U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY—BULLETIN NO. 40, NEW SERIES.

L. O. HOWARD, ENTOMOLOGIST.

PROCEEDINGS

OF THE

FIFTEENTH ANNUAL MEETING

OF THE

ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

WASHINGTON:

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DIVISION OF ENTOMOLOGY.

L. O. Howard, *Entomologist.*

C. L. Marlatt, *Entomologist in charge of experimental field work.*
F. H. Chittenden, *Entomologist in charge of breeding experiments.*
A. D. Hopkins, *Entomologist in charge of forest insect investigations.*
Frank Benton, *in charge of apiculture.*
W. D. Hunter, *in charge of cotton-boll weevil investigations.*
D. W. Coquillett, Th. Pergande, Nathan Banks, *Assistant Entomologists.*
E. A. Schwarz, C. B. Simpson, *Investigators.*
Miss H. A. Kelly, *Special agent in silk investigations.*
R. S. Clifton, F. C. Pratt, August Busck, Otto Heidemann, A. N. Caudell, J. Kotinsky, *Assistants.*
W. E. Hinds, G. H. Harris, H. E. Burke, *Temporary field agents.*
Miss L. Sullivan, *Artist.*

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., March 29, 1903.

SIR: I have the honor to transmit herewith the manuscript of the Proceedings of the Fifteenth Annual Meeting of the Association of Economic Entomologists, which was held at Washington, D. C., December 26 and 27, 1902. The papers presented at this meeting are of an unusually practical nature, and the discussions bring out facts of considerable importance. I therefore recommend the publication of this report of the Proceedings as Bulletin No. 40 (new series).

The term "new series," applied to these bulletins, will be omitted after this number, as it is no longer necessary to distinguish them from the bulletins of the old series, which included only 33 numbers.

Respectfully,

L. O. HOWARD, *Entomologist.*

Hon. JAMES WILSON,
Secretary of Agriculture.

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[a] Withdrawn for publication elsewhere.

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FIFTEENTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

MORNING SESSION, FRIDAY, DECEMBER 26, 1902.

The Association met in the natural history room, third floor, main building of the Columbian University, Washington, D. C., at 10 a. m., December 26, 1902.

The following were in attendance:

W. B. Alwood, Blacksburg, Va.; W. H. Ashmead, Washington, D. C.; C. F. Austin, Collegepark, Md.; H. A. Ballou, Amherst, Mass.; Nathan Banks, Washington, D. C.; H. S. Barber, Washington, D. C.; Frank Benton, Washington, D. C.; J. Chester Bradley, Philadelphia, Pa.; A. F. Burgess, Columbus, Ohio; W. E. Burke, Washington, D. C.; August Busck, Washington, D. C.; A. N. Caudell, Washington, D. C.; D. W. Coquillett, Washington, D. C.; E. P. Felt, Albany, N. Y.; H. T. Fernald, Amherst, Mass.; W. F. Fiske, Atlanta, Ga.; James Fletcher, Ottawa, Canada; G. H. Harris, Washington, D. C.; Otto Heideman, Washington, D. C.; J. S. Hines, Columbus, Ohio; W. E. Hinds, Washington, D. C.; A. D. Hopkins, Washington, D. C.; L. O. Howard, Washington, D. C.; V. L. Kellogg, Stanford University, Cal.; J. Kotinsky, Washington, D. C.; C. L. Marlatt, Washington, D. C.; B. Pickman Mann, Washington, D. C.; George W. Martin, Nashville, Tenn.; Herbert Osborn, Columbus, Ohio; Theodore Pergande, Washington, D. C.; J. L. Phillips, Blacksburg, Va.; F. C. Pratt, Washington, D. C.; A. L. Quaintance, Collegepark, Md.; F. William Rane, Durham, N. H.; P. H. Rolfs, Miami, Fla.; W. E. Rumsey, Morgantown, W. Va.; E. A. Schwarz, Washington, D. C.; C. B. Simpson, Washington, D. C.; Henry Skinner, Philadelphia, Pa.; T. B. Symons, Collegepark, Md.; Mrs. Henrietta T. Walcott, Boston, Mass.; F. L. Washburn, St. Anthony Park, Minn.; J. L. Webb, Washington, D. C.; Wesley Webb, Dover, Del.; C. M. Weed, Durham, N. H.; E. V. Wilcox, Washington, D. C.

The meeting was called to order by the president, Dr. E. P. Felt, who, after calling Mr. Herbert Osborn to the chair, the vice-president being absent, delivered his annual address, which follows:

THE LITERATURE OF AMERICAN ECONOMIC ENTOMOLOGY.

By E. P. Felt, *Albany, N. Y.*

Publication is undoubtedly our most important function, and while discussions of methods and lines of research may modify the matter made public, it seems to the speaker that a consideration of the form and method of publication may not be without value. This subject, it is true, has been mentioned more or less by my predecessors, and

was discussed somewhat in detail by Dr. Forbes in 1893 and by his successor, Dr. Howard, in 1894. The address of the former constitutes one of the most critical analyses of a portion of our literature and of methods of publication, while that of the latter is an exceedingly complete record of what had then been published in economic entomology in this country and abroad. Dr. Forbes had occasion in 1893 to call attention to the fact that the literature of American economic entomology was increasing with great rapidity, and this has been even more manifest in later years. Somewhat over 10,000 newspaper articles about injurious insects have been published since 1860, while a rough estimate of the number of octavo pages devoted to the subject gives us a total of nearly 50,000, of which about one-quarter are found in bulletins of the agricultural experiment stations, and were therefore published since 1888. It is impossible to discuss this literature in detail within the time at our disposal, and only a few of its more salient characteristics can be brought out. It seems to the speaker that this is not the place for destructive criticism, and the following is presented in hopes that it may suggest methods whereby we may render our work of greater value to the general public. It is also well known to the speaker that his hearers are undoubtedly obliged to modify their publications, more or less, on account of conditions over which they have comparatively little or no control.

Dr. Forbes, as a result of carefully examining over 115 articles in 1893, came to the conclusion that economic entomologists were advancing more as a body of irregulars than an organized soldiery, and he drew from these publications the inference that we as a body were fairly well satisfied with our present methods of investigations; or, if not, at least were not in a condition to improve them at the time. He also failed to find a record in those publications of any new method of research, either adopted or proposed, in either field or laboratory; nor did he observe any noticeable departure from the stereotyped form of presentation, and he concludes that our methods of report and publication of dissemination and enforcement were lagging far behind our methods of research, and were receiving far too little attention. He also calls attention to the fact that we are very likely to forget that we are writing for the men to whom entomology is a perplexing, obscure, and displeasing subject, of which they know little or nothing good, while on the other hand they are frequently experts in crop inspection, and far quicker, as a rule, to observe injuries to their crops than are we, and much more likely to discriminate between them. He argues from this that crop injury and its characteristic appearance should lead in our discussions of injurious species, closely followed by remedial and preventive measures, and that a description of the insect and an account of its life history should be awarded a subordinate place, especially in monographic accounts, and calls attention to the

comparative inefficiency of miscellaneous collections of articles, such as comprise the bulk of most reports and bulletins, so far as reaching the public is concerned.

The economic entomologist of America can not be charged with lack of energy and thoroughness, particularly when a species inflicts enormous losses upon staple crops.

A brief résumé of the literature reveals the somewhat surprising fact that over 1,825 octavo pages have been occupied by various writers in discussing the Rocky Mountain locust. The next insect to approach in importance this very serious pest, so far as the extent of the literature devoted to it is concerned, is the comparatively recently established San Jose scale, accounts of which already fill 1,160 pages. This species is closely followed by the excellent reports and the exhaustive monograph on the gypsy moth, comprising a total of 1,154 pages. The chinch bug comes next in importance, if we may judge of its rank by the 1,032 pages devoted to a discussion of it by various writers; and this is closely followed by the cotton worm with 908 pages, which is frequently treated of with its associate the bollworm, so that the two have monopolized 1,328 octavo pages. The codling moth is one of our older insects, and it is perhaps not surprising that 887 pages have been devoted to a discussion of its habits and the methods of controlling it, while the Hessian fly, also an early importation, has an extensive literature of over 629 pages. The periodical cicada has a literature extending over 647 pages, while 100 bulletins or separates, comprising 1,624 pages, are largely devoted to discussions of insecticides and apparatus for their application.

The estimates given above are only approximate, and have been rigidly limited to articles appearing in the more permanent bulletins and reports, no account being taken of newspaper articles. The entire literature of any one of these insects must be much more extensive than indicated by the above figures. It is probably impossible to avoid the somewhat extensive duplication of work represented by these figures, because the entomologist of each State is obliged to meet the demands of his constituents, and it is therefore frequently necessary to republish many well-known facts.

The monographic accounts of these species serve a very useful purpose in showing how much there is to be learned concerning each insect, and afford worthy models to inspire the investigator engaged in studying the life histories and habits of less known forms.

NEWSPAPER AND MINOR ARTICLES.

An estimate based on the bibliographies of American economic entomology and a calculation of the number of articles published between January 1, 1900, and December, 1902, gives the enormous

number of 12,163 articles issued since 1860. This estimate includes not only newspaper articles, but also most, if not all, of the reports and bulletins published by American entomologists, and at the same time it probably omits a number of articles worthy of enumeration in this list. Undoubtedly some of the articles are practically duplications of others, and yet, after making all due allowance, we can hardly admit that less than 10,000 minor articles have been prepared for the public press by American entomologists during the last forty-two years. This is an enormous number, and despite the fact that some consider newspaper entomology as of little importance, the speaker can not help feeling that this mass of literature represents a very important part of the work of the economic entomologist. Reports are issued for the public, bulletins are prepared for the general dissemination of information, but the man who wishes to learn concerning an insect pest is much more apt to read his agricultural or local paper than to go to his bookshelves and search for some report or bulletin which may contain the desired facts. In other words, the speaker is inclined to believe that our newspaper and minor articles are much more generally read than the more detailed notices given in reports and bulletins, and on this account he considers newspaper entomology a very important factor in developing our work, and believes that all articles prepared for the press should receive careful attention and be adapted to the readers of the periodical. The attention of scientific men is not infrequently called to ridiculous statements concerning scientific facts in daily or weekly papers. Such are not calculated to inspire respect for the publication, and yet do they not indicate an opportunity of which we may avail ourselves? They show that the publishers recognize the demand for scientific information. The paper attempts to meet it in much the same way as it supplies information concerning many more familiar things. The reporter, who is of value in working up the account of a railway wreck, may fail when he discusses the life history of an insect; and we, as economic entomologists, should undertake, so far as possible, to supply this demand with concise popular accounts, giving the facts which the people wish to know. We can never entirely suppress sensationalism, but we can exert a strong influence toward moderation, and the speaker is of the opinion that most agricultural journals of America have already come under its influence, and as a rule apply to reputable parties for information, rather than rely upon unknown sources. The work begun with the agricultural and horticultural press can be gradually extended till most of the reputable weekly and daily publications of our country recognize the necessity of securing accurate information regarding various phenomena in natural history, and insist upon placing such before the public. This desirable end, however, will be brought about gradually, and will be hastened in proportion as

we appreciate the importance of the subject and give these popular articles the necessary attention. We can not expect the public to appreciate the desirability of accurate information on this subject if those who pose as authorities are content to give out inaccurate, undigested, poorly worded articles in answer to queries. The agricultural and daily press of America is worthy the best we can give it, and in proportion as we meet that demand will we be successful in extending the influence of the work in which we are interested.

REPORTS.

Aside from newspaper articles, this form of publication has been the first employed in ecomomic entomology. The earliest report is that by Dr. Thaddeus William Harris, of Massachusetts, whose classic writings form the basis of all subsequent work in this branch of natural history. There is no necessity for the speaker describing or praising this work, since his hearers are all familiar with it, and it suffices to call attention to the fact that Dr. Harris's work is really a practical systematic account of the more important species known at that time.

The admirable series of reports prepared by Dr. Asa Fitch, entomologist of the New York State Agricultural Society, and practically State entomologist of New York, are equally well known and contain a mass of information with which every worker in this branch must familiarize himself if he would succeed. The arrangement of the reports by Dr. Fitch is very different from that obtaining in Dr. Harris's treatise and consists in a systematic grouping of the insects under important food plants. Dr. Fitch evidently believed in making his writings accessible to those who were not entomologists and who had no special interest in the subject. His reports form the beginning of a series which in reality was continued by Dr. Lintner, though in different form, the latter's reports being composed very largely of detailed accounts of species which had come prominently to notice during the period the report covered. These individual accounts are almost invariably grouped systematically and are in many respects models in their thorough, lucid, concise treatment of injurious species.

The series of reports and other entomological publications by the Federal Government was begun by Townend Glover in 1854 and has continued, with a few breaks, in one form or another to the present day. The work of Glover was seriously hampered and his reports, while containing a mass of valuable information, were far from what he would have made them had conditions been more favorable. It will be observed, however, that he evidently planned his work with the intention of ultimately reaching the desired end, no less than that of giving popular economic accounts of all of the more important groups of insects. For example, his report for 1867 is concerned largely

with the food habits of beetles, that of 1875 with the Heteroptera, that of 1876 with the Homoptera, and of 1877 with the Hymenoptera.

His work was continued by the late Dr. C. V. Riley, of whom all of us know, and to whose writings coming generations of economic entomologists must constantly refer. Dr. Riley began his work in Missouri and his nine reports issued there from 1869 to 1877 have been characterized by Dr. Howard as forming "the basis for the new economic entomology of the world." These reports are original, practical, scientific, and include a multitude of facts and intelligent deductions which have had a potent effect upon the science. The work begun in Missouri was ably continued in the United States Department of Agriculture, with the exception of an unfortunate break of two years, down to the untimely death of this gifted scientist. His work in the Department of Agriculture was in many respects a continuation of that begun in Missouri, and the large amount of information gathered and published is most remarkable. The reports of this man are largely composed of independent accounts of various species coming prominently to notice from year to year. Dr. Riley's skill with the pencil and his accurate dilineation of insect life has added very materially to his reputation.

The later work of the Division of Entomology has been continued by one with whom we are well acquainted, and at present we will leave his work and turn to a consideration of other reports.

The magnificent series of volumes on economic entomology prepared by the State entomologists of Illinois contain an immense amount of information and will ever remain enduring monuments to their writers. There are special features in this series of reports which are worthy of mention. Dr. Le Baron began in his third report his Outlines on Entomology, which was continued in his fourth, and Dr. Thomas in the sixth report began a series of papers designed to form a popular account of the entomology of the State, particularly of those species of economic importance. His successor, Dr. Forbes, has given us several papers of noteworthy value. His twelfth report includes a discussion of the food relations of predaceous beetles, and the appendix to the fourteenth is an index to the twelve earlier reports. The fifteenth and sixteenth give much space to a detailed consideration of the chinch bug, and the seventeenth contains an analytical list of the entomological writings of Le Baron, and renders his work more accessible to other writers. The eighteenth report contains an admirable monograph on insects injurious to Indian corn, and the nineteenth is devoted largely to a monographic account of the work with chinch-bug fungus, the appendix comprising a detailed study of the Mediterranean flour moth by Professor Johnson.

The State entomologist of New Jersey has issued a series of reports since 1890 which contain a mass of original observations concerning

insects injurious during the various years. These accounts are grouped under important food plants as a rule. Exceptional features are that his report for 1893 contains a brief general account of the more injurious species belonging to all orders, and that for 1895 an interesting and valuable paper on the Relation of Insects to Fruits. Later reports give much space to crude petroleum as a remedy for San José scale.

The late State entomologist of Minnesota, Dr. Otto Lugger, began a series of reports which promised, when completed, to form a remarkable contribution to the entomology of America. His second report treats of parasites of man and domestic animals, the third of the Orthoptera, the fourth of Hemiptera, the fifth of Coleoptera, the sixth of Lepidoptera, and it is stated that the manuscript treating of the Diptera[a] was nearly completed at the time of his death. It is certain that had this series of reports been carried to an end, America would have been favored with one of the best general works on practical entomology which has yet been issued.

The reports of the Entomological Society of Ontario, beginning in 1870 and extending to date, is a remarkable series of publications, replete with interesting and valuable observations by many writers upon the economic insects of that section. These reports, and those from 1884 to date, of Dr. James Fletcher, entomologist and botanist of the Central Experimental Farms, include most of our records concerning the insects of the northern part of America, and are composed largely of original observations and exceedingly practical recommendations and deductions from observed facts.

It will be seen from the above that the reports of various State entomologists differ widely one from the other, and that within certain limits at least a considerable choice is admissible. There has been of late years a marked tendency toward specialization, which is perhaps as well exhibited in the publications of the United States Department of Agriculture as anywhere. The report of the Entomologist, which was formerly a contribution of some 200 or 300 pages, has been cut down and comprises relatively few pages devoted to a general discussion of conditions. The entomological matter formerly appearing in the report has been subdivided and is made public either as special papers in the Yearbook or as bulletins treating of some special subject, which may be either economic or systematic. It seems to the speaker that generally speaking this is a step in the right direction. The general public is not interested in entomology itself, and will read bulletins or reports on the subject only when some practical end is served. It must, therefore, be approached from this point of view. The speaker has been impressed for some years with the

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[a] Since reading the above Professor Washburn has informed us that he has failed to find any such manuscript, and if it ever existed it has probably been lost.

idea that extended reports on entomology, while they contain a great deal of very valuable and useful matter, do not appeal to the public mind, and he is therefore inclined to think that wherever conditions will admit our publications should be of a special rather than of a general character. The annual report on entomology, wherever it is possible to have one, is a very convenient method of publishing observations and other records which could not be properly included in a bulletin, and such reports should have a limited circulation. They are more for the economic entomologist, the one who wishes to go back to original sources of information, and do not appeal to the general public.

There are, however, special reports on well-defined economic groups, which are of greatest value to the general public and of utmost utility to the nation. I refer in particular to such works as Hubbard's Orange Insects, Comstock's Cotton Insects, the reports of the United States Entomological Commission on Rocky Mountain Locusts, and Dr. Packard's report on Insects Injurious to Forest and Shade Trees, and to the monographic report on the Gipsy Moth, by Messrs. Forbush and Fernald. These are the highest form of report, and, when properly prepared, constitute an exceedingly valuable record concerning species of great economic importance. Such works as these appeal not only to the practical or economic entomologist and the systematic worker, but also to every man interested in the crops or products affected by the insects treated. Such work as this adds very materially to the prestige of economic entomology in America, and will continue to do so just as long as the parties engaged in such efforts are well qualified and possess the high ideals governing those who have gone before.

BULLETINS.

Next to newspaper articles, bulletins appear best to reach the popular mind. The first important bulletin on economic entomology, so far as known to the speaker, is No. 1 by the United States Entomological Commission, which was issued in 1877, and which was followed by six others, five being devoted to popular accounts of specially injurious insects or groups of insects, and the other, No. 6, being a detailed index and supplement to the classic Missouri reports previously mentioned. This latter, therefore, in reality helped to render more accessible a mass of earlier published observations. This series of bulletins was closely followed and overlapped by a series begun under the authority of Dr. Riley, then chief of the Division of Entomology, United States Department of Agriculture, and continued through 33 numbers. This earlier series has been followed by a second series, which already includes 38 popular and 9 technical bulletins.

About 400 entomological bulletins have been issued in America by various State experiment stations and other public officials charged

with the study of entomology, and the limited time prevents their discussion in detail. These publications, however, may be grouped as follows:

1. Popular brief accounts of individual insects or groups of insects of economic importance.

2. Monographic accounts of individual insects or groups of insects of economic importance.

3. Technical bulletins.

There are a number of advantages and some disadvantages in the use of bulletins as a medium for rendering information available. These publications are not so permanent in character and unless carefully bound by the recipient are liable to be lost or even worn out by constant use. On the other hand, the bulletin usually permits a much more prompt publication than is possible with the annual report and in addition allows a much more elastic grouping of matter. This of itself is of considerable value, particularly when publications are used, as many of us do use them, to answer queries in regard to this or that insect. If we have a bulletin treating only of the species involved, it will usually answer every question, while if we send a report, which may include accounts of a number of other insects, the treatment of the one under consideration may or may not be full enough to answer the requirements of the case; and an additional disadvantage in sending reports is that we may be obliged to transmit a mass of matter which has comparatively little or no interest to the recipient. The bulletin is therefore desirable whenever we wish to publish promptly and economically.

It is very difficult to define the scope and character of the popular bulletin. Generally speaking, it should be brief, concise, and contain very little more information than is necessary for the practical fruit grower or horticulturist who wishes to control the species in question in an intelligent manner. This means that many details, which are of considerable value to the systematic student and the biologist, must be rigidly excluded. These brief popular bulletins may, as previously mentioned, treat not only of one insect but of an economic group, and it seems to the speaker that the latter in the long run are bound to be more successful and beneficial. He has been informed, for example, that the excellent publication on Household Insects, Bulletin No. 4 (new series), Division of Entomology, United States Department of Agriculture, is very popular and that the demand for it is simply enormous.

There is another form of the brief popular bulletin which is exceedingly well represented in the circulars issued by the Division of Entomology. These, as we all know, are very brief accounts of individual species and are exceedingly useful in answering queries from time to time. Such circulars are abridged from fuller accounts, and this

form of publication has been used by a number of entomologists with a great deal of success.

Another device for the popularization of scientific matter has been adopted by the New York State agricultural experiment station at Geneva and consists in prefacing every bulletin by a very brief synoptic account of its contents, and, in not a few instances, there is a popular edition of the bulletin as well as an extended one. This popular edition is very little different from a circular treating of an individual species except that the popular bulletin includes the same field as the more extended publication, whether that treats of a single insect or a group of insects.

Monographic economic accounts of insects are exceedingly valuable, and are absolutely necessary to the advancement of the science. Recent years have witnessed the issuing of a number of noteworthy publications of this character, among which may be mentioned Slingerland's account of the codling moth, Card and Gillette's studies of the same insect, and other bulletins of a similar character. In such publications as these, we should have a summary of all that is known, together with a mass of original information. This work is absolutely necessary, and probably the best method of making it public in the majority of cases is by the use of the bulletin. These bulletins, however, must of necessity be published at irregular intervals, and therefore can have little connection one with the other.

This scattered method of publication has serious disadvantages and the monographic accounts of economic groups are designed to remedy this evil. We have a number of noteworthy publications illustrating this line of effort, among which may be mentioned Forbes's excellent account of insects injurious to indian corn, Forbes and Hart's economic entomology of the sugar beet, Slingerland's climbing cutworms, and others of like character. Such publications appeal to the popular mind because, as a general rule, they approach the subject from the aspect of the practical grower, and are of more general service than the detailed monographic accounts of individual insects.

The technical bulletin is a publication of entirely different character and is, or should be, designed almost solely for the use of the economic worker and not for the general public. These bulletins are usually issued in limited editions and sent only to those who can use them to advantage. They may be and frequently are largely systematic in character and should include monographic accounts of considerable economic importance on such subjects as parasites, leaf feeders, borers, etc. Excellent representatives of these are seen in Howard's Study of Insect Parasitism, Marlatt's account of Nematinæ of North America, Coquillett's Revision of the Tachinidæ, and Hunter's Aphididæ of North America. Such works as these, though frequently embodying much systematic and biologic work which apparently has

no direct bearing upon the practical aspect of economic entomology, are absolutely necessary as a basis for further work. These more technical studies are in reality of equal if not greater value in developing economic entomology than the more popular practical accounts which are prepared for the general public. It is true that they are accessible to and read by fewer individuals, but these individuals are the parties who prepare the popular accounts and make free use of the more technical matter wherever it can be employed to advantage, so that in reality the public receives full benefit from any such publication.

JOURNALS.

The various entomological journals published from time to time contain more or less economic entomology, only one of which can be mentioned at this time. The economic department in Entomological News, conducted by Dr. J. B. Smith, was instituted a number of years ago by Dr. Skinner, and affords an opportunity for the prompt publication of shorter articles and is a valuable feature of the periodical. There are three journals which have been devoted entirely to economic entomology. The Practical Entomologist, which ran through two volumes, and the American Entomologist, which completed three, are the only instances of publications supported in part at least by subscriptions which have been devoted very largely to economic entomology. The shortness of their lives is eloquent of their lack of support. A unique serial, devoted entirely to economic entomology and independent of subscribers, was issued by the Department of Agriculture under the joint editorship of the late Dr. Riley and Dr. L. O. Howard and is well known to every worker in the science as "Insect Life." There is perhaps no other publication which contains so much original information concerning entomology within so limited a space as these seven volumes. The numbers were issued approximately monthly. The editor was the Chief of the Division of Entomology, and as he was supported by an able staff of assistants, not to mention the entomologists of the entire country, there was nothing in the publication which was not reliable, and the effect upon the development of the science was extremely beneficial. It afforded a ready medium for the announcement of interesting and valuable discoveries and received the hearty support of every worker in the science. The monthly issue of the numbers kept every entomologist informed regarding the doings of his associates and served as a general stimulus to all. We can but regret that it was necessary to discontinue such an admirable publication, and while its loss is in part made good by the most excellent series of bulletins issued by the Division of Entomology, still there are features in the periodical which have not been, and probably can never be, made good by the issuance of bulletins at

irregular intervals. This series of bulletins can never command such a general support of working entomologists as a publication issued at regular intervals, and consequently, with the discontinuance of Insect Life, economic entomologists lost a ready means of communicating one with the other, and the speaker feels that the development of the science has been hindered by its suppression. A publication dependent upon subscription can never fill the place occupied by Insect Life, since it must cater to its readers and give considerable space to well-known facts, whereas a publication independent of subscribers can follow a definite plan and restrict its matter to that which is original or of great value on other accounts.

GENERAL WORKS.

There are several general works on economic entomology which have been published, aside from reports and other official publications by State or station entomologists. One of the earliest and the best in a great many respects is Saunders's Insects Injurious to Fruits. The injurious species are grouped, according to the part injured, under important food plants. Each account, while brief, gives a résumé of the more important facts concerning the species.

The early edition of Professor Saunders's work was closely followed by Cooke's Injurious Insects of the Orchard, Vineyard, etc., a work which covers the entire field of economic entomology in less than 500 pages. The treatment of each species is necessarily brief, and while the accounts are grouped according to food plants the systematic position of a species and its synonymy are indicated. The work was prepared particularly for the use of fruit growers and vineyardists in California, where it appears to have found its principal sale.

Dr. Weed's Insects and Insecticides (1891) treats of the more important injurious insects and methods of controlling them in a volume of less than 300 pages. The limited space made a rigid selection imperative, and the account of each species is brief. It is an exceedingly valuable work, and the following year was followed by Kellogg's Common Injurious Insects of Kansas, which covered the same field as the preceding work. The treatment is a little different, and a feature worthy of special mention is the brief diagnosis preceding the account of each species. Dr. Smith's Economic Entomology (1896) is a work prepared along very different lines from the preceding, and gives brief practical accounts of all the more important injurious insects within the limits of 466 octavo pages. The various accounts are necessarily limited and the arrangement is systematic, a discussion of the injurious or beneficial species of the different orders being preceded by a brief account of ordinal and family characteristics.

The same year The Spraying of Plants, by Lodeman, appeared, and while the scope of the work is greater than that of entomology, much

of the latter is included. The most prominent characteristic of the volume is its great condensation, more facts being included within its 400 pages than perhaps in any other volume of its size.

The present year has been marked by the appearance of Fumigation Methods, by Professor Johnson, a monograph of the application and uses of hydrocyanic acid gas, and by the publication of Sanderson's Insects Injurious to Staple Crops, which latter is prepared on somewhat similar lines to Saunders's Insects Injurious to Fruits and covers its field more fully than has hitherto been done.

INDEXES.

