Rothamsted Experimental Station, Harpenden, - T. Palmer-Jones

Bee Department.

Work on Treatment of Bee Diseases - Dr L. Bailey.

European Foul Brood. The effect on E.F.B. of the quaternary ammonium compounds such as Cetavlon and Deciquam is being tested. Deciquam has been found to destroy E.F.B. but is too toxic to bees in the necessary concentration.

I Laboratory Methods: These compounds are tested on larvae reared artificially in polythene cell cups kept in jars above 2% KOH solution. The KOH keeps the humidity at about 90% and removes excess CO_2. Incidentally, it has been found that combs made of polythene are useless for practical beekeeping because the wax moth will bore through them. Perspex can be used instead of polythene and round holes may be bored in it instead of the usual hexagonal ones. The polythene or perspex cups are stored in alcohol to keep them sterile.

Testing of Cetavlon: Three bee larvae infected with E.F.B. were removed from a hive and ground up in a mortar with 5 cc of distilled water. The strength of the infection was tested by spreading a standard loop of the suspension obtained over an area of one sq. cm. marked on a slide and examining the smear under the microscope against a nigrosin background. If necessary, larvae may be kept alive after removal from a hive for several days in a refrigerator at 3°C.

Serial dilutions of the suspension were then prepared, using Cetavlon as a diluent, so that the infected material was exposed to one part of Cetavlon in 1000, 10,000, and 100,000. These dilutions were stored for 24 hours in a refrigerator at 3°C. It appears possible that larvae infected with E.F.B. may contain some volatile toxic substance as sometimes, whentheir freshly ground-up bodies are used in tests on healthy larvae grown in cell cups, unexpected mortality of these occurs. If this material is kept for some days before use, however, such mortality does not occur.

Then a loopful of royal jelly was placed in all the cells of four pieces of polythene comb, each of which contained twelve cells. One such group of twelve cells is always used for testing each dilution or as a control.

A two day old larva was then put on top of the royal jelly in each cell and the four pieces of comb placedabove the 2% KOH in four screw-top jars after inoculation with loopfuls of 1/1000, 1/10,000, 1/100,000 Cetavlon plus the undiluted suspension of ground-up larvae as a control. The jars were kept in an incubator at 34°C. This operation was completed at 5 p.m. At 10 a.m. next day the larvae were given a loopful each of royal jelly, and at 6 p.m. a loopful of special yeast food - 25% honey and 10% yeast extract (Difco). The royal jelly was stored in the inner cabinet of a refrigerator at -10°C. Under such storage conditions it can be held for a year. On the third day yeast would have been fed the larvae at 10 a.m. and 6 p.m., but feeding was discontinued as the larvae were mainly dead.

...s: A fine pipette with a very small bulb is used to deliver a loop of yeast extract on top of the larvae. A fresh pipette is used for each group of cells and it is placed in lysol after use. The platinum loop used to deliver royal jelly and other material to the larvae is flamed when appropriate.

Further Tests Commencing 19/7: Larvae two days old were placed on loops of royal jelly in cell cups at 10.30 a.m. At 11 a.m. another loopful of royal jelly was given to ensure an adequate food supply, and the larvae were inoculated, in the usual groups of twelve, with loopfuls of 1/1000, 1/10,000 and 1/100,000 Cetavlon. One group was also inoculated with the undiluted infected material, and an untreated control group was maintained. 19/7. 6 p.m. Royal jelly fed. 20/7. 9.30 a.m. Yeast extract fed and also at 1 p.m. and 5.30 p.m. On 20/7 all the larvae were alive except those treated with 1/1000 Cetavlon which is thus shown to be toxic in this concentration. 9.30 a.m.: Yeast extract fed. Noon: Yeast extract fed, larvae short of food. 5.30 p.m.: Yeast extract fed. 22/7 Larvae killed and smears prepared.

The experiment showed that concentrations of 1/10,000 and 1/100,000 Cetavlon prevented the infection of all larvae. Undiluted infected material caused disease in several larvae.

NOTES: The Americans rear larvae three days old on nylon gauze touching cotton wool soaked in the yeast plus honey solution already described.

Larvae can be conveniently transferred by sucking them against a fine opening at the end of a glass tube.

Mortars and equipment used for handling E.F.B. are sterilised in Lysol to prevent the disease spreading to apiaries.

II Field Methods: Experiments are being conducted on the feeding of Cetavlon to hives infected with E.F.B. and the spraying of combs of such hives with it. The mode of transmission of E.F.B. is being studied.

An E.F.B. infection always drops in summer during the honey flow. Is this due to the antibiotic effect of freshly gathered honey? Some authorities have found that honey has such an effect but it does not last.

ACARINE DISEASE: Efforts are being made to discover an acaracide which will destroy the mites with one or two applications, and not eight, as in the case of Folbex.

Ovotran or PCPCBS. Strips of heavy blotting paper were soaked in 5% $NaNO_3$ and dried, then soaked in ovotran and dried. Finally they were folded in a "V" shape, with holes punched along the mid-rib to assist combustion, macerated with a file, and burnt in hives to find what effect the fumes would have on the bees and queens. It was found that the bees in strong hives were excited and dropped down on the burning strips which they put out. In weaker hives the strips burnt satisfactorily.

NOTE: PK and dimite have the same effectiveness against acarine as chlorbenzylate.

Steps to Take if Acarine Found in New Zealand: Dr. C.G. Butler considers as did the Swiss, that if acarine was found in one apiary it would already have spread to others. He suggests:

(i) All bees should be destroyed in the infested apiary.

(ii) A cordon 3 - 5 miles in radius be put round the infested apiary and no bees be allowed in or out.

(iii) Examination of all hives within the cordon should be made and infested bees destroyed, if practicable, or treated with an acaracide such as Folbex.

(iv) We should ceaseall importations of bees from the U.S.A.

(v) I consider we should have the means to compensate beekeepers whose bees were destroyed in such an emergency - perhaps a type of insurance.

