A G Robinson

# PROCEEDINGS OF THE

# ENTOMOLOGICAL SOCIETY OF MANITOBA

VOLUME 13 1957

# N O T E

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Editor-Librarian.

# Proceedings of the

# ENTOMOLOGICAL SOCIETY OF MANITOBA

Vol. 13 1957

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Wong, H. R. Forest Biology Laboratory, Box 156, Univ. of Manitoba, Winnipeg, Manitoba.

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* Life member.

## ENTOMOLOGICAL SOCIETY OF MANITOBA FINANCIAL STATEMENT

## FOR YEAR ENDING DECEMBER 31, 1957

### Receipts

| | | |
|---|---|---|
| Balance in Bank, Dec. 31, 1956 | | $107.52 |
| Members' dues, 1957 | | 73.00 |
| Members' dues, 1958 | | 115.00 |
| Registration for 1957 spring meeting | $14.00 | |
| Sale of tickets for smorgasbord | 57.00 | 71.00 |
| Registration for 1957 fall meeting | 13.00 | |
| Sale of tickets for banquet | 46.00 | 59.00 |
| Sale of Proceedings | | 13.00 |
| Refund of Expenses of Western Tour of International Congress | | 57.80 |
| Cheques outstanding | | 126.00 |
| | | $622.32 |

### Expenditures

| | |
|---|---|
| Subscriptions to Ent. Society of Can. | $160.00 |
| Spring banquet expenses | 98.20 |
| Fall banquet expenses | 81.00 |
| Banking expenses | 2.83 |
| Reimbursement of refund of expenses of Western Tour of International Congress I.G.P.C.E. | 57.80 |
| Receipt book costs | .45 |
| Bank balance in hand Dec. 31, 1957 | 222.04 |
| | $622.32 |

Audited and found correct - Jan. 21, 1958

P. H. Westdal

W. Romanow

Proceedings of the

ENTOMOLOGICAL SOCIETY OF MANITOBA

A society to foster the advancement, exchange
Vol. 13 and dissemination of entomological knowledge 1957

## INTRODUCTION

The President is usually allowed a page or two in the Proceedings to discuss the highlights of Society affairs or present trends in scientific thinking. It is assumed that a look at the past and present will be of some use to the incoming Executive in shaping the path of the future.

Among the Society's accomplishments during the year might be mentioned the preparation of a brief on extension entomology and a successful spring meeting. The brief, entitled "The Urgent Need for an Extension Entomologist in the Province of Manitoba", was prepared by your Executive. It was endorsed by nine commercial or professional organizations, and copies of the brief and endorsements were sent to the Premier of the Province and to the Minister and Deputy Minister of the Department of Agriculture and Immigration. The Premier acknowledged the brief on February 4, 1957, stating that an extra copy had been prepared for the Minister of Mines and Natural Resources. A letter from the Minister of Agriculture and Immigration, dated June 20, stated that Mr. D. R. Robertson had been appointed as Provincial Entomologist. The Society cannot claim full credit for taking the initial steps in this appointment, because action in this direction had also been taken by other individuals or organizations. However, the Society is gratified that the appointment has been made, and extends its best wishes to Mr. Robertson in his new venture.

Little need be said about the Spring Meeting, because the 13th Volume of the Proceedings is largely a report of this meeting. Seven papers were presented, including one prepared by our guest speaker, Mr. W. S. McLeod. It should be noted that two or three years ago the Society asked Prof. A. V. Mitchener to write a "History of Manitoba Beekeeping". A paper by this title in Volume 13 of the Proceedings marks the successful conclusion of this assignment.

What of our present thinking in the affairs of the Society and research in general? The year 1957 was the geophysical year, which introduced the I.C.B.M. and Sputnik. It marked a new era for physicists and mathematicians. This was also an era of crop surpluses, and agricultural science is likely to be faced with serious competition from other branches of science. How should we meet this competition, bearing in mind that openings in physical sciences may increase at the expense of agricultural science? Do we need to examine this problem in relation to education in general or the high school and university curricula in particular?

A few days ago, an honours student in physics told me that he had always planned to take undergraduate work in biology. Unfortunately, he couldn't find lucrative summer employment or encouragement in this field. Eventually he found summer employment as a drag-line operator at $2.05 an hour; he was subsequently encouraged to persue physics as a career; biology lost an excellent student. Perhaps this is an indication that more attention must be devoted to attracting students to biology <u>before</u> they enroll for university training.

It has been said that to meet the scientific manpower shortage, we cannot depend on coercive syllabi and, that rival field of enterprise are essential to attract the right people to the right vocation. If this is so, it is difficult to explain Russia's phenomenal growth in the physical sciences. Is she making equal progress in training agricultural scientists? This and related questions are left unanswered, with the hope that the incoming Executive will produce the answers, which at the moment fall within the realm of complexity and perplexity.

In conclusion, I wish to thank the other members of the Executive, the contributors to the Proceedings, the Editor-Librarian and those who assisted in various aspects of the clerical or stenographic work and program planning. Without the help of these persons, the Entomological Society of Manitoba could not lay claim to a successful year.

W. A. Reeks
President

## SPRING MEETING

### Business Session

The Spring Meeting of the Entomological Society of Manitoba was held on April 17 and 18, 1957, at the Entomology Building, University of Manitoba. W. A. Reeks presided.

Minutes - D. R. Robertson moved that the minutes of the last general meeting be adopted as published in the Proceedings of the Entomological Society of Manitoba. Seconded by R. J. Heron. Carried.

Treasurer's Report - T. V. Cole reported that the charge of $1.25 for the Smorgasbord was raised to $1.50.

Common Names Committee - W. A. Reeks for W. J. Turnock reported that the committee had not passed on any common names. He raised the question as to what insects should be given common names.

Prof. A. V. Mitchener was of the opinion that common names should be given to some insects that are not necessarily of economic importance for purposes of teaching. He said that the local committee should actively review economic fields for insects without common names and check on common names appearing in literature.

Motion - T. V. Cole moved that the Common Names Committee contact persons working in economic fields as forest, vegetable, fruit, forage, stored products, and live stock insects to see if any insects of common occurrence should have common names. Seconded by W. G. Ives. Carried.

Recommendation - Prof. Mitchener suggested that more members should be added to the Common Names Committee to add some spark.

Resolutions - The following amendments to the constitution of the Entomological Society of Manitoba were presented as a Notice of Motion on April 1, 1957.

Preamble - At the present time the Constitution of the Entomological Society of Manitoba provides for annual election to the office of President. (Article 7, see also Proceedings Entomological Society of Manitoba 11:38-39 (1955)). This practice is in conflict with Article V Section 4 of the constitution of the Entomological Society of Canada which states that directors representing the regional societies shall hold office for a two year period. The By-laws of our society require that the representative on the Board of Directors of the national society shall be the president. In order to remedy this conflict, I propose to move the following amendment to the constitution at the forthcoming meeting of the society. Article 7. to be amended as follows:

Article 7. Elections

Elections to be held once a year at the annual meeting of the Society. Election to the office of Secretary, Treasurer and Editor-Librarian shall be for a period of one year. The office of President shall be held for a two year term and shall not be held by the same member for two consecutive terms.

Moved by R. J. Heron
Seconded by L. D. Nairn

In view of the fact that the Vice-President of the society has in most cases succeeded to the presidency on the retirement of the incumbent, it is proposed to amend Article 6 to take cognizance to this practice. Motion of amendment of Article 6 will be made as follows:

Article 6. The officers of the Society shall consist of Past-President, President, President-elect, Secretary, Treasurer, and Editor-Librarian. The Past President shall be that person who has most recently completed a term of office as President. These officers shall constitute the executive with full power to act on behalf of the Society within the bounds of the constitution and to appoint comittees as necessary.

Moved by R. J. Heron
Seconded by L. D. Nairn

Following some discussion the Mover and Seconder agreed to withdraw their motion to amend Article 7. Elections.

Following discussion of the amendment to Article 6, the Mover and Seconder were asked to rephrase it.

Motion - A. G. Robinson moved that the resolution be tabled until April 18 for redrafting. Seconded by D. R. Robertson.
Carried.

The redrafted amendments were submitted as follows:

Article 6 of the constitution amended to read: The Officers of the Society shall consist of Past-President, President, President-elect, Secretary, Treasurer, and Editor. The Past-President and President shall be those persons who have most recently completed terms of office as President and President-elect, respectively. These officers shall constitute the executive with full power to act on behalf of the Society within the bounds of the constitution and to appoint committees as necessary.

Moved by R. J. Heron
Seconded by L. D. Nairn
Carried.

By-Law No. 4 amended to read: The Regional Director on the Board of Directors of the Entomological Society of Canada representing the Entomological Society of Manitoba shall be that member of the Society holding the office of President during the first year of his term on the Board.

Moved by R. J. Heron
Seconded by W. G. Ives
Carried.

Library of Entomological Society of Manitoba

Motion - A. G. Robinson moved that we offer to the Library of the Science Service Building, University of Manitoba Campus the entire contents, present and future, of the Library of the Entomological Society of Manitoba, with the understanding that members of the Society be allowed to use this material during normal Library hours. Seconded by W. R. Allen. Carried.

Note of Apology from Executive to the Membership of the Entomological Society of Manitoba

W. A. Reeks apologized on behalf of the Executive for having presented the 'Brief on the Need for an Extension Entomologist for the Province of Manitoba' in the name of the Entomological Society of Manitoba without first informing the Membership.

Motion - A. V. Mitchener moved that the action of the Executive in presenting to the Premier of Manitoba the 'Brief on the Need for an Extension Entomologist for Manitoba' be approved by the membership of the Society. Seconded by H. R. Wong. Carried.

Nominating Committee - The Chairman, W. A. Reeks, asked the following members to act as a nominating committee and to bring a slate of officers at the fall meeting:

The committee composed of: Dr. A. J. Thorsteinson, G. L. Warren and F. L. Watters.

Entomological Society of Canada - G. L. Warren, representative of the Entomological Society of Manitoba on the Council of the Entomological Society of Canada reviewed the minutes of the Entomological Society of Canada. He reported that the 7th annual meeting of the Entomological Society of Canada would be held at Lethbridge in late October.

Common Names Committee - Prof. A. V. Mitchener, Chairman of the Common Names Committee of the Entomological Society of Canada reported on the work of this body. He urged that more common names be submitted.

Editor-Librarian - Dr. W. R. Allen reported that the Proceedings for the fall meeting held in conjunction with the I.G.P.C.E. has been published.

He reported that subscriptions for the Proceedings have been received from the British Museum and the Anti-Locust Research Centre.

Motion - The meeting moved a vote of thanks to the Editor-Librarian for the excellent job on the I.G.P.C.E. Proceedings. Seconded by H. R. Wong. Carried.

Motion - W. R. Allen moved that Honoraria of $5.00 each be presented to Mr. Byron Snead and Miss Mamie McCowan for work on the Proceedings. The funds were to come out of the I.G.P.C.E. fund. Seconded by T. V. Cole. Carried.

Motion for Adjournment - Moved by T. V. Cole.

Scientific Business

The scientific session of the spring meeting convened in the Department of Entomology, The University of Manitoba, on April 17 and 18.

The session consisted of six papers, mainly on topics of general interest, presented by, W. S. McLeod, A. V. Mitchener, T. V. Cole, D. R. Robertson, L. O. T. Peterson, and J. L. Hitchon.

In the evening the members attended a buffet supper and dance at the Officers Mess, Carpiquet Barracks.

## BIOLOGICAL TESTING OF HOUSEHOLD INSECTICIDES

W. S. McLeod, Officer in Charge
Pesticide Testing Laboratory
Department of Agriculture
Ottawa, Ontario

Biological testing may be employed in measuring residues of insecticides in foods, screening unknown chemicals for insecticidal activity, or testing the effectiveness of formulated products against insects. The techniques employed in these and other types of bioassay vary so widely as to make it impossible to deliver a comprehensive discussion of biological testing in the time available.

However, my topic "Biological Testing of Household Insecticides", is a limited one, and I shall confine my remarks to this subject. This is the field in which we are engaged, in part, in the Pesticide Testing Laboratory.

Naturally, my paper will reflect the experience I have had there.

It might be pertinent to say that the Pesticide Testing Laboratory was built in 1952 to analyse the performance of commercial insecticides in the enforcement of the Pest Control Products Act.

Certain basic principles should be borne in mind in the establishment of a laboratory for the bioassay of household insecticides. In order that results may be compared with those from other laboratories engaged in the same type of testing, it is desirable to use standard rearing and testing techniques and standard cultures of insects whenever possible. All laboratories should use the same reference standard insecticide in their control tests. In the individual laboratory, all necessary precautions must be taken to ensure that rearing rooms will not become contaminated with poisons from the testing zone, either by transfer by air currents, garments, or equipment. Rearing techniques and equipment should be designed for mass production without sacrificing uniformity of cultures. Rearing techniques should be designed to prevent, or at least reduce to a minimum, the artificial selection of a particular strain of the original standard culture.

The test should be conducted on the species named in the product label (though it is not feasible to attempt to rear and test all the species that may be named there) and, as nearly as possible, in accordance with those directions. Nevertheless, the conditions of the test must be scientifically defined in precise terms that will permit reproducibility of results. The product itself should not be diluted or modified in any way in preparation for the test except in accordance with label directions.

Although many techniques were considered, it was finally decided to test household space sprays by means of the Peet-Grady Method, using the N.A.I.D.M. 1948 strain of house flies, with the Official Test Insecticide (O.T.I.) of Chemical Specialties Manufacturers Association as the reference standard, and employing the large-group method. This method is published annually in the Soap and Chemical Specialties Blue Book.

The Peet-Grady chamber is a small room measuring six feet in each dimension. It may be of plywood or Masonite construction, but stainless steel is preferable if there is danger of contamination with residual insecticides. The floor should be covered with kraft or bogus paper, and changing between tests is facilitated if the paper is rolled through slots at the bottom of the side walls.

There must be a door to the chamber, a source of light, and windows for observation of the test. Fluorescent lighting is preferable to incandescent because of low production of heat. As a result of experiments on fluorescent tubes of the "daylight" and "black light" (ultraviolet) type, we concluded that there was no significant difference in O.T.I. mortalities between equal intensities of the two types in the range from 40 to 160 watts. However, it is essential that there be some light, and it should be bright enough to enable the technician to proceed with his work. It is also desirable that the upper corners be as brightly illuminated as the rest of the chamber to obtain the necessary flight of flies: otherwise, when disturbed by handling and release from the cage, they will invariably tend to come to rest in a dark corner. As for observation windows, we have found it best to locate them in the ceiling where the technician can command a view of the entire floor of the chamber at one time, though a window in the door is also useful.

The chamber is equipped with a fan capable of exhausting 1,000 cubic feet of air per minute, and this runs for at least 10 minutes after every test. Screened ventilation ports are located in the lower parts of the chamber walls in such locations as to ensure that incoming air will carry all insecticidal mists out of the corners of the chamber. In each wall, there is a spray port $1\frac{1}{2}$ inches in diameter through which the atomizer nozzle is inserted for the emission of the spray. The atomizer is the DeVilbiss No. 5004, especially manufactured and individually calibrated to discharge 12 ml. of O.T.I. at $12.5 \pm .5$ p.s.i. in $24 \pm 1$ seconds.

In the large-group procedure, it is customary to perform tests in groups of four, consisting of three candidate products and one O.T.I. The order of testing is random within the group, and it is convenient to run two such groups each day. The evaluation of a particular product is based on the comparison between its performance and the performance of the O.T.I. in the same group, and final evaluation is the average of not less than four replications of the test. It is required that the 24-hour mortality from the O.T.I. shall fall between 30 and 55 per cent and that all O.T.I. mortalities for a day shall be within 10 percentage points of each other.