The literature of American economic entomology has become so extended that detailed indexes are an absolute necessity; otherwise many valuable records are lost, so far as the busy worker is concerned. The first general index published was that to Riley's nine Missouri reports, and in many respects it is a model publication. It is not only very detailed, but every insect is indexed by its specific as well as its generic name, something which the speaker is inclined to think of great importance. The many changes in nomenclature make it very difficult for a person to keep up with them, and the index which lists a species by its specific as well as generic name aids materially in this respect. This publication is perhaps open to one criticism, in its having separate indexes for plants and insects. This is to some extent a matter of taste, and yet the speaker is inclined to believe that the general index, including all references, is superior, since no question can arise as to which index is before the seeker for information. This is something which used to trouble my distinguished predecessor not a little and my hearers are probably aware that all the later indexes prepared under his direction have included every reference.

The next general index to appear was that by Professor Forbes of the first twelve reports of the State entomologists of Illinois. This is prepared on very nearly the same lines as that to Riley's Missouri reports, and is also open to the criticism of having separate indexes for plants and insects. It is, however, admirably gotten up and has proven of great value to working entomologists, since it renders more accessible the vast amount of information recorded in these reports.

Neither of these general indexes, or the later one prepared by Dr. Lintner, have aided in making accessible the vast amount of information annually published in newspapers, bulletins, reports, or other publications by the economic entomologists of America. This literature is widely scattered, and the preparation by Mr. Henshaw of a bibliography of the more important writings of Messrs. Walsh and Riley made way for general indexes to the publications of other American writers on economic entomology. My hearers are all familiar with the admirable series of bibliographies prepared under the auspices

of the United States Department of Agriculture, Division of Entomology, which have rendered this vast literature accessible to economic workers. It is only a question now of consulting a few indexes, and the average worker, if he has an adequate library at his command, can easily learn what has been recorded concerning injurious species under consideration. If one were to criticise these publications at all, it might be allowable to suggest that the indexes be made a little more detailed, particularly in the later publications. The addition of references to specific as well as generic names and to food-habit records would materially increase the value of the volume without greatly extending its limits.

The general index to that magnificent series of volumes known as "Insect Life" has proven an invaluable publication to almost every economic worker, and our hope is that in the future we will see more such aids to research.

Indexing is to some extent a thankless task, and yet a very necessary one if we would keep abreast of the times. The value of the index lies not in its length, but in its usefulness, and the speaker has always felt that it was by all means advisable to index all important references, at least, under several names, wherever that could be done with propriety. No two men think alike, and an index should be made for the use of all. Some approach a subject from one side, others from another, and unless the index is general enough to include all it is liable to be comparatively useless to a great many. The speaker is of the opinion that the general index should include, as previously stated, references to generic, to specific and common names, to food plants; and every index of a series of volumes should also include illustrations, preferably under a general title, such as figures, because it sometimes occurs that a worker is searching for a good illustration, and if by turning to a few general indexes and looking under figures he can find where all such have been published it is an immense aid.

It is impossible to lay down any fixed rule as to what references shall and what shall not be included in an index. This depends somewhat upon the character of the work. In general, the speaker believes that every isolated fact not specifically included in the title of the publication should appear in some form in the index, if the object of the index is to make accessible the contents of the volume. The speaker is gratified to observe that some of our more recent bulletins are being indexed, and while there are undoubtedly publications of this character where an index is superfluous, in a great many instances it is of decided value and should be incorporated wherever circumstances permit.

A table of contents is also of much value and adds considerably to the completeness of any publication. It need not be an extended one unless the work requires it, because a very brief summary may

include everything that is desirable. It is not necessary to devote an entire page to the table of contents and the speaker can not but commend to his hearers the plan of the university of the State of New York of placing on the cover page of its bulletins a brief summary of the contents. It requires little space, is conspicuous, and usually meets every requirement.

The above discussion of the various forms of publications and the purposes which they serve has been entered into because the subject is one of prime importance, and while undoubtedly each of us has given the matter consideration before, it may be that a joint discussion will bring out facts of value. The speaker recognizes the limitation imposed upon various entomologists and is well aware that it is not always practicable to choose between different forms of publication. Each institution usually has certain methods which have become established through years of usage and there is more or less difficulty in securing a change. The advantage of discussing the matter on this occasion is that whenever a change is possible we may know how to use it to the best advantage. The ideal scheme of publication, it seems to the speaker is about as follows:

1. Newspaper articles.
2. Brief popular circulars.
3. A little more extended but brief popular bulletins, treating of economic insects or groups of insects.
4. Monographic popular accounts of economic insects or groups of the same.

It seems to the speaker that if the science is to be advanced in the future more attention should be paid to monographic accounts of economic groups. These should be extended enough to include most of the forms of importance, and at the same time give references to more detailed accounts of each species or group of species, so that the student more deeply interested in the subject can continue his studies further.

5. Reports containing records of activity and such other matter as can not be conveniently grouped in a bulletin or special treatise.
6. Technical bulletins or systematic accounts of natural groups of greater or less importance.

We all recognize the fact that systematic and economic entomology can not be separated one from the other. They are joined together by bonds which no man can sever. Many of the groups of insects are of considerable economic importance, and the speaker is of the opinion that he who will work out a synopsis of any such group is doing much to advance the science of economic entomology. We are to-day hampered by the fact that it is extremely difficult for the beginner to recognize injurious species, or for the one more advanced to determine many forms which may be brought to his notice on account of unusual

depredations. This difficulty can not be overcome till every group having any economic importance has been carefully treated in a systematic way, and if this account also includes a brief general discussion of the economic importance of the groups, subgroups, and possibly even genera and species, together with references to the more important literature treating of each, we have at our command a series of works which would be of the greatest value to all subsequent students of economic entomology. Such works as these would necessarily be very concise, and yet, if properly arranged and with well-selected references, would prove of utmost value not only to systematic, but to economic workers, and would also be exceedingly helpful to all having even a general interest in the groups treated. Dr. Lugger's reports are an approach to this ideal, but it seems to the speaker that such accounts might well be more detailed and should include, as nearly as possible, every species in the fauna; and that the value of such treatment would be immensely increased by the addition of bibliographic references as mentioned above.

Referenee has been made to the close analytical study of our economic publications by Dr. Forbes, and the speaker can do no better than bring his remarks to a close by quoting this talented scientist, as follows:

> It is not the wealth one gathers, but that which he puts to use, which makes him rich. It is not the knowledge we acquire, but what we succeed in making application of, which makes us wise. It is not the facts of entomology we discover, but those which we persuade the farmer, the gardener, or the fruit-grower to use diligently for the protection or the preservation of his crops, which make our entomology economic. To discover without publishing effectually is to waste our time as servants of the public. To publish valuable results without making sure of their appreciation and appropriation by our constituents, is to fail of real usefulness and the reward of usefulness. To bring a result to bear on the practice of one man only when a thousand are suffering for the want of it, is to fail in 99.9 per cent of our proper undertaking. We must first do exact, exhaustive, conclusive, practical economic work, and then we must find means to get that work utilized or it is an economic dead loss.

The address was listened to with much interest, and, on motion of Dr. Howard, a vote of thanks was tendered to Mr. Felt. The discussion of the address was postponed until the afternoon session, but is here inserted in connection with the address.

Mr. Washburn called attention to the fact that Mr. Felt had referred to some notes on Diptera, which he thought possibly were left in Professor Lugger's possession. A careful search for these notes had been made by Mr. Washburn, but none were found. A year had elapsed between Dr. Lugger's death and the time of his taking charge of the work in Minnesota, and during that period things were in a rather chaotic condition.

Mr. Banks remarked that he would like the members to express their opinion as to what they considered desirable in the way of indices. He stated that it was difficult to obtain all the references in newspapers, and thought that those published by agricultural weeklies were hardly worth the trouble of indexing.

Mr. Osborn stated that he thought this to be a very important part of entomological literature for the practical farmer and horticulturist. Many of these men do not get the publications from the experiment stations and they depend upon these agricultural articles. While it seemed a very thankless sort of task, he thought that an entomologist should be willing to attend to this feature of the work for the benefit of the class of persons mentioned. Mr. Osborn further remarked that he had sometimes found himself looking in a plant index for an insect's name, but had usually discovered his error in a very short time.

Mr. Felt spoke of the annoyance which he experienced in referring to separate indices, such as is found in the Entomologists' Monthly Magazine, which has a number of special indices; and, while he did not know the experience of other entomologists in regard to this point, in his own experience he had found the food-plant index invaluable.

Mr. Banks stated that at the present time a great many genera had been duplicated in botany and zoology, and it was sometimes difficult to tell whether a plant or an insect was referred to.

Mr. Felt replied that he thought the name of the plant in connection with the insect affecting it is very easily indicated and he thought there was very little reason for separating the plant and insect indices.

Mr. Hopkins stated that his experience had been similar to Mr. Felt's in looking up references. It is somewhat confusing to turn to two indices, and he thought the suggestion by the president was in harmony with progress in this line. In his opinion, the host-plant index should be included with the other, and he urged the importance of both the common and the scientific names of host plants in the index. The trouble suggested by Mr. Banks could be avoided by using common names. By using the most popular common name, followed by the scientific name, it would be at once apparent which species was referred to.

Mr. Hopkins further remarked that in reference to indexing newspaper articles it seemed a waste of time. If it is some well-known agricultural journal, like the Country Gentleman or some of those papers of which permanent files are kept and good indices made, it might be worth while; but many of our agricultural papers, as well as newspapers, have no index, and a file of the paper is not kept. He did not consider it of much use to refer to these, from the fact that the reference could not be looked up. Furthermore, most of these newspaper articles are simply summaries of what has already been published elsewhere.

Mr. Kotinsky thought that the only objection thus far made to the separation of the plant index from that of the insect index is that one constantly discovers himself looking in the wrong place. He thought that use might be made of Mr. Felt's suggestion of heading the respective pages with the words "plant index" or "insect index" as the case might be. He thought the plant index should be made particularly with reference to the idea of indicating the food plants of the insects and thought use should be made of Mr. Schwarz's suggestion of not making an index simply of names, but an index of information that would be found in the publications cited. If the plant index be used to indicate the food plants of insects and at the same time measures be taken to avoid confusing plant and insect names as Mr. Banks had found himself doing, he thought a considerable advance would have been made.

Mr. Felt remarked that in making an index the work should be considered not only from the standpoint of the specialist, who is looking perhaps for some particular record, but from the standpoint of all who may have occasion to use that index. Generally speaking, he was inclined to think that an entomologist would hardly use and incorporate the name of an insect in his report without accompanying it with some fact which would probably be useful to some person, and while Mr. Schwarz's criticism of indices of Dr. Lintner's report might be true, he did not think that it would apply in all cases. Mr. Felt stated that he had modified the method of making indices somewhat in later years, and had omitted indexing some matter which Mr. Schwarz would probably be very glad to have left out; and yet, as a matter of fact, he thought these minor references might have been of some service to others. Mr. Felt spoke further on a little device which he had used in his indices, namely, the inclusive reference. He considered it a serious mistake to index a name, say of the Hessian Fly, wherever it occurred in a publication without giving any idea whatever as to the character of the reference, particularly where there was a detailed account. He thought that if the inclusive reference was used, giving a little synopsis, a much more serviceable index was secured, and then it was easy to distinguish between extended notices and mere references.

Mr. Howard referred to the indices of the Proceedings of the Entomological Society of Washington, prepared by Mr. Schwarz, and considered them perfect models of short indices.

Mr. Banks queried whether recent nomenclature should be used in index work or the nomenclature well known to entomologists.

Mr. Felt remarked that he had considered incorporating something about this matter in his address, but thought it might prolong it unduly.

The report of the secretary and treasurer was read and referred to an auditing committee appointed by the Chair, as follows: Dr. Henry Skinner and Mr. E. A. Schwarz.

The following names were proposed for membership by Mr. Howard: August Busck, J. Kotinsky, Otto Heideman, R. P. Currie, H. G. Dyar, W. E. Hinds, G. H. Harris, H. G. Barber, H. E. Burke, and J. L. Webb. Mr. Quaintance proposed for active membership Messrs. R. I. Smith and T. B. Symons, of the Maryland Agricultural College. Professor Webster proposed for foreign membership the name of Mr. Joseph Jablonowski, of the Entomological Station, Budapest, Hungary.

Mr. Marlatt inquired if election was necessary in the case of those qualified by their official position.

Mr. Felt thought that according to the constitution it was not, and that the only question was should a committee determine whether their positions qualified them for membership.

On motion of Mr. Osborn, a committee consisting of Messrs. Osborn, Quaintance, and Banks was appointed by the chair to consider the names which had been presented for membership and any others that might be proposed during the sessions.

Mr. Marlatt moved that the chair appoint a programme committee to arrange a programme for succeeding meetings, which was duly carried. The chair named Messrs. Marlatt, Fernald, and Burgess.

Mr. Howard moved that a committee of three be appointed on resolutions, which was carried, and Messrs. Washburn, Busck, and Rumsey were named by the chair.

A paper was next presented by Mr. A. F. Burgess, as follows:

ECONOMIC NOTES ON THE FAMILY COCCINELLIDÆ.

By A. F. Burgess, *Columbus, Ohio.*

Several years ago while located at Malden, Mass., I became interested in the study of the food habits of this family of beetles. Considerable data was collected at that time, and since some additional notes have been obtained; and it seems desirable to place the facts on record, as they may serve as an aid to some future investigator of this subject.

Many of these beetles hibernate during the winter in the adult stage. In Massachusetts it often happens that the most common ladybird, *Adalia bipunctata*, hibernates in dwellings, and sometimes appears during midwinter in rooms which are heated, usually to the disgust of the housewife, who, not recognizing the friendly character of her guest, immediately wages a war of extermination.

The following species have been captured on dates which indicate that they hibernate as adults:

Megilla maculata DeG.—Several hundred examples taken March 31, 1900, at Urbana, Ill. It is a common species in that locality.

Hippodamia glacialis Fab.—Taken at Malden, Mass., November 4, 1897.

Hippodamia parenthesis Say.—Taken at Malden, Mass., November 4, 1897. Taken at Urbana, Ill., April 5, 1900.

Coccinella trifasciata Linn.—Taken at Malden, Mass., April 13, 1898.

Coccinella 9-notata Hbst.—Taken at Malden, Mass., April 12, 1898.

Coccinella sanguinea Linn.—Taken at Malden, Mass., May 1, 1898. Taken at Urbana, Ill., April 15, 1900.

Adalia bipunctata Linn.—The most common species in eastern Massachusetts occurs under loose bark of trees and in sheltered places during the winter.

Harmonia picta Rand.—Taken at Malden, Mass., May 1, 1898.

Mysia pullata Say.—Taken at Malden, Mass., May 2, 1898.

Anatis 15-punctata Oliv.—Taken at Malden, Mass., January 12 and April 10, 1898.

Chilocorus bivulnerus Muls.—Taken at Malden, Mass., April 13, 1898. Taken at Urbana, Ill., April 26, 1900.

Pentilia misella Lec.—Taken at Lakeside, Ohio, October 27, 1900. Large colonies were found under cloth bands, which had been tied around the trunks of plum trees infested with San Jose scale. There were thousands of beetles in this orchard.

Brachyacantha ursina Fab.—Taken at Malden, Mass., May 5, 1898.

Hyperaspis signata Oliv.—Taken at Malden, Mass., May 1, 1898.

Of the 14 species above listed, *Megilla maculata* and *Adalia bipunctata* were the only ones which were found during the winter in colonies. In most cases isolated beetles remain during the winter under the loose bark of trees or under leaves or rubbish, and come forth on the first warm days in spring to search for food.

Early in the spring of 1898 they were first found feeding upon plant-lice eggs. These eggs do not hatch until several days after the beetles appear; hence this habit of the beetles serves to reduce the number of lice considerably.

April 13, 1898, many specimens of *Adalia bipunctata* were found feeding on the eggs of an aphid, which was particularly abundant on the white birch at Malden. A few days later *Anatis 15-punctata*, *Coccinella sanguinea*, *C. 9-notata*, and *Chilocorus bivulnerus*, as well as *Adalia bipunctata* and its variety, *humeralis*, were found busily engaged in feeding on the aphid eggs. Thousands of specimens of Adalia were present, and large numbers of Anatis, the other species occurring in moderate quantities. Three days later both Adalia and Anatis were found mating, and an egg-cluster of the former species was also discovered.

The aphid eggs were found hatching April 18, the young lice at once proceeding to the leaf buds, which were just beginning to burst open. The development of foliage was considerably retarded by the cold and wet weather which characterized the spring of 1898.

Larvæ of Adalia were found May 1. At this time an excellent opportunity was offered to observe the interrelations between several

species of insects. The ladybirds in both adult and larval stages fed greedily on the eggs of the plant-lice and the young lice as soon as they hatched. Accompanying the beetles was also noted several species of predaceous bugs, the most common one being *Podisus serieventris*. Although this species was occasionally found feeding on the plant-lice, it was continually observed preying upon the ladybirds in all their stages. The particular species upon which it was taken in the act of feeding were *Adalia bipunctata* in the egg, larval, and adult stages; *Coccinella trifasciata*, and *Chilocorus bivulnerus*. Four specimens of *Podisus serieventris* were once observed feeding on a single adult *Adalia bipunctata*.

It is a well-known fact that many species of insects will become cannibals if kept in confinement with insufficient food, but *Adalia bipunctata* has been observed repeatedly in the woods feeding upon the eggs of its own species when plenty of other food was available and within easy reach.

By the last part of July scarcely a plant-louse or a ladybird could be found in the locality where they had both been so abundant.

Several species of Coccinellidæ were bred in confinement, and the following table gives their egg-laying records. A pair of beetles was placed in each jar with food, and the record was continued until the female died:

Egg-laying records of several species of ladybirds.

[The asterisk (*) indicates the date on which the experiment was begun.]

Date.	Adalia bipunctata.		A. bipunctata. var. humeralis.		Anatis 15-punctata.			Coccinella sanguinea.	Coccinella 9-notata.	Coccinella trifasciata.
April 6	*									
8		*								
11		29								
13		15	*							
17		29			*					*
18	9	27								
19		9								
20			14							
22					13					
23		2	8		20					
24	8									
28					9					
May 1	13				9		*			
6						*	12	*		
8						14	17	7		
9			15							
10						6	12			
11			12						*	
12			13			12	9			24
13			20		6	20	5			
14						17		12		
16			6							
18			21			26	4			20
19		11	18			27	1			9
20					14	1	10			
21			8			5				18
22			2			8				
23			1							12
24			7	*						
27				10						
28				19						
29							3			
30				23						
June 2				33						

Egg-laying records of several species of ladybirds—Continued.

Date.	Adalia bipunctata.		A. bipunctata, var. humeralis.		Anatis 15-punctata.			Coccinella sanguinea.	Coccinella 9-notata.	Coccinella trifasciata.
June 3	.....	.....	.....	.....	.....	.....	.....	.....	.....	28
4	.....	.....	.....	16	.....	.....	.....	.....	.....	.....
7	.....	.....	.....	.....	.....	.....	.....	.....	18	.....
8	.....	.....	.....	12	.....	.....	.....	.....	23	15
9	.....	.....	.....	.....	.....	.....	.....	.....	21	.....
10	.....	.....	.....	6	.....	.....	.....	.....	60	.....
11	.....	.....	.....	.....	.....	.....	.....	.....	38	16
12	.....	.....	.....	.....	.....	.....	.....	.....	39	.....
13	.....	.....	.....	13	.....	.....	.....	.....	15	.....
14	.....	.....	.....	20	.....	.....	.....	.....	20	.....
15	.....	.....	.....	20	.....	.....	.....	.....	.....	.....
16	.....	.....	.....	.....	.....	.....	.....	.....	.....	18
17	.....	.....	.....	.....	.....	.....	.....	.....	2	.....
19	.....	.....	.....	.....	.....	.....	.....	.....	20	12
21	.....	.....	.....	.....	.....	.....	.....	.....	.....	16
22	.....	.....	.....	.....	.....	.....	.....	.....	.....	20
24	.....	.....	.....	13	.....	.....	.....	.....	.....	.....
26	.....	.....	.....	.....	.....	.....	.....	.....	.....	25
27	.....	.....	.....	.....	.....	.....	.....	.....	.....	10
28	.....	.....	.....	20	.....	.....	.....	.....	.....	.....
July 4	.....	.....	.....	.....	.....	.....	.....	.....	.....	15
6	.....	.....	.....	.....	.....	.....	.....	.....	.....	19
8	.....	.....	.....	.....	.....	.....	.....	.....	.....	15
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	18
14	.....	.....	.....	.....	.....	.....	.....	.....	.....	9
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
26	.....	.....	.....	.....	.....	.....	.....	.....	.....	12
27	.....	.....	.....	.....	.....	.....	.....	.....	.....	15
28	.....	.....	.....	.....	.....	.....	.....	.....	.....	20
30	.....	.....	.....	.....	.....	.....	.....	.....	.....	19
31	.....	.....	.....	.....	.....	.....	.....	.....	.....	23
Aug. 6	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
7	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
9	.....	.....	.....	.....	.....	.....	.....	.....	.....	4
	30	122	145	205	71	136	73	19	251	426

A pair of *Adalia bipunctata* var. *humeralis* (see column 3) was placed in a jar with food April 13, and eggs were deposited on April 20 and 23. On May 3 the female was isolated, but continued to deposit eggs for three weeks. The eggs, 105 in number, laid from that date until May 20, hatched, but 18 laid subsequent to the 20th did not hatch. In this case the female continued to lay fertile eggs for sixteen days after being isolated.

Several species of ladybirds were reared, and the number of days spent in each stage is given below. In cases where more than one individual of a species was reared the average number of days spent in each stage is given in the table.

Number of days spent in different stages of development by several species of ladybirds.

Species.	Egg.	First larval.	Second larval.	Third larval.	Fourth larval.	Pupa.	Adult to adult.
Adalia bipunctata	6	6	5	5	7	9	38
Adalia bipunctata var. humeralis	5	6	5	6	7	9	38
Anatis 15-punctata	8	6	6	5	12	9	46
Chilocorus bivulnerus	13	.....	.....	.....	.....	8	.....
Mysia pullata	7	10	5	9	14	7	52
Coccinella sanguinea	7	5	6	5	7	7	36
Coccinella 9-notata	7	6	4	2	6	6	30
Coccinella trifasciata	5	5	6	4	6	8	36

I did not succeed in rearing *Chilocorus bivulnerus*, but secured only the data given in the table.

The length of time spent by these beetles in their different stages varies considerably; it is influenced chiefly by the food supply and weather conditions.

If they are furnished with an abundance of food, and the weather is very warm, the length of time spent in each stage may be considerably reduced.

The next table gives a somewhat incomplete record of the average amount of food consumed daily by the beetles and the amount eaten during each larval stage while they were being reared in captivity. The aphids which served as food were of different species, and would average about the size of half-grown apple aphids. The birch aphid eggs were of the same form and color, but slightly smaller than the eggs of the apple aphis.

Number of aphids consumed daily by ladybirds of several species during different stages.

Species.	First larval stage.	Second larval stage.	Third larval stage.	Fourth larval stage.	Adult stage.
Adalia bipunctata	6	7	23	10	10
Anatis *15*-punctata	51	55	107	213	90
Mysia pullata	.....	.....	.....	.....	50
Coccinella sanguinea	10	55	60	.....	.....
Coccinella *9*-notata	23	36	.....	.....	100
Coccinella trifasciata	10	30	50	155	50

An adult specimen of *Adalia bipunctata* consumed 100 aphid eggs daily, and an adult of *Chilocorus bivulnerus* ate about one-half as many of these eggs during the same period.

The records given show in a general way something of the economic value of the insects discussed, and gives, it is hoped, more definite data concerning some points in their life history than has been published heretofore.

Mr. Marlatt stated that he had been much interested in this paper, and thought that it threw light on a number of matters about which information was needed. He asked Mr. Kotinsky to give a brief statement on the amount of food which the Asiatic ladybird would eat, since Mr. Kotinsky had been looking after those details. He further stated that the egg records which Mr. Burgess had given were interesting, but he did not consider them of sufficient number to warrant definite conclusions as to the number of eggs deposited by the insects. He thought Mr. Schwarz could give some information on that point. He thought that probably all ladybirds would be found to live for a considerable length of time, the imported *Chilocorus similis* sur-

viving nearly a year, and that egg laying normally extended over a protracted period.

Mr. Kotinsky stated that he had been charged by Mr. Marlatt with the care of the imported Asiatic ladybird ever since it had reached this country, a little over a year ago. He had had occasion to closely watch its food habits until during the summer, when large numbers were available and could safely be confined for close observation. At Mr. Marlatt's suggestion he had once placed three larvæ, one each of the first, second, and third stages, in a jar upon a peach twig covered with young newly hatched peach scales (*Diaspis pentagona*). These had been kept for seventy-two hours, and after making very liberal allowance it was calculated that they had eaten in the course of those three days some 14,000 larvæ, an average rate of 1,500 in the course of twenty-four hours, or a little over one per minute for each beetle larva. Upon a closer observation still he had found that a half-grown larva about the second stage would eat a larva of the scale in the course of about five or six seconds, and would consume about 5 or 6 per minute. He thought the larvæ spent some time wandering about, resting, etc., which accounted for the reduced average when rates per day were considered. Only on one occasion, and that an abnormal one, had he observed one of the larvæ to eat another. This occurred when two full-grown larvæ were confined upon a stick which had no food upon it at all. He was rather surprised to find that the smaller of them had been eaten into by the large fellow immediately back of the head. The beetles themselves are equally voracious. He had not had a chance to count, but they will eat the scale in all stages and plenty of them. It is very interesting to watch them devour an old scale. They do not bore underneath it, but gnaw a hole through the scale close to the exuvium and presumably suck the juices of the scale insect. Time and again he had found the mutilated skin of the adult female adhering closely to the inside of a scale. Once in a while he had seen the beetles chasing each other and enjoying themselves generally upon the twigs. It was also very amusing to see a female sitting over a scale, the ovipositor projected underneath, and herself engaged, in many instances, in calmly devouring the host, which she had apparently withdrawn from beneath its dome. He had never found an egg beneath a scale when it was perforated. Normally the egg is deposited underneath the scale, but he had seen some deposited on the bark, but in no instance had he observed that under these conditions they hatched into larvæ. He had also found some eggs among the bristles of empty pupæ cases.

Mr. Kotinsky further remarked that he had been much interested in the note made by Mr. Burgess on the failure of breeding *Chilocorus bivulnerus*. In spite of all his efforts for over a year now, he had failed absolutely in obtaining the eggs from this species. Mr. Heideman

had once called his attention to a tree on the grounds of the Department of Agriculture thickly covered with the Putnam scale (*Aspidiotus ancylus*), upon which were feeding a number of the twice-stabbed ladybird larvæ. These were the first larvæ of this species which he had noted last summer, as they were unusually scarce. Repeated attempts to obtain the eggs from either the captured adults or other beetles reared in confinement had resulted in disappointment. He expressed a desire to compare eggs of this species with those of *Chilocorus similis*. He was not aware that the egg of any *Chilocorus* had been previously described, which accounted for the difficulty experienced in finding the eggs. There were only two beetles of the Japanese ladybird left in the spring, and the absorbing problem with him had been to find the eggs. Some one had suggested that these might be found in clusters on the surface of the bark, but this did not prove to be the case. He had frequently turned up the scales upon traversed twigs to see whether the scale insects were edible, and in the course of these examinations had discovered underneath the scale something which had at first been taken to be a parasite of the scale insect, but which upon closer examination proved to be the egg of *Chilocorus similis*.

Mr. Howard remarked that he was not aware of other careful observations upon the life history of Coccinellids in this country except the series of Mr. Marlatt and Mr. Kotinsky, and those made by Mr. Coquillet in California, and his recollection was that the total life from egg to adult of *Vedalia cardinalis* in California was much shorter than the life histories which Mr. Burgess had followed in Massachusetts.