NOSEMA DISEASE: The effect of pH upon the effectiveness of fumagillin is being studied by feeding solutions of it to bees artificially infected to the maximum with Nosema.

The effect of sugar syrup upon fumagillin is being estimated by making up the fumagillin in sugar syrup and keeping the solution from 1 - 6 months when it is tested against Nosema-infected bees.

Artificial Infection of Bees with Nosema: A dose of one million spores per bee ensures that the bee becomes heavily infected with Nosema. The spores are obtained from the intestines of infected bees and counted in a haemocytometer. They are fed in sugar syrup on the wires of a cage to 180 bees at the rate of a million spores per bee. The bees are not given sugar syrup until they have consumed this infected material. Then they are supplied with water and sugar syrup.

Acetic Acid: A very effective method of treating Nosema depends on exposing infected material to acetic acid fumes. These fumes also kill the eggs and larvae of the lesser wax mothin 24 hours. Experiments are now being carried out to discover if the greater wax moth is also killed. (See reprints).

Transfer of Combs: Nosema may be treated by placing the queen bee and one comb of brood in the centre of a super of foundation comb which is separated by a queen excluder from the old brood chamber placed underneath. The old brood comb is removed as soon as possible. This method depends on the fact that dried faeces in combs carry the Nosema spores and spread the infection. Acedic acid kills the spores in dried faeces. Seereprints for full accounts of above.

Apparatus for Collecting Samples of Bees: The rapid removal of samples of bees from hives is often necessary for diagnosis of disease or to study the effect of treatment. A very convenient apparatus has been designed at Rothamsted for the purpose. In brief it consists of a piston which sucks the bees into a removable sampling chamber. The apparatus is compact and hand-operated. A scale drawing has been made.

U.K. and Importation of Bees. The importation of queen bees from Italy was stopped some time ago more because the bees were heavily infected with Nosema than because of Acarine infestation.

The U.S.A. has only recently banned the importation of bees from European countries, and much acarine must have been brought in before this measure. But apparently it has not become established there. During a visit just after the last war Dr. Butler dissected bees in many parts of the U.S.A., but never found one acarine infestation. But bees in the U.S.A. have a serious type of Nosema and E.F.B. is widespread.

Hive Ventilation: It has been found at Rothamsted that bees winter much better in a humid atmosphere if small vents are put in their hive lids. These vents are two in number and placed opposite each other. Diagrams showing their location have been obtained. The use of these vents in many parts of New Zealand would help to reduce excessive moisture in combs removed for extraction.

Bee Behaviour: Mr Ribbands has been carrying out experiments on the scent of bees. He has found that the scent of the bees in a hive is determined by the type of nectar they are collecting. Bees from different hives can enter each others hives with impunity if they are collecting the same nectar.

There is evidence that queen bees can be safely interchanged between hives collecting the same nectar.

I spent some time with him in Wales working on this subject. We brought up ten hives which, together with another ten, were placed in two groups on the heather. Before being brought to the heather all surplus honey was removed so that after a few days all the hives would have stored only heather honey under like conditions. Then the queens in each group were interchanged without any losses.

Factors affecting the Nectar Secretion of White Clover. The opinion at Rothamsted is that farming practices that enrich the soil and favour growth of white clover also favour nectar secretion. But application of ammonium phosphate or other treatments which cause rank growth reduce nectar secretion as the growth occurs at the expense of the nectar producing plant substances.

Beeswax. Much beeswax is imported from E. Africa and used in foundation comb which is often unsatisfactory in performance owing to the low m.p. of such waxes. A market is open to New Zealand in this sphere.

Nicotine Sulphate as a Repellent. Kelsey states in a letter of April 1st 1955 that the addition of nicotine sulphate at the rate of 1 part in 1,280 of D.D.T. spray would repel bees. Dr. Butler does not agree and states that nicotine sulphate is in any case too volatile to last long, whereas D.D.T. is persistent.

Pollination of Red Clover. Dr. Butler asserts that under the conditions found in the U.K., very good pollination of this crop with hive bees takes place. These often collect extractable quantities of red clover honey. Bumble bees are not needed. This does not necessarily apply to New Zealand conditions.

Pollination of Broad Beans. Hive bees pollinate these very efficiently and bumble bees are quite unnecessary for this purpose. The beans have extra floral nectaries which are sometimes visited by bees instead of the flower nectaries. Hive bees also sometimes collect nectar through the holes bored atthe base of the flowers by bumble bees.

Importation of Bumble Bees. Instead of importing bumble bees as pollinators perhaps it would be better to bring in the small bee Melipona Iridapennis. (Really a Trigona bee). This is very prevalent in South India and Ceylon and is an excellent pollinator. The colony has multi-queens and does not swarm away. The bees store very little honey. The bees would be unlikely to live in the colder parts of New Zealand.

Cost of Running Rothamsted Bee Department.

		£
Apparatus and hive maintenance		2000
Professional Staff (Salary)	Dr. Butler	1850
	Mr Ribbands	1355
	Dr Bailey	1062
	Mr Simpson	1077
	Dr Free	722
	E. Carlisle	868
	Apiarist	785
	Lab. assistants	625
	" "	290
	" "	300
	" "	403
	" "	375
	" "	355
	" "	403
	" "	403
	" "	306
	" "	403
	" "	300
	Casual	

(Contd)

Cleaners and caretakers		£400
All the above salaries are paid plus 10%		
Total salaries		£12,282
	10%	1,228
	Total:	£13,510
Expenditure: Wages and Salaries	£13,510	
Apparatus and hive maintenance	£2,000	

If allowance is made for travelling expenses and building maintenance the total expenditure would be over £16,000.

During World War II beekeeping was regarded in the U.K. as an essential industry and supplies of sugar were made available to all beekeepers, even those with one hive.

The average annual crop of honey produced in the U.K. is difficult to estimate, but would probably not exceed 1,000 tons.

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REPORT VII APIDICTOR, SIGHT GLASSES, DESTRUCTION DISEASED BEES, ETC.