At the start of the test, the chamber must be free of insecticidal residues, have clean paper on the floor, and have its temperature at $82 \pm 2°$ F. The exhaust duct and the ventilation ports must be closed. In the large-group test, approximately 500 flies aged between three and six days and capable of flying are liberated in the chamber. Cages showing more than 8 per cent non-flying and dead individuals should not be used for test. Immediately after the release of the flies, the technician steps out, closes the door, and sprays 12 ml. of the test insecticide into the chamber, emitting equal aliquots through each port and oscillating the atomizer nozzle slowly in the horizontal plane. The chamber remains closed for 10 minutes. Then the ventilating ports are opened, the exhaust fan is turned on, and the technician begins to pick up the paralyzed flies. These are placed in a clean cage with a supply of sugar syrup and are held at 82 ± 2° F. for 24 hours, at which time the count of dead and living is recorded. The flies that remain active at the end of the 10-minute exposure are counted and discarded. The chamber walls and ceiling must then be washed and the paper on the floor changed. The adequacy of the cleaning procedure is checked by leaving about a hundred flies in the chamber over night. A mortality exceeding 8 per cent is evidence of the need for further cleaning before starting the next day's tests.

The Peet-Grady Method is in some ways a difficult one to handle. It sometimes happens in a particular laboratory that O.T.I. mortalities do not fall within the required range of 30 to 55 per cent. The essential conditions of dosage, rate of application, and timing are prescribed and may not be modified. The operator is obliged, therefore, to manipulate those conditions which affect the reaction of the flies themselves. He may add a little sugar to the diet to increase their energy. He may starve them for a little while before the test. He may change the method of cleaning the chamber, knowing that the flies are attracted to rest in the vicinity of regurgitated materal. He may wipe down the chamber walls or ceiling with a smear of Bon Ami or Celite to reduce their desire to rest on such a surface. Perhaps the addition of a little wetting agent to the wash will secure the desired results. He should check age, sex ratio, age of parent flies in the breeding culture, disturbance of the flies immediately before or during the test, time of day, and many other factors. Perhaps the flies need to be fed not only on Saturday but also on Sunday in order to reduce the differences in test mortalities between days in the following. These were investigated, along with many other factors, in an effort to bring our O.T.I. mortalities into line. Almost always the variation between replicates was greater than between treatments in these experiments. Finally, after a year and a half of constant effort, our test results began to fall in line. Actually, while we think that our present results are due to modifications in the washing technique, the method of release of test flies in the chamber, and the timing of the period of starvation before test, we are not able to attribute our success precisely to any one or any particular combination of these. We only hope we can continue to get results.

The Cockroach Spray Test Method, on the other hand, was chosen without much hesitation. It is widely accepted and used by the commercial laboratories. It is relatively simple and is easily adjusted when mortalities fall out of the official range. Like any other biological testing technique, it is subject to the variations that characterize this type of work, but we have been satisfied with it in the Laboratory. It, too, is published annually in the Blue Book.

The test is run in a small spray tower about 18 inches square and 30 inches high, open at the top and enclosed at the bottom by a floor of 2 x 2 mesh galvanized hardware cloth. The front usually consists of a sliding panel. The atomizer is the same DeVilbiss No. 5004 and the reference insecticide is the same O.T.I. used in the Peet-Grady Method.

The official test insects are adult male German cockroaches. Unlike house flies, no standard strain is available, and each laboratory uses whatever strain is suitable and easily obtained.

Twenty cockroaches are placed in a metal treatment container with an open top and a 16 x 16 mesh screen bottom. The walls of the container are greased to prevent escape of insects. Air passes continually through the DeVilbiss atomizer during test. The container of insects is centred in the target area on the floor, and a vial containing a measured dosage of the insecticide is applied to the intake tube of the atomizer. Thirty seconds later, the container is removed, and the cockroaches are immediately transfered to a greased crystallizing dish where they are held for 48 hours before mortality is assessed. Moribund insects are counted as dead.

For an official evaluation of a product, a total of at least 10 treatment containers having 20 cockroaches each are sprayed, but these must not all be run on the same day or on the same culture. A spray dosage is chosen such that the O.T.I. will give a 48-hour mortality between 70 and 90 per cent, and the dosage must be constant throughout the entire series.

The great advantage of this particular technique is that one can adjust dosage until the O.T.I. mortalities settle in the required range. Often there are fluctuations until the operators develop a certain amount of skill, but then the results will usually be satisfactory. Later, if variation occurs, one is permitted to readjust dosage as needed. This is in sharp contrast to the difficulties encountered in attempting to bring Peet-Grady mortalities back in line.

During the past 18 months, we have tested about 60 products registered under the P.C.P. Act for cockroach control, and some of these have been sampled several times. We believe we have a good idea about the performance of these various materials and are now preparing a statement of the test method, which will eventually be published in the Regulations under the Act.

Although we have run small-scale tests on mosquito repellents, fly traps, poisoned baits, and pressurized space sprays, the only other category of household insecticides on which a considerable amount of work has been done is the fabric protectants. Here we have materials used by manufacturers of rugs, felts, and fabrics for the protection of their products as well as sprays sold to the housewife for application to fabrics in the home. The latter are further subdivided into two categories on the basis of long-term and short-term protection.

A study of the literature shows that many testing techniques have been published, all agreeing in certain basic principles but differing in minor details. We felt that we should begin with a very thorough test and simplify it later when our experience and accumulated data would support a decision to omit certain features. Also, we decided to emphasize at first the testing of household sprays giving approximately one month and, later, by minor modifications, to adapt the technique to suit the other classes of products. As a test cloth, we chose the standard mothproofing test fabric of the American Association of Textile Chemists and Colorists.

Accordingly, we developed a method of spraying small patches of the test cloth. After aging for 28 days, these patches are placed in salve tins and are infested with webbing clothes moth and black carpet beetle larvae of suitable age and size. These are permitted to attack for two weeks in controlled temperature and humidity before results are assessed.

Mortalities are recorded but are not considered in the final evaluation of the product because our objective is to measure fabric protection rather than toxicity to insects. Some insecticides such as DDT, when applied at low dosages kill most of the clothes moth larvae but still permit some visible damage to the cloth, while at the same time they protect the fabric from carpet beetle attack without killing a single larva.

With clothes moth larvae, our assessment is based on weight of fabric lost due to feeding. This is required to be less than 8 mg. after correction for humidity changes during the test period. The test is valid only if larvae infesting untreated test patches have consumed more than 30 mg. of cloth. Unfortunately, the larval excrement is so tangled with silk that it cannot be weighed with accuracy.

For the black carpet beetle larvae, both fabric weight loss and weight of excrement are checked and both must pass their respective standards. Fabric loss must be less than 8 mg. and excrement weight less than 5 mg., while the untreated checks must exceed 30 mg. and 15 mg. respectively.

In all cases, the results on the test cloth are calculated against those on the corresponding controls to give a rating of percentage protection, which must exceed 75 to be considered satisfactory.

Finally, the test patches are examined for damage visible to the naked eye. It would be very satisfactory if we could perfect a technique such that any visible damage would automatically fail the product, but this may not be a practical approach. After all, 10 larvae are confined on two square inches of cloth in a salve tin from which there is no escape. This is a heavy rate of infestation, and they must either eat or starve. Perhaps it is inevitable that there will be a small amount of visible damage, particularly with the clothes moth larvae, which tend to cut off some wool fibres for the construction of their silken tubes. However, we are working on our technique and hope eventually to find a satisfactory solution to this problem.

We believe that, when we are ready to test household sprays guaranteeing long-term protection from fabric pests, we will be able to use this same technique of infestation and taking results. It will, of course, be necessary to make some changes in our method of handling the treated patches before testing in order to achieve a suitable aging of the product.

Some work has been done on the testing of fabrics treated with permanent-type protectants during the process of manufacture. Essentially, the chemicals used are colourless dye-type materials that enter into an irreversible chemical union with the woollen fibres. It follows that the test insects must do a little chewing on the fabric before they can come into contact with the dye. Whether the chemical is toxic or merely distasteful, we do not really know.

The problem, however, is not one of testing but rather one of administration. How should the guarantee be worded and how much damage should be tolerated in assessing the test results? We are concerned that our answer to this question should be acceptable to both the manufacturer and the public.

This, then, is the record of accomplishment to date. For the future, at least two techniques are proposed, and other will no doubt be required. For household aerosol bombs, we plan to use a Peet-Grady type chamber of plywood construction, modified to suit the type of product, and painted on the inner surface with a high-gloss white enamel. For household dusts, we propose to use a vacuum bell-jar type of apparatus, which has been planned in principle but not designed in detail.

We anticipate, however, that new products will continue to appear and that we will be required to prepare new testing techniques to measure their efficiency. This aspect of our work, being full of problems, is most interesting, and we are happy in the thought that our laboratory will never settle into a program of strictly routine analysis. Such a situation is out of the question when one works with living insects.

## A HISTORY OF BEEKEEPING IN MANITOBA TO 1957

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### MANITOBA BEEKEEPERS' ASSOCIATION

The earliest available record of beekeeping in Manitoba is around 1887 or 1888, although no doubt honey bees were kept here before that time. William J. Gatley who lives near Austin, Manitoba, told the writer that his father, Josiah Gatley, kept honey bees then and that they were obtained through some person at Portage la Prairie. He said that at that time all hive bodies, frames and other hive parts were made by hand. In 1889 an Experimental Farm apiary, consisting of two colonies of Italian honey bees, was established at Brandon by the superintendent, Mr. S. A. Bedford. Largely through his interest, the Manitoba Beekeepers' Association with a membership of 17 was organized in Winnipeg on February 24, 1903 at which time he became its first president. The relatively few beekeepers, estimated at between 150 and 200 in 1903, obtained such good yields of honey that they believed that there were great possibilities for beekeepers in Manitoba and that such an organization would be very helpful in stimulating interest among beginners. Furthermore, such an organization could, they believed, make more widely known the fine quality of local honey compared with honey that was being shipped in from Ontario.

The newly organized M.B.A. held annual meetings in 1904, 1905, and 1906 but for some unknown reason the fourth annual meeting was not held until February 1909. Practically no minutes of any meetings held between 1909 and 1922 are available and therefore we do not know when conventions were held during that period, but the February 1922 convention officially was numbered 15. No convention was held in 1932 due to the depression. In 1944 the 36th. annual convention was held in January. At that time it was decided to hold the next convention that autumn instead of early in the next year and in error the convention which was held in November 1944 was numbered 38. From that time until the present, regular annual conventions have been held and these have been numbered consecutively and correctly which brings us to the fiftieth annual meeting in 1956.

In review of the records of the M.B.A., it seems that the Association has been most active and thriving when the members had some definite objective in view such as the appointment of a provincial apiarist, the formation of local associations which purchased honey bees and supplies for their members, the formation of the Manitoba Cooperative Honey Producers Ltd., classification and grading of honey, standardization of containers, marketing, disease control, legislation concerning inspection and the movement of honey bees and other matters of vital concern to beekeepers.

For many years prominent beekeeping authorities from the United States and from other provinces in Canada were invited to attend the conventions and address the members at the regular sessions and annual banquets. Such U.S. authorities as G. H. Cale, G. S. Demuth, C. L. Farrar, Chas. Hausman, M. Haydak, Francis Jager, J. A. Munro, E. R. Root, M. C. Tanquary and others have attracted many Manitoba beekeepers to the annual meetings of the M.B.A. From other Canadian provinces, such prominent men as F. R. Armstrong, E. Braun, W. A. Chrysler, W. J. Craig, C. B. Gooderham, R. F. Holtermann, C. A. Jamieson, G. J. Jarvis, W. G. LeMaistre, Morley Pettit, R. M. Pugh, T. H. Shields and others have contributed much to the programs of the annual meetings. It is a fact, however, that local beekeepers and their associates in Manitoba have been largely responsible for the continued success of the conventions. They are legion and for that reason must remain unnamed. An interesting innovation first introduced in 1942 was a panel discussion by local authorities on sweet clover. This proved so population that no less than seven panel discussions on various topics appeared on the 1943 program. Each program for the next few years was featured by several panel discussions by members and these have persisted until the present time but with decreasing emphasis.

Many outstanding beekeepers have been president of the M.B.A. throughout the years of its existence. I hope that I shall be excused if I single out one whom I think did more than any other to advance the interests of beekeeping in Manitoba. This was Mr. G. M. Newton, a business man and extensive beekeeper who was president of the M.B.A. for 10 consecutive years from 1921 to 1930 inclusive. He was a fearless and persistent advocate and worker for our beekeepers. It is of interest to observe that the first Honoary President of the M.B.A. was the Honorable J. D. McGregor, Lieutenant-Governor of Manitoba, an Angus cattle breeder and beekeeper, who made his first public appearance after his appointment, at the 1930 M.B.A. convention.

Looking back over the last half century it must be recognized that the activities of the M.B.A. have been largely responsible for most of the benefits Manitoba beekeepers now enjoy.

PROVINCIAL APIARISTS:

Manitoba's first Provincial Apiarist was Mr. R. M. Muckle, a graduate of the Manitoba Agricultural College, who made his first report to the Provincial Government for the year ending November 1, 1916. He presented two further annual reports as Provincial Apiarist for 1917 and 1918 after which apparently the position no longer existed. In June 1921, Mr. L. T. Floyd, who had been Provincial Apiarist in New Brunswick, was appointed to that position in Manitoba and held the office until his retirement in 1945. During this 24 year period the beekeeping industry experienced many changes and was greatly extended. Following Mr. Floyd's retirement, Mr. E. C. Martin was appointed Provincial Apiarist in 1945 and remained until 1950 when he accepted a position as Assistant Professor of Entomology at Michigan State College. Mr. D. R. Robertson, the present Provincial Apiarist, was appointed April 1st., 1951. In addition to the many duties connected with the position each of these last three men assisted with short courses offered in the Department of Entomology at The University of Manitoba. Mr. Robertson also holds the position of Lecturer in Entomology in that Department and is presently lecturer in beekeeping courses offered to degree and diploma students in agriculture. In addition he is in charge of the Department of Entomology apiary. Thus there is a very close association between Apicultural instruction and the beekeeping industry in Manitoba.

One of the main responsibilities of the Provincial Apiarist is for the inspection of apiaries for honey bee diseases and the administration of that part of "The Animal Husbandry Act" relating to honey bees. In addition he arranges for and addresses meetings in the country, sends out many news letters to beekeepers, acts as secretary-treasurer of the M.B.A. and provides general information on beekeeping to all inquirers.

THE UNIVERSITY AND THE BEEKEEPER:

The first university two weeks' short course in beekeeping was offered in 1923 with an attendance of 26 men and women. Since the course began instruction has been offered annually, in later years as a one week's short course, to a total of approximately 696 students from all over Manitoba and even from beyond the borders of the Province. These students not only learned about honey bees and beekeeping in a systematic way, but also were able, when they returned home, to assist their neighbours to become better beekeepers. The instruction given to this group has been one of the University's greatest contributions to beekeeping in Manitoba. Hundreds of diploma course students during the years also have had instruction in beekeeping and although relatively few of these young farmers have become beekeepers they did get an appreciation of the value of honey as a food and the place occupied by honey bees in Manitoba agriculture, especially in connection with the pollination of many farm crops. As most of these men are on Manitoba farms today, their informed sympathetic attitude towards honey bees is of some considerable value. All students in the degree course in agriculture who have specialized in Entomology included in their studies a thorough systematic course in apiculture. This means that many professional entomologists are informed on the subject and the place honey bees should occupy in our agricultural practices. The course in apiculture given to the specialists in Entomology has always been available as an optional course to the senior students in the degree course and has been elected by many of them through the years.