Mr. Coquillet stated that his observations on those ladybirds in California had been so long ago that the details had passed from his mind.

Mr. Fiske stated in relation to the life history of *Chilocorus bivulnerus* in Georgia that he considered it a most valuable species from an economic standpoint, and that he had had a good many opportunities to observe its younger stages and to observe it throughout the year. The eggs had been for a long time unknown to him, but last spring he had found them in considerable quantities upon old peach trees infested with the cherry scale, and the eggs were situated under the scales on the bark. At the time they were found they were brown in color instead of yellow, as he had expected. They were not reared to full maturity. He mentioned a very interesting instance which had occurred in Georgia the present year indicating the value of ladybirds. The season had been very long and unusually dry and the plant-lice had had an unusually good opportunity for development; especially was this true of the cotton aphis. Although this insect usually disappears about the first or middle of June, it continued the present year up until the 1st of July and threatened to do considerable damage.

About the middle of July letters began to come in to the Department concerning a so-called new insect occurring on cotton. The prevalence of the Colorado potato beetle in Georgia at the present time led many of the cotton growers to think that this plant was being attacked by the Colorado potato beetle. Upon receiving specimens of the insect injuring cotton, it proved to be *Hippodamia convergens*, the specimens received being mostly in the larval and pupal conditions. For some time something over twenty letters a day were received from cotton growers concerning this insect. He had made two or three trips to the cotton fields to observe this species and found that it occurred in very extraordinary numbers; thousands of them on the cotton plants. There would be as many as a dozen or fifteen or even twenty larvæ and pupæ of this ladybird on one tip of the plant, perhaps no more than 3 inches long. There were also present larvæ of certain lace-winged flies, but he considered this ladybird beetle the principal agent in checking the outbreak of the cotton aphis.

Mr. Fiske further stated that both he and Mr. Scott had been giving considerable attention to the ladybirds as found in Georgia and hoped soon to be able to publish a paper on them. One species, an *Exocomus*, had been reported as feeding on scale insects, and he was informed, he thought by Mr. Schwarz, that this genus was one that fed almost exclusively on scale insects. He had observed this species frequently, and so far it had occurred largely on plant-lice and only occasionally on scale insects.

Mr. Burgess remarked in reference to *Chilocorus bivulnerus* that he had attempted to rear it a number of times, but had been unable to do so. This species appeared to feed on plant-lice, and when plant-lice eggs were offered the beetles early in the spring they were devoured quite greedily. In his own experiments he had been able to obtain only two or three eggs of this species, and they had been deposited on a twig placed in a jar. Only one of these eggs had hatched, and this was how he had obtained the record indicated, of the length of the egg stage.

The next paper, presented by Mr. F. L. Washburn, was as follows:

DISTRIBUTION OF THE CHINCH BUG IN MINNESOTA.

By F. L. Washburn, *St. Anthony Park, Minn.*

From observations made last summer, from reports of correspondents, and from press articles it is evident that the chinch bug has been this season confined to the southeastern, south central, and southern portions of the State. Careful examination of Professor Lugger's past reports indicates that this is not a condition of affairs

peculiar to this year, but can be regarded as the permanent condition in Minnesota.

An imaginary line drawn from Mora, in the east central part of this State, southwest to Benson and then south to Iowa would include on its southern and eastern side the area infested this year. It is not to be understood that all of this territory was occupied by the chinch

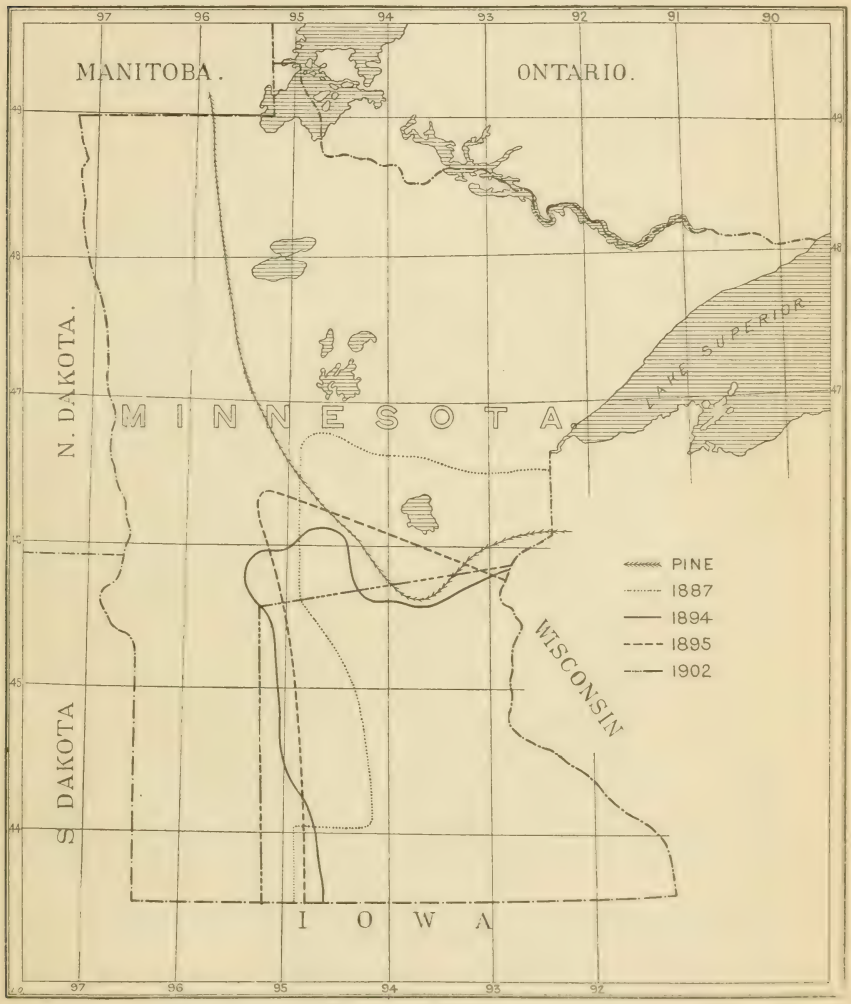

FIG. 1.—Map showing distribution of chinch bug in Minnesota.

bug, but all the infested counties heard from would be included by such a line. I note that Dr. Lugger's reports for 1887, 1894, and 1895 coincide quite closely with the conditions of 1902. To make this more clear I have had a map (fig. 1) copied from one of his reports, to which I have added the line I refer to as representing my findings this year. In the years noted (1887, 1894, and 1895) Dr. Lugger found the same

counties infested which I have reported upon and in addition, as you will note from the chart, a few counties to the north. He also refers to one isolated example in 1895 from the extreme northern part of the State near Lake Vermilion. This latter reference, as far as I can make out, is something in the nature of a rumor. I can find no specimens in the collection substantiating the report. The chinch bug is not known in the Red River Valley along the western border, nor is it known north of the imaginary line shown in the map, with the possible exception above noted. It occurred to me that these conditions might interest entomologists, particularly as maps have been published and republished indicating in a general way that the chinch bug is found over the entire State. It must be admitted that a few sections might have chinch bugs which are not reported; nevertheless the close similarity in the findings of the late Dr. Lugger and the present entomologist would seem to place the matter of its distribution beyond question. The year has been unfavorable for this pest, the summer having been a decidedly wet one. I might say that much of the blame of injury caused by the Hessian fly, a pest even now of almost universal occurrence in Minnesota, has this summer been laid at the door of the chinch bug, with which farmers are much more familiar than they are with the former insect.

At the conclusion of this paper Mr. Burgess inquired of Mr. Washburn if the chinch bug fungus was being used in Minnesota to any extent at the present time.

Mr. Washburn replied that it had been almost entirely abandoned. It had not been found practicable.

The meeting then adjourned, to reassemble at 2 p. m.

AFTERNOON SESSION, FRIDAY, DECEMBER 26, 1902, 2 P. M.

The meeting was called to order by the president, who, after calling Mr. Osborn to the chair, presented a paper on the following subject:

OBSERVATIONS ON THE GRAPEVINE ROOT-WORM.

By E. P. Felt, *Albany, N. Y.*

[Withdrawn for publication elsewhere.]

Mr. Burgess remarked that the life history of the grapevine root-worm had been worked out by Messrs. Webster and Mally several years ago, and that this had been published along with results of their experiments in its control. A year ago he had carried on a few experiments under Mr. Webster's direction for spraying for this insect with arsenate of lead, and, although the results were not con-

clusive, it appeared that some considerable benefit had been derived from the spraying. He stated that the grapevine root-worm occurred in the grape districts in northern Ohio, especially east of Cleveland, where in some localities it did a great deal of injury.

The next paper was presented by Mr. Osborn, as follows:

A METHOD FOR MOUNTING DRY COCCIDÆ FOR PERMANENT PRESERVATION.

By Herbert Osborn, *Columbus, Ohio.*

Probably all who have had occasion to preserve scale insects have appreciated the desirability of obtaining a more practicable method than those now in vogue. The writer has tried the several methods in use, such as pinning in insect boxes, inclosing the specimens in glass vials or tubes, placing them in folded papers, etc. Each has its own disadvantage, and one common to all is that of the danger of the scales being scraped off or loosening in time so they fall off.

The plan now proposed is to put the specimens, together with the twig or leaf to which they are attached, between two slips of mica which are the size of the standard 3 by 1 microscope slide, the two slips being bound together by pieces of gummed paper, as in mounting lantern slides. At one end a label may be placed. The whole fits into a microscope-slide box, and the mounts may thus be filed along with balsam mounts. The advantages to be gained by the method are: Preservation from moisture, from insect pests, and from ravages of other character. Not the least of the advantages are those of storing and facility of handling. Thus, the mounts may be filed, as described above, in slide boxes, or they may be pinned in insect boxes or placed under glass for exhibition purposes, and if desired they can be wrapped in bundles and carried in the pocket into the field. This latter suggestion may meet with sympathy from those field collectors or inpectors who desire to take with them into the field authentic specimens for reference.

The method of mounting may be varied for the different kinds of specimens. Thus, thin leaves may be simply pressed between the two sheets of mica and the edges bound. For pieces of bark and thicker leaves or rind of fruits a cell about three-fourths of an inch by 2 inches may be made from cardboard, in which the specimens may be placed, the mica slips being bound over the cell. For still thicker pieces, such as small twigs, the cell may be made deeper while the ends of the mount are left thin in order to fit into the grooves in the slide boxes.

The specimens to be mounted should be thoroughly dry. In the case of leaves, pieces of bark, orange rind, or parts that tend to curl,

in order that they may lie to the best advantage they should be dried, as in the preparation of botanical specimens, between blotters. If desired, glass slides may be used and mica used for covering. The advantage of mica over glass is evident, as the mica is not subject to breaking as readily as glass and is much lighter.

The expense for material is but little more than 1 cent per mount, and the mounts can be made in very short time by anyone neat at pasting, so the cost of the method is certainly within reason.

The next paper was presented by Mr. Felt, and was on the following subject:

RESULTS OBTAINED WITH CERTAIN INSECTICIDES.

By E. P. Felt, *Albany N. Y.*

[Withdrawn for publication elsewhere.]

At the conclusion of this paper it was voted to defer discussion until a series of papers of a similar character had been presented.

The next paper was presented by Mr. Quaintance.

FURTHER NOTES ON THE LIME, SULPHUR, AND SALT WASH IN MARYLAND.

By A. L. Quaintance, *College Park, Md.*

At the Pittsburg meeting in June last I presented some notes on the use of the lime, sulphur, and salt wash as a treatment for the San Jose scale in Maryland. Further observations have been made on these tests, and it appears desirable to briefly present the results, particularly since the conclusions reached in June as to the lack of efficiency of the wash now appear to have been premature.

Experiment I.—Twenty badly infested Japan plum trees were treated at College Park, Md., on March 4. The last examination before the Pittsburg meeting was made on June 2, practically three months later. At this time the young live scales were very numerous, crawling around over the limbs and branches, and many had already settled. Live adult females were also very abundant even where the wash was still adhering to the trees. Scraping infested branches with a knife blade flatwise pressed out an abundance of the oily fluid from the

bodies of the insects. The per cent of scale killed by the treatment was carefully estimated at from 55 to 60.

Examinations of these trees at different times during July and August revealed that the scales were gradually becoming less and less instead of more numerous, as would have been expected from the large per cent of adult insects that had escaped treatment. By the first week in July the over-wintering females were practically all dead, having given birth to their young. The young larvæ to a considerable extent failed to permanently establish themselves, and practically all of those which had settled soon afterwards died. Only here and there could a live maturing insect be found, and these were mostly on the terminal growth. By the middle of August the old scales were peeling from the trunks and branches, and on September 6, the date of last examination, the trees were noticeably brighter and smoother, owing to the general falling off of the dead scales. But comparatively few live scales could be found, although these same trees were alive with the crawling larvæ in June.

Experiment II.—This test was made at Annapolis Junction on 225 10-year-old apple trees and about 50 2-year-old peach trees. The wash was applied March 27 and 28. An examination on June 13, about two and one-half months later, showed young, crawling lice in great abundance, and the mature breeding females were so numerous that but little good appeared to have been accomplished by the treatment. The percentage of scales killed was placed at from 45 to 50.

This orchard was not examined again until September 8. Instead of finding these trees badly infested with scale they were found to be remarkably clean. Live scales were really hard to find even this late in the season. The old scales had largely shelled off and the trunks and limbs had taken on a slick, healthy appearance. Even on trees that had been encrusted with scales the results were apparently equally good.

The final outcome of these tests of the wash was quite a surprise. It would appear that results have been expected too soon after the application of the wash; and it further appears, as has recently been shown by Mally[a] in the case of *Diaspis pentagona*, that a sufficient amount of the wash probably remains on the trunks and limbs to destroy the larvæ coming from those females which escaped the treatment. The final effect of the wash in the two cases cited and in other cases that have come under my observation leads me to believe that we have a most valuable treatment for the San Jose scale in the lime, sulphur, and salt wash.

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[a] Entomological News, vol. 13, p. 223.

Following this paper the secretary read a communication from Mr. W. E. Britton, as follows:

THE LIME, SULPHUR, AND SALT MIXTURE IN CONNECTICUT.

By W. E. Britton, *New Haven, Conn.*

In the spraying experiments conducted by the station during the spring of 1902 the lime, sulphur, and salt mixture was given a trial in three different localities in Connecticut. April 1 a pear tree near New Haven was sprayed with a mixture containing 50 pounds of lime, 50 pounds of sulphur, and 50 pounds of salt to 150 gallons of water. Another pear tree was sprayed on April 15 with a mixture made in the same way. On May 23 a careful examination of these trees showed that less than 1 per cent of the scales were alive. The same formula was used on one peach tree and one cherry tree at Bridgeport April 16. No living insects could be found on these trees when examined on June 23. The trees were very late about putting out their leaves, and on April 18 six Japanese plum trees and one peach tree at Terryville were sprayed with a mixture made of 30 pounds of lime, 20 pounds of sulphur, 15 pounds of salt, and 60 gallons of water. On June 24 the trees were examined and the percentages of living insects were found to vary from 0 to 7, the average of the seven trees being 3.36 per cent. In each case this insecticide was used in comparison with 25 per cent crude oil mixed with water and several other mixtures. It proved to be as effective in destroying the scale insect as any of the other preparations employed, and in no case did it injure the trees, while some harm followed the application of crude oil, both undiluted and in the 25 per cent mixture, in several cases. The largest percentage of living insects on the sprayed trees occurred on branches which were very badly infested, being covered several layers in depth with the bodies of the insects. The insecticide in some cases had not penetrated the mass sufficiently to kill those at the bottom.

The lime, sulphur, and salt mixture has also been used in several large Connecticut orchards the past season, and has given satisfactory results. It will be employed much more extensively the coming season.

At the conclusion of this paper the subject was opened for discussion.

Mr. Alwood remarked that for some years he had been somewhat of an advocate of both refined and crude oil. In Virginia they had sprayed thousands of trees with these forms of petroleum, and in the main good results had followed. In some cases the results had been remarkably good. He desired to call attention to a case where the use of oils had been very beneficial. This particular case was a young

orchard of about 500 winesap apples. Scale insects were discovered on these trees, he thought in 1898, about three years after setting. The insects were discovered in the summer, and five trees out of the 500 or more were quite badly coated. There had been, of course, some spread to other trees. The young orchard was in a very beautiful condition, and the owner had appealed to him to do something to stop the spread of the insects. He had already been making experiments in the way of summer work, and so he recommended spraying these trees with pure kerosene, 150° flash test, and this had been done. Three of the trees had died from the treatment. They were covered with the scale, and of course were weak from the effect of the insect. Two of them had lived through the application of pure kerosene in the summer and are still living, and up to the present time were free from scale. He further stated that he had applied kerosene to some thousands of trees in the summer time, and in no case had trees been killed by its use except where he had killed them purposely in order to determine how much oil the trees could stand.

In the case of the young orchard cited, the insects had not all been exterminated and the oil was again applied in the dormant season, and this was repeated in 1900. In 1901 the application had been changed to crude petroleum late in the winter season or early in the spring. The scale was not eradicated by this treatment, and crude petroleum was used again in 1902. He thought the last application had largely eradicated the scale; but he had visited the orchard the 1st of September, 1902, and had found a very few San Jose scale on five trees. The infestation was chiefly at the base of the trees in the region where the trunks of the trees and soil come together. Some few had been found in crevices of the bark. He explained that this instance was mentioned because that orchard to-day is a remarkably fine one, 8 years old, apparently uninjured by the treatment, and the scale, while not eradicated, has been so thoroughly repressed that it had accomplished no harm. The trees that were first so thoroughly treated with the pure kerosene are apparently free from the scale. There are a few trees in the orchard which were never badly infested, probably six or eight, which are still slightly infested. This is only one of a good many cases in Virginia which could be mentioned, but was to be considered illustrative of the work where intelligently done.

Mr. Fiske stated that in Georgia the San Jose scale had been the chief feature of the work of the department of entomology for a good many years past. They had been obliged to fight it with every known means, and for some years oil had been recommended. In a way the oil treatment had been successful where applied correctly. Still there had been a good deal of complaint from growers that peach trees had been killed by the oil and that the fruit buds had been injured. He had found in comparing the published results with oil in the different parts of the country that a considerable difference of opinion prevails

as to its value. Last winter, in order to straighten out certain vexed points, a series of experiments had been instituted by the department. Several different orchards had been used, embracing trees in different stages of growth and in different conditions. These had been sprayed with oil, with the lime, sulphur, and salt wash, and various other mixtures. A few points had been cleared up, but the results of these experiments had raised numerous other points, so that on the whole, from his standpoint, he had not been much enlightened by the tests. In Georgia at the present time the question is not what is the best general treatment for the San Jose scale, but what is the best treatment for any particular orchard, and the conditions in every orchard are different. In the experiment work last winter two orchards had been used, one of which was two years old, containing large trees for their age, healthy and thoroughly infested with the scale. The other was an orchard of 4-year-old trees, healthy, rather mature, and, if anything, worse infested with scale than those of the younger orchard. The experiments were duplicated on these two orchards, which were situated about half a mile apart, the soil and weather conditions being practically the same. Frequently the same insecticide had been applied to the respective orchards on the same date and by the same hands. A treatment that had been perfectly successful in the older orchard was anything but successful on the young trees. For instance, 20 per cent petroleum in one application on the older trees was very effective in killing the scale, and in August and September there were practically no scales to be found on those trees. In the younger orchard, however, while it killed probably as many of the scale, yet, owing to the healthful condition of those trees, every young scale that hatched and settled down seemed to be successful and in due time gave birth to young. Thus in the fall in this orchard there were trees practically dead with the scale where hardly a live scale could be found in the spring. In the younger orchard there were half a dozen different varieties of peaches. On some varieties the scale was killed and in August they were practically free, while, with the same treatment in every respect, other varieties were badly infested with the scale. There were fully ten times as much scale on some varieties as on others. He considered it important in treating the San Jose scale to get first of all a knowledge of the condition of the tree as affecting the health of the scale. He considered it necessary to know, when advice was asked concerning treatment for any given orchard, what the condition of the orchard was. He considered that perhaps 20 per cent oil would be satisfactory or not, depending on the age and condition of the trees. In his opinion this was one reason why the results with oil had varied so much.

The present winter the lime, sulphur, and salt wash had been recommended largely, although with certain reservations, and he wanted to know if any who had experimented with it had found it unsatisfactory.

Mr. Alwood desired that those who had used the lime, sulphur, and salt wash would make their experience known, because he considered it a very important question. He stated that he had not used the wash enough to have come to definite conclusions about it. He considered that it was very important to discover a treatment that would not prove injurious to trees, for in his opinion the average workman would often be likely to injure trees by the oil treatment.

Mr. Fiske remarked that in connection with their experience with the wash as used last winter, the results were very much like those already reported by Mr. Quaintance. The scale had not been killed at once, and notes made in May as to the efficiency of the wash indicated that it was very unsatisfactory. It was estimated that from 10 to 25 per cent of the scales were alive on the trees at that time. Examinations in August, however, showed that the per cent of live scales was very much less. He did not think that the insects which actually escaped treatment bred so fast on trees sprayed with the lime, sulphur, and salt mixture as in the case of those sprayed with oil.

Mr. Burgess stated that a great deal of spraying had been done last winter in Ohio with crude petroleum, especially in the peach district, and a great deal of damage had been done. As a rule, crude petroleum had been used undiluted. He considered that if a grower uses a pump designed to make the mechanical mixture of the oil with water and sprays liberally, he may get as much oil on the tree as if he sprayed sparingly with the undiluted crude oil. A good many of the growers—a majority of them, in fact—used the pure crude oil. A large number of trees had been killed and a large number had been seriously injured. These were mostly peach. He did not recall at that time that apple trees had been seriously hurt by the use of pure crude petroleum, although a number of orchards had been treated with this substance, and the owners were of the opinion that the scale had been greatly reduced.

In reference to the lime, sulphur, and salt wash, Mr. Burgess stated that a few experiments had been made and a few growers had used the mixture, and, from what he had seen, the results were good. Some of the growers from northern Ohio had, within the last month, visited some of the peach and apple orchards in southern Illinois that had been treated by the spraying force employed by Dr. Forbes. These orchards had been treated the past winter with the lime, sulphur, and salt wash, and had been visited by the growers in order to get an idea of what could be done with this wash. They appeared to be very well satisfied with the treatment, and some were making arrangements to use it on their trees. Mr. Burgess further stated that in the peach district of northern Ohio he did not consider it advisable to recommend the use of crude oil in any form except to those growers who had been able to handle it successfully in the past. While some had

been able to spray their orchards with this substance without injury, many others had not. The reason for this difference was not plain to him, as in some cases, at least, there was reason to believe that the men were equally careful.

Mr. Webb stated that the results from spraying with the lime, sulphur, and salt wash had varied widely in Delaware. In some cases the results had been excellent. Five hundred 3-year-old trees in fair condition, only moderately infested with the scale, had been thoroughly sprayed with this wash, so that they were white from top to bottom. Shortly afterwards the trees had been examined very carefully by Professor Sanderson, who thought that not 25 per cent of the insects had been killed; but in August and September there were but very few living scales to be found. Mr. Webb stated that he had examined the apple trees frequently himself, and was very soon struck with the fact that no young scales could be found. On the other hand, an orchard on the adjoining farm, a year or two older, sprayed by the same men and under apparently similar conditions, showed very poor results. At no time during the season were the trees at all free from the young, crawling scales, and by the middle of the summer a great many of the trees had been ruined. On the whole, very little benefit seems to have come from the treatment. Mr. Webb thought there was undoubtedly an explanation of the difference in results, but was not able to account for the difference himself. Mr. Webb mentioned other cases where orchards of from 500 to 1,200 trees had been sprayed, though the work had not been done very thoroughly, but he considered the results excellent in view of the fact that the work had been done so poorly. Considerable crude oil and some refined oil had been used in Delaware on peaches and plums as well as on apples and pears, and there had been absolutely no injury, unless, as mentioned by Mr. Alwood, the attempt had been made to kill the trees. With some pumps, making a mechanical mixture of oil and water, the mixing had not been well done, some trees showing just a trace of oil and others were covered with a thick coat. Yet no injury had resulted from such treatment, so that the majority of fruit growers are rather inclined to use the oil.

Good results had also been secured by the use of the soap emulsion, which was used to a considerable extent, and, all things considered, he thought probably this had given best results. The refined kerosene had been used almost exclusively in making this soap emulsion, but very little of the crude oil being used. In one instance, where 25 per cent emulsion had been sprayed on plum trees just before the buds had opened, there had been no injury, and a full crop of fruit had been borne by the trees the following year. This same orchard had been treated in the spring of 1902 with approximately 33 per cent of kerosene emulsion with very excellent results, although the treatment

had been given somewhat earlier than that of the year previous. In another case an orchard of 3,000 trees had been sprayed with 20 and 25 per cent kerosene-soap emulsion, using two or three times as much soap as is ordinarily prescribed, also using Good's potash whale-oil soap. This treatment had been given during the spring of 1903 and up to November, but very few live scales were to be found in the orchard. It required very careful examinations to find any scales at all on approximately 90 per cent of the trees.

Mr. Alwood desired to know exactly how the emulsion had been prepared.

Mr. Webb stated that he had not done the work himself, simply observing it, but it was his recollection that a pound of soap was used to a gallon of water and a gallon of oil to make the emulsion, and then 2 gallons of water were added to make the 25 per cent mixture, and in other cases 3 gallons of water to make the 20 per cent mixture.

Mr. Fiske stated, in reference to the emulsion, that it had been used to some extent in Georgia last winter. It had been experimented with quite extensively, and the present winter a large number of growers were discarding their kerowater pumps and making the emulsion. They are putting it on at the rate of 16 per cent, and in general their method of procedure is to make an emulsion of 2 pounds of soap.

Mr. Fernald remarked that the San Jose scale had been in Massachusetts for some years, but that there had not been an opportunity for experimenting upon it until the present year. Last year and the year before the college orchard had been found to be quite badly infested. This orchard consists of 600 trees, ranging from 6 to 30 years old, and the infestation by the scale was very general. The idea in undertaking the tests was to determine the value of the different substances employed under New England conditions. Different trees were treated, the applications being made last spring, about March 27 to April 14. At that time the weather was quite variable, so that there was an opportunity to test the effect of different kinds of weather upon spraying operations. In view of the fact that it had been suggested that temperature and weather conditions in general might affect the results from spraying, full meteorological records were kept for every tree. This included a record of the temperature, force and direction of the wind, humidity, etc. A careful study of the records indicates that no relation exists, except possibly in a slight degree in the application of kerosene. Mr. Fernald did not consider that the weather made any perceptible difference, except as stated. As to the best method of determining results, the speaker stated that he soon became satisfied that early counting of the percentage of living scale was one that could not be depended on, from the fact that at that time of the year so many of the young scales are killed by the weather. Inspec-

tions were made every week over the whole orchard, and were continued until stopped by snow. Inspections were entirely in reference to the abundance of living scale as compared with the original inspection. The trees have been classified according to the results. Results were given as follows: Good's potash whale-oil soap No. 3, 2 pounds to the gallon of water, was sprayed thoroughly over all kinds of trees, including cherry, pear, apple, peach, plum, apricot, and nectarine. An examination showed that 28.12 per cent have been freed from the scale; the remaining 72 per cent are still infested. With the crude oil one or two additional facts should be mentioned. In regard to the unreliability of kerowater pumps, Mr. Fernald said that the one used by him had recently been in the hands of the manufacturers, who said that it was all right. Nevertheless, this pump often varied 20 per cent within five minutes. Of the trees treated with crude oil 40 per cent were freed from the scale, but many badly infested trees still remain. Mr. Fernald questioned if entomologists could afford to recommend to the fruit grower a pump which is likely to be as unreliable as was the pump used in his experiments. Twenty per cent kerosene put on in the same way gave a percentage of 44.44 of trees entirely freed from the scale. Bowker's tree soap gave 52.68 per cent freedom from scale, over half of the trees treated being cleared from the pest. Bowker's soda whale-oil soap gave 40.44 per cent freed from scale. Good's soap, 1 part, and lime, sulphur, and salt wash, 9 parts, was tried and gave only 28.8 per cent of freed trees. Lime, sulphur, and salt wash cleared 66 per cent of all the trees to which it was applied, and part of it was applied one evening just previous to a rain. This application had been made on March 29 and was still perceptible on the trees on June 10.