Apidictor: Commercial beekeepers must examine hives at intervals during the spring to prevent swarming, which weakens the hives and reduces their honey crop. Hive examination is heavy work and costly in labour. Mr E.F. Woods, a Sound Engineer, has recently invented an instrument called an apidictor which he claims will detect swarming in beehives in a few seconds without the need to pull them to pieces and examine the combs. It consists of a microphone which is inserted in the hive entrance and picks up the special sounds emitted by bees in a hive when it is preparing to swarm. These sounds are relayed to the beekeeper through amplifying and screening equipment and he then knows which hives in an apiary require attention. Two of these instruments have been flown to New Zealand for the first extensive trials yet made. If the trials are successful, the apidictor will be of great value to commercial beekeepers.

Bee Research Association: I spent a day with Dr Crane, Director of the Bee Research Association. The Association has an immense collection of books, reprints, journals, etc., dealing with every aspect of beekeeping. I was able to buy from the duplicate collection of journals nearly all the missing numbers of the Bee World needed to complete the set at Wallaceville Animal Research Station.

Poisoning of Bees by Dusts and Sprays: No legislation dealing with this subject exists in the United Kingdom. I have, however, obtained full copies of that in force in Germany and France. The German decree has been translated into English for me.

Standard Colour Glasses for Honey: The National Beekeepers' Association asked me to investigate the possibility of securing standard colour glasses to enable producers to pack uniform grades of honey for the local market, in line with standard packs of the Honey Marketing Authority. Three 2-oz. sample bottles of liquid honey were received from Mr R.S. Walsh, Honey Grader. These were matched as follows:-

Colour 100
" 87
" 60

Messrs Kodak Co., Harrow and Wealdstone, near London, recently prepared colour glasses for British beekeeping organizations and particulars are given in Honey Grading Glasses. British Standard 1656: 1950. I found Messrs Kodak willing to undertake the preparation of such glasses for New Zealand. A set of three, two inches square, would cost approximately 12/- for a minimum order of 150 sets. But the firm state it would be extremely difficult to prepare separate colour glasses to match the honeys with 100 and 87 points as there is so little colour difference between them. How close must the colour glasses be to the samples

submitted, i.e. how many points could they deviate + or -. Would it be possible to use two colour glasses instead of three, one glass to match colour 60 and one to match colour 90, say, as is done in the United Kingdom. This would mean that honeys over 60 and under 90 would fit in the intermediate class. If it were possible to use an arrangement like this, the cost of the glasses could be reduced.

Mr P.S. Milne, N.A.A.S. Beekeeping Advisory Officer at Rothamsted:

Much valuable information has been obtained from Mr Milne; it includes film strips, information on spray poisoning, diagnosis of disease, and work of the advisory service.

I was shown a viewing box containing an ultraviolet bulb which had been found very useful in demonstrating the presence of American foulbrood in the scale stage in combs. The scales fluoresce and can be immediately recognized.

The ultraviolet bulb is mounted horizontally and the light is concentrated to some extent by a lens so that it falls over an area large enough to cover most of the comb being examined. Material required:-

125 Watt black glass mercury lamp MBW/V for 240-250 volts	£3. 0. 0
Choke type Z1838	£4.19. 0
3 slot B.C. lamp holder, brass, back plate type S3158	3. 2

The above apparatus would be very useful at Wallaceville.

Mr N.B. Gallagher, Park Crescent, Portland Place, London:

Mr Gallagher is interested in acting as an agent for the marketing of New Zealand section honey. I gave him full information on the subject and he is writing to Mr Field at Foxton.

Course for Field Officers of the N.A.A.S.: This course was held at Westham House, Barford, Warwick, for four days. It was attended almost solely by Field Officers, who correspond to Apiary Instructors in New Zealand. Lectures and demonstrations were given and I lectured on New Zealand beekeeping. The course was most interesting and I was impressed by the standard of those attending. However, the organization of the Advisory Officers is very cumbersome and they are responsible to several authorities, which does not make for efficiency in the field.

Building Research Station, Garston, Watford: I visited this station to find out if any new paints or preservatives suitable for bee hives had become available. It appears that we have nothing to learn regarding the preservation of timber with substances like Celcure. However, the Station was helpful in the matter of paints and I have much information on two-paint systems which will be of use in New Zealand.

Destruction of Bees in Hives Infected with A.F.B.: The following method is based on trials carried out at Rothamsted, and after further tests in New Zealand may be found to be the answer to this problem. When applied to a hive the aerosol at once prevents the bees flying and they can be burnt without the danger of any recovering.

Destruction of Honey Bee Colonies using Pyrethrum Aerosol.

Apparatus.

1. Aerosol Projector Ex. Messrs Sparklets Ltd., Queen Street, N.17.
Volume of container 100 ml.

Materials. For each hive 1 Sparklets bulb.
70 ml. solution containing

Pyrethrum Extract 25%	4 ml.
Acetone	36 ml.
Tetrachloroethane	30 ml.

1 newspaper

Procedure.

Insert nozzle of projector in the entrance of the hive and give one short spray into the hive. Block up the entrance except for a small hole with paper. The initial dose of pyrethrins will activate the bees. Spray in 2/3rds of the remainder into the hive, both upwards through the entrance and down through the feed hole. Wait for two minutes, loosen the crown board spray across each corner of the combs, refit crown board and leave the hive for at least ten minutes but preferably longer.

Care must be taken to allow the projector to stand for a while after filling, to ensure that the temperature of the liquid equals atmospheric values. Cold liquids will result in poor atomisation.

The addition of a curved end to the nozzle will improve its use on hives.

Purchase of Extract.

The Overseas agents for the Pyrethrum Board of Kenya and other sources of African Pyrethrum have no agents in New Zealand, but as the annual amount likely to be consumed is small, the London Agents, Messrs Mitchell Cotts Ltd, Winchester House, Old Broad Street, E.C.2, have undertaken to ensure the availability of this material on the receipt of a direct order. The current prices are about £4 per pound of extract. Please quote reference P/1101(B)/5613.

