees is a loss to the farmer, and therefore to be looked upon as a set-off to that extent against the benefit conferred by the bees in other ways, it will be necessary to consider to what extent it is possible that such loss may be occasioned.

Quantity of Honey Furnished by Pasture Land.

In the first place, it must be recollected that a large proportion—in some cases the great bulk—of the honey gathered by bees is obtained from trees, as, for instance, the linden in Europe, the bass-wood and maple in America, and in this country the forest trees, nearly all of which supply rich forage for the bee, and everywhere from fruit trees in orchards. A large quantity is gathered from flowers and flowering shrubs reared in gardens; from clover and other plants grown for hay, and not for pasture; and even in the field there are many shrubs and flowering plants which yield honey, but which are never eaten by cattle. Pastures, therefore, form but a small part of the sources from which honey is obtained; and in dealing with this grazing question we have to confine our inquiries to clovers and other flowering plants grown in open pastures, and such as constitute the ordinary food of grazing stock. In order to meet the question in the most direct manner, however, let us assume the extreme case of a large apiary being placed in a district where there is nothing else but such open pastures, and growing only such flowering plants as are generally eaten by stock. Now, the ordinary working range of the bee may be taken at a mile and a half from the apiary on all sides, which gives an area of about 4,500 acres for the supply of the apiary; and if the latter consists of a hundred colonies, each producing an average of 100lb. of honey, there would be a little more than 2lb. of honey collected off each acre in the year; or, if we suppose so many as two hundred hives to be kept at one place, and to produce so much as 10 tons of honey in the season, the quantity collected from each acre would be 4lb. to 5lb.

Proportion Possibly Consumed by Stock.

Let us next consider what proportion of those few pounds of honey could have found its way into the stomachs of the grazing stock if it had not been for the bees. It is known that during the whole time the clover or other plants remain in blossom, if the weather be favourable, there is a daily secretion of fresh nectar, which, if not taken at the proper time by bees or consumed by cattle, is mainly evaporated during the midday heat of the sun. It has been calculated that a head of clover consists of fifty or sixty separate flowers, each of which contains a quantity not exceeding one five-hundredth part of a grain in weight, so that the whole head may be taken to contain one-tenth of a grain of honey at any one time. If this head of clover is allowed to stand until the seeds are ripened it may be visited on ten or even twenty different days by bees, and they may gather on the whole one, or even two, grains of honey from the same head, whereas it is plain that the grazing animal can only eat the head once, and consequently can only eat one-tenth of a grain of honey with it. Whether he gets that one-tenth grain or not depends simply on the fact whether or not the bees have exhausted that particular head on the same day just before it was eaten. Now, cattle and sheep graze during the night and early morning, long before the bees make their appearance some time after sunrise; all the flowering plants they happen to eat during that time will contain the honey secreted in the evening and night-time; during some hours of the afternoon the flowers will contain no honey, whether they have been visited by bees or not; and even during the forenoon, when the bees are most busy, it is by no means certain that they will forestall the stock in visiting any particular flower. In a field so overstocked that every head of clover should be devoured as soon as it blossomed, then, of course, there would be nothing left for the bees; but if, on the other hand, as is generally the case, there are always blossoms left standing in the pasture, some of them even till they wither and shed their seeds, then it must often happen that after bees shall have visited such blossom ten or even twenty times, and thus collected one or even two grains of honey from one head, the grazing animal may, after all, eat that particular plant and enjoy his one-tenth of a grain of honey just as well as if there had never been any bees in the field. If all these chances be taken into account it will be evident that out of the 4lb. or 5lb. of honey assumed to be collected by bees from one acre of pasturage probably not one-tenth, and possibly not even one-twentieth, part could under any circumstances have been consumed by the grazing animals—so that it becomes a question of a few ounces of fattening matter, more or less, for all the stock fed upon an acre during the whole season; a matter so ridiculously trivial in itself, and so out of all proportion to the services rendered to the pasture by the bees, that it may be safely left out of consideration altogether.

Bee-keeping as a Branch of Farming.