The conclusions reached by the speaker were that the lime, sulphur, and salt wash is the best treatment for the average man to use who has not had experience in spraying. Although the wash is hard to make and disagreeable to apply, the speaker nevertheless thought that in view of its low cost and the safety with which it might be applied, and, further, on account of its apparently continuous action, extending clear into the summer, that this wash would more nearly meet conditions in New England than anything else tried. Mr. Fernald considered it desirable that investigations should be made in reference to the preparation of the wash to simplify this process as much as possible.

Mr. Marlatt remarked that one interesting feature of the last two years is that after a lot of experimentation we are coming to the methods which have been followed in California for many years, namely, the use of the lime, sulphur, and salt wash and kerosene emulsion.

Mr. Fiske desired to know if anyone present knew anything about the Texas crude oil. He stated that it was now very cheap in the

South, and that many were asking if the Texas crude oil could be used in place of the Pennsylvania crude oil. He had used the Texas crude oil last summer as a summer treatment, with no injurious effect.

Mr. Caudell remarked that he had used the Texas crude oil while in Texas to keep ants from his insect collection. He understood that one defect was that it was of a very sticky nature, and if used on plants was likely to fill up the pores, thus suffocating them.

Mr. Marlatt stated in connection with the lime, sulphur, and salt wash that in his opinion a considerable part of the lime commonly used might just as well be left out. He thought that the use of kerosene emulsion would become more general from the fact that it was possible to secure a definite strength, no matter how the pump might work. He stated that there was some difficulty in preparing it, but if made as in California the work was greatly simplified. It is made up and put on the market, so that anyone desiring it in small quantities can secure it at no great advance in price.

Mr. Harris stated that he had used "Corsicana" oil in certain experiments against the cotton-boll weevil in Texas, and it was his experience that it had killed the plants.

The next paper was presented by Mr. Felt, and was on the following subject:

NOTES ON INJURIOUS INSECTS.

By E. P. Felt, *Albany, N. Y.*

[Withdrawn for publication elsewhere.]

The discussion of this paper was deferred until several of a similar character had been presented.

Mr. Osborn then presented the following paper:

INSECTS OF THE SEASON IN OHIO.

By Herbert Osborn, *Columbus, Ohio.*

In a previous paper I have noted some of the insect occurrences of the early part of the season; and as there has been no very excessive abundance of any pest during the latter part of the year, a rather brief review will suffice to put on record such as have attracted attention.

Grapevines have suffered quite severely from attacks of the leaf-hoppers (*Typhlocyba* spp.), in some cases the vines showing a decided wilting and the crop being evidently materially checked in growth. Leaf-hoppers, too, have been quite troublesome on roses and noted on many other plants. They are possibly only in about the average abundance.

Grasshoppers have been plentiful, *Melanoplus differentialis* being especially abundant in some localities, though I am not aware that it has occasioned any unusual concern on the part of farmers. Chinch bugs have been plentiful enough to be met with frequently in collecting, but I have not learned of any extensive injuries except in one or two instances in the early summer. Heavy rains and wet weather in July probably served to check them. The Hessian fly has not been attracting much attention, and there is apparently not much to fear from it for the coming crop. The wheat-stem maggot (*Meromyza americana*) was found in wheat fields hear Sandusky, but only occasional stems were infested, and the loss from this species would not average more than 1 to 3 per cent in the fields examined.

Chionaspis corni Cooley was found in a clump of *Cornus asperifolii* about 3 miles from Sandusky in such quantities that several of the shrubs were nearly dead and others so severely infested that they must very likely succumb by another season. Were the dogwood planted to any extent as an ornamental shrub, this might readily become a serious pest.

An occurrence of the cigarette beetle (*Lasioderma serricorne*) was brought to my attention by one of the furniture firms of the city, who reported the damage of certain plush upholstered furniture and desired information as to the insect and especially in reference to the probability of its having gained entrance to the articles while in their possession. An examination of the furniture showed the plush covering to be penetrated at points and the insect to occur in considerable numbers in the cotton immediately beneath the plush and in many cases fragments of the plush covering mingled with the cotton. Underneath the cotton, in the filling, no specimens were observed. This evidence seems to show conclusively that the insect had entered after the covering had been put in place and was not due to the presence of the beetles or their eggs or their larvæ in the material used for filling. It seems that the furniture had been sent to this firm for re-covering; kept in their shops but a few days and returned to the owner, and that the injury had not been discovered until some eighteen months after being in the shops. In the meantime the house had been closed and unused for a period of some six weeks. The conclusion seems evident that the attack originated in an infestation occurring very likely during the time that the house remained unused, the beetles possibly gaining access by means of cigarette packages or some infested articles of furniture, and the fact that the articles were unused permitted the insect to become fairly well established. The firm in question are to be commended for their attitude in the matter, as they were anxious to make good any injury that could be traced to their own factories or to negligence on their part. The fact that no other furniture in their establishment has shown injury from this insect, along with the fact

that the furniture was in their possession for so short a time, makes it very certain that the infection was not due to their rooms or factory being infested. Specimens have been received from Prof. J. C. Hambleton, who found them at West Jefferson.

Chrysanthemums in Columbus were very seriously infested with plant-lice (*Nectarophora* sp.), apparently undescribed. They were first observed in a greenhouse in the early fall clustered on stems and leaves, and later they were found invading buds and blossoms to such an extent as to disfigure them very seriously. The manager of the greenhouse used tobacco-stem fumigation, but he did not succeed in more than giving a temporary check to the species.

The beech blight (*Schizoneura imbricata*) was quite abundant, producing the usual whitened appearance of the beeches.

It may be worth while here also to put on record the occurrence of the white ant (*Termes flavipes*) in the vicinity of Sandusky. Specimens were found there by Mr. O. A. Swezy. The species is abundant in central Ohio, but I have not met with it so far north before.

The fall canker-worm has been quite abundant and depositing numerous clusters of eggs, so there is every probability of a continuation of the ravages of this pest another year.

The following paper was presented by Mr. Quaintance:

ENTOMOLOGICAL NOTES FROM MARYLAND.

By A. L. Quaintance, *College Park, Md.*

The most noteworthy entomological fact even in Maryland the present year has been the occurrence of the periodical cicada. About the last of May 500 return postals were sent out to correspondents in various parts of the State to determine as accurately as possible the distribution of the insect. By means of replies from correspondents, and by personal observation, the distribution of the cicada has been fairly well determined for Maryland. The accompanying map will indicate the occurrence of Brood X in Maryland for 1902.

Considerable injury was occasioned by the cicadas, particularly in the more heavily wooded and the mountainous sections of the State. Young orchards of both peach and apple were in many instances so seriously punctured that prompt and severe pruning appeared necessary to save the trees. The current fruit crop in several peach orchards was quite destroyed. The cicada made its appearance, on the whole, from about the middle of May to the 1st of June, and had largely disappeared by the first week in July.

Injury from flea-beetles has been quite pronounced, particularly on tomatoes and Irish potatoes. Numerous complaints have been received,

and the usual offender has been *Epitrix cucumeris*. The injury by flea-beetles around Easton seems to have been particularly severe, and one trucker reported that he had been obliged to replant tomatoes a third time to secure a stand.

Selandria cerasi was noted as quite injurious in a young cherry orchard near Coleman, Kent County, Md., July 15. At this time the foliage was largely eaten from the trees and the orchard had a browned and burnt appearance. This was the only notable instance of injury from this pest in the State coming under my observation the present year.

Epilachna borealis was reported injuring melons at Denton, Md., under date of August 24. This species has been noticed by the writer both last year and this year in the vicinity of Denton, feeding princi-

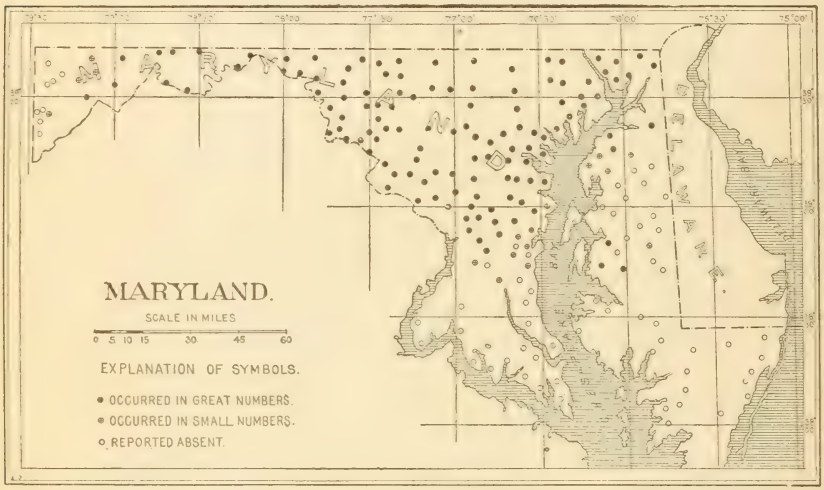

FIG. 2.—Occurrence of Brood X of the periodical cicada in Maryland in 1902.

pally on squash vines. It seems to be well established in this locality, and is more injurious around Denton than any other location in the State with which I am familiar.

The rose-chafer (*Macrodactylus subspinosus*) was very abundant and destructive in many parts of the State during the greater part of June. Fruits seem to have suffered particularly, and complaints were made in some cases that peaches, plums, cherries, apricots, and pears were largely destroyed. A correspondent at Prince Fredericktown, Calvert County, sent samples of green peaches, the contents of which had been quite excavated by the beetles.

Sweet potato slips were severely injured in the spring in the vicinity of College Park by the several species of Cassididæ, which feed on this plant. *Cassida bivittata*, *Cassida nigripes*, and *Coptocycla bicolor* were observed attacking the plants. *C. bivittata*, however, was the most

abundant. Injury from succeeding broods was not noticed, and the damage apparently was occasioned by the over-wintering adults.

The black peach aphis (*Aphis persicæ-niger*) was noticeably injurious in certain peach nurseries on the eastern shore. Injury was probably at its height by May 1, and later reports indicated that the lice had largely disappeared from the nurseries by the middle of the month. The aphis was occasionally observed on old peach trees here and there in the State throughout the summer. A badly infested peach tree was observed in Frederick December 22 with lice of all ages, notwithstanding the fact that freezing weather had been experienced in this locality on several occasions previous to this date and a heavy snow had just disappeared from the ground.

The apple-leaf aphis (*Aphis* spp.) seems to have been more than usually abundant in early spring, attacking the young unfolding leaves. Many complaints were made of this pest, and it was necessary to prescribe remedial measures. In one instance whale-oil soap at the rate of 1 pound per gallon of water was used without injury to the young foliage. Injury from this insect, however, was not particularly noteworthy during the summer, and complaints largely ceased with the passing of the brood from the over-wintering eggs.

Melanoplus bivittatus was abundant at Hancock and near Keedysville, both in Washington County. In the former instance considerable injury had been done to newly planted apple trees. The clover in an adjacent field had been cut, and the insects turned their attention to the apple trees, quite stripping several adjacent rows of foliage and bark. The grasshoppers were full fledged by June 18, after which date injury soon ceased. Attempts to secure eggs of this species confined in large breeding cages failed utterly, although the insects were given every attention which appeared necessary.

The green pea louse (*Nectarophora pisi*) failed to put in its appearance in time to injure early peas. This seems to have been the case during the last two or three years, and the practice of planting early peas is a method largely in vogue among Maryland growers to avoid injury from this pest. A correspondent from Middleburg sent potato tips thickly infested with the *Nectarophora* sp. under date of June 24. He stated that the insects had made their appearance over night.

The onion maggot (*Phorbia ceparum*) was reported as having been injurious to onions during the previous year by Mr. J. Kolb, of Royal Oak, Md., under date of June 21, 1902. No reports were received of injury during the present year.

The strawberry weevil (*Anthonomus signatus*) has been quite destructive to the strawberry crop both on the eastern shore and in western Maryland. The destructive work of the insect was variously placed by different growers at from 25 to 50 per cent of the crop. Certain

strawberry growers at Ridgely, Caroline County, have determined that the planting of profuse blooming varieties is a satisfactory way of escaping loss from this pest. It appears to be the concensus of opinion that the following varieties, mentioned in order of maturity, are most likely to answer the purposes: Rio, Superior, Tennessee Prolific, and Gandy. While Gandy is not a profuse bloomer, it is quite late, and seems to be the best variety of its season. With these varieties, with the exception of Gandy, the work of the beetles proves to be actually beneficial, by thinning out the bloom. The use of pistillate sorts, as commonly recommended, has not been found satisfactory, and has been largely abandoned.

Injury from the imported elm leaf-beetle (*Galerucella luteola*) was noted July 8 at Frederick, Md. At this time the foliage of certain elms had been largely destroyed. This is the only instance where injury from this species was noted by the writer the present year.

The rose sawfly (*Monostegia rosæ*) became noticeably destructive to roses about the middle of May quite generally over the State.

During July report was received from Mr. Richard Vincent, jr., of Whitemarsh, to the effect that some insect had greatly injured his young celery plants. A careful examination of the celery seed beds was made July 28, and one immature individual of the negro bug (*Corimelæna pulicaria*) was found on the plants, which Mr. Vincent thought to be the same insect which had been so abundant and destructive a short while previously.

The unusual prevalence of the white-marked tussock moth (*Orgyia leucostigma*) in 1901 led some to fear that the insect would again be abundant in 1902. During late May and early June of the present year larvæ of this species were observed in comparatively small numbers, but larvæ of the August brood were exceedingly rare and attracted no attention whatever.

Nests of the fall webworm (*Hyphantria cunea*) were observed quite generally over Maryland during late June and early July, but the second brood failed to show up to any extent.

Mr. Weed presented the following paper:

NOTES FROM NEW HAMPSHIRE.

By Clarence M. Weed, *Durham, N. H.*

During recent years New Hampshire has been fortunate in escaping the attacks of several lately introduced insect pests of first importance that have ravaged other States. The most notable of these are the elm leaf-beetle, the San Jose scale, the gypsy moth, the brown-tail moth, and the pear-tree psylla. The last two seasons have shown,

however, that our good fortune was only temporary, for four of these five pests have gained a foothold within our borders.

For several years there has been reason to expect that the imported elm leaf-beetle, which has been so troublesome in other States, would attack the elm trees along our southern borders, although there seemed to be some reason to hope that it would not flourish in the central and northern parts of the State. It was something of a surprise, therefore, to receive from Conway Center larvæ of this pest, with the report that they had been at work upon an elm tree for at least two seasons. To make sure of the identification, the specimens were sent to Dr. L. O. Howard, who said that they were undoubtedly the imported elm leaf-beetle. If this insect can successfully establish itself in the White Mountain region I can see no reason why it should not become a pest in all parts of the State to the southward.

For years I have been expecting the advent of the San Jose scale into our State, but have been unable to find any trace of it until this season. The very fact that there are practically no nurseries in the State not only rendered the finding of the pest more difficult, but made it more probable that it would be introduced without our knowledge. At present two infested localities are known, though it is probable that others exist. In the one first discovered the insect apparently was introduced on a tree set nearly eight years ago, the tree having been purchased from the nursery near Boston which appears to have been largely instrumental in spreading this scale through Massachusetts. In the same neighborhood the pest appears to have been reintroduced last spring on trees bought of a local agent, who had purchased them outside the State. The other infestation, which is at Dover Point, originated from peach trees bought of a local greenhouse man who imports trees from outside the State.

We have as yet no nursery-inspection law in our State, and the scarcity of nurseries would render a law so named something of a misnomer. We need, however, and shall probably get this winter, some law that will be helpful in the matter.

Another pest which appears to have been added to our lists comparatively recently is the pear-tree psylla, which has been destructively abundant during the season at least in Concord and Newmarket. Very likely we shall hear of it in many other localities in the near future.

The brown-tail moth seems to have been first introduced into New Hampshire in the summer of 1899, probably by a severe gale that blew the adults along the coast northeast from Boston. A winter nest of this insect was found in December, 1899, at Seabrook, the southeastern town of the Granite State, by Mr. F. C. Moulton, of the Gypsy Moth Commission, and in the summer of 1901 an adult moth was taken at light in Hampton, the town directly north of Seabrook. No damage from the pest has been reported, but doubtless its general presence in our southeastern region is only a question of a few years.

We have not yet, so far as I know, any evidence of the presence of the gypsy moth within our borders. But now that the State of Massachusetts has practically abandoned its heroic fight against this pest, it seems to be only a question of time when it will spread over our forests. Probably our people will then get a new idea of the possibilities of the damage that may be caused by insect pests.

Canker-worms have been very destructive in southern New Hampshire this year. Our observations show that the spring species is the one chiefly destructive. A comparative test of banding with bodlime and spraying with arsenicals showed that the latter was much the most satisfactory remedy.

On the whole the most puzzling recent entomological event in our region has been the sudden extinction of the hordes of squash bugs that overwhelmed cucurbitaceous plants last year. It does not seem to me possible to attribute this to natural enemies, and unless it was due to the open winter I am at a loss to account for it. It has long seemed to me that this subject of the sudden disappearance of insect pests was one needing careful and continuous investigation by many entomologists working in conjunction, and I venture to suggest that a permanent committee of this association might well be appointed to follow up the subject from year to year.

In New England there has been of late considerable discussion regarding the free use of arsenical preparations as insecticides. While much of the adverse criticism is of course uncalled for and absurd, it seems to me that entomologists should be careful about recommending arsenicals for such crops as cabbages and currants. While there is no doubt that arsenicals can be used safely on these crops, if used intelligently, there seems to be unusual danger that ignorant people will use them too late. Consequently it seems safer to recommend for insects affecting such plants the less dangerous insecticides.

We have found this season that the use of a 5 per cent kero-water spray is entirely efficient against the cabbage worm, and have again demonstrated the effectiveness of insect powder against the same pest. I believe that for our New England conditions these are the most satisfactory remedies.

Mr. Burgess called attention to the reference in Mr. Felt's paper to the willow curculio, and stated that during September of last year he has found specimens of this insect at Ashtabula, Ohio, which is in the northeastern corner of the State. This year it has been found in Lake County, at a point 30 or 40 miles west of Ashtabula. Referring to Mr. Osborn's remarks concerning the chinch bug in Ohio, he stated that early the present spring the prospects for a severe outbreak of the chinch bug in Ohio were very good. A large number of com-

plaints has come to the experiment station during the early spring in regard to this insect, particularly from the southern, central, and southwestern sections of the State; but a little later in the season, probably in June, the weather became wet, and, probably owing to the increase of the fungus disease, the damage decreased to a great extent. He asked if the disappearance of the squash bug had been quite general the present year. He thought that probably many entomologists in the northeastern United States had had a good many reports of its extreme destructiveness, and he had been much puzzled over the complete disappearance of the insect.

Mr. Felt stated in reference to the willow curculio that he had located it last summer at a point in Chautauqua County, where it could hardly have been carried on stock. In reference to the squash bug, it had not been quite so bad in New York state the present season as last year.

Mr. Fernald stated that the squash bug had not been particularly prevalent in Massachusetts the present year, while it had been unusually so in 1901. He was, therefore, of the opinion that the testimony from Massachusetts would go to sustain Mr. Weed's estimate for New Hampshire. He referred to an interesting German publication by Bachmetjew on the "Temperature relations of insects," which had appeared last summer, which had a bearing on the question of the relative abundance of insects during different years. He considered this a very important paper as relating to the so-called "critical point," and thought the entomologists of the northern United States would do well to test his conclusions.

Mr. Weed remarked that the lack of precise knowledge concerning fluctuations in the abundance of insects had led him to state that he considered this one of the most important economic subjects to be considered at present. These fluctuations have generally been attributed to weather or natural enemies, and he considered that we knew very little in regard to the precise rôle which natural enemies play in regard to our injurious insects. This was strongly brought out by a series of observations by Mr. Fiske and described in a paper which he stated would be published shortly. In this paper Mr. Fiske had detailed his observations on the parasites and hyperparasites of the American tent caterpillar for a period of several years, and his conclusions were, as he remembered the matter, that the parasites had very little to do with the fluctuations of the American tent caterpillar. Very often these fluctuations could be traced to the weather, but on the whole very little was known as to the exact cause which entered into these variations. He thought it safe to conclude that the disappearance of the tent caterpillar two years ago was due to the extraordinary weather conditions just after the hatching of the young larvæ, but he thought it important that definite observations should be made along this line to determine as accurately as possible the real factors concerned.

Mr. Hopkins stated that there was a possibility of variation in a species having something to do with its change in habit from an enemy of secondary to one of primary importance. Referring again to the species *Dendroctonus frontalis*, he had concluded, after a study of many hundreds specimens, that it was a variety of this which was so destructive to the pine forests in West Virginia, and that it had apparently varied from the typical species in a way to enable it to become more destructive. He thought that if it is possible for it to vary in that direction it is also possible for it to vary in another direction, and thus become more sensitive to climatic and other conditions which would exterminate it, as it was exterminated by the severe cold of 1893.

Mr. Felt called attention again to the forest tent caterpillar and stated that in New York State at least the evidence was very largely in favor of the insect being controlled by its natural enemies, for the simple reason that, in looking over the infested areas, it is found that the places where it is most abundant move gradually away from the locality where the original outbreak occurred. These localities of severe infestation have been moving eastward in New York State, and he could readily see how parasites or natural enemies might become locally abundant on account of the numbers of the caterpillars.

Mr. Weed agreed with the opinion held by Mr. Felt, and mentioned one or two localities in New Hampshire which supported this view. He spoke of one region where the Dipterous enemies were very abundant.

Mr. Felt remarked that in regard to the tussock moth in Washington, he believed it to be held that this insect had been largely checked by its parasites.

Mr. Skinner stated that he recalled Mr. Howard's statement in reference to this point, and said that the same condition was true in Philadelphia. It had been his observation that parasites increased largely during the abundance of their hosts.

Mr. Osborn stated that from his point of view it was evident that there was some general influence affecting the abundance of insects, and that there must be some widespread condition also affecting parasites. The squash bug had been present in Ohio, but not so abundant as last year. He had observed that a considerable number hibernated during the past winter. The chinch bug hibernated last year in large numbers and promised to do a great deal of damage the present season, but early summer rains came in such quantities that the insects were destroyed. They practically disappeared in injurious numbers after the first of July. The cankerworm had been very abundant in Ohio, and the fall cankerworn had appeared in considerable numbers, and he thought it likely that it would prove quite abundant in the spring.

Referring again to the forest tent caterpillar, Mr. Weed stated that in New Hampshire, to which State his remarks referred, the facts

appeared to be that the caterpillars hatched and died at the time of a very severe frost in the middle of May. Mr. Fiske had visited the infested regions and saw the caterpillars after having hatched from the eggs, and later they had disappeared. He thought there were no parasites that could have been at work during the brief interval between their appearance and disappearance.

Mr. Alwood observed that many of the entomologists were obliged to give practically all their attention to a few practical problems. He had heard some mention concerning the leaf aphids of the apple. This pest had become more and more troublesome in Virginia and it had been his custom to destroy the eggs in winter by spraying with lye. He had felt quite sure that a great many were destroyed in this way. Yet last winter, although the lye treatment had been given, the apple-leaf aphids had developed enormously and threatened to do great harm. It was therefore necessary to spray them with a soap wash as the buds opened. It was his idea that this insect should be treated in winter by destroying the eggs, and the question was brought up to draw out the experience of others in reference to winter treatment of this pest.

Referring to the woolly aphis of the apple, Mr. Alwood stated that it had become exceedingly injurious in Virginia. Its occurrence in nurseries was the source of considerable concern, and he had not been able to find a practical method of helping the nurserymen. Something was needed that was entirely practical and that could be easily applied to the young growing plants, and not too expensive. He desired to know if anyone had had experience in treating this insect on a large scale. Mr. Alwood also inquired if anyone had actually and positively determined where the female insect naturally deposits her egg. He referred to the considerable literature on this subject, and he had himself found eggs, which he supposed to be those of this insect, but when hatched they were not *Schizoneura lanigera*. He had been able to secure large numbers of eggs in confinement and a few of these had hatched, but he had never succeeded in raising a stem mother to maturity. He had spent considerable time on the life history of this species, but had never quite completed the life cycle. He desired information on this species, and also why it is this pest develops on new land in such enormous numbers in the course of a year or two, thus ruining sometimes as much as 75 per cent of the nursery trees.

Mr. Marlatt said that Dr. Howard had made some careful studies of *Schizoneura lanigera* in 1878–79 (recorded in the Annual Report of the Department of Agriculture, 1879, p. 259). These included the discovery of the true sexed generation and the winter egg, the latter attached within crevices of the bark.

Mr. Hopkins called attention to the fact that Mr. Rumsey, of the West Virginia Experiment Station, had prepared a thesis on *Schizo-*

neura (*Thysoruna*) *lanigera* while at Cornell University. He considered it a most excellent piece of work, which as yet was unpublished. Mr. Hopkins desired to know the present status of the gypsy moth.

Mr. Fernald replied that he had been all over the gypsy moth territory several times during the past summer. At the time when work with this insect ceased, owing to cessation of support from the legislature, the gypsy moth territory had been exceedingly reduced, and in the greater part of that territory the moth could not be found at all, except a straggler here and there, but it would take days of hunting to find it. In the original centers of infestation, namely, Medford, Malden, and Belmont, the moth was still in fair abundance. The work during the later years had been to drive the insect toward the center from the outside. It is not three years since the work stopped, and the moth is as yet scarcely anywhere as abundant as it was when at its worst. So far as he was able to judge, the moth had nowhere spread to its original outside bounds, but it was very bad in a number of places.

The meeting then adjourned, to reassemble on the following day at 10 a. m.

MORNING SESSION—SATURDAY, DECEMBER 27, 1902.

Mr. Marlatt gave an illustrated lecture on applied entomology in Japan, covering the subject of entomological schools and establishments and the practical workers in the science, and also a general account of the principal insect enemies of the more important fruits and field crops. The lecture was illustrated by lantern slides of entomological establishments, charts of important insects, and nearly a hundred views of agricultural and horticultural scenes. The following paper is an abstract by the author:

APPLIED ENTOMOLOGY IN JAPAN.

By C. L. Marlatt.

OFFICIAL ECONOMIC ENTOMOLOGY.

The study of insects injurious to agriculture and horticulture has an official status in Japan in connection with the department of agriculture and commerce, and with agricultural colleges and experiment stations very much as in this country. At the central experiment station at Nishigahara, near Tokyo, is a well-equipped entomological laboratory and experimental greenhouse and gardens, looked after by four or five capable entomologists under the direction of the chief entomologist, Mr. S. Onuki. This is the central and chief entomological bureau of the Empire. Some rather bulky monographs, giv-

ing evidence of being valuable productions on rice insects and insect pests of other crops, have been recently issued from this laboratory. The entomologists connected with it also make frequent trips of inspection throughout Japan and give lectures and talks before agricultural societies and bodies of farmers, carrying instruction in this way into the very homes of the people. Popular publications and placards are also issued. There are nine branches of this central experiment station and, in addition, many provincial stations. Several of these have entomologists, and in some cases very creditable laboratories, as, for example, at Kumamoto, in the island of Kyushu, where Mr. K. S. Shoshima is doing most excellent work.