Various: I visited Dr F.N. Howes, Kew Gardens, an authority on bee plants, and attended lectures on biological aspects of the transmission of disease at the London School of Hygiene and Tropical Medicine.

VISIT TO BUCKFAST ABBEY

On 2nd August I arrived at Buckfast and stayed there until the 6th, spending the time with Brother Adam of St. Mary's Abbey, Buckfast. He is a very active beekeeper and has specialised in producing and extracting heather honey, which resembles N.Z. manuka honey in many ways, particularly in being difficult to extract. So I was interested in seeing how Brother Adam handled it.

Brother Adam raises over 200 queen bees every year, most of which are used to requeen the Abbey hives which number more than 300. These are thus, for the most part, requeened every year.

<u>Isolated Mating Apiary:</u> I visited the queen mating apiary on Dartmoor, about 10 miles from the monastery, at a height of 1,300 ft. in a sheltered valley. Conditions here are ideal for controlled mating as there are no other bees within a radius of six miles and no swarms could maintain themselves on the moor. The mating boxes are made to accommodate 16 Dadant half-frames, each box being divided into two (crosswise) to take them. Another division (lengthwise) by means of movable division boards gives four compartments each holding four half frames. These mating nuclei can support themselves, and a fertile queen can overwinter in them, but they are small enough to prevent drones being raised. The correct type of drone is provided by full sized hives maintained in the apiary.

The mating boxes are supported on single legs of preserved timber, and have a roof with a small gable and an inner feeder mat. The roof is secured by a chain which passes over the top and is fastened to the leg.

<u>Moving Hives to the Heather:</u> When the honey flow in the low lying areas, mainly clover, finishes the hives are moved out in August to Dartmoor where a second flow is harvested from the heather. One apiary of 30 hives is moved

at a time in a truck. The hives are closed in front with wooden blocks and covered with wire screens. These are secured with two metal rods which have wing nuts welded to the top so that they can be screwed into metal threads fixed in the bottom boards. The apiaries are made ready for moving the day before. While at Buckfast I helped to prepare and move two apiaries. The bees are moved out between 5 and 6 a.m. when the air is still cool. The whole operation was very simple because of good equipment and organisation.

Honey and Wax Extraction: Extraction of the non-heather honey crop proceeds on usual lines, a radial extractor and steam-heated uncapping knife being used. The heather honey is extracted by cutting out the combs, wrapping them in cloth, and placing them in an electrically heated hydraulic press which operates at a pressure of 0.63 tons per sq. inch. Twenty-three tons of honey have been pressed in twelve days with a loss of only 1.4% of honey. The press would cost approximately £1,500 now. The extracted honey, whether centrifuged or pressed, is pumped into storage tanks - eleven each of 2.5 tons holding capacity. All tanks are fitted with coils through which warm water can be circulated before the honey is bottled. Heather honey contains much water, up to 23%, and must be heated to about 120°F. to sterilise it and so prevent fermentation.

An automatic bottling machine which can fill 1,500-2,000 1 lb. cartons per hour is used. It was manufactured by the Roberts Patent Filling Machine Co. Ltd., Deane Road, Bolton.

The press used for extracting the heather honey was built by Messrs. Wilcocks, Dial Foundry, Buckfastleigh, Devon. This firm manufactures bee-keeping equipment for Buckfast Abbey, France, and Egypt. I interviewed Mr. Wilcocks and saw their honey tanks, radial honey extractors, and honey pumps.

These last are much more expensive than ones made in N.Z. The other equipment is well made but would be expensive as it is not mass produced. The heather honey press showed extremely good workmanship. Similar presses have been manufactured for tropical countries with viscous honey, and for Mr. Gale a successful commercial British beekeeper. I have asked Mr. Wilcocks to send me specifications and prices of the honey press and other equipment.

ACARINE.

Acarine Disease: Brother Adam does not believe in treating acarine disease but in breeding bees that are resistant to it. He has bred a bee which is so resistant that acarine causes him no trouble, although bees in his district are usually very prone to develop the disease. The resistance is not due to yeasts on the bees attacking the acarine mite but is inherited as a dominant trait.

If acarine appeared in N.Z. it would be worth considering bringing in some of these acarine resistant bees.

Adrenaline for Hypersensitivity to Bee Stings.

Adrenaline in a very convenient form for treating severe cases of hypersensitivity can be obtained from Cuxson, Gerrard and Co. Ltd., Oldbury, Birmingham. One box of 5 x 1.1 ml. Ampins. Injection Adrenaline Tartrate B.P. 1 in 2,000. The sterile ampoule has a protected sterile needle which can be bared and pushed into the skin of the patient in cases where symptoms are too severe to risk waiting until the arrival of a doctor.

REPORT ON OVERSEAS TRIP - CONTINENTAL SECTION - T. PALMER JONES

I departed from Auckland, New Zealand, on 29 April and arrived in Rome, Italy, on 5 May, when I commenced fourteen days' annual leave. While in Rome I saw Conte Dr A. Zappi Recordati, who occupies much the same position in the Italian Department of Agriculture as does Mr Fawcett in New Zealand. The Count has a special interest in bees, having kept them himself, and is President of the Italian Government Beekeeping Association. The Count was most helpful and gave me a letter of introduction to the National Institute of Agriculture at Bologna, which is the centre of Italian beekeeping research.

In conversation the Count said that the food habits of the Italians are such that it is difficult to sell much honey in Italy. Insecticides are becoming a menace to bees and are being applied from the air. Acarine disease was introduced into Italy across the French and Austrian borders in 1940. It is now treated by burning strips of paper containing an insecticide inside the hive - these Folbex strips are sold by the Geigy Co. The Frow remedy is not used. The use of royal jelly in pharmaceutical preparations, and even toothpaste, is sweeping Italy and is an embarrassment to the Government, who do not recommend it.