The Department of Entomology has had the co-operation of many beekeepers scattered throughout Manitoba in compiling records of the annual nectar flows since 1924. Daily records of scale colony gains or losses have been compiled for five months beginning May 1st. each year. These records show that the main flow begins around the end of the third week in June and continues well into August. With the life history of the worker honey bee known, they also show that package honey bees should be installed, especially in southern Manitoba, by the middle of April for best results. Other investigations have shown that hive bodies should be painted white and that two pound packages are preferred. The Department of Entomology had something to do with getting shippers to use lighter containers for shipping honey bees.

The first bulletin on "Package Bees" published in Canada (1931) was prepared by the writer and probably had something to do with the increasing use of package bees in Manitoba. Numerous articles in the Journal of Economic Entomology, the American Bee Journal, Gleanings in Bee Culture and the Western Canada Beekeeper were prepared by members of the Department. A general bulletin (two editions) prepared jointly with the Provincial Apiarist on beekeeping was made available. Many popular stories on beekeeping were prepared for the press. The radio was used frequently to give publicity to beekeeping. Members of the staff who were most concerned with these activities were E. C. Martin, W. S. McLeod, A. V. Mitchener and D. R. Robertson.

FEDERAL APIARISTS:

The apiary started at the Experimental Farm at Brandon in 1889, which was before an experimental apiary was established at the Central Experimental Farm at Ottawa, was maintained until 1920 when it was moved to Morden. In 1934, the apiary was returned to Brandon where it has remained until the present time. Mr. Bedford experimented with overwintering and swarm control. Mr. Ed. Braun was placed in charge of the apiary when it was moved to Morden and continued in that position at Brandon where for many years he was ably assisted by Mr. J. E. Geiger. Subsequent to Mr. Braun's transfer to Ottawa in 1950, Mr. J. C. M. L'Arrivee was appointed as his successor as of April 6, 1956. In the meantime Mr. Geiger carried on the work at Brandon.

At Morden research work was carried on comparing yields from different sized packages of honey bees and the best arrival dates for packages. Comparisons were made between packages and overwintering colonies for yields of honey. Queen supersedure was studied and attempts were made to control American Foul Brood with formalin and chlorine treatments. At Brandon, the Italian, Caucasian and Carniolan races of honey bees were compared. Methods of cellar and outside wintering were studied. Projects on dividing overwintered colonies for increased production were undertaken. More recently studies were made on pollination of legumes by honey bees and nectar secretion from these plants.

Mr. Braun took an active part in the organization of the Manitoba Co-operative Honey Producers Ltd. He prepared many articles and several bulletins on beekeeping and spoke at many meetings of beekeepers.

PUBLICATIONS ON BEEKEEPING:

The first journal published in Manitoba dealing with beekeeping was the "Western Gardener and Beekeeper" which began publication with the March issue 1922. In April 1923 the above publication was combined with the "Western Poultryman" to form a publication known as "Western Gardener and Beekeeper and The Western Poultryman" which was published by Dawson Richardson Publishing Company until December 1924. The next journal published in Manitoba dealing with beekeeping was named "Canadian Beekeeper and Gardener" and appeared as Vol. 1, No. 1, April 1927. It was published at 100 Adelaide Street, Winnipeg. Lack of sufficient public interest forced the publisher to discontinue this journal apparently after the first number. Another, more successful venture in the field of publishing in the interests of beekeeping was undertaken by Mr. Frank Williams when he began publishing the "Western Canada Beekeeper" in July 1938. Mr. Williams was an experienced newspaperman who took a keen interest in beekeepers and beekeeping and who was an outstanding editorial writer and editor. Although this journal was to serve prairie beekeepers especially, its value to the industry was not recognized by them and unfortunately, it was forced to wind up its business affairs with the June issue 1952.

Bulletins, journal articles, pamphlets and circulars on beekeeping have been prepared by a number of Manitoba officials including E. Braun, L. T. Floyd, J. E. Geiger, E. C. Martin, A. V. Mitchener, R. M. Muckle and D. R. Robertson. In addition, some of the beekeepers themselves have published articles on certain aspects of apicultural practices in this province.

HONEY BEES:

Through the years the most popular race of honey bees kept in Manitoba has been the Italian. Relatively few

Caucasian or Carniolan honey bees have been kept although a few beekeepers have preferred the Caucasian race in recent years. Previous to 1927, when Dr. R. L. Watson published his "Controlled Mating of Queenbees", little had been done to improve any race of honey bees due to the extreme difficulty of controlling the mating of the queens. Some improvement in quality and markings has resulted from this discovery of a method of artificial insemination of queens since that time and Manitoba has benefitted along with other areas. This is especially true for us since we import most of our queens with our spring packages from the southern states where queen rearing is a speciality. Emphasis is being placed by queen breeders on strains showing productive capacity, gentleness, disease resistance, colour markings, etc., which no doubt will continue to bring still greater improvements with the passing of the years.

Although honey bees have changed relatively little during the past fifty years, their importance to our agricultural economy has changed. Originally they were kept entirely for honey and wax production. In recent years greater attention has been given to their importance as pollinators of various crops, and Manitoba farmers and beekeepers are beginning to show interest. Our native pollinating insects are becoming scarcer as, with increased cultivation, the nesting places of these insects are decreasing. Furthermore, our greatly increased acreage of crops which benefit by insect pollination, requires even more pollinators. The possible health-giving properties of royal jelly are being studied elsewhere with increasing interest.

APIARY EQUIPMENT:

Most of the hive bodies in the earlier years were of the eight frame Langstroth size, but beekeepers were gradually changing to the ten frame hive body in the nineteen twenties. The larger Dadant hive body never became popular in Manitoba. Telescopic hive covers replaced the type which could more easily be blown off by the wind. Frames in earlier times were spaced by means of metal staples tacked to the sides of the end bars. These were gradually replaced by frames having wooden end pieces which were cut in such a way as to be automatically self-spacing. The original solid bottom bar frame has been replaced almost entirely by the split bottom bar frame.

Foundation was first made in Manitoba by small, imported, hand-turned presses and later by commercial manufacturers and was known as plain foundation. Later this was partly replaced by foundation having vertical crimped wires embedded in it and to a lesser extent, by foundation the center part of which was a vegetable wax which was covered on both surfaces with beeswax. These latter types were imported from the U.S. and have been replaced in turn almost entirely by plain commercial beeswax foundation.

For many years honey bees fed, when stores were lacking, on combs of honey introduced into the hive. Sugar syrup, made by dissolving granulated sugar in water, later replaced honey and was fed by means of feeder cans or honey pails having a couple of small holes punched in their lids. These feeder cans were placed top down with an empty super over the frames. In recent years dry granulated sugar has been used by some beekeepers to feed colonies.

Relatively few beekeepers until recent years have had satisfactory honey houses or good extracting equipment. The trend in the last ten years from the small beekeeper to the commercial apiarist with hundreds of colonies has been responsible for the change from the kitchen and the hand turned extractor to the sanitary special building and power equipment for handling the crop, either for transfer to the Manitoba Co-operative Honey Producers Ltd. in Winnipeg or for producer packing. In general the greater the number of colonies owned by a beekeeper the better are his facilities for handling his crop.

MANAGEMENT:

The early beekeepers in Manitoba depended upon wintering their honey bees in cellars and upon swarms maintaining their colonies and for increase. Wintering losses often were very great and consequently the increase in the size of apiaries was slow. Around 1920 Manitoba beekeepers began to import honey bees from the southern states in the spring. Some nuclei as well as packages were brought in by railway express at first, but beekeepers soon found that they preferred the packages. The Manitoba Department of Agriculture and Immigration for the first time mentioned package importations in its report dated December 31, 1922, when it stated; "The bee population of the province was increased by large importations of package bees from the Southern States". Many of the packages were brought into Manitoba at that time in late May or even early June which was much too late for them to build up in time for the nectar flow. A long term study of the beginning and duration of the nectar flow was begun in 1924 by the Department of Entomology at the University and resulted in a recommendation that packages should be here by the middle of April or as soon after that as possible if they are to build up to optimum strength by the beginning of the main nectar flow. Packages brought in early gave excellent yields of honey and soon many beekeepers ceased trying to overwinter their honey bees and depended upon packages. At present probably 80 to 90 per cent of the colonies kept in Manitoba are imported each spring.

Packages at first were shipped by express almost entirely, although a few came by mail. It was reported at the 1939 convention that honey bees had been trucked into Manitoba for several years and that in 1938, fifteen truck loads had been reported. One truck load had journeyed from Baton Rouge, La. in 60 hours. In 1922 the average cost of packages was around $5.35 each. The cost gradually dropped due to keen competition until in 1931 the average cost per package was around $2.45. At present, the average cost ranges from $3.75 to $4.00 depending upon the shipper. These prices are based upon lots of 10 two pound packages with queens F.O.B. at the shipping point. At present nearly all of our extensive beekeepers bring their packages, each containing a feed can of sugar syrup, into Manitoba by truck. From 300 to 1,000 two-pound packages can be handled on one trip depending upon the size of the truck used. It is of interest to observe that from 1944 to 1946 inclusive, the Federal Government paid a subsidy of 50 cents per pound of honey bees on all importations.

Throughout the years, supersedure of many queens accompanying the packages has been a serious problem shortly after the packages have been installed. Extra queens must be brought in for requeening those colonies which for some reason not well understood, lose their queens. Colonies which are allowed to requeen themselves are practically valueless as surplus honey producers. Research on the causes of this supersedure has been neglected and is needed badly.

Better roads and the increased use of trucks have had an important influence on beekeeping over the past decade. Many apiarists now run their colonies each year in a number of yards placed in locations where honey bee pasture is likely to be abundant. Honey filled supers are trucked to a central point for extraction. The trend towards fewer beekeepers with larger apiaries in the last few years is shown in Table 1. This is an important development in the industry.

Until recently little attention had been given to the usefulness of honey bees as pollinators of certain crops now grown in Manitoba. Recent crop specialization with increased acreages of alfalfa, alsike, buckwheat, flax, rapeseed, red clover, sunflower and sweet clover as well as fruits and certain vine crops, all of which either require or are benefitted by cross-pollination, has focused attention on the importance of honey bees in obtaining the greatest returns from these crops.

The swarming season in Manitoba is centered on the first week of July with swarms occurring from June 1st. to the middle of August. Beekeepers here have always been much interested in swarm control and now that no beekeeper wants swarms for increase, its control is more important than formerly.

HONEY PRODUCTION:

The number of beekeepers, the number of colonies and the annual honey production vary from year to year. Estimates

## TABLE I

## SOME MANITOBA BEEKEEPING RECORDS AVERAGED FOR FIVE YEAR PERIODS

## 1921-1955

| Years | Avg. No. Beekeepers | Avg. No. Colonies | Avg. No. Colonies per Beekeeper | Avg. Yearly production in pounds | Avg. Yields per Colony in lbs. | Avg. Prices per lb. in cents to producer |
|---|---|---|---|---|---|---|
| 1921-25 | 946 | 11,990 | 12.6 | 1,135,000 | 95 | 17.6 |
| 26-30 | 1,934 | 31,606 | 16.3 | 3,364,000 | 106 | 12.4 |
| 31-35 | 2,626 | 36,978 | 14.0 | 4,601,000 | 124 | 7.5 |
| 36-40 | 3,308 | 54,945 | 16.6 | 6,698,000 | 121 | 7.4 |
| 41-45 | 3,269 | 49,561 | 15.1 | 4,549,000 | 91 | 13.0 |
| 46-50 | 3,322 | 60,800 | 18.3 | 5,598,000 | 92 | 18.2 |
| 51-55 | 1,366 | 39,480 | 28.8 | 4,655,000 | 118 | 13.8 |

These statistics were compiled from the annual "Report on Crops, Livestock, Etc." for the Province of Manitoba.

made by the Manitoba Department of Agriculture and Immigration each year have been averaged for five year periods beginning in 1920 and are shown in Table 1. These data show that following the 1921-1925 period the number of beekeepers increased rapidly, reaching a peak during the period 1936-1950. During the same time the number of colonies reached a high point after which colonies declined in numbers. Production reached an all-time high point in the 1936-40 period and was good during 1946-50, but subsequently has been lower. The average yield per colony was highest from 1931-40 after which it declined, but was up again for the 1950-55 period. The low average production per colony during 1941-50 was due largely to the relatively poor yields during August.

Our main surplus nectar sources in the early part of the last fifty years were mostly wild flowers. Sweet clover, both white and later yellow, was then introduced into our agriculture and grown for seed or when cut for hay was allowed to grow up again for pasture, when many of the plants bloomed until frosts came. In either instance the crop bloomed over a long period when honey bees could work the flowers. In 1939 the sweetclover weevil was first reported in Manitoba and the subsequent ravages of this insect to seedling sweet clover did much to discourage farmers from seeding this crop. It will be noted in Table 1, that following this period average yields per colony dropped for ten years. Farmers discovered that sweet clover when pastured took much moisture from the soil. This practice of pasturing was changed to one where sweet clover stubble was plowed down as soon as the hay crop had been removed. This further reduced the August nectar yield. Other important nectar producing plants were alfalfa, alsike, red clover, white Dutch clover, sowthistle and fireweed. Buckwheat, rape-seed and sunflower, all of which produce surplus nectar, have been introduced into our cropping practices within recent years. These yeild nectar later in the summer and in consequence the August nectar flow is again increasing.

Colour of honey depends almost entirely upon the floral source of nectar. All clovers produce a water white, mild-flavoured honey which goes into the most favoured class. It was during the period that sweet clover was the main source of nectar that Manitoba beekeepers were awarded many of the top prizes at the Toronto Winter Fair where they were in competition with beekeepers throughout Canada. For example in 1936, Manitoba honey won first, second and third prizes with granulated honey; second and third prizes with liquid honey and first and second prizes for beeswax at Toronto. It is more difficult at present to get a sample of pure sweet clover honey. The new sources of nectar from buckwheat, rape-seed and sunflower produce darker honeys with distinctive flavours although that from sunflower has a rich yellow colour, with a flavour liked by many consumers.

Most of our honey through the years has been extracted and sold either in the liquid or solidified form. Consumers in Manitoba have become accustomed to using most of their honey in the solidified form, especially in the winter. A few beekeepers have specialized in producing comb or section honey which sells for about double the price of extracted honey. Some honey is creamed and sold in glass. A small quantity is sold in glass as liquid honey with a small piece of comb honey in it.

The nectar flow in Manitoba has been studied in the Department of Entomology at the University of Manitoba for the past 33 years and considerable useful information has been compiled and published. The main nectar flow begins around the end of the third week of June and continues as a single flow until the end of the season. During the 10-year period, 1925-1934, scale colony gains were made as follows: June 6.3 per cent, July 51.4 per cent, and August 38.0 per cent. For the 20-year period 1935-1954, the scale colony gains in June were 9.9 per cent, in July 68.3 per cent, and in August 20.7 per cent. The other small gains in each period were made in May and September. There is now some indication of a return to a better nectar flow in August. It must be remembered that the main nectar flow varies somewhat from year to year with the variations in our seasons. We are fortunate that in our latitude we have many hours of sunshine each day during our nectar flow.

Honey bees may be kept in any agricultural area in Manitoba where nectar producing plants are grown in abundance. One fairly large apiary has been run at The Pas for several years, but the most northerly commercial beekeeping area is Manitoba is located in the Swan River Valley.