The important agricultural colleges, as, for example, the ones at Komaba, Sapporo, and Kumamoto give instruction in applied entomology, and have capable men in charge. Many of us are familiar with the excellent work done by Prof. M. Matsumura, of the agricultural college at Sapporo, and of the work of Prof. S. Sasaki, of the agricultural school at Komaba, a branch of the Imperial University at Tokyo. In the regular instruction in zoology, also at the Imperial University in Tokyo, Prof. S. Watase is giving special prominence to systematic entomology.

EARLY NATIVE WORK IN ENTOMOLOGY.

Any review of the work in economic entomology in Japan must include an account of her pioneer and foremost entomologist, Mr. Yasuchi Nawa, of Gifu. Among the pleasantest features of the writer's trip in Japan were two visits paid to Mr. Nawa's establishment in the inland city of Gifu, lying in the great interior valley of the main island of Hondo. Mr. Nawa's interest in the subject developed at an early age, and has been actively prosecuted for the last twenty-five or thirty years with the greatest enthusiasm in his establishment, a sort of entomological academy or school housed in a considerable series of buildings. His own work and that of his students and assistants in systematic and applied entomology is of a most excellent character, and compares favorably with that of our own agricultural colleges and experiment stations. It will be remembered that among the best of the collections of foreign insects exhibited at the World's Fair in Chicago in 1893 was one made by Mr. Nawa, and this collection was afterwards most generously donated to the National Museum.

Mr. Nawa's academy is attended by advanced students and also by teachers and instructors from various educational institutions, colleges, and universities of the Empire. Most of these students are men of mature years who are attracted by the fame of Mr. Nawa and his work and wish to fit themselves for teaching entomology or for special work in the field of applied entomology. Mr. Nawa is now 50 years old,

TRANSLATION OF PLATE I.[a]

TITLE: ILLUSTRATIONS OF INJURIOUS INSECTS.

No. 12, *Tsumaguro yokobai*. Food plant, rice.

[Translation.] No. 12, *Tsumaguro yokobai* (*Selenocephalus cincticeps*); food plant, Ine (*Oryza sativa*).

DESCRIPTION OF INSECT AND ILLUSTRATION.

The *Tsumaguro yokobai* belongs to the half-winged class of insects, and is the kind known as a leaf-hopping insect. It has four or five broods a year, and is especially an enemy of the rice fields, where it extracts the juices from this plant, killing it or greatly lessening the yield. The male of this insect has the tips of the wings black, but the tips of the wings of the female are uncolored. The eggs are placed beneath or inside the sheath of the leaves of rice, from 10 to 20 together, and that part of the leaf covering the eggs generally changes later to brown. The young insect appears in two colors, one yellow and the other grayish black. When the rice comes into head, these insects gather on the ripening grain and extract the juices to such an extent that the seeds become a mere shell. During the winter this insect inhabits grassy strips along the roads and paths, and is especially found on the grass *Astragalus latoides*. To control this insect the rice seed-beds should be carefully planted in narrow rectangles instead of in a solid mass, and all farmers should cooperate in this respect. To collect and destroy the insects these beds may be gone over with special collecting machines or by sprinkling the water covering the seed beds with kerosene oil and brushing the insects into it. It is desirable to protect the parasitic enemies of this pest.

EXPLANATION OF ILLUSTRATION.—*a*, eggs, enlarged; *b*, single egg, still more enlarged; *c*, young insect after the second molt; *d*, after the third molt; *e*, pupal stage; *f*, male insect; *g*, female insect; *h*, insects injuring the rice plant, natural size; *i*, discoloration of leaves and stem of rice as result of work of this insect; *j*, bee parasite of egg, greatly enlarged. [Japanese lettering rendered in English.]

LETTERING OF RIGHT SIDE.

 Printed 33d year Meiji, November 26; issued same year, December 2. Price 15 cents. Illustration by Shichiro Ito.

LETTERING OF LEFT SIDE.

Author and publisher, Yasuchi Nawa, prefecture of Gifu, Gifu City. Printer, Matsutaro Ōkuma. Place of publication, The Nawa Insect Laboratory, Gifu, Kyomachi.

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[a] The translation of Plates I and II was very kindly made for the writer by Mr. Masanao Hanihara, third secretary of the Japanese Legation, Washington.

JAPANESE INSECT PLACARD, SHOWING ENEMY OF RICE PLANT.

and has devoted his life to this work from pure love of the subject and with very little aid other than the laboratory fees, and the results which have followed from his industry and enthusiasm are truly remarkable. In recent years the Government has recognized the extreme value of his work in education and the study of economic problems in entomology, and there is a proposition now on foot to give him a regular subsidy, small in amount but sufficient to enable him to continue his work with greater confidence.

At the time of my first visit to Gifu an annual provincial fair was in progress, and Mr. Nawa was also giving an entomological exposition for which he had been preparing for a number of years. This exhibit was open to the Japanese public, and streams of visitors were going through the gates and paying the small fee to study it. It comprised very much such an exhibit as would be made at one of our general expositions, filled several large rooms, and included cases illustrating the life, habits, and means of control of injurious insects, many illuminated charts and photographs representing insect work, life-history studies, and classification, also models of machinery for the collection and destruction of insects, and, in fact, a complete exhibit of a most creditable order.

The work of Mr. Nawa and his school finds its popular exploitation through a monthly magazine edited by Mr. Nawa entitled "The Insect World." Mr. Nawa also prepares and publishes large charts, each representing one of the more important of the injurious insect pests of rice, mulberry, or other crop or fruit. These charts illustrate in color the damage to the plant and the insect in all stages, give a complete record of the insect's habits for the year, and detail means of control, and are designed to be posted in public places and offices for the benefit and instruction of the rural classes. (See Pls. I and II.) A great many such charts have already been published, copies of most of which were given to me. They are examples of the practical nature of the work which this school is putting forth. In technical entomology some very important monographs have been published which, unfortunately, are sealed works so far as the western reader is concerned.

Mr. Nawa is very materially assisted by his daughter, Miss Taka Nawa, an only child, who has inherited her father's love for the study of insects and is endowed with very decided artistic talent, and is to be credited with many of the beautiful illustrations of insects which appear in the magazine referred to and in the economic circulars and other publications.

If space permitted, mention should be made of several of the assistants and associates who are most efficiently aiding in Mr. Nawa's school and economic work.

TRANSLATION OF PLATE II.

TITLE: ILLUSTRATIONS OF INJURIOUS INSECTS.

1. *Eda shakutori*—Food-plant, Mulberry.

[Translation.] 1. *Eda shakutori* (*Hemerophila atrilineata*); food-plant—Kuwa (*Morus alba*).

DESCRIPTION OF INSECT AND ILLUSTRATION.

The *Eda shakutori* belongs to the scale-winged class of insects or moths, and causes great injury to mulberry trees. It occurs throughout Japan, but is not always recognized, because in the larval stage it mimics a dead branch and is with difficulty seen. There are numerous methods of getting rid of this insect, but the best one consists in collecting the caterpillars in early spring about the time when the leaves are coming out. In doing this the specimens which have been killed by the parasitic bee should not be destroyed.

EXPLANATION OF ILLUSTRATION.—*a*, eggs of this insect on the lower surface of the leaf; *b*, egg, much enlarged; *c*, larva after second resting stage, as it appears in early spring about the time the buds are coming out; *d*, larva after third stage, illustrating manner of traveling by looping its body; *e*, larva in resting position, resembling a dead branch attached or steadied by a line or thread running from the head to twig; *f*, cocoon secreted in decayed hollow of tree; *g*, chrysalis; *h*, male moth; *i*, female moth; *j*, larva killed by parasitic wasp and inflated with cocoons of latter; *k*, male and female parasites; *l*, calendar showing yearly cycle of this insect [outer figures representing the months, counting from the top of the calendar from right to left; inner figures, counting again from right to left, representing (1) egg stage, (2) larval stage, (3) pupal stage, and (4) adult stage; in other words, representing the winter in the larval stage; May and June, pupa stage; July, adult stage; July and August, egg; August and September, larva; September and first of October, pupa; October, adult and egg stage, and winter, larval stage again]. [Japanese lettering rendered in English.]

LETTERING OF RIGHT SIDE.

Third edition. Copyrighted. Printed Meiji, year 31, February 25, issued February 28. Second edition same year, printed December 10, issued the same date. Third edition, Meiji, 33d year, October 10. Price, 15 cents. Illustration by Shichiro Ito.

LETTERING OF LEFT SIDE.

Author and publisher, Yasuchi Nawa, Prefecture of Gifu, Gifu City. Printer, Matsutaro Ōkuma. Place of publication, the Nawa Insect Laboratory, Gifu, Kyomachi.

JAPANESE INSECT PLACARD, SHOWING ENEMY OF MULBERRY.

OTHER PRIVATE ESTABLISHMENTS.

There are a few other private establishments for the study of entomology in Japan; for example, that of Baron Takachiho, in the island of Kyushu. Here in a well-equipped entomological laboratory excellent work is being done by the baron, assisted by an enthusiastic corps of workers, and including Mr. S. I. Kuwana, whose publications on Coccidæ are well known on this side.

CONTROL OF RICE INSECTS.

Applied entomology in Japan received a great impetus a few years ago from the enormous destruction occasioned to rice fields by certain species of Jassids. The loss in a single year from these insects was estimated at 20,000,000 yen ($10,000,000). The results of the studies which followed this great loss have been the devising of methods effectively preventing such occurrences in the future. These Jassids do their greatest damage to the seed beds—little flooded areas thickly planted with rice, which, after having made a growth of 6 or 8 inches, is transplanted to the fields. It is found possible to destroy the first brood of these insects in the seed beds by the method which we employ to destroy mosquitoes, namely, covering the surface of the water with kerosene. Immediately after flooding with a film of oil the rice is brushed in such a way that the Jassids are knocked into the water. The oil is then washed off by allowing water to run freely through the beds. In reply to questions as to the possibility of using this oil to destroy mosquitoes, which breed in numbers in rice beds and in rice fields, it was shown that this was impracticable, because the oil could not be left on the rice fields for any length of time without injury to the plants.

In the trip through the island of Shikoku during the month of June the system of Government rice inspection and the enforcement of the kerosene treatment was observed in operation. Supervisory and police regulations have been enacted, compelling the general adoption of this means of controlling these pests. This work is under the general supervision of the central experiment station of the department of agriculture in Tokio, but is carried out by provincial authorities. Rice inspectors, or more properly, rice seed-bed inspectors, are sent out from the provincial experiment stations, of which there are now some 32 in as many provinces, in addition to the 9 branches of the central experiment station of Tokio. The number of inspectors for each province ranges from 5 to 15, and it is their duty to visit every one of the innumerable little farm holdings and see that the plantings for the rice seed beds have been made according to rule and the operations against the insects have been properly carried out. Fines for improperly planting or for omission of remedial treatment

range from 50 sen (25 cents) for the first offense to 5 yen ($2.50) or more for the second or later cases of neglect. The regulations are to plant these seed beds in patches 4 feet in width with a small path between, and to attend at the proper season to the kerosene treatment. The planting in 4-foot strips instead of in a broad bed, as was formerly the custom, is to facilitate the going through the beds and knocking the rice and jarring the insects into the kerosene-covered water. These Jassids are the most important insect enemies of the rice in Japan, but many other rice insects have been studied and the information gained has been exploited by means of popular circulars. One of these placards or circulars is illustrated in Plate I.

ANCIENT METHODS OF INSECT CONTROL.

Prior to the enormous development of applied entomology in Japan practically on the lines followed in the United States there were undoubtedly certain native methods of controlling insect pests. These for the most part were purely hand methods, which were especially applicable on account of the tiny areas under the supervision of individual cultivators, the rice fields often being only a few yards square, and the orchards and gardens covering only very small fractions of an acre, and perhaps rarely two or three acres. Mr. Hagino, secretary of the local agricultural society of Okayama, in the province of Bizen, informed the writer that during winter as a means of eradicating scale insects, principally the Diaspis on the peach and the Leucaspis on pear, he had all of his trees given a thorough scraping with a little oval knife or blade made from bamboo, and washed the trunks and limbs at the same time with salt water of about the strength of ocean water. The low pruning of these trees and the growing of most of them on trellises, after the fashion of grapevines, rendered it comparatively easy to go over the trunk and branches very thoroughly. The work was done by women, who were able to clean about 30 trees a day. With labor as cheap as it is in Japan this system is undoubtedly inexpensive and fairly effective.

In the adjoining province of Bitchu a proprietor of a considerable orchard, Mr. Watanabe, the pioneer of the fruit industry in that region, in his work against insects employs a lot of boys to beat his trees (peach and plum) and collect and kill curculios and case-bearers, the latter being picked off by hand. The curculio is jarred to the ground by a quick stroke given to the trunk of the tree, and is readily detected by the sharp-eyed boys and promptly crushed. By the same hand methods peach curl and blight are removed from trees.

In northern Japan a primitive method of insect control was witnessed in a vineyard. A patriarchal Japanese gentleman, clad in nothing but his loin cloth, the season being in August and very hot, was observed going slowly about underneath the trellises of a vine-

yard of an acre or more in extent, evidently engaged in collecting insects. He carried a stick or wand in one hand and long shears in the other. The end of the stick had been dipped in some sort of insect lime, and it proved that he was collecting hornets and wasps, which were presumably injuring the ripening grapes. His method consisted in deftly touching the wasp with his wand and catching it upon the lime, and then promptly cutting it in two with his shears. He was so intensely interested in this occupation that he paid no attention to my presence.

SILK INDUSTRY.

The importance of the silk crop of Japan has led to a good deal of experimental work in connection with some of the agricultural stations looking to improvement of methods of silk culture. The insect enemies of the mulberry have also been very carefully studied. A consideration of the silk industry as a whole in Japan would be out of place in this connection. It is an industry which extends practically throughout the Empire, the most important district, perhaps, being in north central Japan, especially about Fukuoka, where the mulberry is grown in great quantities and in orchards of considerable extent. Elsewhere, as a rule, it is grown as a hedge plant or in little garden patches. The trees are cut back each year, so that they often have the appearance of osier willow stumps. Sometimes the young leafy branches are tied up in great bundles and carried to the villages to be sold to local silk raisers, a fairly fixed price being received for these mulberry shoots, which may be kept for several days if stored in a cool, dark place. There is, therefore, a regular business of supplying and selling leaves as well as of raising small batches of worms. The silk output of Japan is the accumulation of the small productions of millions of people rather than of large coöperative or individual operations.

Following this lecture Mr. Simpson read the following paper, also illustrated with lantern slides:

OBSERVATIONS UPON THE LIFE HISTORY OF THE CODLING MOTH.

By C. B. Simpson, *Washington, D. C.*

During the past three seasons the writer has been studying the codling moth in the Pacific Northwest under direction of Dr. Howard. The insect in some localities of that region was injuring practically all of the apples, and unless some means were found of controlling it, abandonment of apple culture on a commercial scale was being seriously considered by many growers.

A complete report of this investigation is now in course of preparation, and at this time it is thought appropriate to give some of the more interesting and important results obtained by a study of the life history.

In 1897 Professor Card noticed that the larvæ which hatched from eggs laid upon the leaves would eat out considerable portions of the leaves before entering the fruit. This was stated to occur more frequently in cages than in the field.

In Farmers' Bulletin No. 127 of the Department of Agriculture, Mr. Marlatt notes these observations and suggests that the larvæ are killed by eating the leaves.

Professor Cordley found the past season that two young larvæ just hatched tunneled into the midrib of the leaves, and one of these fed until it was about full grown. In a letter to the writer he concludes as follows:

> I believe that with careful attention it could have been brought to maturity on a diet of leaves alone. When one considers that it lived and grew for more than three weeks upon leaves that had been severed from the tree, sometimes for several days, and that it was apparently more thrifty between June 16 and 25 than in the earlier days of its existence, one must acknowledge that, while the proof is by no means positive, the indications are that codling moth larvæ may fully develop on a diet of perfectly fresh apple leaves without ever having tasted fruit.

The writer has many times taken both young and old larvæ and fed them for some time upon leaves, and they seemed to thrive upon this diet, but on account of lack of care and attention I never brought any to maturity. The older larvæ eat the leaves by folding them together and eating out irregular holes. Many observers have noted that the larvæ feed for several days in the calyx when they enter at that place. On examination of the tissue of the calyx one can see that its structure is much like that of leaves. General results obtained by spraying were very satisfactory, and the efficiency of the spraying can not be accounted for by the entrance holes in the fruit in which the larvæ are found to have died. In the spring a great majority of the eggs are laid upon the leaves. In one instance one female moth in confinement laid 20 eggs upon the leaves and 1 upon the fruit, while another laid 22 eggs upon leaves and 2 upon the fruit. Professor Cordley writes that he has no record of a single egg being deposited upon the fruit until after it has lost its pubescence. Later in the season, particularly with eggs of the second generation, the proportion of eggs upon fruit and leaves are found to vary greatly. Some countings made in August, 1902, gave an average of 50 per cent on fruit.

Taking all the data into consideration, the writer believes it safe to conclude that the larvæ of the codling moth can reach maturity on a diet of leaves alone. To what extent this occurs under normal field conditions yet remains to be determined, but the writer believes that

the greater amount of effectiveness of arsenical sprays used against this insect is due to the leaf-feeding habits of the larvæ.

The question of the number of generations was again considered, and all the data secured show that there are two generations at Boise, Idaho, and the possibility of even a partial third generation is very meager. Professor Aldrich states that he has distinguished a partial third generation at Lewiston, Idaho, this past season. I wish to call attention to a misquotation occurring in my 1901 report in regard to Professor Gillette's views as to the possibility of a third generation, as I find that the definite statement that a third generation could not occur was not made by Professor Gillette.

Mr. Marlatt in 1895 gave a relation between the number of generations of this insect and Dr. Merriam's life zones, in which he states that there is one generation in the Transition, two in the Upper Austral, and three in the Lower Austral. In general, I find this to be correct, but in view of new data relating to subzones and partial generations some exceptions must be recognized. I have an immense amount of data on all of these points that is not as yet fully worked over.

In conclusion, I would say that we can congratulate ourselves that the codling moth can be controlled in the Pacific Northwest by quite inexpensive methods.

At the conclusion of this paper Mr. Simpson showed lantern slides, illustrating the life history and numerous methods of control of this insect.

Mr. Washburn next presented the following paper:

A CRITICISM UPON CERTAIN CODLING MOTH OBSERVATIONS.

By F. L. Washburn, *St. Anthony Park, Minn.*

It is with a feeling of diffidence that I address you on a topic which is worn so threadbare and has been so well threshed out as that of the codling moth, and I feel that I am probably taking more of the time of the association than is really my due.

Although educated in the East and living in past years in Minnesota, I have spent the last thirteen years on the Pacific coast, and hence come among you as something of a tenderfoot, though a tenderfoot from the West and not from the East.

While at the California experiment station last spring I received bulletin No. 69 from the Oregon station in which Mr. Cordley, who is my successor there, criticises my work done upon the life history of the codling moth in 1892. I later noted a criticism much to the same effect from Mr. C. P. Gillette in the Entomological News for June of

the current year. The work was done so long ago it had become as a closed book to me, and it required considerable effort to take up the old thread and recollect just what I had in mind when the bulletin was published.

Mr. Cordley says that I worked out the length of time required in the different stages of the life history of the first brood and then claimed four broods for the Willamette Valley in Oregon upon the mathematical calculation as to the time required. His criticism is a just one, for that is exactly what I did do, the very nature of the case making it impossible to observe the sequence of broods with anything like exactness. He might have gone further in his criticism, for in the bulletin referred to, after making with some emphasis the statement that the moth is four-brooded, I inserted the accompanying table as proof of this, which table really disproves rather than proves it:

	A.	B.	C.	D.	E.
Moths emerge from cocoons	June 1	June 20	Aug. 9	Aug. 28	Oct. 17
Egg laying (when moths are about 10 days old)	June 11	June 30	Aug. 19	Sept. 7	Oct. 27
Hatching of eggs (5 to 10 days)	June 21	July 10	Aug. 29	Sept. 17	Nov. 6
Life of larvæ in apple (4 weeks)	July 19	Aug. 7	Sept. 26	Oct. 15	Dec. 4
End of larval and pupal stages in cocoon (3 weeks), and emergence of moths.	Aug. 9	Aug. 28	Oct. 17	Nov. 5 or following spring.	Emerged the following spring.

Mr. Cordley in his critical discussion goes on to say that he has never been able to get a moth to mature as late as October 15. In fact, he writes to Mr. Gillette that he has never been able to rear a moth later than September 15. One at once draws the inference that October 15 or before, in his estimation, marks the last appearance of the imago, and Mr. Gillette, referring to Mr. Cordley's statement that he has never been able to rear a moth later than September 15, cites it as proof that the larvæ of the codling moth begin to hibernate in Oregon as early as the first week in August, which fact he says almost certainly cuts the number of broods to two. Mr. Cordley further says that in column "D" of my table there is an implied inference that at least a partial brood of moths would appear November 5. A glance at the table will show that that matter is left in doubt. I note, too, that Mr. Cordley says my statement regarding a third or fourth brood at Corvallis is without any foundation of fact. What answer would he make then to the fact that I found a moth out of doors as late as November 15? This moth must have originated in an egg laid somewhere between September 15 and September 25, which I believe, though I may be wrong in my assumption, either points to a third brood or to such extreme irregularity in the life history of the moth in western Oregon as to preclude a successful study of the number of broods.

Turning to Mr. Gillette's criticism in the Entomological News for June, 1902, page 194, I find this statement:

> In Mr. Washburn's table he places the beginning of egg hatching for the first brood of moths June 21, for the second brood August 29, and for the third November 6, and the fourth he does not give, but figured like the others it would come January 15, and the larvæ would not mature before the first week in February. As these dates are to mark the appearance of the brood, the last brood would come much later.

This statement is either very ambiguous, or Mr. Gillette quite misunderstands the table, for I meant to convey the information that the first brood of moths appeared June 1 or earlier.

Referring to the table under discussion, it is to be noted that moths brought me from the apple room on June 20 and referred to in column "B" as brood No. 2 were undoubtedly the latter part of brood No. 1, this first brood running from May 16 (since early moths appeared May 16) to June 20; hence columns "A" and "B" represent the first brood only, and they are naturally followed by "C" and "D." In this way the table works out all right, but for two complete broods and a possible third, not for the fourth.

Mr. Cordley's conclusions in 1898 regarding the efficacy of spraying before June 11 tallies exactly with mine, as well as his observations as to the extreme injury caused later in the season. His notes also as to egg hatching and larvæ affecting the apples (rarely before June 25) are practically identical with mine.

In conclusion I will say that this short paper is not, as is very evident, an attempt to justify my reports in the Oregon bulletin, No. 25, nor is it in any way a criticism upon the most thorough work done by Mr. Cordley. I have ventured to present it with the intention of publicly placing the correct interpretation upon the table published in 1893 and wrongfully interpreted at that time. It seems to me that the number of broods of the codling moth in western Oregon is still to be regarded as a matter of some doubt.

A discussion of Mr. Simpson's paper followed.

Mr. Washburn inquired of Mr. Simpson if there were but two broods of the codling moth in western Oregon, and also desired to know the significance of finding a moth as late as November 15.

Mr. Simpson replied that the codling moth varied as much as five weeks in coming out in the spring. He thought the finding of a moth as late as November 15 would not indicate a third brood. Two generations could be accounted for, but the moths of a given generation do not all come out at the same time. Some may come out five weeks earlier than others in the spring.

Mr. Washburn thought it difficult to accurately count the number of broods in a climate like that of Oregon, with which statement Mr. Simpson fully concurred.

Mr. Alwood, referring to the statement made by Mr. Simpson of the cost of 1 cent per tree for spray, desired to know the size of the trees.

Mr. Simpson explained that the trees were 8 years old and much larger than trees of this age in the East. These trees produced from 6 to 20 boxes of apples, with a very good average of 10, a box equaling approximately a bushel. The soda-lime arsenite was used.

Mr. Burgess desired to know the cost and weight of the gasoline sprayer tried by Mr. Simpson.

Mr. Simpson stated that the cost was $320. The weight had never been accurately taken so far as he knew.

Mr. Fletcher stated that he had been much interested in Mr. Simpson's observations in Montana. He considered the duration of the different broods a very interesting subject and thought that the fact was established that there might be a considerable variation. He questioned the possibility of drawing conclusions from orchard observations alone. Attention was called to the commonly noted occurrence, by anyone who had bred insects, that as large a proportion as half of a brood might go over for a whole period, until the next time of the regular occurrence of the species, and if such observations were made in the orchard, wrong conclusions might be drawn. He did not consider it desirable that entomologists should speak of a partial brood.

Mr. Osborn stated that in determining the number of broods he considered that if the average time of appearance in greatest abundance were taken, results would be much more reliable as a basis for determining the number of broods. He mentioned a case where the codling moth appeared as late as the latter part of June from apples stored in a cellar where it was rather cool and development was retarded.

Mr. Marlatt said that he was very much interested in Mr. Simpson's confirmation of the feeding of the larvæ on the leaves, and not only had this been confirmed, but our knowledge of the extent of such feeding had been much increased. The work of some earlier experimenters and observers had demonstrated that codling moth larvæ would feed on leaves, but that they did it normally and to a considerable extent in nature had not previously been so fully demonstrated. He thought this was a very interesting feature of Mr. Simpson's work. It indicated that the poison catches the caterpillar very frequently on the leaves, especially as it has been shown that a considerable percentage of the eggs are placed on the leaves. When one comes to think of the matter it is not at all surprising that the young larvæ will feed on the leaves. Before entering the fruit they normally work two or three

days in the blossom end on the calyx, and the sepals are practically leaf tissue; they are green and are covered with the leaf hairs, and are to all intents and purposes little leaves.

Mr. Fletcher presented the following paper:

CAN THE PEA WEEVIL BE EXTERMINATED?

By Dr. James Fletcher, *Ottawa, Canada.*

My object in bringing the subject of the pea weevil prominently before this association is to make an appeal for cooperation to those of our members who hold official positions in those States of the Union where peas are grown for seed. I am led to do this at the present juncture for two reasons. In the first place, the loss from this insect is now very great, amounting annually in the Canadian Province of Ontario alone to upward of $1,000,000; in the second place, because I believe that from certain exceptional features of this attack, extensive as it is, there is more reasonable hope that it might be entirely put a stop to, than is often the case with an insect injury of anything like the same magnitude; and, further than this, because the present time is most opportune for making a special effort. Owing to the extent of this injury, many growers of peas have relinquished the cultivation of this important crop over large areas where, but for the depredations of the pea weevil, it would be one of the most remunerative crops they could grow.

The life history and habits of the pea weevil are probably well known to everyone here present. I shall therefore merely remind you in the briefest way possible of the leading facts which bear upon its possible extermination. The pea weevil is an exotic insect which feeds entirely upon an exotic plant. It has no other known food plant than the cultivated pea, and this is an annual, which in Canada never survives the winter or produces a volunteer crop the second year from seeds left on the land the previous year, which have failed to germinate. The pea weevil normally passes the winter inside the seed peas and emerges the following spring before or at the time the seeds are sown. A proportion, however, the number of which varies with different seasons, emerge during the same autumn that the seeds ripen, leave the peas, and hibernate in the perfect state. This autumn emergence furnishes one of the greatest difficulties in securing an effective remedy. The weevils which pass the winter inside the peas can be destroyed by the treatment of the seed at any time before sowing; on the other hand, those which leave the peas in autumn hide in various shelters during the winter and can not be reached, but fly to the field

and, together with those which were contained in untreated seed, attack the growing crop. As soon as the new pea pods are formed the females lay their eggs upon them. The larva on hatching eats its way through the pod and enters one of the forming peas. Here it remains until full grown and before emergence has destroyed a large proportion of the contents of the seed it infests. This diminution of the food contents of the grain amounts to over one-sixth of the whole of the large peas and nearly half of the small varieties, but when the grain is required for seed the loss is greater than this. From several experiments I have found that only about 12 per cent of small seeds and 18 per cent of those of the large varieties will produce plants, which are later in developing, and most of them diminished seriously in vigor and crop-producing power.