Later, I visited the National Institute of Agriculture, directed by Dr Ida Giavarini, assisted by Dr Giulia Giordani. The Institute is well appointed, with an agricultural museum, chemistry and biology laboratories, and offices. Samples of bees are received from all over Italy for diagnosis of disease, routine dissection being carried out by a staff of eight girls. Acarine and Nosema diseases are common in Italy, and A.F.B. is

fairly widespread. As far as I could gather, diagnosis of bee diseases and their treatment is the main function of the Institute. Some research is carried out on academic subjects.

Treatment of Acarine Disease: A mixture of methyl alcohol (98%) and essence of mustard (2%) is used to treat the affected bees inside the hive. A wick is placed in the bottle holding the mixture so that evaporation occurs more rapidly. One application is given in Autumn and two in Spring. None are given in Summer. This method is much faster in application than the Folbex one, in which strips impregnated with insecticide are burnt in the hive. One of the Folbex strips must be burnt each week for eight weeks, treatment being discontinued in Autumn and Winter. Eight strips cost 2/6 in Italy.

Treatment of Nosema: Fumagillin is used.

Queen Raising Apiaries under Supervision: When acarine disease reached Italy, many countries, such as England, ceased to import Italian queen bees. The Italian Government then took steps to ensure that queens were raised in certain apiaries supervised by the Institute, so that they could be guaranteed free from acarine disease, and the export trade revived. I inspected the largest of these apiaries, belonging to Gaetano Piano at Castel S.Pietro Dell ' Emilia. All hives within 3 Kil. of this apiary must be inspected at intervals for acarine disease. Twice yearly, samples from all 500 nuclei in the apiary are collected and examined for acarine disease at the Apicultural Institute. If these tests prove negative, a Government Certificate is issued for export. The weakness of the scheme appears to me to be

that they have no staff with a practical knowledge of bees at the Institute, and apparently depend on the queen bee breeder himself to collect the samples. Countries that already have acarine disease and wish to import queens could rely on such measures, but they are completely unreliable for New Zealand, which is free.

Management of Queen Bee Raising Apiary: Two nuclei per box are used, with frames less than half Langstroth size. Both nuclei are covered with one roof. The Dolittle system of raising queen cells is employed, and apiary management is very efficient. The apiary site is most picturesque and the honey flow lasts six months from various sources. Alfalfa provides the main flow.

Visit to Research Centres in Switzerland: I arrived in Berne, Switzerland, on 19 May, and remained there at the Liebefeld-Berne Bee Research Station until 28 May. The Station is under the direction of Dr H.U. Gubler.

The Swiss State runs a Federal Experimental Station at Berne, with branches at Wadenswil and Zurich. The beekeeping section, under Dr Gubler, is attached to the Dairy Research Station and has under its control, besides research, an advisory service run by part-time Apiary Instructors. These send in samples of bees and combs for diagnosis of disease and give practical advice. There are no full-time Apiary Instructors.

Little honey is eaten in Switzerland; crops are poor, and there are no commercial apiarists. Honey-dew from pine trees is a valuable crop.

I spent sufficient time with each member of the staff to obtain full information on the work of the Station. The result of these talks and demonstrations is now set out:-

Mr H. Schneider-Acarine Disease: Without treatment a hive suffering from acarine disease is certain to die in one to two years. The mites lay four to six eggs in the prothoracic tracheae only, where they take two to three weeks to become adults. Infested bees do not die through suffocation or through wing damage caused by the mites sucking their blood. Drones and queens can become infested.

Dr Morgenthaler found that only young bees can become infested. He took bees that were 100% infested and mixed them with bees of varying ages. Infestation of bees older than five days was negligible, and bees older than nine days, which would be on field duties, did not become infested. Infestation cannot occur outside the hive.

Mites can enter the tracheae of old bees, but it is easier for them to enter those of young bees with less stiff bristles protecting the spiracles, and they prefer to parasitize these. When the infestation is fourteen days' old, young mites are continually leaving the spiracles, and in Winter, when no young bees are available to infest, they attack the roots of the bee's wings, where they suck its blood. They are driven out of the tracheae as these become hardened with dried blood and excretions. Although conditions at the wing bases are not as congenial as inside the prothoracic spiracles, the mites can develop fully in these places. Very badly infested bees may lose their wings, but others may only lose their use; such bees cannot fly in the Spring, and crawl out of the hives. After March, young bees are available for infestation and mites are not found at the wing bases. If more than 50% of the bees in a hive are infested in the Autumn, it dies, while if the infestation is less than 50%, it is weakened. Bees die only if the wing bases are infested,

and loss of honey production is due to lack of bees and not to the weakening of bees suffering from a tracheal infestation only. Exceptions to this are as follows:-

(i) If a new hive is formed with bees, but no hatching brood, the mites will attack the wing bases of old bees because no young bees will be available for three weeks.

(ii) If a hive is infested 70-100%, the mites may attack the wing bases because insufficient young bees are available.

It is only during the Spring inspection that the bee-keeper discovers hives infested with acarine disease. During the Winter months the bees may have starved to death through being too weakened to crawl to their honey stores, or many may be unable to fly when leaving the hive in the Spring. The agitation of bees by the mites causes the bees to breed much earlier than usual, and this is a symptom of the disease.

Schneider constructed an apparatus which could measure the weight required to tear the wing off a bee. 20 g. is required for healthy bees, but as Winter progresses it is found that increasing infestation lowers the weight required for diseased bees to 5 g. The hind wing is used as it is more infested at the base.

A hive with an 80% infestation showed no wing damage after Frow treatment. An infested hive treated with sulphur showed some damage.

By tearing a wing off a living bee, Schneider can tell if it has a wing base infection, but great experience is required before this method of diagnosis can be used accurately.

A very active queen will lay so many eggs that the acarine mites cannot infest a high proportion of the young bees and the hive can cope with the disease. In countries such as New Zealand, where the bees do not hibernate, the wing bases would not be infested and little mortality would be expected.

It has been shown that bees with tracheal damage only do not live a shorter time in an incubator than uninfested bees.