There is still one point which may possibly be raised by the agriculturist or landowner: "If the working of bees is so beneficial to my crops, and if such a large quantity of valuable matter may be taken, in addition to the ordinary crops, without impoverishing my land, why should I not take it instead of another person who has by right no interest in my crop or my land?" The answer to this is obvious. It is, of course, quite open to the agriculturist to keep any number of bees he may think fit; only, he must consider well in how far it will pay him to add the care of an apiary to his other duties. No doubt everyone farming land may with advantage keep a few colonies of bees to supply his own wants in honey—the care of them will not take up too much of his time, or interfere much with his other labours; but if he starts a large apiary with the expectation that it shall pay for itself, he must either give up the greater portion of his own time to it or employ skilled labour for that special purpose; and he must recollect that the profits of bee-keeping are not generally so large as to afford more than a fair remuneration for the capital, skill, and time required to be devoted to the pursuit. In any case, he cannot confine the bees to work exclusively on his own property, unless the latter is very extensive. When such is the case, he may find it greatly to his advantage to establish one or more apiaries to be worked under proper management, as a separate branch of his undertaking; but in every case, whether he may incur or share the risks of profit and loss in working an apiary or not, the thing itself can only be a source of unmixed advantage to his agricultural operations, and consequently if he does not occupy the ground in that way himself he should be glad to see it done by any other person.

Chapter XXV.

THE NEW ZEALAND APIARIES ACT, 1907, CONSOLIDATED 1908.

In which is incorporated Amendments, and Regulations 1908-13-17-20, and 1924.

The following is a digest of the above, and is now in force:—

Interpretation.

In this Act, if not inconsistent with the context—

"Apiary" means any place where bees are kept:

"Bee-keeper" means any person who keeps bees or allows the same to be kept upon any land occupied by him:

2. (1) Or has in his possession or allows to be kept on any land occupied by him any appliances that have been used in connection with apiculture:

(2) "Disease" means foul brood (*Bacillus pluton* and *Bacillus larvæ*), bee moths (*Galleria mellonella* and *Achræa grizzella*), "Isle of Wight disease" (*Nosema apis*), and any other diseases or pests from time to time declared by the Governor in Council to be diseases within the meaning of this Act:

"Frame hive" means a hive containing movable frames in which the combs are built, and which may be readily removed from the hive for examination:

"Inspector" means any person appointed by the Governor as an Inspector under this Act.

Bee-keeper to give Notice of Disease.

3. Every bee-keeper in whose apiary any disease appears shall, within seven days after first becoming aware of its presence, send written notice thereof to any Inspector appointed under this Act:

4. The Governor may from time to time appoint Inspectors and other officers to carry out the provisions of this Act:

Powers of Inspectors.

5. Any Inspector may enter upon any premises or buildings for the purpose of examining any bees, hives, or bee appliances, and if the same are found to be infected with disease he shall direct the bee-keeper to take within a specified time such measures as may be necessary to cure the disease; or if in the opinion of the Inspector the disease is too fully developed to be cured, he may direct the bee-keeper to destroy by fire within a specified time the bees, hives, and appliances so infected, or such portions thereof as the Inspector deems necessary:

(2) The powers of entry conferred on an Inspector by the said section 5 may be exercised by any person authorised in writing in that behalf by the Inspector, and any person so authorised shall forthwith report to the Inspector the results of the examination made by him.

Removal of Bees to New Hives.

6. In any case in which it is found by an Inspector that the bee-combs in any hive cannot, without cutting, be separately and readily removed from the hive for examination he may direct the bee-keeper to transfer the bees to an approved frame hive within a specified time:

Inspector's Directions to be Obeyed.

7. (1) Every direction by an Inspector shall be in writing under his hand, and shall be either delivered to the bee-keeper personally or sent to him by registered letter addressed to him at his last-known place of abode.

(2) Every such direction shall be faithfully complied with by the bee-keeper to whom it is addressed, and, in default of compliance within the time specified, the Inspector or any person authorised by him in writing in that behalf may within one month destroy or cause to be destroyed by fire, at the expense of the bee-keeper, any hives other than properly constructed frame hives, or any bees, hives, and appliances found to be infected with disease.