MARKETING:

Most of the honey produced in the earlier part of this century was retailed locally in tin pails, many having wire handles and holding two and one-half, five or ten pounds of honey gross weight, although some was sold in glass. Later pails were made to hold two, four or eight pounds net weight to conform with pails used to retail jam and marmalade. Subsequently waxed paper containers holding one and two pounds of honey were added to the containers used for the retail trade. Unfortunately during the earlier period the consumer took a chance on the colour and moisture content of every pail of honey she bought and disappointments were all too common. Beekeepers who had a quantity of honey for sale called on the honey brokers and competed with one another in selling their honey at wholesale prices. The resulting unsatisfactory condition of the industry, stimulated by widespread fermentation in honey in 1938, led to the formation under "The Companies Act" of Manitoba of the "Manitoba Co-operative Honey Producers Ltd.", which was registered July 14, 1938. The purposes and objects of the

M.C.H.P. Ltd. under Letters Patent on Incorporation were:

1. "To carry on the business of producing, grading, buying, processing, packing, advertising, selling, manufacturing and dealing in honey and other apicultural products and supplies on the co-operative plan."

2. "To erect, buy, sell, lease, own, operate and control machinery, buildings, real estate and other equipment and facilities."

3. "To carry on such other business and to do all such other things as may be necessary or convenient for the purpose of carrying out the objects of the association".

The M.C.H.P. Ltd. was patterned after the Ontario Honey Producers' Co-operative Ltd., which was formed in 1923 and much guidance was received from officials of that organization. The Manitoba plant began operations in 1939 with Mr. E. B. Chown as the first manager who held that position from June 1, 1939, until April 1942, when he was succeeded by Mr. Frank Garland, who has continued as manager to the present. Officers of the organization are President, Vice-President, Secretary-Treasurer, Manager and seven directors, two of whom are the President and the Vice-President. With shares at $20.00 each there are at present approximately 900 shareholders. The shareholders extract their own honey and ship it in 70-pound containers to the co-operative plant. Here the honey is stored and subsequently pasteurized, seeded with honey containing small crystals and put on the market in an orderly manner. At present approximately from 75 to 80 per cent of the commercial honey and approximately from 55 to 60 per cent of all honey produced in Manitoba passes through the M.C.H.P. Ltd. plant.

The M.C.H.P. Ltd. first began to handle beekeepers supplies and take orders for package honey bees in 1939. The sale of antibiotics to supress honey bee diseases began in 1954. Old combs are rendered for beeswax which is bought for cash or exchanged for supplies. Consumer honey is sold from coast to coast with the principal markets in Manitoba, Ontario, Quebec, and B.C. in that order. As conditions permit, honey is also exported. By blending honey the Co-operative has been able to supply to the public a fairly uniform product throughout each year and from year to year at a stable price. The formation of this organization was an outstanding event in the history of beekeeping in this province.

The unsatisfactory condition of some honey privately offered for sale led to the passing of "Regulations Respecting Marking, Grading and Marketing of Honey in the Province of Manitoba under 'The Manitoba Livestock and Livestock Products Act'" and filed in November 1948. Under "Manitoba Regulations No. 39/48", beekeepers, among other matters, were required to classify, grade, pack and mark honey offered for sale in accordance with the provisions of the Act and Regulations. Classes of honey are based on colour as follows: white, golden, amber and dark. Each class is graded No. 1, 2, or 3, according to moisture content. Regulations respecting packing and container markings are stated. Specific instructions with regard to sanitary conditions are included in the regulations. These regulations are being enforced strictly and have been the means of improving the quality and reputation of Manitoba honey.

Table 1 shows the average price of honey to the beekeeper for 7 five year periods from 1921 to 1955 inclusive. The price varied from year to year, but when averaged for five years indicated trends depending upon a number of factors including yields not only in Manitoba, but also in the whole of Canada.

Honey advertising requires money. Little of this was available for advertising purposes in early years; beekeepers did what they could to keep their product before the public by placing exhibits of honey bees, honey and beeswax at many large and small provincial fairs. The Canadian Beekeepers' Council, a Canada wide organization, was formed in Winnipeg in 1939 to promote interest in the use of honey. A voluntary manufacturers container levy was instituted in 1947 and this was made permanent in 1949 at one-fifth of a cent a pound of honey on all cans and paper containers sold. This money is turned over to the Canadian Beekeepers' Council to advertise honey in Canada. Manitoba beekeepers benefit through advertising done in areas where most honey is retailed.

The Manitoba Honey Marketing Board, consisting of five members was set up in 1953 under the "Manitoba Natural Products Marketing Act" with power to regulate and control the marketing of honey in Manitoba. To date, its only action has been to set floor prices for honey. The two distributors of cans in Manitoba charge an extra two cents per case of tins holding 48 pounds of honey. This money has been turned over to the Manitoba Marketing Board to finance its operations since its first order was announced.

DISEASES AND PESTS:

The principle diseases of honey bees in Manitoba are American Foul Brood, European Foul Brood, Sacbrood and Nosema. A.F.B. was first reported in Manitoba in 1910 and E.F.B. in 1917. A.F.B. and its control has been under discussion almost annually at the M.B.A. meetings since it was first reported. For many years E.F.B. was not very serious, but in 1954 and since then it has rather suddenly attained considerable importance. Sacbrood, the third disease of brood, is of much less importance. Nosema is a disease of the adult honey bees which has been recognized for a number of years, but is not as important as the first two mentioned. For many years burning all honey bees, brood, combs, and equipment infected with A.F.B. has been the recommended method of control and it is still practised to a limited extent. The older shaking method of control is no longer recommended. More recently sodium sulfathiazole, a sulfa drug, and terramycin, an antibiotic, were recommended and used to control A.F.B. Terramycin and another antibiotic, streptomycin are recommended and used to control E.F.B. Fumagillin (Fumidil B) is recommended for the control of Nosema.

An "Act for the Suppression of Foul Brood Among Bees" was passed February 20th. 1914 by the Legislative Assembly of Manitoba. An amendment was made on April 5, 1924. The Animal Husbandry Act, 1954, Part VIII, pp. 97-101, sets forth the present law relating to "Bees and Bee Diseases" in Manitoba.

Honey bees in Manitoba are molested by certain animal pests. Ants of various species are widespread among apiaries and at times are quite harmful to a single colony or to several colonies. Skunks catch live honey bees at the hive entrances and eat them. Bears occasionally invade apiaries and push over the hives and feed upon the honey. Mice eat holes in stored combs containing honey. The greater wax moth has been known to injure honey combs stored in a heated building in Manitoba during the winter, but no damage will occur in unheated buildings.

The writer has attempted to record some of the highlights in the history of Beekeeping in Manitoba to the present time as he has found the facts in the records and as he remembers them through his professional associations with beekeepers and honey bees for more than a third of a century in Manitoba. Messrs. D. R. Robertson and F. R. Garland have been particularly helpful in providing data for this paper and the writer is duly gratefuly for this assistance.

# METHODS OF STUDYING HABITS OF WILD BEES AS POLLINATORS OF ALFALFA IN MANITOBA

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There are two sorts of ecology according to Andrewartha and Birch (1954). One sort is a study of the niche held by a particular species. The other is a study of the community. Niche may be defined as the place of an individual in the biotic environment. A caterpillar and a mouse occupy similar niches because they both eat plants. A marsh hawk and a lady beetle occupy similar niches because each eats other members of its kind. A community is an assemblage of species in a particular habitat. A prairie aspen bluff is a community that may include trees, shrubs, shade-loving herbs, fungi, birds, predacious and herbivorous mammals, and a multitude of insects. A smaller community may be a punky log and may include an animal such as a mouse or raccoon, birds such as a woodpecker or a wood duck, and insects such as a leaf-cutter bee, a carpenter ant, a predacious solitary wasp, and many parasites.

Because of the enormous task of unravelling the ecological relationships of even a simple community, the method of studying the niche of a particular species is usually followed. Andrewartha and Birch (1954) state that ecology should be studied in three stages carried out simultaneously. (1) The physiology and the behaviour of the animal must be investigated. This should be done in the animal's native haunts and in the laboratory. (2) The physiography, climate, soil, and vegetation of the area must be investigated. (3) The number of individuals in the population that has been selected for study must be measured as accurately as practicable. To obtain the information required in these three stages, the general outline for studying bees as presented by Linsley, MacSwain and Smith (1952) was followed in the Wanless area with modifications.

## General Considerations

### Taxonomy and Nomenclature

Accurate determinations of species are important in any ecological study. This is particularly true for bees because there are many species very similar in appearance but different in habits. Muesebeck et al (1951) list 6 families, 99 genera, and 3,287 described species and subspecies of bees in America north of Mexico. Of these, 119 species are social in habit. The rest are solitary or semi-social. In Manitoba there are at least ten species of leaf-cutter bees in the genus *Megachile*. Neave (1933) lists 23 species of bumble bees. The keys of Franklin (1912) and Milliron (1939) were found most useful in identifying *Bombus* spp. The keys of Mitchell (1934-37) were very helpful in determining the leaf-cutter bees. To simplify the determination of the main species of *Megachile* in Manitoba, an illustrated key was prepared. Enlarged photographs were made of structures difficult to distinguish. This key was invaluable in speeding up identification of the leaf-cutters. Many other genera of bees are not easily distinguished from *Megachile*. The key to genera by Michener (1944) has been regarded as a classic in this field. The casual observer may easily confuse *Megachile* spp. with some species of syrphid flies, or bumble bees with their dipterous mimics. A series of preserved specimens of each species is essential to the study. Common names have generally been considered impractical for bumble bees and leaf-cutters because of the difficulty of separating the species in the field.

## Importance

The ecologic and economic importance of species being studied should be determined. In the Wanless area the most important pollinators of alfalfa are *Bombus terricola* Kirby, *Megachile frigida* Sm., and *M. inermis* Prov. These are economically important. Other species of *Bombus* and *Megachile* in the area that prefer wild plants are ecologically important because of their role in maintaining a balance of wild plant species. Hobbs (1956) calculated that one *M. perihirta* Ckll. female could produce two pounds of seed under most favourable conditions. He estimated that this species, at a population of one bee per 24 square yards, working in the field one-third of each of 15 days, could produce an alfalfa seed crop of 1,200 pounds per acre. To learn the importance of a species, the observer must know its average rate of tripping, weather conditions under which it works, and its population density. The rate of tripping of an individual bee may be determined by following it from floret to floret and recording the number of florets visited and the number tripped per minute. Weather conditions must be considered because tripping and visiting are more rapid at high temperatures and low humidities. The rate of tripping is important to determine the economic importance of a species. Leaf-cutter bees are commonly recognized as being more rapid and efficient trippers than bumble bees.

## Population

The population of the species should be determined regularly to establish its importance and fluctuations in numbers. Although leaf-cutters are more efficient trippers of alfalfa, the higher population of bumble bees in the Wanless area has resulted in the latter being responsible for most of the seed set during certain years. The population of bumble bees evidently fluctuates to a greater extent than that of leaf-cutter bees. It is necessary to know when these fluctuations occur to determine the factors responsible.

According to Linsley, MacSwain and Smith (1952), the most widely used method of determining bee populations is that of Vansell and Todd (1946), used by the United States Department of Agriculture. By this method all the bees are counted in ten square-yard areas and the total is multiplied by 484 to give an estimate of the number of bees per acre. A modification of this method was used in the Wanless area by counting all bees in an estimated four square yards in each of four random places in each field and averaging the number counted. Each area in which a count was made was entered slowly to disturb the bees as little as possible. After the observer waited until the bees had resumed normal activity, all were counted that visited florets within a yard of the observer during one minute. Counts were made at about weekly intervals when conditions were considered to be most favourable for flight.

The sweep method, with a standard 15-inch net, has some advantages over the area method where certain species, such as bumble bees or honey bees, are the main pollinators. However some species of leaf-cutter bees would be frightened away and not collected by the sweep method.

### Distribution

The geographic and ecologic distribution of each species of pollinator should be determined. The geographic distribution may be determined by making collections in as many different localities as possible, by examining collections made by other workers, and by reference to the literature. The ecologic distribution can only be made by observation in the field to determine the niche held in a particular community. A log-nesting leaf-cutter is not found in open country where logs are not present or in the forest where clearings are not available to supply food plants.

## Determining the Life History of a Bee

### Overwintering and Emergence

The first step in learning how a bee overwinters is to find its hibernation quarters. Examination of the bee at intervals throughout the winter shows when or if development or change occurs. Such factors as the general locality and characteristics of the hibernating site should be recorded. Temperature, moisture, pH, and air movement are important factors in the microhabitat. After the most favourable conditions for survival in nature have been determined, the limits the bee may withstand in each factor should be determined in the laboratory. This may be done by varying one factor and keeping the others constant. The effect of variation of two or more factors such as time and temperature or moisture and temperature must be considered.

Emergence data should be obtained under natural conditions in the field and under controlled conditions in the laboratory. Placing emergence screens or traps over the hibernation quarters is one method of collecting the bees as they emerge. With log-nesting leaf-cutter bees, care should be taken to place a one-way bee escape at the tunnel entrance in the log to prevent the bees from going back into the tunnel. Field collections and observations made at the time of year the bees are expected to emerge provide additional information. With economic species such as B. terricola, the possibility of increasing the strength of colonies by breaking the dormancy of hibernating queens and inducing them to nest earlier should be investigated. This may be done by removing queens from hibernation quarters at intervals during the winter and providing them with conditions conducive to nesting. Little work has been done on attempting to keep colonies active throughout the year.

Pre-nesting Activity

The pre-nesting period of a bumble bee queen is the longest and most hazardous period of her life. The observer should determine the activity of the queen from the time she emerges from her cell in the colony until she selects her hibernation quarters. Information should be recorded on the following: time from emergence to hibernation, food preferences, mating, and place and time of resting periods. Some of this information may be obtained by observing marked queens in the field, but because of the difficulty in keeping in contact with them, additional information must be obtained from observations of queens caged under conditions as close to natural as possible. Similar techniques may be used to determine the activity of queens after hibernation and before nesting, when they are feeding and selecting nesting sites.

The pre-nesting period of leaf-cutter bees extends from the time they become adult in the spring to nesting during early summer. During this period data may be collected, by field observations, on relative numbers of males and females, courtship and mating, male rivalry, importance of food and water, and use and selection of resting sites.

Nesting Activity

The concealment of bee nests makes continuous observations on nesting habits in nature difficult. Intermittent examination of the nest should reveal the time spent by the bee or bees on nest construction, rate of egg laying, of larval development, method of feeding the larvae, relative numbers of the various forms and size of the bees as the season advances, and presence of parasites, predators, or inquilines.

Inducing Bombus queens to nest in artificial nests facilitates observations on nesting activity. Bumble bee queens have nested in pint sealers in cages. The change in the queen's behaviour and appearance as she becomes broody and forms cells can be observed readily. The manner in which she builds the cells, oviposits, broods the eggs, progressively feeds the larvae, and care for the brood should be noted. The time spent in egg, larval, and pupal stages may be determined.

Leaf-cutter females were induced to nest in glass tubes placed in holes bored in logs about 15 inches long. Part of the top of the log was made removable to watch the activity of the bee within the tube. Information obtained included: (1) cell construction: number, shape, and type of leaf cuttings, method of placing and cementing the cuttings, times required to obtain and to place them; (2) cell provisioning: number and time of pollen trips, method and time required to place the pollen, composition of pollen mass; (3) oviposition: time to oviposit, method of placing the egg, egg position; (4) sealing the cell: number and times of trips, type and shape of leaf cuttings, other material used, method of sealing; (5) closing the tunnel: number and type of leaf cuttings, other material, method of handling; (6) reaction of bee to other insect visitors, parasites, and predators.

Special rearing techniques must be used to determine the life history details of immature bees. The larvae of leaf-cutters were found susceptible to drowning in their food supply when their cells were moved. They were also attacked by molds if humidity was too high, and were very subject to desiccation if the humidity was too low. Group rearing may be conducted in petri dishes furnished with moistened plaster of Paris, sterile sand, or blotting paper.