I have carried on an extensive correspondence with pea growers, grain merchants, and seedsmen with the object of discovering their views as to the most practical method of controlling the pea weevil, and find that all are agreed that the loss is excessive and that some definite action is urgently needed if the paying production of peas for home consumption and export is to be preserved. The pea crop is one of special value to Canadian farmers, not only because no other feed fully takes its place as food for stock and in connection with dairying and hog raising, but on account of the high reputation of Canadian and Northern-grown peas on the European markets. It is also highly advantageous from the farmer's standpoint. The pea being a legume, the soil is enriched in nitrogen by its culture and at the same time the land is left in the best tilth for fall wheat and other crops.

It is generally acknowledged that peas are an advantageous and desirable crop to grow, but it is now a fact that, owing to the pea weevil, they are not being cultivated over a large area where formerly peas of the very first quality were produced and could be again produced if the pea weevil could be controlled. The vital question is, then, Can this be done? I feel confident that it can, but it will require concerted action and cooperation. What, then, is the best and quickest way to reach this end, and what difficulties shall we have to contend with? To begin with, I must acknowledge that, almost with one voice, those I have consulted have expressed the opinion that the only way is to give up growing peas entirely for one or two years, so as to starve the insect out, and to enforce the measure with legislation.

Theoretically, at first sight, this seeems to be a perfect remedy, and if a complete cessation of the cultivation of peas were possible no doubt it would be a solution of the difficulty. But after considering this matter very carefully I can come to no other conclusion than that it would be an absolute impossibility to prevent some sowing peas within the breeding range of the insect. For this measure of starvation to be successful, not only would every large pea grower and

farmer within this area, both in Canada and the United States, have to desist from sowing peas entirely, but also every private individual who wishes to grow a few green peas for the table. If laws were enacted looking to this end it would be quite impossible to enforce them. Among gardeners and the general public there is, I opine, neither information nor unselfishness enough to induce them to deny themselves to such an extent as to give up this favorite vegetable for the benefit of other people or of any branch of trade. Even among those who grow and handle peas in large quantities for the market there is a great lack of knowledge with regard to the pea weevil and its habits. Some do not know for certain which of the several enemies that attack the pea actually is the pea weevil. Owing to the prevalent inaccuracy with which popular names are applied to insects, nearly everything in the shape of an insect which attacks crops conspicuously is for the time being styled "the bug." The pea weevil is known generally as "the pea bug," but nevertheless is often confounded with such different insects as the pea moth and the destructive pea aphis.

It therefore appears that what is now most fitting and necessary, as looking to ultimate victory against this enemy, is a vigorous campaign of education through the ready means at our disposal, viz, official reports and bulletins and the agricultural press. All uncertainty should first be done away with and accurate definite knowledge distributed as to the habits of the insect, the best remedies to apply, and when and how to apply them. There are effective sure remedies for the pea weevil; and growers must be made to understand this, and to see that by adopting them, even at some small trouble, they will greatly benefit themselves, while by neglecting them they will injure themselves, their neighbors, and the whole country. I have confidence enough in the common sense of Canadian and American farmers to believe that they will adopt them.

In conjunction with Professor Lochhead, the Ontario provincial entomologist, and Professor Zavitz, the experimentalist of the Ontario agricultural college, at Guelph, this campaign has already been begun by us in Canada. Important meetings of farmers have been addressed, including an assembly of all the farmers' institute workers of the Province of Ontario. During the coming winter the subject will be brought prominently before every farmers' institute meeting held in the Province. Timely articles will be issued advising pea growers not to sow a single grain which has not been first treated, nor to allow seed merchants to sell them peas which have not been fumigated or otherwise treated to destroy the weevil. These measures, however, will only reach a small number of those who are concerned, so no opportunity will be lost of bringing the importance of this subject before the country. The public press in Canada has already done much and

will doubtless do more. In my official capacity I shall do my utmost to bring about what I believe is possible—the extermination of the pea weevil in Canada—and I now make an earnest appeal to the members of this association to cooperate with me in the same direction. If all who sow peas in Canada and the United States will adopt any one of the remedies and carry out the suggestions made below, I am confident that a tremendous advance will be made in a single year, and that as early as the second year extermination might be looked for.

REMEDIES.

Fumigation.—Fumigation with bisulphid of carbon is a sure remedy. When properly done, either in specially constructed buildings known as "bug houses" or in any tight bin, every weevil is surely killed if the seed containing them is fumigated for forty-eight hours with this chemical, using 1 pound by weight to every 100 bushels of seed, or, in smaller quantities, 1 ounce to every 100 pounds of seed. For the treatment of small quantities of seed, particularly by farmers, I have found that an ordinary coal-oil barrel is very convenient. This will hold about 5 bushels, or 300 pounds, of seed, which may be treated with 3 ounces of bisulphid of carbon. Care must be taken to close up the top tightly. This is best done with a cap made specially for the purpose, but fine sacks laid smoothly on the top, over which boards are placed with a weight on them to hold the covering down closely, will answer. Fumigation with bisulphid of carbon is, I believe, the remedy most to be relied on in this campaign. It is perfectly effective, is now regularly used by the large seed merchants, and in future will be much more generally used.

Holding over seed.—Where only a few peas are used, a most reliable remedy is the holding over of seed until the second year. Peas should always be bagged up and the sacks tied at once after threshing.

Treating with coal oil.—A remedy which has been used by many farmers with satisfaction is to drench the seed with coal oil, using about half a gallon to a barrel, or 5 bushels, of peas. While applying the coal oil the seed should be placed on a floor where it can be shoveled over constantly to insure the treatment of all the grain.

Scalding seed.—When peas are found at the time of sowing to contain living weevils, these may be destroyed by simply pouring them into a pot of scalding water. The water should be drained off at once or the seed cooled by turning in cold water.

RECOMMENDATIONS.

1. Everyone, when purchasing seed peas, should refuse determinedly to buy any without the assurance that they have been treated; and, further, even after this, he should examine for himself and see that

any contained weevils are really dead. It must be remembered that of weevil-injured seed only about one-quarter will germinate and produce plants; consequently much more seed must be sown.

To secure a supply of seed peas free from weevil injury it will be necessary for growers to handle their crop somewhat differently from what has been the usual practice. This injury is now of an exceptional nature; therefore exceptional measures must be taken to avoid loss.

2. Pea growers should harvest their peas sooner than is usually done—as much on the green side as is safe—thresh them as soon as dry enough, and fumigate them at once or sell to grain buyers, who for their own interest will do so. This treatment has many advantages. Not only is one of the very greatest difficulties in providing a practical remedy—the shelling out of peas in the field—in a large measure avoided by harvesting earlier, but the straw is of a very much higher quality for feed and the seed is heavier and better for every purpose—for export, for feed, and also for seed, because it is of a higher germinating power. In addition to this, the weevil at that time is much less advanced in growth, and consequently has destroyed a much smaller proportion of the bulk of the seed. The average date for pea harvesting is between July 20 and August 20. I have no record of the pea weevil becoming mature and leaving the seed before August 15, and it is usually later than this. Experiment has shown that the weevils at all stages may be killed inside the peas by fumigating them with bisulphid of carbon as soon as they are hard enough to handle. When peas are required for feeding they should be ground as soon as dry enough, and to prevent the meal from becoming musty some old dry peas should be mixed with the new ones. The greatest difficulty of all is with regard to the peas which shell out in the field at the time of harvesting. This, however, will be to a large measure obviated by reaping early, when the seed will not shell out so much as when left till the regular time. The cleaning up of pea fields by turning in hogs is a generally recognized practice, and the work is done very thoroughly by these animals. Where hogs are not available poultry will do the same work, and where neither of these can be used the land should be plowed so deeply that the weevils can not work their way out when they leave the peas.

In the discussion of this paper Mr. Felt remarked that the question was a very interesting one, and speaking as one of the Northern entomologists he desired to assure Mr. Fletcher of his cooperation as far as possible. He did not consider that the pea weevil was as important in New York State as it was farther north. He had looked over the office records extending back as far as eighteen years and noted only two complaints regarding this species. It was his belief that New York parties bought their seed from more northern growers.

He suggested that seedsmen be induced to advertise the fact that their seed peas had been fumigated and thought that this would give them an advantage, in a business way, over those firms who would not take the trouble to do this work. He stated that a number of New York nurserymen had been induced to advertise the fact that their stock had been fumigated, and did not see why this arrangement could not be made with dealers in seeds.

Mr. Weed remarked that it appeared to him that a little pressure might be brought on the seedsmen by having each official entomologist write to the seed growers in his State and ask if the peas being sold by him had been properly fumigated. It was his idea that a list of seedsmen should be published, indicating those who fumigated and those who did not.

Mr. Felt read a notice from Dr. Howard to the effect that entomologists who wished to visit the National Museum collections during Sunday would be admitted on presentation of Dr. Howard's card. This courtesy had been extended by Director Rathbun.

Mr. Marlatt announced that the Entomological Society of Washington, through the courtesy of Mr. W. H. Ashmead, would entertain the visiting entomologists that evening, and extended a warm invitation to all to meet the society at Mr. Ashmead's residence at 8 o'clock p. m.

The meeting then adjourned, to reassemble at 2 p. m.

AFTERNOON SESSION, SATURDAY, DECEMBER 27, 1902.

The meeting was called to order by the president.

Mr. Schwarz announced that there were still a few sets of the publications of the late Dr. Riley which Mrs. Riley had kindly placed at the disposal of the members of the association free of charge. He invited anyone desirous of securing sets of these separates to make this fact known to him.

Mr. Ashmead moved that Mr. Nawa, of whom Mr. Marlatt had spoken during his address in the morning, be made a foreign member of the association. He thought that Mr. Nawa had been doing a good deal for economic entomology in Japan, and that the Association should recognize him for this work. This motion was duly seconded and, at the suggestion of the president, his name was referred to the committee on membership.

The report of the committee on membership was next called for and is as follows:

The committee on membership recommends for active membership: F. C. Pratt, Washington, D. C.; J. Kotinsky, Washington, D. C.; Otto Heideman, Washington, D. C.; W. E. Hinds, Washington, D. C., and H. G. Dyar, Washington, D. C.

For associate members: H. S. Barber, Washington, D. C.; R. P. Currie, Washington, D. C.; G. H. Harris, Washington, D. C.; W. E.

Burke, Washington, D. C.; J. L. Webb, Washington, D. C.; T. B. Symons, Collegepark, Md.; R. I. Smith, Collegepark, Md.; G. W. Martin, Nashville, Tenn.; A. F. Conradi, Durham, N. H., and H. L. Price, Blacksburg, Va.

For foreign membership: Josef Jablonowski, Budapest, Hungary, and Yasushi Nawa, Gifu, Japan.

H. Osborn,
A. L. Quaintance,
Nathan Banks,
Committee.

Upon motion of Mr. Ashmead, the report was accepted and the secretary was instructed to cast an affirmative ballot for the Association.

The programme was then resumed, the first paper being by Mr. Alwood, as follows:

A NOTE ON THE OVIPOSITION OF THE SEVENTEEN-YEAR LOCUST (CICADA SEPTENDECIM).

By William B. Alwood, *Blacksburg, Va.*

In presenting this note I wish first to mention a rather curious observation made by me last year at the Virginia Agricultural Experiment Station at Blacksburg. We were expecting the locusts and had designed, if occasion warranted, to experiment upon some sprays with a view of preventing oviposition by the female in the fruit trees of the experiment-station orchards. At the proper season the insects appeared in great numbers, so abundantly, in fact, that one could gather up a quart in a few minutes at the time they were issuing from the earth. The young orchards at the station were then in the main 12 years old and fine vigorous young trees, but there were also trees ranging down to 2-years set, so that the insects had every opportunity to select suitable branches for oviposition if they were inclined to do so.

Careful observation from day to day revealed the fact that they seemed to be making no efforts whatever to oviposit in the trees of our test orchards, but after lingering for some days in the trees they flew away. Thus by the time the locust season was about half passed our orchards were practically clear of the insects. In no instance did we detect them ovipositing in the twigs or branches of our trees. However, the past summer we have noticed perhaps half a dozen instances where oviposition occurred.

Why they did not choose to oviposit in the branches of the orchard trees at the experiment station has been rather a puzzle to me. I have only one suggestion to make, and that is that, as we spray our orchards very thoroughly with Bordeaux mixture, and the limbs and

twigs were quite covered with a thin coating of the fungicide, this may have in some measure acted as a deterrent to the locusts. I would not like to make the assertion that Bordeaux mixture will deter this insect from oviposition, but the fact observed warrants one in suggesting that it will be an interesting experiment to make when opportunity again presents itself. Other orchards near us were very badly punctured by the female insects.

It occurred to me that it would be an interesting matter to collect data on the various plants chosen by the female insects for deposition of their eggs, consequently I had one of my students follow this matter up quite closely, and he collected the following list of plants, all of which showed the characteristic oviposition of this cicada:

List of Plants Punctured by the Cicada (Cicada septendecim).

1. Coniferæ—Pine Family.—Red Cedar (*Juniperus virginiana*).
2. Cornaceæ—Dogwood Family.—Dogwood (*Cornus Florida*).
3. Cupuliferæ—Oak Family.—Alder (*Alnus viridis*); Beech (*Fagus ferruginæus*); Birch (*Betula* spp.); Chestnut (*Castanea americana*); Red Oak (*Quercus rubrum*); White Oak (*Q. alba*).
4. Ebenaceæ—Ebony Family.—Persimmon (*Diospyrus virginiana*).
5. Ericaceæ—Heath Family.—Blueberry (*Vaccinium* spp.); Huckleberry (*Gaylussacia* spp.); Laurel (*Rhododendron maximum*).
6. Hamamelidiæ—Witchhazel Family.—Gum (*Liquidambar styraciflua*).
7. Juglandaceæ—Walnut Family.—Black Walnut (*Juglans nigra*); Hickory (*Carya alba*).
8. Leguminosæ—Pulse Family.—Locust (*Robinia pseudacacia*).
9. Oleaceæ—Olive Family.—Ash (*Fraxinus americana*); Lilac (*Syringa vulgaris*).
10. Platanaceæ—Plane Tree Family.—Sycamore (*Platanus occidentalis*).
11. Rosaceæ—Rose Family.—Apple (*Pyrus malus*); Blackberry (*Rubus occidentalis*); Hawthorn (*Cratægus* spp.); Peach (*Prunus persica*); Plum (*Prunus* spp.); Quince (*Pyrus cydonia*); Raspberry, red (*Rubus strigosus*); Raspberry, black (*R. occidentalis*); Wild Cherry (*Prunus serotina*).
12. Salicaceæ—Willow Family.—Poplar (*Populus* spp.); Willow (*Salix* spp.).
13. Sapindaceæ—Soapberry Family.—Maple (*Acer rubrum*); Sycamore maple (*Acer pseudo-platanus*).
14. Tiliaceæ—Linden Family.—Basswood (*Tilia americana*); European Linden (*T. europæa*).

This list shows that 14 botanical families, comprising 30 genera and 33 species of plants, were used by the female cicadas as a nidus for their eggs at our place.

In the discussion of this paper Mr. Schwarz stated that he considered the seventeen-year locust to be one of the most interesting insects we had in this country, and desired that the economic entomologists should bear this in mind in their recommendations for the destruction of the insect. He did not consider the injury done by this species of any particular significance. He thought it to be the duty of economic entomologists to carefully map out the extent and number of broods

of this species, so that it would be possible to accurately indicate to orchardists the time when trees could be most safely planted. The full distribution of many of the broods had never been determined and he considered it very desirable that this should be done.

Mr. Alwood remarked that in his experience injury from the seventeen-year locust had frequently been quite severe. He mentioned an instance where 400 or 500 5-year-old trees in an orchard of 5,000 had been so injured by the cicada that they had been pulled out.

Mr. Marlatt spoke in behalf of the sentiment expressed by Mr. Schwarz, and emphasized the fact that the periodical cicada is our most interesting insect, and thought it would be unfortunate if it were exterminated. He considered that the damage occasioned by it, on the whole, was slight, but that in individual instances considerable injury had been done. He referred to an orchard belonging to Mr. M. B. Waite, near Washington City, where the cicadas had come out from the edge of a woods and had punctured a few of the adjacent rows quite badly, so that one year's growth was lost. Properly cut back, no lasting injury would be sustained.

Mr. Hopkins agreed with Mr. Schwarz as to the interest surrounding this species, and remarked in regard to the broods that he was beginning to be somewhat skeptical as to the propriety of using the term brood with its present significance. He thought that as the knowledge of this species increased it would be found that there was a great deal of intergrading, and also that representatives of so-called broods were likely to appear every year, even in the same State. He had evidence from West Virginia that the periodical cicada appeared annually in certain localities. He thought it would be very difficult, except where the intervals were marked, to designate them as distinct, or to refer each to a recognized brood.

Mr. Marlatt called attention to the work of Dr. Gideon B. Smith, who lived in the first half of the last century, and who had studied the cicada very extensively between 1825 and 1850, or thereabouts. Dr. Smith had prepared a very important paper, which he had never published. An abstract of Dr. Smith's record of broods had been published in the speaker's paper on the cicada (Bulletin 14, United States Division of Entomology). Dr. Smith had called attention to the idea just advanced by Mr. Hopkins, namely: The fact of the gradual breaking up of old broods, which in the course of time might cause the cicada to appear in every cicada-brood region every year. This did not mean that the seventeen-year period would be lost, but that there would be such a splitting up of the broods by acceleration and retardation that the marked periods of appearance in considerable numbers would cease.

INJURIOUS INSECTS OF THE YEAR IN CANADA.

By James Fletcher, *Ottawa, Canada.*

The season of 1902 in Canada has been a remarkable one, being of an unusually damp and cool nature. This has had an effect not only upon the development and yields of many of our staple crops, but also upon the prevalence of some of the important crop pests. There was a noticeable absence of injury by some of the best-known insect enemies of cereal and orchard crops, such as the Hessian fly, the wheat-stem maggot, the codling moth, the plum curculio, the cankerworms, and the tent caterpillars. Peas, formerly such an important crop in Ontario, were little sown this year, from fear of the depredations of the pea weevil, and some substitute crops, such as the grass pea, soja beans, emmer, and clovers, were cultivated in their place. The season, however, was inauspicious, and these crops were not grown with satisfaction. The season, although favorable for most fodder crops, was adverse to corn, the most important of all, over large areas.

INSECTS AFFECTING CEREAL CROPS.

Grain crops were little injured by insects during 1902 and yielded unprecedented returns. There was an almost phenomenal disappearance of the Hessian fly in western Ontario. No injury appears to have been done, although during the season of 1901 both the occurrence of the insect and its injuries were excessive. A serious outbreak of the Hessian fly, however, occurred in Manitoba, and the losses were doubtless far more extensive than was recognized, owing to the enormous crop. In Manitoba there is only one brood of this insect, the flies of which appear in spring at the time wheat is just sending up its stems. Larvæ from eggs laid upon the young leaves and hatching before the stems shoot up, attack the root shoots and do much harm, although this is seldom noticed by farmers. Those larvæ which hatch later locate at the bases of the leaves of the lowest joints of the stem. The "flax-seeds" are formed by the end of June, but the flies do not emerge till the following spring. Cutting high and the burning over of stubble are recommended as remedies.

LOCUSTS.

A considerable amount of injury was done in Manitoba during the past season by the Rocky Mountain locust, the lesser migratory, Packard's, and the two-striped locusts. My object in mentioning this now is to draw the attention of entomologists to the Criddle mixture of horse droppings poisoned with Paris green or some other convenient insecticide. Full details of this method have been given in my later annual reports which, according to the constitution of this association,

are regularly sent to every member. I need not, therefore, take up time now in repeating these further than to say that the mixture has been improved during the past year by Mr. Criddle and that it has been eminently satisfactory in controlling locusts. The mixture now consists of 1 pound of Paris green mixed with 60 of fresh horse droppings. To this is added 2 pounds of salt and the mixture is then scattered round the edges of fields which it is thought may be invaded by a swarm of locusts. This remedy, of course, is also available for grasshoppers in all parts of the country. The most convenient receptacle for mixing this and carrying the material to the field is half of a coal-oil barrel mounted on a cart. A piece of shingle answers well as a paddle to distribute the mixture with.

The injuries by the pea weevil and the possibility of eradicating it I have already laid before the meeting in a separate paper. This is perhaps the entomological problem of most importance in Canada to-day.

INSECTS AFFECTING ROOT CROPS.

Root crops throughout the Dominion have been exceptionally fine and there was little complaint of injury by insects. The Colorado potato beetle was complained of in the new Mormon districts of Alberta, lying in the foothills of the Rocky Mountains, also in Manitoba in a few localities, but was not a cause of much loss. In Prince Edward Island, on the other hand, it was extremely abundant and destructive, owing, perhaps, to an unusually hot and dry period which prevailed during July.

Some injury was complained of to potatoes in Manitoba by blister beetles. This was to be expected as a consequence of the abundance of grasshoppers during the last four or five seasons.

The turnip aphis (*Aphis brassicæ* L.), which for many years has been very troublesome in Canada, was abundant this year only on the Pacific coast and in Newfoundland. Its attacks were chiefly on cabbages.

INSECTS AFFECTING FRUIT CROPS.

The eye-spotted bud-moth.—Fruit crops have on the whole been very satisfactory. In the apple orchards of Nova Scotia there was great irregularity of production, some orchards being heavily loaded while others close to them had very poor crops. This I attribute largely to the temporary abundance in the maritime provinces of the eye-spotted bud-moth (*Tmetocera ocellana*), which I detected there last winter on the trees in the larval condition and in remarkable numbers. It can not be denied, however, that Canadian fruit farmers have progressed enormously during the last half decade, as is testified by the general adoption of spraying and other common-sense methods of

advanced horticulture. The self-styled "practical man of experience," who wants no science, as he calls it, but does everything in a rule-of-thumb manner, comes to grief and loses money every time he comes in contact with the really practical man, who does not brag about being one, but who wants always to obtain from specialists the best and latest information on all branches of his work.

The San José scale.—Introduced into Ontario in 1897, this most pernicious enemy of the fruit grower has spread through that part of Ontario lying between Niagara and Hamilton, and west of that line to the Detroit River. In fact, it now occurs throughout the peach-growing districts which lie to the west of Lake Ontario and to the north of Lake Erie. This small area is the only part of Canada infested by the scale; but splendid work has been done by the provincial government through its officer, Mr. George E. Fisher, the inspector of San José scale, who has been constantly at work since 1898, and his results have been such that they seem worth bringing before the Association. I think it may now be claimed that with the lime-sulphur-and-salt wash, or with a modification of this in which the salt is omitted, as a winter wash, followed in summer by the ordinary kerosene emulsion, we have a practical remedy by which the San José scale can be controlled. The Federal Government is enforcing strictly the San José scale act, which is practically the one that was agreed upon at the Washington conference held in January, 1898. It is unfortunate that the United States Congress did not simultaneously put through the similar act which was agreed upon at that time, but which it will be remembered was neglected owing to the outbreak of the Cuban war. Had this bill become a law the two countries could have worked together to prevent the transshipment of infested nursery stock from one to the other. By the Canadian San José scale act all nursery stock imported from countries where the scale is known to exist is fumigated entirely at the expense of the government. There are six ports of entry where fumigating houses are located, and these have worked admirably. The San José scale act has been rigidly enforced, and with excellent results, for there has not been a single well-founded complaint of injury to stock, of undue delay chargeable to the fumigation, or of living scales having been found on any trees in the large number of consignments of nursery stock which have been imported into Canada through the fumigation stations.

The attention to fruit pests, especially to all kinds of scale insects, which has been evoked by the advent of the San José scale in Canada, has had a good effect by teaching our fruit growers and farmers the importance of knowing more about the insect enemies of their crops and the necessity of careful definite work in all branches of their business.

New fruit pests.—Some new enemies of fruits, perhaps of only minor importance, but worthy of mention here, are the following:

The blackberry soft scale (*Eulecanium fitchi* Sign.) and the rose scale (*Aulacaspis rosæ* Bouché) appeared in injurious numbers in several localities in western Ontario in blackberry plantations.

A noctuid (*Scopelosoma tristigmata* Grote) and a geometer (*Mesoleuca truncata* Hufn.) were sent in from Vancouver Island as having done harm in strawberry beds.

A single specimen (the first recorded) of the brown-tailed moth (*Euproctis chrysorrhœa* L.) was caught at light in St. John, New Brunswick. I do not think that this means that the insect has spread to New Brunswick from Massachusetts, but rather that a moth or the pupa was brought direct from Boston on one of the many passenger ships plying reguiarly from that port to St. John. It indicates, however, how easily this or any other insect might be spread to a new locality.

Of rather more importance than the above-mentioned is a new injury reported this season from several places in western Ontario and observed in a few cases last year at Ottawa, by the larvæ of the sawfly (*Taxonus nigrisoma* Nort). These larvæ are frequently found in autumn on different kinds of Rumex and Polygonum, of which they reduce the leaves to a skeleton. The injury to apples is done by the green larvæ boring into the fruit in autumn. From the appearance of the burrows, which run in for about half an inch into the flesh of the apple and which contain no black excrement, I am led to hope that this is merely an accidental injury, the larvæ merely boring into apples as they might into any soft, firm substance, in which to excavate their winter quarters. The usual habit is for the larvæ to bore into the pithy stems of herbaceous plants. I have no record of the larvæ attacking the leaves of apple trees, but Professor Lochhead, of Guelph, saw these larvæ climbing up the trunks of apple trees in October. The injury to fruit was, however, of rather a serious nature, the apples being much disfigured, and in many instances they were rendered unfit for market and had to be fed to pigs. Should this sawfly larva become a regular enemy of the apple, a remedy which suggests itself is the destruction of all weeds growing near the trees which belong to the dock or smart-weed family.

FOREST INSECTS.

The birch skeletonizer (*Bucculatrix canadensisella* Chamb.).—The birches, particularly the white birches, throughout the greater part of Canada east of the prairie provinces have been greatly disfigured during the past two seasons by the small larvæ of this tineid. Owing to the cool, damp season of 1902, the attack was not apparent until a fortnight later than in 1901, and it is hoped that the ultimate effect on

the trees will be less severe. Birches, however, were in many places entirely defoliated by the middle of September. The destructive work of these caterpillars was also considerably added to by a large aphid (*Callipterus mucidus*) and by a green leaf-hopper (*Empoasca smaragdula* Fall.).

Mr. Washburn in discussing this paper stated that the locust trouble was a very interesting one in Minnesota, and also a very serious one. He stated that the farmers were very slow in using poison bait, such as bran and horse droppings, because poultry roam over the wheat fields, and in scratching over the poisoned droppings would suffer. For this reason it was almost impossible to use the poison bait in Minnesota.

Mr. Alwood inquired if anyone had ever poisoned chickens with an arsenite.

Mr. Fletcher stated that he had been investigating this point for some years, but had never heard of a single instance.

Mr. Marlatt made the suggestion that ordinary white arsenate be used instead of Paris green, the former being very much cheaper. He said that Paris green is the most expensive of all arsenicals, costing 20 to 25 cents per pound, whereas arsenic could be purchased at a few cents at the most. He said that the simple arsenite of copper was as effective as Paris green, and could be purchased for about one-half the cost of the latter. Difficulty was experienced, however, in procuring the arsenite of copper in sufficient quantities to supply the present demand; hence he thought Paris green (the aceto-arsenite) would no doubt be largely used for some time to come. As relating to this particular case, he was inclined to recommend simply poisoning the bait material with white arsenic. He suggested that an enormous quantity of poisoned material would be necessary to insure the destruction of the locusts in their widespread outbreaks.