Infected Bees, etc., not to be Kept or Sold.

8. No bee-keeper shall—

(*a*) Keep or allow to be kept upon any land occupied by him any bees, bee-combs, hives, or appliances known by him to be infected by disease without immediately taking the proper steps to cure the disease; or

(*b*) Sell, barter, or give away any bees or appliances from an apiary known by him to be infected by disease.

9. No bee-keeper shall keep or knowingly allow to be kept on any land occupied by him any bees except in a properly constructed frame hive.

Offences.

10. Every person is liable to a fine not exceeding five pounds who—

(*a*) Obstructs an Inspector or any person acting under the written authority of an Inspector in the exercise of his duties under this Act, or refuses to destroy or permit the destruction of infected bees and appliances.

(*b*) Fails to comply with any direction given under the provisions of this Act by any Inspector.

(*c*) Commits any other breach of this Act.

11. No person shall be entitled to compensation for anything lawfully done under this Act.

12. The Governor may from time to time, by Order in Council gazetted, declare any disease or pest affecting bees or apiaries (other than those mentioned in section 2 hereof) to be a disease within the meaning of this Act.

(1) The Governor may from time to time, by Order in Council gazetted, prohibit absolutely, or except in accordance with regulations under this Act—

(*a*) The introduction into New Zealand, either generally or from any specified place, of any bees, honey, comb-foundation, appliances, or other thing which is diseased or infected with disease, or which in his opinion is likely to introduce any disease into New Zealand; or

(*b*) The removal from any specified portion of New Zealand to any other portion or specified portion of New Zealand of any bees, honey, comb-foundation, appliances, or other thing which is diseased or infected with disease, or which in his opinion is likely to spread any disease.

(2) For the purposes of this section the Governor may, by Order in Council gazetted, appoint any specified ports to be the only ports of entry for bees, honey, comb-foundation, or appliances, or for any specified bees, honey, comb-foundation or appliances.

The Governor may from time to time, by Order in Council gazetted, make regulations—

(*a*) Prescribing the manner in which diseased bees, honey, comb-foundation, appliances, and infected packages shall be treated, cleansed, destroyed, or otherwise disposed of;

(*b*) Prescribing the manner in which any bees, honey, comb-foundation, appliances, or other things introduced into New Zealand in contravention of this Act or of any regulations thereunder, shall be treated, cleansed, destroyed, or otherwise disposed of:

(*c*) Providing for the registration of apiaries, and the terms and conditions of such registration;

(*cc*) Prescribing fees to be paid on the registration of apiaries and the method of disposal of such fees;

(*d*) For the inspection, grading, packing, marking, stamping, branding, and labelling of honey;

(*e*) Prohibiting the exportation of honey from New Zealand otherwise than in accordance with such conditions as may be prescribed.

REGULATIONS.

Extract from N.Z. Gazette No. 115, 12th July, 1917.

Registration of Apiaries.

2. Every bee-keeper shall, on or before the 15th day of August, 1917, and in the month of June in the year 1920 and in every third year thereafter, make application to the Director in or to the effect of the form in the Schedule hereto, for the registration of his apiary; provided that in the event of—

(*a*) Any apiary being established, or

(*b*) Any apiary being transferred from one bee-keeper to another,

subsequent to the gazetting of these regulations, application for the registration of such apiary must be made as directed within twenty-one days after such establishment or transfer has been effected.

3. Forms of application for registration of an apiary shall be obtainable, free of charge, from the Director, or from any District Agent or Apiary Instructor of the Department of Agriculture.

Extract from N.Z. Gazette No. 39, 5th June, 1924.

Regulations Relating to the Introduction into New Zealand of Bees or Appliances.

1. In these regulations "appliance" means any hive, frame, comb-foundation, or other thing used in connection with the keeping of bees and the harvesting of their products.

2. The introduction of bees into New Zealand is prohibited, save with the precedent consent of the Minister of Agriculture.

3. Each application for authority to import bees must be made in writing, and must state the name and address of the breeder, and the location of the apiary from which it is proposed to secure such bees.