Infestation in Switzerland occurred prior to 1922, when work on acarine was commenced. A beekeeper in Geneva bought infested bees in France and sold them in Switzerland, so spreading the disease. The French-speaking part of Switzerland was more infested than the German part, which bought fewer of this beekeeper's hives. Now bees are not allowed into Switzerland from countries known to have acarine disease, and permission must be obtained to import them from acarine-free countries. The disease crosses the Swiss border, via swarms, from France, where control is not efficient. Attempts have been made to educate French beekeepers along the border in methods of treatment, but the position is hopeless.

Spread of Acarine: The disease is spread by young bees drifting from hive to hive and by swarms. Marked bees have been found more than one Kil. away from their parent hive. If one infested hive is found, all hives in apiaries within bee flight of it have been exposed to infestation. At first, when control measures for Acarine were applied in Switzerland, a cordon of 3-4 Kil. diameter was put round uninfested hives and all hives within this area were treated until free from disease. Later, it was found that infested hives were always found outside the cordon. Cordons are still applied, however, in spite of their limitations.

A good beekeeper can diagnose acarine disease, or at least suspect its presence, when 20% of the bees in a hive are diseased. Early diagnosis is most important. Beekeepers are obliged to inform the Research Institute when acarine is discovered.

Treatment of Acarine Disease: At first no treatment was available and infested hives were destroyed. Later it was found that other cases of disease always occurred nearby; so if a few mites were found in neighbouring hives, these hives, too, were destroyed. Destruction of diseased hives was carried further and further afield, but still the infestation was found.

Then, in 1928, Frow's remedy came at a time when a law was being framed which would have meant that all bees within flight range of a diseased hive must be destroyed. So Frow's remedy saved the industry. It was:-

Nitro-benzol	...	2 parts
Petrol	...	2 parts
Safrol	...	1 part

Two c.c. were put on a pad fitted with a handle, so that it could be inserted in the hive. Treatment was carried out for seven consecutive days and the pad then left in the hive for three more.

Many other ways of applying the treatment are known, but this official method is the best available. During the war methyl salicylate was used as a substitute for safrol, but it was not so good. Other combinations of drugs were also tried without improvement. The Frow remedy suffers from the disadvantage that it cannot be used during the breeding period, because it may kill the young larvae, so it can be used only in Winter. Sometimes, when fine weather comes in Winter, bees are able to fly from the hive, and as they have lost their sense of smell through the Frow remedy, robbing starts. The treatment

must be stopped at once in such cases. In 1945, although 10,000 francs worth of damage was caused to bees by the Frow treatment, some beekeepers still considered it was satisfactory. It was realised by now that all hives in the areas affected with acarine would require Frow treatment if the disease was to be eradicated. It was difficult to carry out such a programme, although acarine is considered an epidemic disease in Switzerland and hence the Government had powers to order such general treatment. However, this would have involved much responsibility and the Frow treatment had been found to be not 100% effective as some mites survived its application.

Then Renny in England discovered the sulphur treatment. Sulphur-impregnated paper is lit in a smoker and the SO_2 puffed into the hive. Schneider considers this treatment quite safe. Three puffs are given each hive for ten days, treatment is stopped for one week, and then the hives are treated as before for ten days. Mr Schneider considers this method most effective if it can be carried out longer than above, until the first young bees appear - say, every second day for two months. Although an easy and quick method, it is not always carried out properly.

The Folbex treatment has only recently been developed. It is now the official remedy. Remedies for the red mite were tried for acarine control at Liebefeld, being sent there by the Geigy Co. Chlorobenzene (chlorobenzilate) was found to be the best and was used to impregnate absorbent paper which could be burnt in an open space in the hive. The treatment should commence during the first week in April, when young bees are being reared. These remain free from acarine as the old bees die. One Folbex strip is burnt once a week for eight weeks.

Every beekeeper in Switzerland is ordered through the Government to attend an instructional course in the use of Folbex. There are severe penalties for non-compliance - a fine and destruction of all the beekeeper's hives. There are twenty-two Cantons, each with a part-time bee inspector who works with the local veterinarian, who is responsible for all animal and bee diseases; during his training he attends a course of a theoretical nature on bee diseases. Each Canton carries out its own programme of disease control and most have different methods of doing this. The Liebefeld laboratory supplies advice.

After each Folbex treatment the beekeeper and the apiary instructor both have to sign an official sheet (see copy). The sheet is retained by the apiary instructor. Experience has shown that eight sets of signatures are necessary to ensure that the treatment has been carried out. After the eight treatments, Liebefeld examines samples of bees from the treated hives. If properly applied, the treatment is 100% effective in eradicating the disease. Five treatments are not considered sufficient, and eight are necessary. Switzerland is now largely free from the disease, after the use of Folbex for eight years.

The correct time in the season to apply Folbex is all important. If used in New Zealand, careful consideration of this aspect would be necessary. The amount of Folbex required in New Zealand would be more than in Switzerland, on the basis of ½ strip per five combs of bees.

Folbex must be applied at night, when all the bees are inside the hive. After lighting the strip, the hive is closed for half an hour. If the hive is opened before the half hour

has elapsed, the bees will rush out, and if the hive remains closed more than the half hour, the bees will be distressed.

The Folbex strip may be placed on a metal holder, which can be pushed inside a hive along the floor after ignition. This method could be used for treating Langstroth hives. A sample of the metal holder was obtained, together with a sheet of instructions for the use of Folbex strips.

The use of methyl alcohol and mustard oil (see notes on Italy) for the treatment of acarine is cheap and easy, but not 100% effective. It must be carried out permanently and causes robbing. It is not used in Switzerland.

In Belgium the P.K. treatment (material made in the U.S.A.) is used. It is similar to Folbex.

Dissection for Acarine Disease: The following solution is used to keep insects awaiting dissection:-

Oudemann's	Alcohol, 95%	1000 c.c.
	Distilled water	400 c.c.
	Glacial acetic acid	128 c.c.
	Glycerine	80 c.c.