Mr. Fletcher explained that it was not necessary to cover an entire field, but that the poison should be placed around the edges. With regard to the use of arsenic as a substitute for Paris green he considered this very undesirable, from the great danger of poisoning from its accidental or careless use. He thought arsenic resembled flour, sugar, and some other household stuffs too much to allow of its general prescription. The reason that he had continued to recommend Paris green was that it is well known, and could not on account of its warning color be mistaken for anything else. He would have no hesitancy in using arsenic himself or advising its use by specialists, but would not dare recommend it for everybody, and particularly if it were likely to be kept about dwelling houses in the country, as a result from having some of the poison left over. Fruit growers living

at a distance from towns, or for the sake of economy, generally buy more materials at once than they require to use at the time. No matter how great the danger may be, people soon get careless.

Mr. Marlatt desired to know what objections there would be to the use of the simple copper arsenite as a substitute for Paris green.

Mr. Fletcher stated that he preferred the former to Paris green in some ways, not only on account of its being cheaper, but from the fact that it was susceptible of much more even distribution in the water, but it seemed also more likely to injure foliage. He had used disparene with great satisfaction.

Referring to the danger of poisoning fowls by poison bait scattered in the field, Mr. Wilcox stated that about a year ago he had had occasion to read an extended article bearing directly upon this point. Several forms of arsenical poisons had been tried on chickens and pigeons, and also, as he remembered it, on ducks. The details of the test had passed from his mind, but he was greatly impressed with the very large quantity of poison which fowls could eat before they were affected by it.

Mr. Fernald called attention to an interesting observation which he had made in the course of his nursery-inspection work in Massachusetts, namely, that he had found the San Jose scale occurring on the arbor vitæ and also on the white spruce. While he hardly thought that the insects would be able to permanently establish themselves on these plants, yet he desired to call attention to the matter.

Mr. Kellogg then presented the following paper:

NOTES ON CALIFORNIA COCCIDÆ, ALEURODIDÆ, AND SCOLYTIDÆ.

By V. L. Kellogg, *Palo Alto, Cal.*

Mr. Kellogg made a brief report on the work being done at Leland Stanford Junior University on the Coccidæ, Aleurodidæ, and Scolytidæ of California. A collecting trip was made in the summer of 1901, by foot and horseback, for a thousand miles through the great coniferous forests of northern California for the purpose of collecting specimens and notes for a study of the conifer-infesting scale insects. Mr. Coleman, the assistant who undertook this trip, brought back 22 species of Coccidæ from 26 species of conifers, 10 of the insect species being described as new. Of these 10 the immature stages of 4 are described and a complete life history of 1. A graduate student, Mrs. F. E. Dorsey, has described 20 new species of Aleurodidæ found in California, thus increasing the number of known North American species in this family from 40 to 60. In the case of every one of these 20 new species the immature stages have been studied by Mrs. Dorsey and described. Experiments have been carried on in combating *Dendroctonus valens* in Monterey pines in the arboretum of Stanford University, in the

grounds of Mr. Timothy Hopkins at Menlo Park, and in the grounds of the Hotel del Monte, on the Bay of Monterey. Small, close canvas tents have been put around the trunks of the trees, and in these tents hydrocyanic acid has been used. This gas readily penetrates the burrows of *Dendroctonus* and kills practically all of the larvæ and adults in the burrows. As many as 300 larvæ have been found in a vertical length of 3 feet of trunk, and all of these larvæ have been killed by the gas. Such a procedure is, of course, not at all practicable in fighting *Dendroctonus* in forests, but seems to offer a means of killing the pest when attacking a few choice trees, as is the condition in the parks and grounds in the neighborhood of the university.

PLANT ENVIRONMENT AND INSECT DEPREDATIONS.

By F. William Rane, *Durham, N. H.*

We are constantly learning something new about the relationship between insect and plant life. A new species hitherto unknown is discovered, and shortly it may be this insect lays claim to some of our domesticated plants, and thereafter continues to menace or prey upon it as commonly as though this had ever been its custom. Again, species that we have long known for some reason change their appetites, or rather enlarge upon their food supply, so as to include in their *menu* plants heretofore not cared for. Such events are constantly taking place, and entomologists are ever ready to make new observations. To find an old friend taking a meal on a heretofore strange plant is noted with interest. Although experience has shown that these simple observations may not indicate much, yet they are important, for as time goes on conditions may arise wherein this indicated outbreak may occur.

Economic entomology has come to be a great factor in America, and, with an ever-increasing number of keen observers everywhere throughout our broad land, little happens that is not soon brought to the notice of someone.

The gardener, fruit grower, or farmer that is awake to his calling has a remedy or suggestion at his bidding for most of his insect foes. These remedies are generally looked to by him as cure-alls, and if the insects are only destroyed everything is lovely.

The point that I desire to emphasize in this paper is that simple remedies for insect depredations in many cases are not after all what really is needed. It was not many years ago that everyone had his own remedy for certain insect depredations, and each man that made a success attributed it to his particular treatment. Modern investigation, however, exposes many of these practices as absolutely imprac-

tical. The reason for their success, in other words, was due to other conditions entirely. I remember carrying out an experiment to protect cucurbits from the Diabroticas. Upon collecting all suggested remedies and tabulating them, over 50 were offered. These were tested and, strange to say, none of them were efficacious as recommended.

We are yet in the transitory stage as regards the use of insecticides from the practical man's standpoint. He hears so much about spraying that he thinks if he sprays his crops he is practically assured of a harvest. I feel that, in regard to the use of insecticides, we are likely to duplicate the experience of a prominent chemist with the commercial-fertilizer problem. When commercial fertilizers first came into use he most heartily championed them, and tried in every way to show wherein they were of value, but farmers generally thought them a myth and didn't want to have anything to do with them. Now this same man says the pendulum has swung to the farther extreme. Public sentiment, through the press, bulletins, fertilizer companies' publications, etc., make a person feel that to be without commercial fertilizer is courting failure. In other words, this same man now feels it his duty to caution against the indiscriminate use of these goods, which are without doubt as great a drawback to financial success in some sections as anything.

Our position as regards insect depredations in some States I am inclined to think analogous to the commercial fertilizer problem. I do not desire to be considered as throwing any cold water on the progress of economic entomology, in which field I am ever ready to thankfully accept everything of usefulness. But from the standpoint of the farmers, fruit growers, or gardeners much emphasis should be laid on the fact that though the insects themselves may be destroyed, this does not necessarily insure the conditions desired.

Is it not a fact that those men who are the most negligent about their general knowledge of plant culture have the greatest trouble from insect depredations? I believe that our best entomologists will bear me out in saying that wherever we find practical successful husbandmen we also find the minimum trouble from insect depredations.

It is not an easy matter to lay down any specific and definite law, but that these conditions do exist there is little question. Many insect ravages are doubtless the resultant of an unhealthy condition of the plant, due to improper culture or accident rather than to the natural devouring instincts of the insect. Trees that are girdled or cut down are shortly preyed upon by a great variety of insects that nature evidently considers beneficial, although they are, under some conditions, detrimental. Where cultivated plants that naturally need plenty of available plant food for their development are set out in depleted soil, from the very fact of their previous high degree of culture and breed-

ing they begin to decline, and plant-lice and other insects assist in their extermination. I had three vines (Lonicera) running over my porch. All grew well for a couple of years, when one became badly affected by plant lice, while the others were comparatively free. Upon examination I found that the label wire that had been left on the infected plant was checking its development, and the vine was thereby weakened. Upon removal, new shoots rallied to the support of the plant, but the insects were too numerous and the plant became discouraged, although it never thought of giving up life. The next year I noticed that this same plant was again affected with the aphides, also one of the others, but the third seemed healthy as ever. Upon diagnosing their cases I found the healthy one stood alongside a shrubby border, and its roots had ready access to rich cultivated soil, while the others were in sod ground. Thinking the poverty of their food supply perhaps accountable for their condition, they were fertilized, with the result that, although the insects did not leave the plants entirely, the plants themselves overcame their previous debilitated condition and, as far as the casual observer could tell, were perfectly healthy. Many other facts have come to my notice that also point to the conclusion that, if we understood what the proper culture of the plant should be, many insect troubles could be avoided. I have taken much interest in getting the practical man's views of plant culture, and many object lessons are gained therefrom. Insects and fungous diseases are by no means as troublesome to the man who knows how to get best results from plants themselves as they are to another who knows everything about insects and their control and but little about plant culture.

I have had college graduates who could identify insects and recite on insecticides perfectly, but who found it practically impossible to combat red spider and the like without practically destroying the value of the plants themselves. Another man with little knowledge of entomology or insects, but thoroughly understanding plant culture, has grown the same plants under exactly similar conditions, and I have failed to even find red spider present. If plants are allowed to suffer from crowding, over or under watering, too much or too little ventilation, extremes of temperature, insufficient plant food, neglected breeding, etc., of course one will have trouble, and simple remedies, although under other conditions they might be efficacious, here are utterly useless. I might enumerate further examples, but hope I have sufficiently emphasized the idea that entomologists can not know too much about plant culture, and were it possible I should like to see every economic entomologist as far as possible a practical grower.

The next paper was by Mr. Phillips:

NOTES ON MELANOPLUS FEMORATUS.

By J. L. Phillips, *Blacksburg, Va.*

This locust was first observed in considerable numbers by the writer, in Roanoke County, June 17, 1899. It was in this instance doing considerable injury to a small field of timothy, but was not plentiful enough in the vicinity to attract general attention. Where this insect occurred in considerable numbers, the grass was entirely unfit for hay, as they cut off or destroyed all the blades, and many of the heads, leaving only the stalks. This species was found to be plentiful in the fields near Blacksburg, later the same summer, but it was not present in sufficient numbers to do serious harm.

The observations were not carried on systematically, very little attention being paid to it in 1900 and 1901, but on June 16, 1902, we learned that this insect was doing considerable damage in some portions of Wythe and Smyth counties, about 50 miles west of Blacksburg. This outbreak was investigated at once, and proved to be the most serious one known to us.

The owner of the property where this outbreak occurred claimed that the locusts were first observed on the western border of a pasture field of 30 acres. At the time this investigation was made, the majority of the insects were located in a 20-acre field of wheat, adjoining the pasture field. They had eaten all the herbage on the above-mentioned pasture, leaving the ground bare, but the roots were still alive and had begun to send up a straggling new growth. The wheat was already considerably damaged. Nearly all the blades had been cut off, and many of the heads of wheat also, and they were still feeding. The great majority of the locusts were adult at this time.

Mr. Browning, the owner, claims that on former occasions he had known them to destroy much of the wheat after it was shocked, even cutting the twine bands, so that there was some loss in handling.

These fields are located on the eastern bank of a small stream, which appears to have acted to some extent as a barrier, preventing their entrance to the fields on the west side in any considerable numbers. Later observations this season showed this insect to be present in numbers all through the Valley of Virginia, from Smyth County on the southwest to Frederick on the north. July 22, a small apple orchard near Winchester, about three years set, was found to be almost defoliated, and investigation proved that this insect was responsible for the damage.

Mr. Symons next presented a paper on the following subject:

ON THE POSITION OF THE SETÆ OF THE SAN JOSE SCALE IN INFESTED PLANTS.

By T. B. Symons, *Collegepark, Md.*

[Withdrawn for publication elsewhere.]

Mr. Hopkins stated that in his opinion the subject of Mr. Rane's paper was worthy of careful consideration, as it had to do with quite an important subject. In his own official work in West Virginia he had frequently urged the importance of good culture and good farming in the control of injurious insects, and thought that farmers who gave proper attention to these points would succeed where careless farmers would often suffer severely from insect depredation. This statement did not refer to all insects, but he thought there were many species which are attracted to the less vigorous plants and that such plants succumb while more vigorous ones would repel them or recover the injury.

Mr. Rane stated that the idea of presenting this paper had come to him from observations on men graduating from our educational institutions, especially those going out into economic scientific work. He thought men preparing themselves for work in entomology should be given a considerable amount of work in horticulture and agriculture. If they did not understand these subjects, particularly from the practical standpoint, they were greatly handicapped. He stated that he had had an opportunity of observing the work of a number of young men who had made a study of entomology, and he thought them to be incapable of successfully handling their work in relation to crops. A man might be well fitted for entomological investigation, but would nevertheless not be practical in his recommendations for farmers and fruit growers. He thought the same held true of plant pathologists. A knowledge of entomology, botany, plant pathology, etc., is always to be recommended, but equally so, for the benefit of the results to be derived from plants is a knowledge of ideal plant environment, which is none other than culture.

The following papers, which had been handed to the secretary, were read by title and were accepted for publication in the proceedings of the association.

DEVELOPMENT AND HIBERNATION OF MOSQUITOES.

By H. A. Morgan and J. W. Dupree, *Baton Rouge, La.*

Data in connection with the development and hibernation of mosquitoes is of the greatest interest in determining rational remedial measures. As most of the investigations up to the present time have

been inspired by a desire to reduce the numbers of these pests, to make habitable at certain seasons of the year large areas that may be devoted to a variety of enterprises, and to check the spread of diseases, our studies were begun with the idea of assisting as far as possible in this laudable cause, and we trust that some of the facts as set forth in this paper may prove of value in future work upon this subject.

The mosquito genera that have come under our observations are *Stegomyia*, *Culex*, *Conchyliates*, *Psorophora*, and *Anopheles*, and as many as 24 species have been studied more or less. We had expected to discuss our observations upon all the species common to Baton Rouge and vicinity, but it would take more time than that usually allotted to the discussion of a single topic on occasions like this. We have, therefore, thought best to discuss in a general way the problems associated with the hibernation and development of mosquitoes as a whole and to discuss in detail, though briefly, the life cycle of Psorophora.

The time required for the transformation of mosquitoes, as with most insects, is decidedly a variable quantity, dependent upon food and temperature conditions, and thus statements of so-called normal life of mosquitoes are misleading unless accompanied by the exact conditions under which this information was procured. While with most students of insect development, a knowledge of conditions is assumed, yet public sentiment, upon which science is more or less dependent for the operation of remedial measures, is seldom conversant with details of conditions, and if remedies fail much time is lost in explaining the reasons why failure occurred.

RESULTS OF OBSERVATIONS ON MOSQUITOES.

From our studies of mosquitoes in general we have observed the following:

First. That local pools are common breeding grounds for most species of mosquitoes. Of the 24 species found here every one has, in some stage of its development, been taken from a small pond 10 feet long, 4 feet wide, and of that depth that two weeks' drought was sufficient to evaporate all the water it contained. The lack of enemies of mosquitoes in such places may largely be responsible for the prevalence of such a variety of forms of variable life history.

Second. That most mosquitoes deposit eggs singly upon the surface of the water (exceptions are *Culex pipiens*, *C. consobrinus*, and possibly one or two other species) and, except in the cases of Anopheles and those placed in boat masses, the majority will sink to the bottom of ponds or breeding vessels.

Third. That the sinking of eggs and low temperature, as well as the rapid evaporation of the water of pools on which eggs are laid, produce

in a marked degree variations in the time of hatching. Eggs of *Stegomyia fasciata*, *Conchyliates musicus*, *Psorophora ciliata*, and *P. howardii* have been influenced to the extent of months in the time of hatching by one or other of the above conditions. This point should not be lost sight of in devising plans for the extermination of mosquitoes, and emphasizes the possible variability of life cycles under such conditions.

Fourth. That the hatching of eggs of many species is in some way associated with agitation. In ponds that dried up and remained so for months very small larvæ of *Conchyliates*, *Psorophora*, and a few species of *Culex* could be found in a few hours after sufficient rain fell to produce currents and a shifting of the eggs. In the laboratory eggs were hatched by agitation, while members of the same batch left undisturbed remained unhatched for months. Seasons of occasional showers may be responsible for the prevalence of mosquitoes in more ways than one.

Fifth. That ordinary transient ponds and pools furnish sufficient food for the rapid development of larvæ to make the presence of water only necessary for a period of six or eight days to insure the perpetuation of many species of mosquitoes. On the other hand, water containing but little food that is not subject to complete evaporation may prolong the larval life for months. We have observed the life of *Stegomyia* larvæ prolonged under such conditions two months and eleven days.

Sixth. That the larvæ of mosquitoes are not so fastidious in their food habits as they are reputed to be, but that water saturated with fœcal matter will shorten the larval period of many species. *Stegomyia* under such conditions completed the life cycle in from six to eight days.

Seventh. That water is not essential to the life of pupæ of many species, so long as the ground upon which they rest is moist. Under the latter condition the pupal period is frequently shortened. This is of importance in connection with the proposed remedy of sweeping gutters in which mosquitoes breed. It also has a bearing upon the transient pools as breeding places for most species. In our experiments pupæ were kept as long as three days upon moist cotton before emerging.

Eighth. That most larvæ and pupæ can remain under water a sufficient length of time to be able to survive in cisterns full of water, and that the habit of larvæ, some at least, of bringing to the surface more food than can be devoured at once assists a colony of specimens to procure food without having to go to the bottom for individual feedings. The data associated with the cisterns as chief factors in mosquito production is not sufficient to draw permanent conclusions. One thing is certain, that water blocked in gutters of buildings by

leaves and other material, as well as defective grading of gutters, produces conditions similar to those of the transient pools, so important to the present mode of life of mosquitoes.

Ninth. That the hibernation (i. e., where mosquitoes hibernate or winter in a specific stage of their development) takes place in the species we have studied in the egg and adult conditions. Dr. John B. Smith calls attention to the hibernation of two forms in the larval stage, but up to the present these species have not been observed in Louisiana. Several species keep on breeding through the winter, but development is slower and fewer broods occur, owing to scarcity of food and relatively lower temperature. Even with some of the true hibernating forms long warm spells may bring the stages out of winter quarters. From the above it is plain that mosquitoes are not uniform in seasonal appearance. Some are more abundant one season than another and some may continue longer than others when they do appear. As certain species are specific germ carriers, it is essential that the seasons of different species be carefully studied and tabulated.

Tenth.—We have not found that any species of mosquito will deposit eggs upon anything other than water. Even with *C. sollicitans*, under a variety of conditions, we have not been able to in any way corroborate Dr. John B. Smith's supposition that *C. sollicitans* lay eggs upon marsh grass. The possible explanation is that the eggs of this species are frequently left high and dry by the receding or evaporation of the water upon which they are deposited.

SOME OBSERVATIONS UPON TWO SPECIES OF PSOROPHORA.

The summer of 1902 produced many unusual conditions for the development of those aquatic insects that are dependent upon small ponds or pools for their perpetuation, and also gave adequate opportunity for the study of the adaptability of such forms in overcoming what are regarded as unfavorable environments. Certain sylvan mosquitoes were observed to become very numerous in a few days after heavy showers, even though a drought of three months prevailed previous to the rains. Prominent among the mosquitoes observed were two species of "gallinipper" (*Psorophora ciliata* and *P. howardii*). The natural conclusion to be drawn was that the eggs of these species, as well as of *Conchylistes musicus*, which was invariably found with them, lay unhatched upon the ground during this prolonged dry spell. Hence several *Psorophora* breeding places were carefully watched, and when rain fell in sufficient quantity to fill the ponds under observation larvæ could always be found a few hours after. Our investigations were continued. The conclusion was reached that all of the eggs did not hatch with the first rainfall, but that the alternation of dry and wet weather finally hatched all the eggs that had been deposited the pre-

vious season. In one instance after the first rain (following a three months' dry spell), which occurred on Tuesday at 11 a. m., adults were appearing from the pond on the following Sunday at 2 p. m. Adults were captured and caged to secure the eggs, if possible. This we succeeded in doing. In one case we kept a *P. howardii* female thirty-eight days, during which time she oviposited five times. Several specimens of *P. ciliata* and *P. howardii* were kept thirty to thirty-two days, with three and four ovipositions.

During the month of August it was not uncommon to have larvæ pupate in four days after hatching, and in one case only nineteen hours elapsed after pupation before the adult emerged. In summer, however, the normal pupal life is from twenty-four to thirty-three hours. During November the larval and pupal life is more prolonged. Eggs deposited in August and September have not hatched up to the present time, and are now likely to remain in this condition until next summer.

SOME INSECT INHABITANTS OF THE STEMS OF ELYMUS CANADENSIS.

By F. M. Webster, *Urbana, Ill.*

While studying the *Isosoma* infesting the stems of grains and grasses in connection with some investigations carried out for the Division of Entomology, under Dr. Howard, I have found *Elymus canadensis*, to all appearances, unusually attractive to insect life. As will be observed from the accompanying list, several new forms have been found. Another interesting feature of the matter is that, though often *Elymus canadensis* and *E. virginicus* have been found growing interjacent, not infrequently touching each other, yet the partiality of insects for the former species is strongly indicated in the list. Species marked with a star (*) were reared also from *Elymus virginicus*. Unless otherwise stated, the stems from which the species given was reared were from the vicinity of Champaign and Urbana, Ill.

Isosoma sp. Larvæ living in the stems.

Isosoma sp. Larvæ living in cells in the stems.

Eurytoma sp. nov.? Adults August 15 to 25.

**Eupelmus allynii* French.

**Merisus isosomatis* Riley.

Homoporus chalcidephagus Walsh.

Catolaccus sp.?

Coccophagus sp.? Princeton, Ind.

**Parapteromalus isosomatis* Ashmead MS. nov. gen. et sp. Parasitic on the cell inhabiting Isosoma. Urbana, Ill., and Princeton, Ind.

Coccidencyrtus flavus Ashmead MS. nov. sp. Princeton, Ind.

**Oligosita americana* Ashmead MS. nov. sp. Also reared from same species of grasses from Princeton, Ind., and in connection with *Eurytomocharis eragrostidis* Howard, at Urbana. This is the first time this genus has been recorded in America.

Elasmus websteri Ashmead MS. nov. sp. I am not certain whether this came from the stems of *Elymus canadensis* or from wheat stubble, but in either case it is from Princeton, Ind.

Xanthoencyrtus nigroclavus Ashmead MS. nov. gen. et sp. Princeton, Ind.

Elipsocus sp.? One of the Psocids.

Forda n. sp.? A root louse closely allied to if not identical with one found also about Urbana, Ill., on the roots of cheat, *Bromus striatus*, in July.

**Brachytarsus alternatus* Say. One individual from stems collected near Champaign, Ill.

**Cathartus advena* Waltl. This was reared in considerable numbers from stems of both *E. canadensis* and *E. virginicus* collected in various localities in Illinois and Indiana. Just what the larvæ feed upon is not clear, as the stems in all cases were stripped of leaves and the heads were invariably removed, leaving only the bare stems with, in some cases, the enveloping sheath.

Besides the foregoing a Coccid occurred quite commonly under the enveloping sheaths and the larvæ of some species of Lepidoptera were frequently to be found. I failed to rear the moth from these larvæ, but they feed within the stems, not infrequently gnawing out the center of the joints so that the stem is hollow from bottom to top.

It must be stated in connection with this list of the insect inhabitants of this species of grass that I have made no attempt at an exhaustive study. The prime object in collecting the stems from several and widely separated localities was for the purpose of studying the species of Isosoma infesting them. Elymus appears to be unusually attractive to these insects, but I have invariably found the larvæ vastly more numerous in *E. canadensis* than in *E. virginicus*. This might afford the basis for a discussion of the question as to which of the two species of grass was the older; but, in the language of Kipling, "that is another story." I have little doubt that a further and more extended research will develop a still greater number of insect inhabitants of this grass, and the fact that the new genera and species brought to light may be considered in this case as a sort of by-product from the study of the Isosomas, ought at least give zest to a further study in other localities.

SOME INSECT NOTES OF THE YEAR.

By F. M. Webster, *Urbana, Ill.*

In going about in several States of the Middle West, one of the most striking features of insect attack observed out of the ordinary was the great number of leaves of plants and grasses that had been attacked by leaf miners, seemingly for the most part belonging to several species of Diptera, though, as I failed to rear anything but great numbers of parasites from affected leaves, it is of course impossible to give definite information relative to the host insect. Verbena plants brought from Ohio in June and planted in the open in Urbana were

so completely leaf-mined as to render them worthless. From leaf-mined blades of *Panicum proliferum* I reared myriads of *Pedobius websteri* Ashmead, MS. The whitened tips of the leaves of the Panicum were so numerous along the streets of Urbana, Ill., as to render them conspicuous objects.

Many years ago, at Oxford, Ind., I reared *Eumetopia rufipes* Macq. from the stems of *Panicum crus-galli*. The larvæ were first observed at work in the stems in June, others again in August, the adults appearing August 13. The effect on the stem of the grass is much like that of *Meromyza americana* on wheat, except that the grass is attacked before as well as after heading, the attack being to the upper portion of the stem. I was not then able to get the flies identified, and no report was ever made of the rearing.

Ceratomia catalpæ Edw. attacks the catalpa trees in southern Indiana and Ohio, sometimes completely defoliating them. The larvæ are attacked by Tachinid flies, and the larger portion of them seemed to have been parasitized in this way. Farmers about New Harmony, Ind., report that the cuckoo also feeds upon them.

Pseudoanthonomus longulus Dietz (?) was found in the seed pods of *Menziesia pilosa*, collected in the vicinity of Marlinton, W. Va., probably in July.

Rhodobænus 13-punctatus Ill. was observed feeding on the half-ripe seeds of the garden sunflower, August 16, 1902. I had previously reared the adult beetle from larva found burrowing in the stalk.

Schizocerus zabriskei Ashm., adults of which were observed in Illinois and Indiana in considerable numbers, appeared to be prevented from breeding in purslane through some cause not clearly apparent, as it was rare that the work of the larvæ was to be found.

Again, I have witnessed the work of some of our Coccinellids in terminating an outbreak of aphides. In the vicinity of Princeton, Ind., late in August, I found a field of red clover that, as was clearly indicated by the appearance of the clover leaves, had been literally overrun with a species of aphis, though there were few of them left at the time of my visit. There were, however, swarms of lady beetles and their larvæ and pupæ to be found everywhere. The species most numerous were *Hippodamia 13-punctata*, *H. glacialis*, and *H. parenthesis*. The leaves of the clover were stunted, blackened, and curled with the cast skins of the aphids scattered plentifully over them.

Idolothrips coniferum Perg., both adult and larva, were found among stems of rye in July and in stems of Elymus in August, at Urbana, Ill.

Eurytomocharis eragrostidis How. was observed cleaning its body. To clean the head and thorax the anterior pair of feet was used, and the motions made in doing this can best be illustrated by watching a white rabbit perform the same operation to its face, the quick, jerky motions being similar in the case of each. For cleaning the wings

and abdomen the posterior pair of legs and feet was used, the same ludicrous motions being made in the operation. As illustrating the tenacity of life in this species, an individual was observed at 6.30 a. m. with abdomen, wings, and one posterior leg gone, but it continued to survive in this badly crippled condition until 9 a. m. of the same day.

Anosia plexippus Fab. certainly migrated southward across Illinois in swarms during September. Looking out from my library window in Urbana, Ill., at 3 p. m., September 12, I saw hundreds of these butterflies winging their way hither and yon, seeming to be gathering together in the tree tops. The wind was brisk from the northwest, temperature 55° F., and the sun shining unobscured. Light frost during night of 12th, and it was not until about 9 a. m. of the 13th that the butterflies began to appear. They were, or seemed to be, flying aimlessly about, but by 10 a. m. they had all disappeared, though I was unable to witness their going, on account of other duties. Swarms of these butterflies were reported at Milledgeville, Carroll County, about 160 miles to the northwest, on the 9th, and, later, at Hoopston, to the northeast. The fact of a migration was shown by the continued occurrence of these butterflies in their usual numbers in this same locality during the rest of the month.