4. No appliance which has been used in connection with bees shall be introduced into New Zealand: Provided that in connection with bees imported with the consent of the Minister of Agriculture there may be introduced such used appliances as are necessary to serve as containers for such bees.

CHAPTER XXVI.

CALENDAR, AND BEE-KEEPERS' AXIOMS.

In describing the apiary work appropriate for each month in the year in New Zealand, I have chosen the condition of the average seasons as near as possible midway between the extreme north and south of the Dominion, therefore an allowance of from two to three weeks each way should be made, the north being the earliest.

JANUARY.

In average seasons the bulk of the season's surplus honey is gathered this month. Keep the extractor going, and remove sections as soon as well finished. Look after the ventilation closely, and remember that if bees cluster outside on the front of the hive it indicates deficient ventilation, and bad management, and may possibly lead to swarming to relieve the situation.

FEBRUARY.

This is sometimes a hot, dry month, but a considerable amount of honey is usually gathered in the first half, especially when the season is a bit late. By the end of the third week, nectar secretion rapidly falls off, and the end of the main flow follows soon after. Secure all the surplus honey possible from the hives by the middle of the month before robber bees become active, but if delayed till the latter become troublesome use bee-escapes. This, I consider, is the best month for superseding queens. Keep down weeds and long grass around the hives.

MARCH.

Robber bees are active this month, and every precaution should be taken to prevent robbing. Bodies of hives as they drop out of use should be disinfected by singeing the insides with a painter's blow-lamp. Other implements may be washed in a carbolic acid solution before being stowed away. Store spare combs away immediately they fall out of use, to keep free from wax-moth. Unite all weak colonies with stronger ones.

APRIL.

Robber bees are still active in the first half of this month, when care should be taken when manipulating hives to get through as quickly as possible. Breeding in fair quantities should still be going on, but will gradually diminish as the month advances. As the colonies should be fixed up for winter early next month, see that any prospective shortage of the minimum winter food supply of 40lbs. be made up by feeding this month; any uniting delayed should be done at once.

MAY.

All colonies should be fixed up for winter as early as possible this month. See and note the condition of each in the "field book," to be afterwards transferred to the register.

JUNE.

This is the first month of winter, and should be a quiet month in the apiary, and the less the bees are disturbed during this and the next month the better; see that there is no winter robbing going on, that any leaky covers be repaired at once, and damp mats be changed for dry ones. The end of this month is a good time to move bees.

JULY.

As the new breeding season commences near the end of this month, all top boxes that have been left on up to the present time, and not fully occupied by bees, should be removed, and the hive made snug to encourage breeding. Finish moving bees and establishing new out-apiaries this month.

AUGUST.

All hives should be well overhauled on fine days during the first half of this month, and the condition of the colonies noted in the field book. See that there is a full supply of food in the hives, and lift each on going through them on to a spare bottom board alongside, scrape the bottom board well, and return the hive. Breeding will now be increasing rapidly; send orders to the manufacturers for new material required from them, and make up any on hand, ready for the approaching season.

SEPTEMBER.

This is the month of our vernal equinox, when the weather is usually unsettled, but for many years past I have noticed September as a very pleasant month, and the greater part of October quite the reverse of what it used to be—stormy. Watch the food supply, as there is usually a dearth of nectar toward the end of the month. Colonies to be chosen for raising queens and drones should now receive attention and be stimulated to force them ahead of the others. Selected drones should be flying early next month, and queen rearing may be started with selected eggs at the end of this month. Don't let the hives become over-crowded before giving more room in the shape of another top box. Watch for symptoms of foul brood and mark the hives for treatment in November where disease is seen.

OCTOBER.

This is the month when the first natural swarms issue; if the weather during September has been favourable they may come off during the first week, or may be delayed till much later. Where swarms are not desired, give plenty of working room and ventilation. Watch for symptoms of disease, and mark the hives where they appear.

NOVEMBER.

The first batch of queens should be mated early this month, and dividing for increase may proceed as soon as there are any young queens or nearly matured queen cells ready. All such work needing the break up and disturbance of the colonies should be finished before the main flow of nectar sets in at the end of the month. During the second week, if the weather is settled and warm with a fair flow of nectar on, treat the diseased colonies, if any.