Leaf-cutter females should be observed in the field to determine the time required to bore tunnels, and to learn the number of tunnels furnished with cells. Marking the bees on the thorax with quick-drying, bright-colored paints is an aid in following them from one tunnel to the other. Care must be taken to avoid getting paint on the eyes or the wing base. Several methods of marking are discussed by Linsley, MacSwain and Smith (1952).

## Relationships with Bloom

Synchronization of the blooming period with the main flight period of pollinators is an important factor in fluctuations of legume seed yields. Hobbs (1956) considered that better pollinating services of alfalfa by M. perihirta might be obtained by retarding growth by clipping so that blooming would begin about 30 days before the end of flight. Bees have definite flower preferences. Honey bees do not trip alfalfa to obtain pollen when they can obtain it from other sources. Some species of short-tongued bees cannot reach nectar in the long corolla tube of red clover. The flight periods and flower preferences are important considerations in determining the economic value of bee species as pollinators.

The flight ranges of the pollinators should be determined. Brian (1954) did considerable work on the foraging habits and flight ranges of bumble bees. The flight range may be estimated by determining how far from their colony marked bees may be collected while foraging, and by releasing marked bees at varying distances from their colony and seeing whether they are able to return home. The heavier yield of alfalfa near the edges of large fields suggests that leaf-cutter and bumble bees do not fly farther than necessary from their nesting sites to obtain food supplies.

## Summary

The method of studying the niche of a particular species is more commonly employed than studying the community as a whole. Habitat, physiology, behaviour in the field and in the laboratory, and population and distribution of the species should be studied simultaneously. Correct determinations are particularly important in a study of bees because of their similarities in appearance but differences in habits. To determine the importance of a species as a pollinator, its population, phenology, ability to pollinate, weather conditions under which it works, and flower preference must be known. A combination of field and laboratory studies must be used to determine the life history of each species, including, how it overwinters, pre-nesting activity, and nesting behaviour.

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## TRENDS IN CANADIAN BEEKEEPING

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### Introduction

Canadian beekeeping is becoming centered in the three western prairie provinces of Manitoba, Saskatchewan and Alberta. Twenty to thirty years ago Ontario and Quebec produced fifty to seventy-five per cent of the Canadian honey crop while in recent years their production has been little better than twenty-five per cent.

The average yearly Canadian honey production since 1952 has been 25.7 million pounds which is well below the thirty year average (1926-55) of 30.8 million pounds. As a result quantities of honey equal to and in excess of the difference in averages are being imported into Canada to supplement the declining production.

In some sections of Canada beekeepers are deriving income from the use of honey bees for pollination.

Beekeepers and Colonies

Number of Beekeepers averaged for 5 year periods 1926-55
D. B. S.

| | Mar. | Que. | Ont. | Man. | Sask. | Alta. | B. C. | Canada |
|---|---|---|---|---|---|---|---|---|
| 1926-30 | 704 | 7878 | 8420 | 1934 | 1114 | 174 | 2676 | 22,860 |
| 1931-35 | 636 | 6486 | 8830 | 2626 | 2028 | 568 | 2988 | 24,160 |
| 1936-40 | 712 | 6716 | 8160 | 3308 | 3910 | 1454 | 3076 | 27,340 |
| 1941-45 | 994 | 5730 | 6356 | 3270 | 7828 | 6564 | 4070 | 34,800 |
| 1946-50 | 1016 | 5030 | 5250 | 3322 | 8344 | 7222 | 2326 | 32,480 |
| 1951-55 | 796 | 3538 | 3790 | 1366 | 2638 | 1652 | 1710 | 15,568 |
| *1956 | 740 | 2890 | 2830 | 1200 | 2650 | 1800 | 1830 | 13,940 |

* preliminary estimate

Number of colonies averaged for five year periods 1926-55
D. B. S.

| | Mar. | Que. | Ont. | Man. | Sask. | Alta. | B. C. | Canada |
|---|---|---|---|---|---|---|---|---|
| 1926-30 | 3614 | 103,711 | 168,400 | 31,606 | 4,862 | 3,834 | 18,978 | 335,000 |
| 1931-35 | 3067 | 76,616 | 186,000 | 36,980 | 10,050 | 7,890 | 22,062 | 342,680 |
| 1936-40 | 3130 | 71,554 | 198,800 | 56,746 | 25,410 | 16,268 | 21,068 | 391,140 |
| 1941-45 | 4418 | 84,730 | 204,800 | 49,562 | 53,464 | 42,860 | 23,646 | 463,460 |
| 1946-50 | 5714 | 83,660 | 229,100 | 10,800 | 58,256 | 67,160 | 16,060 | 520,740 |
| 1951-55 | 4838 | 62,640 | 178,020 | 39,140 | 26,880 | 34,560 | 13,160 | 359,240 |
| *1956 | 4600 | 51,600 | 153,900 | 40,000 | 27,000 | 48,000 | 17,000 | 342,300 |

* preliminary estimate

Prior to 1920 most of the beekeepers and colonies were situated in Ontario and Quebec. From 1920 to 1939 a gradual expansion of the industry took place throughout Canada. The largest increases were in the prairie provinces where package bees became extensively used. From 1939 to 1945 the increased demand for honey to supplement and replace sugar which was rationed because of the war, coupled with high honey prices, induced many into beekeeping. As a result the number of beekeepers and colonies increased substantially.

In the post war years 1945 to 1948 the numbers remained at the high level reached during the war but dropped quite rapidly following this period and the numbers continued to decline until 1955.

The reduction in the number of beekeepers after 1948 was not proportional to the decrease in colonies as a trend towards specialization began to take place. While many small beekeepers were going out of business some of the larger beekeepers were increasing. Large amounts of unused bee equipment obtainable at low prices enabled larger beekeepers to increase the size of their operations. This trend towards specialization which took place largely in Western Canada has continued up to the present. The majority of colonies in Canada today are operated by approximately five hundred large commercial beekeepers, who manage three hundred to two thousand colonies each.

The average number of colonies per beekeeper in 1955 was 22.8 as compared to 12.3 in 1945.

In all provinces except Ontario and Quebec the number of beekeepers and colonies has remained relatively constant since 1952 with some increase more particularly in colonies taking place the last two years. In Ontario and Quebec, however, both the number of colonies and beekeepers has continued to decline. The change in these two Provinces may best be explained by a statement made by G. F. Townsend, Provincial Apiarist for Ontario and Head of the Apiculture Division at the Ontario Agricultural College, Guelph, in a brief on Ontario honey production.

"Honey production depends upon a large acreage of suitable honey plants. The most important plants in the past have been alsike clover, sweet clover and buckwheat, with basswood in some years. The sweet clover acreage reached a peak of more than 400,000 acres in 1928 and gradually decreased until in 1947 there was slightly over 100,000 acres and from then on it became so insignificant that statistical records were no longer taken. The same situation existed with the alsike which in 1929 approached almost 200,000 acres and declined to about 30,000 acres in 1942 and showed very little increase, so that records on acreage were dropped in 1947. A similar situation exists with buckwheat which in 1929 reached a total acreage of nearly 300,000 and while there have been large yearly variations there has been a gradual decrease in production until in 1952 it reached a low of approximately 60,000 acres.

During the same period woodlots and fence rows have been removed; most of the basswood trees have been cut down; roadside spraying has destroyed most of the clovers that might be growing wild; and the type of Agriculture has been intensified by the use of balers and forage harvesters thus removing most of the clovers as they come in bloom. During this period there has been a very great increase in the cash crop areas of southern and Western Ontario.

From 1920 to 1955 there have been gradual changes in hay and pasture mixtures. In the '20's sweet clover was recommended extensively, but in the '30's, owing to increased knowledge concerning the growing of alfalfa and the inroads of sweet clover root rot and sweet clover weevil, alfalfa gradually supplanted sweet clover in the hay and pasture mixtures.

During this period alsike was also recommended extensively, but in the early '40's the alfalfa variety, ladino, was introduced and gradually took the place of alsike in the general mixtures, except in the low lying poorly drained areas.

It now appears that birdsfoot trefoil along with ladino will completely replace alsike.

It will thus be seen that there has been a gradual change in the type of clovers grown in hay and pasture mixtures.

All of this has had its effect upon the beekeeping industry. The clovers which are grown extensively now, such as red clover and alfalfa, are very dependent upon good weather conditions for honey production, with the result that good honey years are fewer and farther between and the low production years are much lower than they ever were before."

Although similar changes have taken place in the western provinces it has not been quite so extensive. Beekeeping had never reached the saturation point in these provinces so that honey production could maintain its level and even increase. In western Canada good production per hive and a strong demand for honey at a rewarding price has encouraged persons into keeping bees in recent years and in particular has induced beekeepers to increase the size of their operations.

## Honey Production

Honey Production (lbs) averaged for five year periods 1926 - 1955 D. B. S.

| | Mar. | Que. | Ont. | Man. | Sask. | Alta. | B. C. | Canada |
|---|---|---|---|---|---|---|---|---|
| 1926-30 | 135,000 | 4,045,800 | 14,140,000 | 3,364,800 | 436,800 | 472,600 | 996,200 | 23,681,200 |
| 1931-35 | 114,800 | 3,995,600 | 20,019,000 | 4,601,800 | 930,800 | 1,013,000 | 1,223,600 | 31,498,600 |
| 1936-40 | 160,600 | 4,312,000 | 17,137,200 | 6,699,000 | 2,903,400 | 2,165,600 | 1,282,200 | 34,660,000 |
| 1941-45 | 284,600 | 4,291,200 | 14,564,400 | 4,549,200 | 4,996,400 | 4,110,000 | 1,213,400 | 34,009,200 |
| 1946-50 | 278,000 | 3,776,000 | 10,229,400 | 5,598,400 | 5,511,600 | 6,726,800 | 927,800 | 33,058,000 |
| 1951-55 | 327,600 | 4,001,000 | 11,706,200 | 4,562,000 | 2,888,600 | 4,100,600 | 1,094,800 | 28,680,800 |
| *1956 | 379,000 | 2,941,000 | 7,541,000 | 5,360,000 | 3,753,000 | 4,772,000 | 1,564,000 | 26,310,000 |

* preliminary estimate

Production Per Hive (lbs) averaged for five year periods
1926 - 1955 D. B. S.

| | Mar. | Que. | Ont. | Man. | Sask. | Alta. | B. C. | Canada |
|---|---|---|---|---|---|---|---|---|
| 1926-30 | 40.2 | 40 | 83.8 | 104.2 | 95.6 | 117.6 | 52.6 | 70.6 |
| 1931-35 | 41.1 | 54.8 | 106.4 | 128.8 | 73.8 | 135.6 | 55.4 | 92 |
| 1936-40 | 55 | 60.4 | 86 | 121.8 | 115.8 | 138 | 60.8 | 88.8 |
| 1941-45 | 66.6 | 50.8 | 71.8 | 92 | 93.6 | 899 | 52 | 73.8 |
| 1946-50 | 51.6 | 45.8 | 44.2 | 96 | 99 | 100 | 57.8 | 63.4 |
| 1951-55 | 73.2 | 64 | 63.8 | 117.2 | 109.4 | 118.6 | 83.4 | 76.8 |
| *1956 | 86 | 57 | 49 | 134 | 139 | 99 | 92 | 77 |

* preliminary estimate

Ontario is still the largest honey producing province in Canada but its production has exceeded that of the western provinces by only a slight margin in recent years. Manitoba with the exception of the five year period 1946 to 1950 when Alberta had an average of over 6 million pounds has been the second largest honey producing province. Ontario and Quebec production has continually declined for 25 years.

British Columbia and the Maritime provinces produce only a small percentage of the Canadian crop and their production has not fluctuated greatly over the years.

The greatest percentage of Canadian honey is produced from clovers and is white in colour. Most of the dark honey in Canada is produced in Ontario and Quebec and has represented quite a high percentage of their crops in some years. Since 1953 Manitoba has been producing a million pounds or more of dark buckwheat honey.

The average production per hive has been highest in the three prairie provinces with Alberta having the higher yield per colony of the three.

In 1938 Canada produced 45.7 million pounds and in 1948 45.1 million pounds. The lowest production in the past 30 years was in 1954 when only 19.8 million pounds were produced.

Some Canadian Beekeeping Records

averaged for five year periods 1926 - 1955 D. B. S.

| YEARS | BEE IMPORTS $ | HONEY IMPORTS lbs. | HONEY EXPORTS lbs. |
|---|---|---|---|
| 1926-30 | 67,565 | 81,509 | 1,695,413 |
| 1931-35 | 98,665 | 26,075 | 2,317,536 |
| 1936-40 | 193,645 | 600,813 | 5,018,046 |
| 1941-45 | 463,631 | 905,981 | 1,222,488 |
| 1946-50 | 674,786 | 1,330,447 | 172,572 |
| 1951-55 | 328,376 | 2,112,427 | 335,755 |
| 1956 | 469,973 | *1,505,535 | **122,358 |

* 6 months ** 7 months

Honey Exports

Up until 1940 Canada had a substantial export trade for honey. Over 10 million pounds were exported in 1940. The largest buyer was the United Kingdom and the purchases were almost entirely white honey. A small percentage of the pre war sales were dark or buckwheat honey going to Western European countries such as the Netherlands and Germany.

The outbreak of war and subsequent curtailment of shipping space followed by the post war period of dollar shortages practically eliminated honey from the export market with the exception of small quantities to the United States.

There is still no export market for white honey to the United Kingdom but small quantities of buckwheat honey from Ontario and Manitoba have been going to Western Europe in recent years.

Honey Imports

Up until 1940 imports of honey into Canada were negligible. During the war years when sugar was in short supply and rationed and throughout the post war period when prices were high there was a substantial volume imported. This honey originated mostly in Mexico, Central and South American countries and the West Indian Islands. With the removal of price controls in June, 1947, and sugar rationing in November the importation of honey again became negligible. Some of the honey imported from 1940 to 1947 was used for domestic sales but most was utilized industrially. During the war, industry was forbidden the purchase of Canadian honey unless it had been doing so prior to 1939. No price control was established on imported honey.

From 1947 to 1953 imports of honey were negligible because markets were well supplied with Canadian honey. In 1954 over 4 million pounds were imported chiefly from the United States to supplement the Canadian production which was not sufficient to supply demands. In 1955 imports were in excess of 5½ million pounds and 1956 figures when compiled may indicate over 7 million pounds imported. The honey imported since 1954 has been largely done by commercial packers in British Columbia and particularly eastern Canada for blending and packing in consumer containers. Some liquid honey packed in glass has also been imported from the U. S. Most of the honey comes from the north central United States as it is similar in colour and flavour to Canadian honey.

Honey Marketing

Honey Prices Per lb. averaged for five year periods
1926-1955 D. B. S.

| | Mar. | Que. | Ont. | Man. | Sask. | Alta. | B.C. | Canada |
|---|---|---|---|---|---|---|---|---|
| 1926-30 | 13.1 | 13.6 | 8 | 12.4 | 18.8 | 16.4 | 18.6 | 10.4 |
| 1931-35 | 12.4 | 9.8 | 7 | 7.4 | 11 | 9.2 | 13.2 | 8 |
| 1936-40 | 13.9 | 10.4 | 8.4 | 7.4 | 9.2 | 8.6 | 15.4 | 8.8 |
| 1941-45 | 16.6 | 16.8 | 13.8 | 13 | 14.4 | 14 | 19 | 14.2 |
| 1946-50 | 25.4 | 22.8 | 18.6 | 18.2 | 17 | 16 | 22.2 | 18.4 |
| 1951-55 | 21.8 | 19.8 | 16.6 | 13.8 | 14.8 | 13.8 | 20.6 | 16.4 |

Canadian honey production up until 1925 took place largely in Ontario and Quebec. Honey from these two provinces was marketed throughout Canada. By 1925 Manitoba was producing sufficient honey to supply its own needs and exported honey in 1926 to other western Provinces. Similar growth of beekeeping in Saskatchewan resulted in that Province having surplus production by 1936 and finally Alberta by 1939. Ontario honey which, by 1939 was no longer being marketed on the prairies, however, did maintain command of the British Columbia market and surplus honey from the prairies was exported to Europe.