The complete tracheae must be dissected for a satisfactory diagnosis.

Steps to take if Acarine appeared in New Zealand:

The question of what steps to take if acarine appeared in New Zealand was fully discussed with Dr Gubler. In Switzerland the procedure may be summarised as follows:-

An area where the disease appears is cordoned off and bees cannot be moved out unless the whole area has been free from acarine for one year after a compulsory treatment of infested hives with Folbex strips.

In Dr Gubler's opinion, acarine disease would not be as severe in New Zealand as it is in Switzerland, because there is a long period, six months, in Switzerland during which no young bees are being raised. If acarine disease is found in New Zealand, destruction of the apiary where it appeared would be unlikely to eradicate it, according to Swiss experience - it would have already spread over a large area and outbreaks would flare up later.

It would appear that the best steps to take in dealing with an outbreak of acarine in New Zealand would be as follows:-

(i) A cordon of a radius of 10 Kil. to be put round the infested apiary.

(ii) Find all infested hives in the apiary.

(iii) Destroy bees in badly infested hives and treat lightly infested ones with Folbex.

(iv) No hives to be moved out of the area until a year after the disease completely eradicated.

The following facts are of value in planning such a campaign:-

(a) Disease resistant bees are not known.

(b) Acarapis dies within a day in a dead bee, and quicker on equipment, which thus cannot transmit the disease.

(c) The Frow remedy would not be of much use in New Zealand because it causes robbing when bees are able to fly, as they can do much of the year in our mild climate.

Dr Maurizio - Various Subjects.

Dr Maurizio has worked on a variety of subjects. She is noted for her work on pollen analysis.

Testing the Biological Value of Different Foods for Bees: Bees not more than twelve hours old are caged and fed the test foods in an incubator at 30°C. They are examined for Nosema, as this would affect their metabolism. Control bees are fed on sugar syrup only. After a minimum period of three weeks the pharyngeal glands and fat bodies of the bees are removed and examined. Their size and development are estimated compared with those of the control bees. Hydrolysed casein (vitamin-free) plus vitamin-free dextrose was being tested when I saw Dr Maurizio. This work would be of great use in evaluating pollen supplements.

Biological Tests for Bee Poisons: These were of great interest to me, as I think they will be of increasing value in New Zealand. Crickets are used for testing pollen from rape, which is often sprayed with a solution of benzene hexachloride. The pollen is removed from the bees' pollen baskets. A pollen trap could be used in its collection. The crickets, two to three days old, are left with the pollen in a plugged test-tube for twentyfour hours. They are supplied with water from a piece of water-soaked blotting paper. One cricket is used, followed, if death occurs, by another as a check. If no pollen but dead bees only are available, Aedes aegypti larvae are used. A poisoned bee is macerated in a test-tube of water and ten larvae added. Eggs of the larvae are supplied by the Tropical Institute. The larvae soon show signs of poisoning in a positive test.

Pharyngeal glands: These have two functions (i) they secrete brood food and royal jelly and (ii) they secrete invertase. But invertase enters honey from the plant as well as from the bee. The glucose-fructose ratio varies in honey and the reasons for the variation are being investigated.

Dr Gubler - Nosema apis and Swiss Beekeeping.

Fumagillin has been found effective against Nosema. Sugar syrup containing 35 mg. per litre is fed for three weeks, the volume given being 4-5 l. - 9035 mg. per c.cm. The dosage of fumagillin is affected by the way in which bees winter. In Switzerland, where the bees hibernate in Winter, the dose would be different from that given in New Zealand, where they breed throughout the Winter.

When no honey is coming into a hive, few young bees are raised and the old bees would live longer and be more affected with Nosema. This situation has applied recently in Switzerland, which has experienced several severe seasons. The climate of the Winter preceding an outbreak of Nosema is usually severe, according to Ruth Lottmar.

It would be expected that the Winter preceding the New Zealand epidemic of Nosema in 1946-1947 would be severe (February, March, April severe ?). This would mean that no young bees would be coming on and the old ones would be heavily infested.

Types of Swiss Hive: The Swiss have developed a special hive, which is used mainly in bee-houses. The combs are large, being 35 cm by 27 cm. This type of hive and the bee-houses themselves are completely unsuitable for commercial beekeeping, and it is not surprising to find there are no commercial beekeepers in Switzerland.

In the French part of Switzerland, Dadant hives are used in bee-houses, or they may be kept in the open and wintered without packing.

Not long ago from 14-16 lbs of honey was collected by a hive in Switzerland, but now the crop is only 8-10 lbs. The climate has become worse, more shrubs and flowers are destroyed so that the ground can be used, and insecticides are employed on an increasing scale.

F. Baumgartner - Diagnosis of Disease.

E.F.B. This is caused by Strep. pluton, usually with B. alvei as a secondary invader. Yellow brood appears in the cells of the brood combs. This brood breaks up if it is removed. Strep. pluton is expelled orally by the larvae, and it can be found on the cappings. Strep. pluton is also excreted by the larvae. In diagnosis bacteria are removed in scrapings from the inside of the cappings and examined, nigrosin being used as a background stain. They can also be found in the yellow parts of the larvae.

Bac. orpheus sometimes accompanies Strep. pluton, which must be found for a positive diagnosis. The presence of B. alvei and Bac, orpheus alone is not conclusive. Nigrosin stain is used to provide a background for the three organisms, which are examined with a X950 oil immersion. Strep. pluton can be recognized by its characteristic appearance. (See specimen slides).

E.F.B. is treated with terramycin, although this does not always effect a cure. In some parts of Switzerland the bees and combs are burnt, as in the case of A.F.B. The disease is regarded as less dangerous than A.F.B. Combs should be burnt immediately the disease is found, as they are infectious for about a year.

Herr A. Brugger - Effect of Climate and Temperature on Nosema.

A Nosema infection itself may be relatively harmless, but when allied to other factors heavy mortality may occur. Swiss beekeepers think the pollen collected may be connected with increased mortality, but this is doubtful.