DECEMBER.

With seasonable weather the main flow of nectar should be increasing in volume, and should be full on at the middle of the month. Keep the extractor going, and remove sections when ready; provide plenty of working room and ventilation, or swarming may result just when it would do most harm.

AXIOMS.

There are a few Bee-keepers' Axioms laid down by Langstroth which are as unerring to-day as when first promulgated, and with which every beginner should become familiar:—

1. Bees gorged with honey never volunteer an attack.

2. Bees may always be made peaceable by inducing them to accept of liquid sweets.

3. Bees, when frightened by smoke or by drumming on their hives, fill themselves with honey, and lose all disposition to sting, unless they are hurt.

4. Bees dislike any **quick** movements about their hives, especially any quick movement which **jars** their combs.

5. Bees dislike the offensive odour of sweaty animals, and will not endure impure air from human lungs.

6. The bee-keeper will ordinarily derive all his profits from stocks strong and healthy in early spring.

7. In districts where forage is abundant only for a short period, the largest yield of honey will be secured by a **very** moderate increase of stocks.

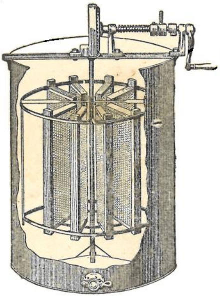
8. A moderate increase of colonies in any one season will, in the long run, prove the easiest, safest, and cheapest mode of managing bees.

9. Queenless colonies, unless supplied with a queen, will inevitably dwindle away, or be destroyed by the bee moth, or by robber bees.

10. The formation of new colonies should ordinarily be confined to the season when bees are **accumulating** honey; and if this, or any other operation, must be performed when forage is scarce, the greatest precautions should be used to prevent robbing.

The essence of all profitable bee-keeping is contained in Oettl's golden rule—**Keep your stocks strong**. If you cannot succeed in doing this, the more money you invest in bees the heavier will be your losses; while if your stocks are strong, you will show that you are a **bee-master** as well as a bee-keeper, and may safely calculate on a generous return from your industrious subjects.

To the foregoing I am tempted to add the following from C. P. Dadant's revision of Langstroth's "Hive and Honey Bee," it being so true: "A man who knows all about bees, and does not believe that anything more can be gained by reading bee journals, new bee books, etc., will soon be far behind the age. Yet as what is written in the bee journals and books, ours included, is not always perfectly correct, every bee-keeper should try to sift the grain from the chaff."



The New
Herrod-Hempsall Extractor

Patented all over the World

No reversing of Combs.
Both sides extracted at the same time.

The illustration is of a machine to take 8 Combs, but a machine 24 inches in diameter extracts 12 Combs at same time. Langstroth or British standard, 4 deep and 8 shallow or 12 shallow Combs.

Machines may be supplied to take 50 or more Combs

Sole Licensee:

ROBERT LEE, Uxbridge, Middlesex, England

THE NEW ZEALAND CO-OPERATIVE HONEY PRODUCERS' ASSOCIATION LTD.

Authorised Capital: £35,000 in 17,500 Shares of £2 each

THIS is an Association of the Commercial Bee-keepers of New Zealand formed for the purpose of organising and controlling the marketing of their honey. It started operations in 1914, and since that date has handled 90% of all the honey exported from the Dominion. The Association, besides taking prompt delivery of all honey offering, and making equally prompt advances to its members, has done valuable work in creating a demand for New Zealand honey in the United Kingdom and Europe, and in carrying out investigations whereby the condition of the honey exported has been greatly improved.

Bee-keepers can join the Association by taking up either deduction or call shares. Deduction shares are paid for by a deduction of ⅛d. per lb. on honey sent in. Call shares are payable 5s. on application and the balance when calls are made.

Offices: Stanley St., Auckland Post Office Address: P.O. Box 1293
Telegraphic & Cable Address: BEES

INDEX

Printed by Whitcombe & Tombs Limited. G43432