During the war years Ontario pulled out of the British Columbia market and it was taken over by the Prairie provinces. After the war the British Columbia market was taken over by Alberta and Saskatchewan. Ontario did not re-establish a market in British Columbia after the war because of lower production, competition and a non competitive freight rate which had been in existence before the war. After the war Manitoba commenced exporting its surplus honey entirely to the eastern Canadian markets. Saskatchewan also started shipping some honey east.

The discontinuance of sugar rationing in 1947, lack of an export market, high production and competition from other sweets brought about an acute marketing problem. For the first time Canada had to sell its production within its own boundaries. Honey prices dropped sharply and a record production of over 38 million pounds in 1948 resulted in a surplus of honey. The Federal Government purchased three and a half million pounds of honey in 1949 to relieve the situation. By 1951 this honey was marketed through normal channels.

Honey prices which dropped sharply in post war years declined until 1952 and then recovered and increased slowly to their present level.

In 1954 a poor Canadian crop with a relatively high price for honey enabled packers to import honey into Canada and maintain their markets. The importation of honey has increased since and is likely to continue as long as the price relationship remains the same.

The bulk of the Canadian production is now handled by packing organizations, and producers concern themselves largely with production. Specialized production coupled with higher grade requirements of the packed product also contributed to the change in marketing.

Honey is no longer being sold in large containers. Eight pound containers have become obsolete and four pound containers less common each year. Packs of two pounds or less are becoming increasingly popular.

Food marketing is now being done extensively through large chain stores. These organizations want continuity in supply of a standard product which most beekeeper producers are not able to provide.

Most honey in Canada is sold in tin or paper containers and as granulated honey. In recent years sales of liquid honey in glass have increased.

Industry makes use of some honey, largely the bakery trade.

Beeswax

The production of beeswax is in direct proportion to the honey crop and consequently is subject to the same fluctuations. For statistical purposes a production of one and one half pounds of beeswax to every one hundred pounds of honey is produced is usually considered nearly correct. Beekeepers at the present time are receiving approximately 55 cents per pound for unrefined beeswax. The price has increased quite gradually and consistently over the past 30 years from 25 cents a pound to the present level.

Canada imports annually a substantial amount of beeswax as the domestic production is insufficient to take care of the requirements of both the beekeeping industry and trade. The largest amount ever imported was in 1955 when 458,000 lbs. was brought in. Most of this was imported from the United States with smaller amounts coming from such places as Chile, Brazil, Cuba and the United Kingdom. The average annual importation of beeswax for the ten year period 1946-1955 was 272,000 pounds.

Pollination

The modern trends towards specialization in all phases of Agriculture has increased the value of honey bees for pollination. Wild pollinating insects with their numbers being reduced because of modern agricultural practices can not be relied on to pollinate the extensive acreages of fruit and seed crops grown today.

In the fruit growing areas of British Columbia, Ontario and Quebec and the Maritimes honey bees are being used extensively for pollination. Beekeepers rent out their colonies to the growers at a set rate per colony or so much per acre of crop.

Although the value of honey bees in the pollination of clovers and legumes is well recognized by seed producers beekeepers as yet are not receiving renumeration to any great extent from seed growers. Beekeepers today are largely interested in honey production so that seed producers usually have their crops well supplied with pollinators without offering any financial inducement to the beekeeper.

Conclusions

Future expansion in Canadian beekeeping is likely to take place in Western Canada.

The marketing of Canadian honey will be influenced by the relationship of American and Canadian honey prices.

With honey production centered in Western Canada some distance from the large eastern markets, problems in marketing could develop which may not appear warranted.

Some beekeepers will receive all or part of their income from pollination as the demand for honey bees for this purpose increases.

Beekeeping is a firmly established Agricultural industry in Canada.

REFERENCES FOR DOMINION BUREAU OF STATISTICS

figures on beekeeping

Crop and Seasonal Price Summaries

Canada Department of Agriculture

Market Information Section, Ottawa

Volume 9 1955 - 56 - Part I

Volume 6 1952 - 53 - Part I

Fruit, Vegetable and Honey Crop and Market Report

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## INSECT PROBLEMS OF WINDBREAKS AND ORNAMENTAL PLANTINGS

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### INTRODUCTION

For half a century federal nurseries in Saskatchewan have produced and distributed planting stock of various species of coniferous and broadleaf trees for windbreaks on farms in the Prairie Provinces. For much of this period trees have been available also to schools, churches and for cemeteries. The total distribution from this source exceeds 259 million broadleaf trees and seven million conifers. The number of farms in the Prairie Provinces receiving trees during this period is estimated at 100,000.

In addition to the output by federal nurseries, private nurseries have supplied the needs for shade and ornamental plantings in towns and cities. As a result of this joint program numerous farmstead windbreaks, many hundreds of miles of roadside and field shelterbelts and numerous ornamental plantings in towns and cities have come into being. The economic advantages which have accrued from this program of tree planting can be conjectured only. It would be impossible to state the benefits derived through conservation of moisture, prevention of wind erosion, protection of home gardens and orchards, shelter for man and beast. Likewise, the asthetic values which have made life more pleasant for humans are great.

Most of the tree species used in windbreaks on farms are indigenous; some are introduced but with qualities peculiarly adapted to our prairie and parkland zones. The species provided at the present time by the federal nurseries are Scots pine, white spruce, Colorado spruce, boxelder, green ash, American elm, willow, poplar and caragana.

The purposes for which trees are grown in the agricultural areas of the Prairie Provinces make them especially valuable to the planters. Consequently any agencies which endanger the well-being, or detract from the appearance of plantings are regarded with disfavour.

## DESTRUCTIVE SPECIES

When tree planting was first begun it is questionable if anyone had surmised the role that insects including mites would play in the growth and well-being of these farmstead and ornamental plantings. It was only after many years that the destructive potentialities of several species became evident. The species which have proved harmful to date can be classified roughly into three groups.

The first group includes such major forest pests as the larch sawfly, spruce budworm, leaf beetles, tent caterpillars, etc. During periods when these species are epidemic in native stands, increased damage from them occurs also in windbreaks and other plantings. At the present time this parallel relationship is exemplified in the larch sawfly and the spruce budworm. Both are more than usually abundant in forest areas in the Prairie Provinces, and, in the last two or more seasons, have caused greater defoliation of larch and spruce in plantations that normally occurs. The outbreaks of such forest pests are cyclic in nature being governed by environmental pressures which are operative over broad regions. Their decline in forest stands is accompanied by a marked decline in plantations. To date such species have not created the greatest problem in the protection of plantations from insects.

More important than these major forest pests are several widely-related species which constitute a second group. These are, more or less, endemic in the forest but rarely destructive. Striking examples of this group are the yellow-headed spruce sawfly, the balsam fir sawfly, the pine needle scale, the spruce spider mite, cankerworms, wood borers, aphids, etc. These species can become very abundant in windbreaks and on shade trees and cause serious damage if they are not checked. Like major forest pests, these species fluctuate in abundance, but such fluctuations may vary greatly in degree and extent for a single species. The limited sizes of the windbreak habitats, which make them vulnerable to rapidly-changing environmental conditions, and the great distances which often separate them, undoubtedly are important contributory factors in these fluctuations. The fall cankerworm is one of the more important species of this group, investigated in some detail, that exhibits this kind of fluctuation. Some species in this group of which the pine needle scale is the best example are very persistent despite climatic changes. Still others, amongst which are the cecropia caterpillar, blister beetles, some leaf rollers, may become very numerous and then decline to such small numbers throughout an entire zone or region as to appear quite absent, and remain at this low population level for several years. In the late 1930's and early 1940's blister beetles were very numerous in southern Manitoba and Saskatchewan, and the cecropia caterpillar was abundant and destructive in south-western and mid-western Saskatchewan and in south-eastern Alberta. The declines in population levels of these species which set in following the early 1940's were general and continuous throughout the regions concerned until these pests seem to have vanished from the insect fauna of the prairie provinces.

A third group is comprised of those pests which, to date, are not found on forest trees and which attack only trees and shrubs that have been imported. The principal members of this group have been the caragana aphid and four or five species of blister beetles.

## APPLIED CONTROL INVESTIGATIONS

The prominent place that insects have occupied as agencies detrimental to the well-being of windbreaks and ornamental plantings has resulted in demands by the general public for information on applied control. Investigative work was undertaken to meet these demands. In applied control, chemical measures, more specifically spraying and dusting with insecticides, have been considered the most applicable, largely because the results are evident soon after the remedial measures have been applied. Except for very local situations, spraying has taken precedence over dusting. The low relative humidities and the prevalence of winds, in the prairie zone especially, interfere with the satisfactory application and adherence of dusts. Over the years the quantity of work on chemical control of windbreak pests has been considerable. The numerous insecticides placed on the market during and since World War II have stimulated greatly this kind of investigation. Most of this work has been carried out in Saskatchewan because of the location of the laboratory at Indian Head and because pest problems in windbreaks and ornamental plantings have been more serious in Saskatchewan, perhaps, than in Alberta or Manitoba. In the investigation of methods of artificial control the immediate objectives were to ascertain that available chemicals were toxic to the various pests yet non-toxic to the host plants, at what concentrations should they be used and when and how should they be applied to bring about the greatest reductions in the current populations. These objectives are similar to those which until more recent years, prevailed in insecticidal investigations undertaken to control orchard pests. The principal species or groups of windbreak pests involved in experimental work on chemical control are the spruce and larch sawflies, spruce spider mite, pine needle scale, spruce aphids, boxelder aphid, caragana aphid, cecropia caterpillar and blister beetles.

For many of the foregoing species investigations of life history and seasonal occurrence were carried out. This work was necessary in order to determine the most vulnerable stage of a pest and the time when a treatment would have its maximum effect on the current population level.

Strange as it may seem, one of the difficulties attendant upon investigation of insect pests on windbreaks has been to find suitable study sites. Few owners of infested windbreaks are willing to permit an infestation to continue unchecked so that information of a bionomic nature can be obtained. What the owner wants is cessation of the damage as quickly as possible. Occasionally, on vacated farmsteads opportunities for bionomic investigation extending over a period longer than one year have occurred.

Added to the difficulty of finding suitable sites for bionomic investigation has been the problem of evolving acceptable techniques for evaluating the effects of applied treatments. This problem is still a very real one. Windbreaks and ornamental plantings are limited in size and are usually widely separated. Consequently the replication of treatments with adequate checks on one site or on several sites is impossible at times. Too often there has been a wide gap between what should be done and what could be done in a given situation. The methods used have been determined by the species involved, type and availability of experimental material, weather conditions, and amount of effort which could be provided at any given time.

In the following paragraphs comments are made on some species for which chemical control investigations have been undertaken. The remarks are purposely general. The names of insecticides and miticides are given but no attempt is made to state the formulations used or the strengths of the treatments applied.

For aphids, reductions in population levels resulting from chemical treatments have been arrived at by estimation and by actual counts before and after treatment on treated and check trees. Just what percentage reduction in the population level is necessary for control of an aphid infestation on trees is open to debate. Certainly it would differ with the species and with the time of season. The caragana aphid, and the boxelder aphid on Manitoba maple, have been the most serious. These species are well exposed on the foliage. On the basis that 98% reduction in the population level was necessary for significant results, DDT, lindane, parathion and TEPP were effective against the boxelder aphid but only parathion and TEPP were effective against the caragana aphid. Malathion was not tested at Indian Head but a perusal of literature shows that it is recommended for use against a variety of aphid species (4, 12). Since winds and low temperatures adversely affect results obtained with nicotine sulphate, this material is not a good one for use in windbreaks in the Prairie Provinces. We have made no efforts to control the woolly apple and the woolly elm aphids on American elm. These species curl the leaves and are difficult to treat. In the United States (4), on shade trees, thorough spraying with DN (dinitro ortho cresol) during the dormant season to destroy the eggs or spraying with lindane or malathion in the spring soon after the insects have reached the foliage has proved effective.

The spruce spider mite has six or more generations yearly. Consequently there is an increasing overlapping of developmental stages as the season progresses. Since the dead mites persist on the twigs there is also an increasing abundance of them to take into consideration in control experiments. Using twig samples at Indian Head it has been possible to ascertain mite populations with reasonable accuracy. In field tests very high mortalities have been obtained with aramite and ovotran sprays. These miticides have replaced lime sulphur in current control recommendations (10, 13, 14). Aramite has a long residual life; ovotran acts also as an ovicide. The use of malathion is also advocated (12) but has not been tested at Indian Head. In perusing literature it was interesting to note that spraying with a glue solution to control mites on spruce trees still finds favour (14). In the 1930's reasonably extensive tests at Indian Head with glue preparations yielded very low kills.

The pine needle scale is the most important pest of spruce in windbreaks and in ornamental plantings in the Prairie Provinces. On no other insect have so many man-hours by personnel of the Indian Head Laboratory been devoted to its investigation; and on no other insect have so many chemicals been used in the search for a scalicide that might be reasonably satisfactory. In its destructive stages the pine needle scale is a sedentary species, except for a short period immediately after hatching. Unless predators are present there is, for sampling purposes therefore, very little loss of either living or dead individuals once the crawlers have settled on the needles. For much of the experimental work with chemicals, data on mortality have been obtained by picking of needles to form samples and counting the living and dead scales on them, or arbitrarily deciding the number of scales which should be adequate for a sample and then examining needles until this number had been reached. This latter method was used by Proverbs (11) in 1955 in assessing results from tests on ponderosa pine in the Okanagan Valley, B. C. More recently at Indian Head, another method of sampling population distribution and abundance of the pine needle scale on spruce has been tried out and found superior to all former methods used. The needles on spruce are arranged in spirals on the twigs. In a very high percentage of the samples examined during the past season five spirals were found to occur. By drawing off the needles in one spiral theoretically 20 per cent of the scale population on the twig irrespective of age of the growth was accounted for. This method eliminated much of the personal element involved in previous methods. It provided relative data for the various years' growths and it standardized sampling so that data compiled by various investigators were comparable.

At the present time spraying with malathion is recommended to control the pine needle scale in windbreaks and ornamental plantings in the Prairie Provinces (8, 12). Earlier measures advocated spraying with dry lime sulphur or miscible oils (7); these treatments have many undesirable qualities not associated with malathion. In Wisconsin, liquid lime sulphur used as a dormant spray and DDT and malathion applied against the crawlers, are recommended (14). Proverbs (11) in tests on ponderosa pine in the Okanagan Valley obtained good control of all stages of the pine needle scale with liquid lime sulphur sprays. He obtained 100 per cent control of the nymphs with two treatments of malathion or diazinon spaced one month apart, but found these insecticides were less effective against the mature scales. At Indian Head and Saskatoon, Saskatchewan very marked decreases in egg deposition resulted from parathion and malathion sprays applied in August against the mature females before egg-laying had begun. At the present time this treatment shows considerable promise.

In the investigation of chemical control, sawfly species on spruce were easier to carry out field tests on than most other pests encountered in windbreaks and ornamental plantings. Except in the late larval stage the larvae of sawflies are not readily dislodged from the foliage. In tests conducted on tall trees, populations on unit lengths of branches were determined before the treatments were applied and again at the conclusion of the exposure period. Reductions in population levels below those occurring on untreated trees were attributed to the treatments applied. On small trees another method was used. The pre-treatment counts were omitted. Immediately after a treatment was applied, ground sheets were spread under the treated and check trees to catch all the larvae which dropped. These were gathered at regular intervals and placed in rearing for information on recovery. At the conclusion of the exposure period all living and all dead larvae remaining on the treated and check trees were collected and counted. This method yields data on the speed of action of a treatment on a species, and on the various larval stages present at the time of application.