Mr Brugger's views apply probably only to Switzerland, where they have been so far worked out only for a restricted area.

When the Swiss winter finishes in March, the bees become active, except in areas with a high altitude, where they are retarded. If such active bees are fed sugar water, they will be stimulated to fly, and if infected with Nosema, they will be unable to regain their hive, the brood will be uncared for, and the hive will die out. It would have been better to leave the hive to collect nectar supplied by Nature. If hives are short of stores, sugar should be fed in Winter, not Spring.

If the Summer, including July and August, is fine, there is practically no Nosema the following Summer. 1947 was the best Summer of the century. 1948 was the contrary, with much rain and cold. 1949 was a fine Summer, very hot and dry; but there was a very great outbreak of Nosema in the less high areas of Switzerland. Here the rainfall was about twice that which fell in the more mountainous areas during 1948. If breeding bees are fed with sugar syrup before July, they can resist Nosema, but if fed after July, they die because they are stimulated at the wrong time.

Herr W. Fyg - Queen Bees.

Herr Fyg is the leading expert on diseases and abnormalities of the queen bee, and receives specimens from all over the world.

He said that there are 68 different types of disease and abnormality which can afflict queen bees' reproductive organs.

Queen bees sent to him are given a number and all particulars are entered on a special form. (See specimen). So far he has dissected 4,000 queen bees, all of which are preserved for reference. Abnormalities in organs other than the reproductive organs can cause sterility or malfunction.

Von Leeuwen's Fixative for Bees

1% picric acid in absolute alcohol	12 T.	Parts by vol.
40% formalin	2 T.	" " "
$CHCl_3$	2 T.	" " "
Conc. Acetic acid	1 T.	" " "

Wash after soaking in above and keep in 70% alcohol. The bodies of the bees should be opened.

Melanosis: Caused by a yeast-like organism or by a bacterium.

Calculi: Calculi form in the rectum and cause injury because the queen cannot excrete and may become distended. The enlarged rectum constricts the oviducts and prevents the queen laying.

Nosema: Many package queens in the U.S.A. are affected.

Amoeba disease: This never affects queens.

Virus disease: A very common disease of queens. A very young queen will be found laying only drone eggs, due to defective sperms. The virus affects the sperms in the spermatheca and enters other organs also. The sperms develop characteristic curls. Herr Fyg discovered the cause of the disease in 1947. The virus is found in the fore intestine, ectoderm, and reproductive organs. No other type of bee, or even queen larvae, have been found with the disease.

Endocrine Glands: These suffer from disturbances about which little is known; from the corpora allata come hormones which stimulate egg laying; the corpora cardicum secretes hormones; there is a prothoracic gland.

Practical Beekeeping.

On 25 May, I went for a drive with Dr Gubler through Mattstetten, Murzelen (where the schoolmaster keeps bees), and Sarisvil, to inspect bee-houses and see the Swiss way of keeping bees. The bee-houses and hives are very expensive and complicated, and appeared to me to be uneconomic, even when allowance was made for local conditions.

I saw a bee-house on wheels, which is towed up to the woods for a month every year so that the bees can collect honey-dew from the pines. The Owner (Mrs Staehli) mixes this with flower honey and sells it for a good price.

It appears likely to me that ordinary, double-walled hives, or single-walled hives with some insulation or winter packing, would be far more efficient and economical than the hives kept in bee-houses. The only advantage appears to be that the bees are easier to handle.

After leaving Berne, I followed an itinerary arranged by Dr Gubler and attended the Seventh International Congress of Comparative Pathology at Lausanne. One of the papers delivered dealt with the effect of industrial wastes on bees.

I then spent a day at Val Mont, Montreux, with Mr Frankhauser, who is secretary of the local beekeepers' association. I particularly wished to see something of the beekeeping in this French-speaking area of Switzerland, as Dadant hives are used here without bee-houses. These hives resemble Langstroth ones, but have deeper frames.

Mr Frankhauser's hives are kept in the open, without bee-houses or special shelter, in an apiary at an altitude of 700 metres. He considered the bee-houses were unnecessary. At greater heights he winters hives in a box-like structure which accords some protection. Usually one super only is used in Switzerland for brood, but the combs are bigger than in our Langstroth hives.

In Zurich, I visited Professor Bovey at the Entomological Institute, where he teaches apiculture. Recently, he has been forced to spend his time dealing with a disease affecting larch trees. This is being combated by spraying affected trees with a virus which attacks the caterpillars causing the disease. He would be interested in the work of our Forestry Department.

I also visited Dr Horber at the Oerlikon Research Station. He has been carrying out interesting work on acclimatising bumble-bees to new sites. The nesting boxes for the bumble-bees are first used as homes for mice, so that the nest material can acquire the authentic mousey smell which attracts bumble-bees. Dr Horber is also making migration studies on wire-worms, which are marked with radioactive wires attached to their bodies. Radioactive D.D.T. is being fed to the Colorado beetle so that acquired resistance to D.D.T. can be studied. Dr Horber specializes in studying the effect of wire-worms on field crops.

Some Conclusions.

The value of the Swiss honey crop is about the same as that of New Zealand, but much less honey is produced, its price being artificially kept up by a duty on imported honey. The value of the bees as pollinators in Switzerland is considered, as it should be in New Zealand, to be about ten times the honey

crop. However, although both New Zealand and Switzerland have beekeeping industries of approximately equal value, far more is spent in Switzerland on beekeeping research. The Laboratory at Liebefeld has a staff of eight, three of whom have degrees, while the remaining ones are highly qualified technicians. The equipment and library is very good. I should estimate the Swiss expenditure on beekeeping research as at least five times that of New Zealand.

The Swiss have probably concentrated more than any other country on the prevention and treatment of bee diseases, and the information obtained from them will be of great value in New Zealand, particularly if we have an outbreak of acarine disease.

NOTE: A very useful type of hive balance was inspected - the Meier Kunten Bienartikel (400 F.).

A large collection of scientific papers was obtained from the Liebefeld staff.