Using the foregoing methods high mortalities in the yellow-headed spruce sawfly larval populations were obtained with lead arsenate, DDT, BHC, parathion, aldrin, toxaphene, chlordane and pyrethrum sprays, and in preliminary trials, with DDT, derris, and pyrethrum dusts. Several of these insecticides are currently recommended for the control of this sawfly and the balsam fir sawfly (1, 9, 14). The effectiveness of malathion on spruce sawflies in windbreaks has not been investigated. Since parathion is lethal in very small doses, however, there is no reason to believe that malathion would not yield effective results. In a preliminary test on the larch sawfly it was very effective against the larvae and destroyed many of the eggs.

In contrast to some geometrids cankerworm larvae are easily dislodged from the foliage, especially the later instars (8). This escape response is particularly evident on warm, calm days. Because of this reaction larval population levels on the larger trees used in the control investigations were ascertained from branch samples collected before the treatment was applied and again from similar samples taken at the end of the exposure period. On small isolated elm trees no pre-treatment counts were made and ground sheets were spread under the tree canopies immediately after treatment to catch the larvae which dropped. In these tests it was necessary to collect the larvae from the ground sheets, at short intervals to avoid losses from the check trees.

In the experiments on chemical control, lead arsenate, DDT, toxaphene, chlordane, parathion and pyrethrum sprays were very effective in reducing current larval populations of the fall cankerworm. The exposure periods in hours required to bring down 90 per cent of the larval populations were: DDT, 10; chlordane, 15; parathion, 20; toxaphene, 40. The results with BHC sprays, even extremely high concentrations, were consistently very poor (6). At the present time DDT and lead arsenate sprays are generally recommended treatments in the Prairie Provinces (6) and in the United States (3, 4).

Some comment is in order at this time on the use of tree-trunk sprays and tree-banding materials to control cankerworms. Spraying the basal eight to ten feet of the tree trunk with DDT in the fall has been found satisfactory in the Maritimes (15). It is primarily intended for large trees which cannot be treated with foliage sprays effectively. This control measure has also been recommended for use in windbreaks in the Prairie Provinces (6). Despite this latter recommendation tree-trunk spraying has limitations. Very often windbreaks have sucker shoots or other low growth in them on which the cankerworm moths will oviposit quite readily. It is not possible to prevent oviposition occurring on such growth by covering it with a poison. This low and often dense growth also makes the use of tree-banding materials impractical in windbreaks. Undoubtedly, measures such as tree-trunk spraying and the use of tree-banding materials have a place in the over-all program of cankerworm control but are intended for unique situations rather than as a general practice.

In this presentation I have dealt deliberately in generalities believing that there is more to be gained at a meeting such as this by sketching the broader field than detailing a small segment of it.

Also, I have made no reference to natural control agencies. By this omission I do not wish to imply that these are not important. On the contrary they are known to be very important in the protection of windbreaks and ornamental plantings. The future fruitful research on many of the known species infesting windbreaks and ornamental plantings will not be to go on adding to the list of contact and stomach poisons effective against them and to refining the dosages required, but to investigate the epidemiology of these species so that when insecticides are used their effects on the beneficial components as well as on the destructive species in a habitat can be ascertained.

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# A Report on an Insecticidal Resin Developed in the United Kingdom

by

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The insecticidal resin concerned in this report is an urea formaldehyde surface coating incorporating an insecticide or combination of insecticides, which produce a highly active "bloom" or surface crystallization. The insecticide is in the form of minute needle-like crystals 10 to 20 microns in length. These shatter readily to 5 to 10 micron fragments, the ideal size for pick up by many insects. The surface is maintained in this highly insecticidal condition over long periods of time. In the laboratory, surfaces containing dieldrin or DDT remained effective four or five years; in practice under the most severe conditions, for example, ship galleys, they were effective for over two years. When I first learned of the laboratory experiments, I obtained samples of the material with which to personally carry out some tests.

The semi-permanent nature of the insecticidal efficiency of this coating aroused a great deal of interest. It was hoped that the use of a prophylactic treatment that would maintain the treated surface at peak efficiency over an extended period of time, would minimize the danger of establishing resistant races. This treatment provided a safe means of using toxicants with high mammalian toxicity, as only a small percentage of the insecticide is available from the surface at any one time. It also permitted long term control with contact insecticides under the severe conditions of high humidity and temperature, grease deposit and constant washing encountered in ship galleys and food preparation areas in general. In addition, a range of insecticides could be incorporated in the resin to produce formulations for specific, specialized purposes.

Investigations were carried out with the well-known insecticides, DDT, gamma BHC, dieldrin, aldrin, pyrethrum and allethrin. DDT and dieldrin produced solid crystal structures on the surface. Gamma BHC and aldrin came off in the vapor phase and provided excellent fumigant effect. Crystallization occurred only when these materials were added in excess. Both natural and synthetic pyrethrins with or without the addition of synergists, proved too unstable to be of any practical benefit. The insecticides whether used in the pure or technical grades were always added in the proportion of the active isomer.

The history of this project is rather interesting. As you know, the International Quarantine Organization lays down safeguards against the transportation of insect vectors of disease from one area to another. One standard control method used in aircraft against vectors of malaria and yellow fever is the release of aerosol spray. In London, we had carried out extensive trials in aircraft to develop a suitable low-pressure aerosol bomb for the World Health Organization. Killing the insects was just one of our aims. Because aircraft were flying at higher and higher altitudes the danger of damage to perspex porthole coverings and plastic used in the structure increased. A blow-out at 30 to 50 thousand feet may kill all on board. Therefore a formulation had to be designed to prevent plastic deterioration. Most of the commonly used solvents caused severe crazing of perspex, however, we eventually solved this problem. Dosage rates were calculated to ensure complete kill of all insects of medical importance. The disinfestation, of course, had to be carried out as soon as the aircraft landed and before passengers and crew were discharged. The disinfestation period lasted ten or more minutes during which the personnel had to remain aboard under a blazing tropical sun at temperatures of 110° F. or higher. Although the bomb is efficient if used at recommended dosage rates, invariably, in many countries it is placed in the hands of a native and the result can be ineffective. Sometimes an over-enthusiastic native sprayed not only the plane but also the passengers and crew with devastating results. To minimize the possibility of inefficient application control with insecticides that had long lasting residual action was indicated.

The Colonial Office had a more pressing problem with internal aircraft in the Colonies. Planes parked on jungle airdromes in active malaria and yellow fever areas, could transport large numbers of infected mosquitoes (Aedes, Anopheles) to malaria-free areas. The aircraft are parked with all doors and windows open; maintenance is very often done in the cool of the night, when artificial light, human activity, odor of oil and gas provide attractive stimuli for the mosquitoes. Colonial Office entomologists were interested in adapting the work of West and Campbell, Barnes in the United Kingdome, Lindquist and co-workers, and Block in the U.S.A., Gilmore in Australia, Harrison in New Zealand; these workers were interested in surface coatings of one form or another incorporating insecticides.

The Colonial Office gave the problem of investigating the "blooming" effect of surface coatings incorporating insecticides to Mr. Paul Bracey and stationed him at their Porton establishment under A. D. Hadaway. A survey of literature disclosed that urea formaldehyde resin plasticized with a castor oil alkyd resin was the most promising vehicle. A series of formulations were tried and from these evolved a standard formula that gave reproducible results. In industry, these resins are used on expensive furnishings etc. and are normally heat cured to the required hardness. However, with the addition of an acid accelerator, the coating may be air dried to the desired consistency. Generally, these experiments showed that an increase in the hardness of the film decreased the "blooming effect". The softer films produced a more profuse "bloom". A standard formulation for comparison and testing purposes was agreed upon as follows:

| | | |
|---|---|---|
| | Urea formaldehyde resin | - 50 parts by weight |
| | Castor oil alkyd resin | - 50 parts by weight |
| Solvents | n(Butanol | - 27.5 parts by weight |
| | (Xylol | - 22.5 parts by weight |
| | (Insecticide | - % as required |

The acid accelerator, 10 per cent concentrated sulphuric acid in n-butanol was added just prior to application in the proportion of 1 part accelerator to 20 parts lacquer. This formula has a clear lacquer finish that can be applied over most surfaces to give excellent protective qualities. It is fire resistant and passes the requirements laid down by B.O.A.C. for aircraft. The "bloom" in the formulation using dieldrin is unnoticeable to the naked eye. The lacquer is applied at about 1 oz. of solution per square yard. In a formulation containing 5% insecticide the actual amount of insecticide in the dried film is 84 mg. per square foot. In laboratory tests with dieldrin we used solvent to remove all surface insecticide, and recovered 4.72 to 9.25 mg. per square foot. This was the largest amount obtained that was available on the surface at any one time. The last permitted rate I have for dieldrin in house-spraying for malaria control in the tropics is 60 mg. per square foot. Fifty mg. per kilogram of body weight is the estimated lethal dose for humans. To absorb this dose a 30 pound child would have to completely remove and absorb the heaviest dosage possible from 122 square feet. After working constantly with the dieldrin formulation for a number of years, neither myself nor my men showed any symptoms of dieldrin poisoning or other ill-effects.

After checking Bracey's laboratory work, I was convinced that large scale field trials should be undertaken. At this time I was employed by the Fungicide and Insect Research Co-ordinator Service for the Commonwealth and we carried out extensive liaison duties. We found that none of the large entomological research establishments could fit these proposed field trials into their programs. I felt that the potential value in the control of insects by this improved technique was too important to leave its practical application to chance. Although lacking money and facilities, I decided to carry out the necessary field trials myself. With borrowed materials, equipment and, initially, personnel from my own staff and the London Port Authority, we managed to complete the project. Conforming with local practice, we formed a small working committee and selected three trial formulations, two being combinations of BHC and DDT, and one of aldrin and dieldrin.

(a) 2% BHC + 20% DDT ) Based on solid
)
(b) 5% BHC + 10% DDT ) Residue left on surface
)
(c) 5% aldrin + 10% dieldrin)

With DDT there is a certain time lag before the crystal growth has developed fully on the surface and peak efficiency achieved. The BHC was added to ensure effective control during the period of low DDT activity. For the same reason Bracey added aldrin to dieldrin. In practice, we found that dieldrin alone was fully effective as soon as the surface was dry. We picked one of the most difficult practical tests available to us. Commercial pest control operators could not control the ever increasing ship-borne infestations of the German cockroach, Blatella germanica (L.). The tremendous improvement in crew quarters on board modern cargo vessels provided ideal conditions for the establishment of this pest. The usual sprays and fumigation practices provided only a palliative and ships became heavily re-infested within a few weeks. The Port Health Authorities in the United Kingdom will not permit a ship to sail until it has passed inspection and proven to be free of rats and insects. Holding up and disinfesting even a moderate sized ship by fumigation costs 500 to 2,000 pounds a day. With the backing and active participation of the London Port Health Authority and the United Kingdom Chamber of Shipping, we set up a series of approximately 30 trials on as many ships ranging from coasters of 800 to 1200 tons to cargo vessels of 7 to 12,000 tons; these ships travelled all over the world and were subject to constant re-infestation. Our criterion of success was total absence of insects. If insects re-appeared the trial was considered a failure. Each ship's captain was issued with weekly reporting forms that were returned to us. In addition we received reports from Port Health Authorities all over the world. Personal inspections were carried out when the ships returned to the United Kingdom.

The technique consisted of treating all the insect harborages, particularly those areas of food preparation and storage. In the initial trials, we treated only specific sections in ships selected for their past history of very heavy infestations. One of the worst infestations I encountered was on a coaster of about 1200 tons running to the continent. It had not been treated purposely during her last call at the London Docks and was heavily infested with cockroaches. The galley and pantry was about 30 x 10 feet. In the evening, we treated this area only, leaving the rest of the ship as a control. Next morning we swept up 2 pails full of dead roaches. The second morning we found 2000 dead roaches. The numbers dwindled to a few bodies over a ten day period. The rest of the ship remained infested, but all roaches invading the galley were killed and this area remained completely free. As our technique improved, we endeavored to completely immunize the ships against re-infestation. The result of $2\frac{1}{2}$ years investigation proved conclusively that a formulation containing 4 to 5% dieldrin, applied according to our technique provided at least two years complete immunity from re-infestation. Actually, we had hoped for a year under these conditions. One of my best co-operators was the captain of a 10,000 ton vessel; this ship travelled in the East Indies and Australia area and was subject to tropical conditions. In spite of weekly scrubbings with detergents and monthly ones with caustic soda, the captain reported complete immunity even at 38 months.

As shown in the formula, the solvents required are n-butanol and zylol. During the actual application, strict precautions against fire were taken in the spraying area. The operators were required to wear full face masks. We used a standard "Aerostyle" paint spray gun working at about 35 lb. p.s.i. air pressure. For ship-work, I designed a small container of one gallon capacity mounted on an alpine pack worn on the operator's back. The air and fluid lines to the gun were kept as light and short as possible to reduce fatigue, and one quick release coupling within easy reach, permitted the operator to disconnect from the air-line instantly. One charging lasted a man about an hour. The unit was designed to provide mobility and flexibility since the technique involved spot treatment. Later we developed a pressurized unit holding two gallons of fluid that could be charged at the shop and taken to the job-site ready for use. The rate of application could not be controlled as efficiently as with the paint gun using air atomization; however large sections of the treated areas were out of sight and slight run-off was of little consequence. The important point was that by using this unit we were able to reduce costs without impairing the efficacy of the treatment. Without the necessity for trained crews and special equipment, we were able to treat an average sized cargo vessel in one day and evening without closing down the operation of the ship, and immunize it for at least two years. The treated surfaces were so hard to detect that some lines requested that a slight color be added for checking purposes.

The trials produced results far beyond our expectations and the technique was so far in advance of current control methods, that we anticipated ready acceptance by the trade. The opposite proved to be true with the exception of one outstanding firm, managed incidentally by an ex-Winnipeg resident. True to British traditions, we had kept these trials very much under cover and it was not until we were sure of our facts that industry was approached. The pest control operators operating in the shipping field did a continuing business in dis-infesting ships as they returned to port. A two-year guaranteed prophylactic treatment failed to arouse interest when first presented to the trade. The development of a new material or technique requires a lot of faith and stamina. Innumerable colleagues are ready to endorse and support a product or idea after it has been proved and in use, but it is difficult to arouse interest during early development, particularly when past achievements in the field have proven unsuccessful. Contemplate for a moment how many people you know personally in your particular field that have developed a new, widely employed product. Those of you who have found yourselves in this position know how much effort is expended. We argued to no avail that this new concept of long term pest control would provide extensive opportunities for new business and compensate many times over for the type of work in vogue. Only one man, another Canadian, M. L. Price, a native of Winnipeg and manager of a relatively new and growing pest control operator firm, saw the commercial possibilities. We managed to have one meeting, just before I departed to do some work in Nigeria and Ghana (the Gold Coast) for the World Health Organization. On my return, he asked me to join the firm and launch the insecticidal resin commercially. British shipping circles are among the most conservative organizations in the world, but in the next 18 months, we had evolved a streamlined commercial technique, designed special equipment, trained personnel all over the United Kingdom and convinced the shipping world of the soundness of our idea. We treated everything from Thames sailing barges to 40,000 ton liners, naval vessels, submarines and even pilgrim ships, specially designed to carry thousands of pilgrims to Jedda, the Red Sea port for Mecca. Subsequent inspection showed we had not once failed. Occasionally, a pocket of infestation turned up on later inspections, but this proved invariably to be in an untreated area that was inadvertently missed, or could not be reached because of cargo. Ships are very complex structures and they all have features that differ in some respects. It is now standard procedure to have new ships insect proofed before they are accepted.

In addition to the experiments on ships during the purely experimental field trial period and later during commercial application, many trials were in progress in the United Kingdom and different parts of the Colonies. Prof. Peacock at Dundee University ran a series of trials with the Pharaoh ant, Monomorium pharaohnis (L.). He showed that aldrin and dieldrin exhibited no repellent properties. Ants contaminated with dieldrin reached the nest contaminating and killing the colony. Aldrin caused a quick kill of the workers; consequently the rest of the colony starved to death. We found that dieldrin properly used, was completely effective against this pest. Incidentally, we encountered ants in ships and on one occasion the infestation was so heavy that the second mate was severely bitten while asleep in this cabin. Once I found them in the insulating material of the steam pipes and cylinders of a three storey reciprocating engine. They were often prevalent in hospitals.

One particularly interesting situation occurred in London at a Medical Research Council establishment devoted to work on poliomyelites. A five storey laboratory using steam heating with coils in the floor provided ideal conditions for Blatella germanica. The roaches could travel along the pipe chases and reach all sections of the building. In the section housing chimps, carefully segregated controls were contracting polio. At the time I was with the Government and in answer to a call for help I surveyed the building where we carried out a treatment with 2 gallons of a dieldrin formulation applied in the proper places. Later, tests with cultures showed that Blatella germanica was carrying the disease. No further trouble was experienced after that first treatment.

The following trials may be of interest to the stored product entomologists. Large brewing firms in the United Kingdom prepare their own malt, usually in buildings of ancient vintage. Because of the difficult working conditions, most pest control operators refused to tackle the Khapra beetle that had been introduced from the East. The problem was difficult because the infestations were in huge storage bins three or four stories high with 4 to 8 bins side by side, separated by 2 x 8 inch planks on 8 inch timbers. When the planks were removed, we found cast-off skins of the Khapra beetle in the 8 inch space anywhere from 10 to 40 feet in depth. First, in conjunction with the Chief Chemist we carried out trials to ensure that pick up of dieldrin by the malt from treated surfaces was negligible. Then we treated the bins and harborages. No trouble has been experienced since.

FUTURE USES

I am convinced that there is a successful future in the development of insecticidal resins. Very little work has been done on attractants incorporated with resins. Here may lie a useful field of investigation. The fumigant effect of low vapor pressure contact poisons such as BHC may offer a useful method of control under certain conditions. This principle has been successfully used in the preparation of an anti-fouling agent on ship bottoms to provide long term protection.

In conclusion, I wish to thank you for the opportunity of telling you about the development of insecticidal resin during my stay in the United Kingdom.

## ANNUAL MEETING

### Business Session

The fall meeting of the Entomological Society of Manitoba was held December 6, 1957, commencing at 1:30 p.m. in the Library of the Department of Agriculture Research Building, University of Manitoba, Winnipeg.

### Minutes

The minutes of the last general meeting held the past spring were read by the secretary who moved the adoption of the minutes as read. Seconded D. R. Robertson. Carried.

### Business Rising out of the Minutes

Library of the Entomological Society of Manitoba - It was reported that the question of housing the Library in the Library of the Research Building was taken up. The Library is now in the Research Building but no guarantee was given as to having the Library indexed.

By-Laws - The amendments to the By-Laws of the constitution of the Entomological Society of Manitoba were reconsidered. It was felt that the amendments still did not give the desired effect.

Motion - H. R. Wong moved that the constitution of the Entomological Society of Manitoba be studied and revised and the revision presented as a Notice of Motion prior to the Spring Meeting. Seconded W. R. Allen. Carried.

The incoming slate of officers will be responsible for the revision of the By-laws and constitution of the Entomological Society of Manitoba.

### Treasurer's Report

T. V. Cole moved that the treasurer's report be adopted as read. Seconded R. M. Prentice. Carried.

Chairman W. A. Reeks suggested that we exercise care in the use of the bank account as we will have to sponsor the meeting of the Entomological Society of Canada in the foreseeable future.

### President's Report

President W. A. Reeks listed two successes for the year. They are:

1. The Brief on the need of a Provincial Entomologist which resulted in the appointment of a Provincial Entomologist.

2. The Spring Meeting. Prof. Mitchener has completed the assignment on a "History of Beekeeping in Manitoba".

President Reeks briefly discussed the problems in recruiting potential biologists. The fields of Physics and Mathematics take many good potential Biologists. The attraction to the other fields appears to be the remuneration involved.

Report of Regional Director of Entomological Society of Canada

G. L. Warren reported on the Annual Meeting of the Entomological Society of Canada held at Lethbridge in 1957. Plans are underway to renumber the supplements to the Canadian Entomologist in a consecutive manner without regard to when they appear. It is planned to increase the number of pages in the Journal and also the price; the advertising is to be dropped although Prof. Mitchener recommends that some advertising be retained. This recommendation is to be taken by R. M. Prentice to the next Executive meeting of the Entomological Society of Canada. Other plans are to have an Editorial Board composed of one member from each Regional Society and one from the Systematic Unit. Consideration is being given to affiliation of the Entomological Society of Canada with the Canadian Federation of Biological Sciences. There are several advantages inherent in belonging to a group with similar leanings.

The next Annual Meeting of the Entomological Society of Canada is to be held at Guelph, Ontario. The 1959 Annual Meeting will be held at Detroit, U.S.A. in conjunction with the Annual Meeting of the Entomological Society of America.

President Reeks reviewed Dr. Glen's address given at the meeting of the Entomological Society of Canada on affiliation of societies.

W. J. Turnock attended several meetings where affiliated societies were involved and gave his impressions of these meetings and the advantages of affiliation.

L. D. Nairn reviewed a meeting of the Canada Institution of Forestry. The relations between the Public and the Forest Industry was the main topic discussed.

Common Names Committee of the Entomological Society of Manitoba

W. J. Turnock moved that the following report be accepted:

1. The committee did not receive any common names.
2. No soliciting for common names was carried out as this means of obtaining common names proved a failure in the past.

3. The purpose of the Common Names Committee is to process common names, not create them.
4. It is not necessary to enlarge the Common Names Committee as a larger committee would only make it unwieldy.

Seconded A. G. Robinson.

Common Names Committee of the Entomological Society of Canada

Prof. A. V. Mitchener, Chairman of the Common Names Committee for the Entomological Society of Canada reported on the activities of the committee. The committee met at Lethbridge at the Annual Meeting of the Entomological Society of Canada. A full committee was present. Eight common names were submitted, of which five were approved, two were rejected and one already had a common name.

The Common Names Committee recommended to the Entomological Society of Canada that the Common Names Committee become a standing committee, of nine members, that the objects of the committee be reviewed, that the Entomological Society of Canada recognize the list of common names approved by the Entomological Society of America, that the Entomological Society of America consider have two Canadians on the Common Names Committee of the Entomological Society of America.

Prof. Mitchener asked that the members show more interest in proposing common names to the local committee.

Common Names Committee

It is the function of the incoming slate of officers of the Entomological Society of Manitoba to nominate the new Common Names Committee.

Report of the Editor-Librarian

W. R. Allen reported that sufficient papers are now on hand for the next Proceedings of the Entomological Society of Manitoba. It will be the function of the new Editor-Librarian to have the Proceedings printed.

Two complete volumes of the past Proceedings are on file but more requests are comming in for various back volumes and issues. According to the By-Laws two complete volumes must be retained by the Society. The question remains as to what to do with the recent requests.

Motion - R. D. Bird moved that the Editor-Librarian name a committee to:

1. study the need for increasing the number of new volumes
2. study the ways and means of reproducing old volumes in short supply
3. study the policy regarding sale of reprints.

Seconded F. L. Watters. Carried.

Report of Nominating Committee

G. L. Warren presented the following slate of officers for 1958 to the meeting for consideration:

President - R. M. Prentice
W. R. Allen moved nominations cease.
Seconded A. G. Robinson. Carried.

Secretary - W. G. Ives
C. Buckner moved nominations cease.
Seconded G. L. Warren. Carried.

Treasurer - L. D. Nairn
D. R. Robertson moved nominations cease.
Seconded W. G. Ives. Carried.

Editor-Librarian - S. R. Loshiavo
F. L. Watters moved nominations cease.
Seconded W. R. Allen. Carried.

President-Elect - P. H. Westdal
W. R. Allen moved nominations cease.
Seconded F. L. Watters. Carried.

In the ceremony that followed, Ex-president W. A. Reeks handed the gavel to the new President R. M. Prentice.

Motion for Adjournment - moved by W. A. Reeks.

o O o

An evening social function was held on December 6, 1957 at the Officers' Mess, McGregor Armories. Dancing and a buffet luncheon were enjoyed by those present.

The year 1957 was a busy one for many of our members and did not permit the executive sufficient time to prepare a suitable scientific program. Several members from the Forest Biology Laboratory were active participants in the Central International Forest Insect and Disease Conference. Other members had their work disrupted in the translocation of laboratories and staff in Winnipeg and Brandon to new quarters in the Canada Agriculture Research Building situated on the University of Manitoba campus. Consequently no scientific session was held at the annual meeting of the Entomological Society of Manitoba.

At one time the majority of the members of the Society were geographically divided between Brandon and Winnipeg and the holding of two scientific sessions per year served a useful purpose. With the recent trend toward centralization in Winnipeg, it may no longer be necessary to have two scientific programs every year. Perhaps we should concentrate on one annual combined scientific and business program. This is a question that merits the active consideration of the Society membership.

## APPENDIX

## ADDITIONS TO THE LIBRARY OF THE ENTOMOLOGICAL SOCIETY OF MANITOBA

The following list contains the names of publications received in exchange for the Proceedings since the list published as an Appendix to Volume 12 of the Proceedings for 1956.

1. Robins, C. R. and E. C. Raney. June, 1956. Studies of the Catastomid Fishes of the Genus Maxostoma, with Descriptions of Two New Species. Memoir 343. Cornell University. From the Albert R. Mann Library, Ithaca, New York.

2. Zastitu bilja (Plant Protection). Vols. 35 & 36 & 37. Published by the Institute for Plant Protection. Beograd-Topcider. Narodna Republika Srbija (Jugoslavija) 1956, and Index to Volumes 27-32.

3. Proceedings of the Entomological Society of Alberta. (4th Annual Meeting). Nov. 9-10, 1956.

4. Bollettino dell' Instituto di Entomologia, Della Universita Degli Studi de Bologna 1956. Vol. XXI.

5. Proceedings of the Entomological Society of British Columbia, Volume 53, Feb. 15, 1957.

6. Redia. Vol. XLI. Giornale de Entomologia, published by Dalla Stazione di Entomologia Agraria, Firenze, Italy.

7. Bibliography of Publications of the Institute for Plant Protection, Belgrade, Jugoslavia. 1954. Memoir No. 2.

8. Bjegovic, Dr. ing. Petar. 1957. Biological Studies on Zabrus tenebroides Joeze and Vivania cinerea Fall. Memoir No. 5 of the Institute for Plant Protection, Belgrade, Jugoslavia.

9. Sutic, Dr. ing. Dragoljub. 1957. Bacteriosis of Tomatoes. Memoir No. 6 of the Institute for Plant Protection, Belgrade, Jugoslavia.

10. Vasiljevic, Dr. ing. Ljubisa A. 1957. Hyphantria cunea Drury. Memoir No. 7 of the Institute for Plant Protection, Belgrade, Jugoslavia.

11. Tadic, Dr. ing. Milorad. 1957. Crysocapsa pomonella. Memoir No. 4 of the Institute for Plant Protection, Belgrade, Jugoslavia.

12. Zivojinovic, Prof. dr. Svetislav and Ing. Milorad Cvjovic. 1956. *Saperda populnea*. Memoir No. 3 of the Institute for Plant Protection, Belgrade, Jugoslavia.

13. Reprints received from Marcel Florkin, Professor at the University of Liege, Belgium.

(a) Leclercq, J. Variabilite du developpement chez deux races de *Tenebrio molitor* L. (Insecte, Coleoptere) elevees en colonies dans un milieu nutritif optimal. Bull. Soc. R. Sci. Liege, 1955, n°2-3, 52.

(b) Leclercq, J. Recherche de sous-races biononiques chez *Tenebrio molitor* L. (Insectes, Coleoptere). Bull. Soc. R. Sci. Liege, 1955, n°2-3, 60.

(c) Duchateau, Gh. et Florkin, M. Constitution de la composante protidique non proteique de l'hemolymphe des chenilles et des chrysalides de *Sphinx ligustri* L. Bull. Soc. Chim. Biol., 1955, 37, 239.

(d) Duchateau, Gh. et Florkin, M. Influence de la temperature sur l'etat stationnaire du pool des acides amines non proteiques des muscles d'*Eriocheir sinensis* Milne Edwards. Arch. Internat. Physiol. Biochim., 1955, 63, 213.

(e) Duchateau, Gh. et Florkin, M. Concentration du milieu exterieur et etat stationnaire du pool des acides amines non proteiques des muscles d'*Eriocheir sinensis*, Milne Edwards. Arch. Internat. Physiol. Biochim. 1955, 63, 249.

(f) Gregoire, Ch. Coagulation de l'hemolymphe chez les Insectes irradies par les rayons X. Arch. Internat. Physiol. Biochim., 1955, 63, 246.

(g) Leclercq, J. Sur la valeur nutritive des farines d'orge pour *Tenebrio molitor* L. Bull. Ann. Soc. R. Ent. Belgique, 1955, 91, 66.

(h) Leclercq, J. On some habits of House Crickets, *Acheta domestica* (L.) (Orth. Gryllidae). Ent. Monthly Magazine, 1954, 90, 302.

(i) Leclercq, J. New data about dl-dicarnitine as a growth factor for *Tenebrio molitor* larvae. Voeding, 1955, 16, 785.

(j) Leclercq, J. Nouvelles recherches sur la variabilite des *Tenebrio molitor* L. et *obscurus* F. (Insectes, Coleopteres) eleves en colonies. Physiologia comparata et oecologia, 1955, 4, 89.

(k) Gregoire, Ch. Blood Coagulation in Arthropods. VI. A study by phase contrast microscopy of blood reactions *in vitro* in Onychophora and in various groups of Arthropods. Arch. Biol., 1955, 66, 489.

(l) Verly, W. G., Koch, G. et Gregoire, S. Le metabolisme de la cycteamine. XVIle Congros Internat. Chim. Industrielle, Bruxelles 11-20 Sept. 1954.

(m) Amanieu, M., Duchateau, G., Florkin, M. et Jeuniaux, C. Systemes d'acides amines non proteiques du plasma de l'hemolymphe au cours de la vie larvaire et nymphale de *Bombyx mori*. Arch. Internat. Physiol. Biochim., 1956, 64, 518.

(n) Jeuniaux, Ch. Premieres etapes de purification d'une chitinase microbienne. Arch. Intern. Physiol. Biochim. , 1956, 64, 522.

(o) Bricteux-Gregoire, S., Verly, W. G. et Florkin, M. Utilisation par *Bombyx mori* du groupe carboxyle de la L-phenylalanine pour la synthese des acides amines de la soie. Arch. Internat. Physiol. Biochim., 1956, 64, 531.

(p) Bricteux-Gregoire, S., Verly, W. G. et Florkin, M. Utilization of the carboxyl carbon of L-phenylalanine for the synthesis of the amino-acides of silk by *Bombyx mori*. Nature. 1956, 177, 1237.

(q) Jeuniaux, Ch. La chitinase exuviale des Insectes. Mem. Soc. R. Ent. Belgique, 1955, 27, 313.