Aphis mali Fitch. Usually, this is not a serious pest of the apple, and in some cases it is really more of a pest of the wheat field than of the orchard. In the State experiment orchard at Orleans, in Indiana, late in October, I had an opportunity of seeing just what the pest was capable of doing among very young apple trees. At that time there were but few of the aphis on the young trees and these few were mostly confined to the tips of the twigs where these had not already been killed. In most cases, however, the little new growth that had been put forth was devoid of healthy leaves, only stunted and dried foliage and stems remaining. The rows of young trees looked as though some one had weeks before passed along with a lighted torch and scorched them, killing the new leaves and tender growth of twigs. Just what this would mean in an experimental orchard of very young trees can only be fully understood by those who have been engaged in such work.

The Hessian fly, notwithstanding its abundance in volunteer wheat, has affected only the earlier-sown wheat. All over southern Indiana and Illinois there is ample proof that September-sown wheat invites the attack of the fly, and that wheat sown in these localities after the first week of October will, as a rule, suffer little from the attack of this pest in the fall. Intelligent farmers are now watching the season as well as the fly, and timing their sowing to fit these conditions.

I do not recall that attention has been drawn to the fact that the red rust of wheat is much more liable to attack fly-infested plants in the fall than those not thus affected. In the fall of 1900 all early-sown

plats of wheat at the Ohio Agricultural Experiment Station were severely attacked by both Hessian fly and red rust, so much so that the station botanist called attention to the occurrence of rust in the wheat fields in the agricultural press. Plats sown before September 25 were all seriously affected by the rust, that sown on the 21st being much more seriously injured than the other plats, for the reason that, with the others, it was attacked by the fly, but the rust coming at the critical period of its growth prevented the plants from sending out tillers, and the damage begun by the fly was thus rendered disastrous by the rust. The present year, in southern Illinois, I also witnessed again something of the same sort, with this variation, however: Where the wheat had been sown on wheat-stubble lands, and sown early, the young plants had been attacked by the fly, and later the damage had been accentuated by the rust: and, singularly enough, the exact location of the shocks of the harvested grain of the previous crop could be clearly observed by the much more reddish appearance of the young growing grain, a fact that could be observed at a considerable distance away. In fact, a circular space the area of the old grain shock was fairly browning under the effect of the rust, which lessened in intensity from this area outward. These brown-yellow spots could be seen regularly in rows across the field as the grain had been shocked at harvest.

MOSQUITOCIDES.

By J. B. Smith, *New Brunswick, N. J.*

It is not always possible at once or entirely to abolish breeding places for mosquitoes and it is highly desirable that we should have at command some material or class of materials that will kill larvæ or for a time make pools uninhabitable for them. There is a popular belief in the effectiveness of certain substances without any real basis, and "mosquitocides" in varying forms testify to the interest which dealers in patent nostrums are quick to discern in the public.

The most readily available of all the materials that have been used is petroleum, crude or partly or wholly refined. Sprayed over the surface of a pool, it forms a film that covers it completely and kills in a short time the larvæ or pupæ that are compelled to try for air through it. In the grade known as fuel oil, it forms a very good practical material where its odor or its general unpleasant mussiness are not objectionable. For sewer or catch basins it is probably as good a thing as can be used, and on quiet waters in confined areas where a thin film can be maintained, its odor will scarcely be offensive. On larger pools, open to the winds or interrupted by grassy or other vegetation a great deal of oil must be used, or an unbroken film, even if secured, will not last long enough to kill more than a small

proportion of the larvæ. I have several times tried the oil on road and open meadow pools when there was only a light wind blowing, to find in a few minutes all the oil film at one side and a very fair congregation of larvæ at the other. In grassy pools the tendency is for the oil to gather about the vegetation, and where there is much floating matter the spread of the oil is materially hindered if not altogether prevented.

Admitting, then, the very great range of usefulness of the petroleums, it was deemed useful to make a number of laboratory trials of other substances to determine whether it would not be possible to obtain something that would mix readily with the water, making it unfit for wrigglers to live in for some considerable period.

Materials for experimental purposes were sent in by the Phinotas Chemical Company of New York; Mr. F. B. Kilmer, president of the New Brunswick board of health, sent me a supply of chloro-naphthalum from the stock of the board, a series of other cresol preparations, and a variety of disinfectants from Johnson & Johnson. These latter samples were not of the firm's manufacture, but, rather, from the stock carried for general use. Other things were purchased as needed.

The larvæ and pupæ used for the experiments were usually obtained from a series of pails kept partly filled with water in my garden, but some were obtained from out-door pools within the city limits. The species was always *pungens*, with an occasional small admixture of *territans* or *restuans*, until in August *Anopheles punctipennis* became common enough to be added.

PERMANGANATE OF POTASH.

Six 1-quart jars were used, each containing 16 ounces of water, in which were from 50 to 100 larvæ, ranging from one-fourth to full grown. A stock solution of permanganate was made, of which 8 drops equaled 1 grain of the crystals.

Jar No. 1 received 1 grain; jar No. 2 received 2 grains; jar No. 3, 4 grains; jar No. 4, 8 grains; jar No. 5, 16 grains, and jar No. 6, 32 grains of permanganate.

In each case the water became at once distinctly discolored, and where the larger amounts were used became so deeply purplish that the liquid was opaque and the wrigglers could not be seen except at the surface. No immediate effects were observable in any jar.

After forty-eight hours all the larvæ in jar No. 1 were yet alive and active. In jar No. 2 about 20 per cent of the larvæ were alive, and these were the larger specimens that would have pupated shortly. In the jars containing the stronger mixtures all the larvæ were dead, and it is fair to say that for certain death to the larva in a reasonable time at least 4 grains of permanganate would be required in every pint

of water. At this rate 1 ounce of the permanganate would make 120 pints or 15 gallons uninhabitable for mosquito larvæ, at a cost of $1\frac{1}{2}$ cents for material.

"MOSQUITOCIDE."

Under this name a preparation, mostly permanganate of potash, was placed upon the market. It was advertised to some extent, and claims were made which, if they were only approximately true, would solve the mosquito question at once and for all time. A small pinch was supposed to rid an ordinary lawn of all insects, and 5 pounds would keep an acre clear for an entire season. So on August 9 a small lot of larvæ and pupæ was placed in four 4-ounce bottles. As the "pinch" was the measure provided for in the directions for use, I put "pinches" of varying quantity into the bottles. The resulting color ranged from a rather clear red to a deep opaque purple. August 10 the deepest-colored liquid was so diluted as to make things visible, and it was found that, while all the larvæ were dead, all the pupæ were alive and active.

A second bottle, in which the liquid was just transparent enough to see through, had a few pupæ and quite a number of full-grown larvæ when the experiment began. August 10 the hood over the bottle was full of adults and most of the larvæ had changed to pupæ. Only a few larvæ remained, but these were very lively. August 11 adults from the last batch of pupæ began to make their appearance and the experiment was closed.

In the other bottles the larvæ developed well, and apparently paid no attention to the presence of the permanganate.

Practically these permanganate of potash preparations are of no value, and this conclusion agrees with that reached by Dr. L. O. Howard.

SALT.

Culex pungens has not been normally found in salt or even brackish water, and I do not believe that the female ever forms its egg boats on such waters. It became a matter of some interest, therefore, to determine what effect the addition of salt would have, and I transferred the contents of one of my garden pails to a 2-quart jar half filled with water. The range was from egg boats to pupæ, and after twenty-four hours the water was one mass of wrigglers, most of them small or very small. I added a small handful of common salt, dropping it through the meshes of the bobbinet hood until it formed a layer at the bottom, which dissolved completely in an hour or two. Forty-eight hours afterwards no bad effects were observed, and the larvæ appeared to enjoy the salt water immensely. I doubled the amount of salt previously used, and it formed a layer over the entire bottom of the jar and did not completely dissolve for ten hours. Twenty-four

hours later the larvæ were as lively as ever, there were no dead specimens, and adults in some number were in the hood. The conditions were allowed to continue, until it became certain that development would continue normally, and the experiment was then closed.

Another series of experiments was made beginning October 4 with "sea salt" as sold in drugstores for the bath. Four jars were used, each with 20 ounces of water, into each of which was placed 50 or more larvæ of all sizes and some pupæ. To jar No. 1 I added one thirty-second of an ounce of sea salt. October 8 this jar contained a few dead small larvæ. October 9 larvæ and pupæ were both active and developing normally. On October 10 there was no change and the experiment was closed.

To jar No. 2 I added one-sixteenth ounce of sea salt. Four days later, October 8, there were only a few dead larvæ, but 15 adults had developed meanwhile. No change taking place, the culture was closed on October 10.

To jar No. 3 I added one-eighth ounce of sea salt. October 8, four days later, there were few living larvæ left, but there were 25 adults in the hood. Next day only one live larvæ remained, and on the 10th all were dead.

To jar No. 4 I added three-sixteenths ounce of sea salt. Four days later, October 8, 34 adults had issued, and there were yet a few living larvæ. On the 10th all save a few full-grown larvæ were dead and the culture was closed.

The extreme amount of salt used was not large, but the result indicates that moderate amounts of salt placed in water would have no injurious effect upon the development of this species.

NAPHTHALINE.

Two jars were stocked with large numbers of larvæ, from the young just out of the egg to pupæ, in about 20 ounces of water. Into jar No. 1 I dropped one large ball of naphthaline and into jar No. 2 I dropped two balls of the same material. I watched developments for a week and could not find that the larvæ minded it in the least. Even the smallest made their way under and around the balls, feeding as freely as they did anywhere else in the jar.

There was no real expectation that naphthaline could be profitably used to destroy larvæ, but it is used not infrequently as a disinfectant, and if it had incidentally any effect in this direction the fact would be worth knowing.

LIME.

Eight pails are used in the garden to secure larval material for experimental purposes. They were established June 11 and kept under observation all summer; but besides *pungens* only an occasional

territans and late in the season some *Anopheles punctipennis* developed.

In the beginning of the season the new pails seemed to offer no attraction to the insects, while last year's pails, all blackened inside, were always fully stocked from the start.

Into one of these old pails I dropped a small quantity of slaked lime, not enough to make the water milky or to cause any obvious change in its appearance. Next morning I found a thin lime scum on the surface, no living larvæ, and two new egg boats, from which no larvæ ever developed. The pail was open to sun and rain, and a week later the lime coating was gone and a new lot of young larvæ was observed.

The experiment was duplicated in one of the new pails, and for over a month the pail had no trace of larvæ. In fact, to start it at all I washed it out and added a little garden soil, with a tuft of sod and a little torn grass. That proved effective at once, and next morning there were two or three egg boats on the surface.

The use of lime may under some circumstances be very convenient and effective, especially in foul pools on dumps and in cesspools. So long as there is enough to form a scum no mosquito larva, *Culex*, or *Anopheles* can develop.

An incidental observation in this connection may prove of interest: A little keg that had contained "Calcothion," which is a ready-made ime, salt, and sulphur mixture, was left outdoors and became nearly filled with rain water. After a few days this swarmed with larvæ, lwhich gathered their food from the lime-coated sides of the barrel and reached the pupal stage before I interfered.

COPPERAS.

Several experiments were made with this material, but the record slips were accidentally destroyed. The result was not encouraging, however, as very large quantities were required to destroy the larvæ, and I did not feel at all certain that the larvæ were not simply starved out by the destruction of their food supply.

CRUDE PETROLEUM.

The subject of the petroleums has already been touched upon and is introduced into this series only to record a small test that was made with an old oil from which the volatile parts had pretty well escaped. This was dropped on the surface of a pail of water to test its spreading power, but it remained persistently in globules and drops and for over an hour did not change at all. Then I stirred up the mixture thoroughly, breaking up the oil into fine globules, but yet it formed no film and killed only a few larvæ. After yet an hour I stirred up the whole mixture once more, and finally, six hours afterwards, all

larvæ and pupæ were dead. This is a hint that if crude oil is to be used it must not be too heavy, but must have light oils enough to enable it to spread thinly over the surface.

PHINOTAS OIL.

This material has been used in a number of places with excellent success and combines in a remarkable degree the water-poisoning quality like that of the cresol preparations, with the surface-coating effect of the light mineral oils. Dropped into water in a coarse spray it sinks to the bottom in globules which begin to dissolve, giving a milky tinge to the water around each. In a short time these globules rise to the surface, burst, and a surface coating extends in each direction from the center. The question was, how little of the material is needed to produce the effect, and to this end a number of experiments were made at different periods in the summer in fresh water and in salt. Only two laboratory tests need be referred to here.

I prepared a mother mixture of 5 cc of phinotas oil in 500 cc of water, the ratio being 1 to 100. Of this I poured 5 cc into 500 cc of water containing mosquito larvæ of all sizes, the strength of 1 to 10,000. In 5 minutes all were dead.

To another jar I added 3 cc of the mother mixture to 500 cc of water (about 1 part in 16,000) and in less than half an hour all the larvæ were dead.

The limit of practical effectiveness may be safely set at 1 part to 15,000 of water; that is, 1 gallon of phinotas oil will so poison 15,000 gallons of water as to kill all mosquito larvæ there may be in the water. It is doubtful whether any other material comes anywhere near this in effectiveness. Furthermore, the action of the material is not affected by the wind. It spreads everywhere throughout the water, and if the body be confined it remains poisoned for weeks unless added to materially.

It would seem as if we had here the ideal mosquito destroyer, and so we have for certain purposes. In sewer or catch basins or in foul or stagnant pools it would be almost impossible to find anything better. In stagnant gutters it is very useful, but the oily surface scum is objectionable. Yet in every well organized mosquito campaign this phinotas oil would seem to be indispensable.

The objection to the material is that it is too effective in undesired directions, for it kills things that it is not desirable to injure if possible. It is quite probable that it has been used in altogether too large quantities; but as used it has killed fish as well as other aquatic animals and insects, and it has been accused of killing chickens and other animals that drank of the water impregnated with it. It is also fatal to vegetable life, and any pond treated with this material in liberal quantities would be completely cleared of all animal and vegetable life, and

would become an ideal mosquito-breeding place as soon as the oil has been sufficiently diluted or carried off.

Personally I do not like the smell of petroleum, although I have worked with and recommended its use often enough, and I do not like the scum and tarry sediment on the plants and borders of pool or pond. Hence, I do not like that feature of the phinotas oil that makes for a surface coating. It is not at all necessary to help the action of the soluble portion, and it is just as liable to become imperfect as the fuel oil, which costs about one-fourth as much and acts only from the surface.

Its field is wherever it is desirable to clear any liquid of mosquito larvæ promptly and without regard to conseqences. It is quite possible that some of the objectionable features would disappear or become materially lessened if no more than enough to obtain the desired result was used; but I would always advise against the use of any poisonous substance in any body of water that contains fish.

A limitation to the material is that it does not do well, if at all, in salt water. During July I tried it at Anglesea in breeding jars and in salt-water pools filled with larvæ of *C. sollicitans*. In neither case did it produce the characteristic milky appearance, although used rather in excess, and in the case of the pools there was none of that surface spread which is usually so characteristic.

These salt-water pools, treated at several places along the shore, proved rather unsatisfactory subjects, and usually I could find, twenty-four hours after treatment, nearly as many larvæ as there were the day before.

Some of the more promising materials were also used on outdoor pools, but no results different from those of the laboratory were obtained.

"PHINOTAS DISINFECTANT 20 PER CENT."

A sample of material labeled as above was reduced to a 1 to 100 stock solution, and two jars, each containing 500 cc of water, were stocked with larvæ of *Culex* and *Anopheles*.

Jar No. 1 received 5 cc of the stock at 4.45 p. m., and ten minutes later most of the *Culex* larvæ were dead. At 5.30 p. m. all pupæ, all *Anopheles* larvæ, and a few full-grown *Culex* larvæ were yet alive. At 8 a. m. next day two *Anopheles* larvæ and some pupæ were yet alive. At 12 m. only pupæ remained alive, and the record had not changed at 4 p. m., when the experiment was closed.

Jar No. 2 received 10 cc of the stock at 4.45 p. m., and ten minutes later nearly all *Culex* and the smaller *Anopheles* larvæ were dead. At 5.30 p. m. one or two *Culex* larvæ were yet feebly alive. At 8 a. m. next day several *Anopheles* larvæ and several pupæ were yet alive, though all larvæ were dead. No adults emerged in either jar.

"PHINOTAS DISINFECTANT 5 PER CENT."

The sample was reduced to the stock solution of 1 to 100, and a jar with 500 cc of water was stocked with larvæ and pupæ of *Culex* and *Anopheles*. At 9.25 a. m. I added 5 cc of the stock solution. At 10.10 a. m. the *Culex* larvæ were dead; at 10.30 the *Anopheles* began to die, and all were dead at 2 p. m. All pupæ were yet alive. Next morning 6 adults were found in the hood and 5 cc of the stock solution was added, doubling the amount in the water. Yet twenty-four hours later several adults were again in the hood and all the pupæ were alive, seeming not in the least discommoded by the disinfectant.

The difference between the action of the material on the larvæ and on the pupæ is most remarkable and, once the pupal stage was reached, development seemed not in the least interfered with.

"PHINOTAS MARK G."

The sample was reduced to the stock solution of 1 to 100 and two jars with 500 cc of water were stocked with larvæ and pupæ of *Anopheles* and *Culex*. At 4.30 p. m. I added 5 cc of the stock solution to jar No. 1, and at 4.55 most *Culex* and some *Anopheles* larvæ were dead. At 5.30 all *Anopheles* were dead, but a few *Culex* larvæ were yet alive. Next day, at 8 a. m., a few pupæ remained alive; at 12 m. everything was dead.

To jar No. 2 I added 10 cc of the stock solution at 4.30 p. m. At 4.50 all *Culex* larvæ were dead; at 5.30 only pupæ remained alive; next morning everything was dead.

SOLUBLE BLAST FURNACE OIL.

I reduced the sample to the stock 1 to 100 mixture and stocked two jars, each containing 500 cc of water, with larvæ and pupæ of *Culex* and *Anopheles*. At 3.30 p. m. I added 5 cc of the stock to jar No. 1, and in twenty minutes all *Culex* larvæ were dead. At 4.40 p. m. all the larvæ were dead, and though the pupæ were alive, the adults died as they attempted to emerge.

In jar No. 2 I added 10 cc of the stock at 3.25 p. m. All larvæ were dead in five minutes; but at 5.30 some pupæ were yet feebly alive.

Of the phinotas preparations nothing is equal in effectiveness to the "phinotas oil." The other preparations mix fairly well with water, form no surface scum, and all impart a milky tinge to the water. The proportion where 5 cc of the stock was used is 1 to 10,000; where 10 cc was used is 1 to 5,000.

"CHLORO-NAPTHALUM."

This is a cresol preparation readily soluble in water, used for disinfecting purposes by the New Brunswick board of health. It forms no surface scum, and turns the water milky when added in any quantity. As it was intended to make a field application to breeding pools within a certain portion of the city limits the substance was tested a little more fully than some others; but as the tests were made in early July, when no *Anopheles* larvæ were available, only larvæ and pupæ of *Culex pungens* were used.

The stock solution in this case was 1 to 200, and 6 jars each with full 10 ounces of water were used. The larvæ in each case ranged from two or three days old to full grown, and between 50 and 100 were in each jar.

Jars Nos. 1 and 2 each received stock solution to make the mixture 1 to 12,800, and at that dilution the water was faintly white tinged. After twenty minutes, 50 per cent of the larvæ were dead—mostly the smaller specimens. After two hours, 25 per cent, including all the full-grown examples, were yet alive, and eighteen hours later there had been practically no change, except that some larvæ had pupated.

Jar No. 3 received stock solution to make the mixture 1 to 6,400, and the water was appreciably white-tinged. After twenty minutes only about 10 per cent of the larvæ were alive, and in two hours only pupæ and a few full-grown larvæ remained alive. After eighteen hours a few more larvæ were dead, but pupæ remained unaffected.

Jar No. 4 received stock solution to make the mixture 1 to 3,200, which rendered the water a little translucent. Though this jar had double the amount of stock solution put into No. 3, the effect was exactly the same, and at the end of ten hours there were quite as many larvæ and all pupæ left unaffected.

Jar No. 5 received stock solution to make the mixture 1 to 1,600, and this made a decidedly milky, opaque liquid, in which all the larvæ were dead in five minutes. One pupæ survived after three hours, but was so feeble that its death was certain.

For practical work, mixtures ranging between 1 to 1,000 and 1 to 1,500 will prove fatal to larval life—that is, to a body of water containing 1,000 gallons or thereabouts, 1 gallon of chloro-napthalum must be added to kill all the mosquito larvæ in it. At that strength it is also a good disinfectant, and its use in gutters and on dumps is cleansing and the effects are lasting.

Pools in which mosquitoes bred in the Sixth ward, in New Brunswick, were twice treated during the summer with this material and in each case the larvæ were killed off and the pools remained free until flooded by heavy rains. The effect on the local mosquito supply was quite marked. The manner of application was to pour a gallon of the

disinfectant into 50 gallons of water, stir thoroughly and apply to pools and gutters with a sprinkler. Sewer catch basins were not treated because it was not realized until late in the season how many of the insects bred in such places.

"PURALINE."

This is a preparation similar to the preceding, but much cheaper, and is also used as a disinfectant. It dissolves in water in the same way and produces a milky mixture. Cresol is the active base.

Several mixtures more dilute than 1 to 10,000 were tried, and proved practically ineffective. Larvæ and pupæ of *Culex pungens* only were used. The effective mixtures were as follows:

To jar No. 1 I added from the stock solution enough to make the proportion 1 to 8,000. An hour afterwards a few larvæ and all pupæ were yet alive, but next morning everything was dead.

Jar No. 2 received stock solution to make the mixture 1 to 4,000, and an hour afterwards all larvæ and nearly all pupæ were dead.

At 1 to 4,000 this material is as effective against mosquitos as the chloro-napthalum is at 1 to 1,000—that is, four times as effective at one-fourth the price. Its range of usefulness is as for the previous mixture.

"TAROLA."

This preparation is from the Barrett Manufacturing Company; is also soluble in water, and produces a milky emulsion.

The usual 1 to 100 stock was made, and 5 cc was added to 500 cc of water containing larvæ and pupæ of *Culex* and *Anopheles*, at 10.40 a. m. An hour later most of the *Culex* larvæ were dead. At 3.15 p. m. a few more pupæ were dead. Next day at 8 a. m. no more pupæ had died, and I added 10 cc from the stock, making the mixture 1 to 2,500; but at 11 a. m. many pupæ were yet alive.

The remarkable resistance of the pupæ to preparations of this character is quite noticeable, and at 1 to 2,500 it was not really more effective than at 1 to 5,000.

"MILKY DISINFECTANT."

This is another of the preparations of the Barrett Manufacturing Company, and produces the same milky emulsion.

The usual 1 to 100 stock was prepared, and at 8 a. m. 5 cc was added to 500 cc of water containing larvæ and pupæ of *Anopheles* and *Culex*. An hour later all the larvæ were dead. At 10.30, as no pupæ were dying, I added 5 cc from the stock solution. At 3.15 p. m., no change being noted, I added 5 cc additional from the stock, and at 5.45 p. m. a few pupæ were dead. At 8 a. m. of the day following some pupæ

were yet alive, but no adults had issued. I added 10 cc from the stock and in a few minutes all the pupæ were dead.

In other words, a mixture of 1 to 10,000 will kill larvæ, but it requires one 5 times as strong to kill pupæ.

"CRETOL, HASSLIGER NO. 1."

This is one of the preparations sent me by Mr. F. B. Kilmer, president of the New Brunswick board of health, and it was tested on the larvæ and pupæ of *Culex pungens* only.

At a dilution of 1 to 8,000 it killed all the larvæ in a few minutes and all the pupæ in an hour.

"CRETOL, HASSLIGER NO. 2."

This material is not so readily soluble as the No. 1 and forms an oily or tarry surface film. I made the usual stock of 1 to 100 and tried it on *Culex pungens* only. I added 5 cc of the stock to 500 cc of water containing larvæ and pupæ, and in a few minutes all larvæ were dead; in half an hour the pupæ also had succumbed.

Both of these preparations are very fatal to pupæ compared with some of the others previously reported.

SOLUBLE CREOSOTE.

This also was sent me by Mr. Kilmer. It mixed readily with water, forming the usual milky emulsion, and was reduced to the usual stock, 1 to 100. It was used on *Culex pungens* only in jars containing 500 cc of water.

To jar No. 1 I added 5 cc of stock at 10.30 a. m. At 2.45 p. m. many larvæ were yet alive, all pupæ were active, and many adults had issued. It was only upon young larvæ that this mixture had any ill effects.

To jar No. 2 I added 10 cc of stock at 10.30 a. m. At 2.45 p. m. all larvæ and some pupæ were dead, while one adult had emerged. No more adults emerged later, and all pupæ were dead next morning. At 1 to 5,000, therefore, soluble creosote is a good larvicide.

"CRESOL, 100 PER CENT."

This is one of the materials referred to as coming from the stock of Johnson & Johnson, but is not a product of their manufacture. All their samples mixed readily with water, and were purer grade materials than any of the preceding.

I reduced the cresol to 1 to 100 and added 5 cc to 500 cc of water containing larvæ and pupæ of *Culex pungens*. Eighteen hours later only the small larvæ were affected; some of the mature larvæ had

pupated and some of the pupæ had transformed to adults. I added 10 cc from the stock, but when, three hours later, no additional effect was noted, the experiment was closed.

"PHENOL-SEPTOL."

The usual 1 to 100 stock was prepared and 5 cc was added to 500 cc of water containing larvæ and pupæ of *Culex pungens*. Two days later nothing had been killed and many adults had issued. I added 10 cc from the stock, and when, two hours later, no added effects were noticeable, added 10 cc more. After waiting yet twenty-four hours and when nothing had been killed, I considered myself fairly entitled to class this as a harmless material.

"SYNOL LIQUID."

This is one of the materials entering into the preparation of synol soap, and it was reduced to the usual stock solution.

To jar No. 1 was added 5 cc to 500 cc of water containing larvæ and pupæ of *Culex pungens*, at 9.45 a. m. At 12 m., no effect appearing, I added 15 cc of stock, which killed some larvæ by 5 p. m.

To jar No. 2 was added 10 cc to 500 cc of water as above. At noon no bad effects were noticeable on the larvæ. At 1.20 p. m. I added 30 cc of stock, and at 5 p. m. only one pupa remained alive.

This is not a reliable larvicide, and is as expensive as it is ineffective.

"SAMPLE C., J. & J."

This was reduced to the usual stock of 1 to 100, and at 8 a. m. 5 cc was added to 500 cc of water containing larvæ and pupæ of *Culex* and *Anopheles*. At 10.30 adults began to issue and, as neither larvæ nor pupæ seemed affected, I added 5 cc from the stock. At 1 p. m. nearly all *Culex* and some *Anopheles* larvæ were dead. Next morning all pupæ were yet alive and several adults had issued. I then added 20 cc from the stock, but three hours later not even one more pupa had died and the culture was closed.

"SAMPLE T., J. & J."

This was reduced to the usual stock solution, 1 to 100, and 5 cc was added to 500 cc of water containing larvæ and pupæ of *Culex* and *Anopheles*. No effect being apparent three hours later, I added 15 cc from the stock, which killed all larvæ in one and one-half hours. Twelve hours later everything was dead.

In another jar I added 10 c. c. of the stock, and all save a few mature larvæ were dead in five hours. Twenty-four hours later a few of the larvæ and all the pupæ were yet alive.

It appears as the result of these experiments that there are several preparations that will serve both as disinfectants and larvicides even when highly diluted. In almost every city and town there are foul or imperfect gutters where water lies, and sewer or other catch-basins, always containing water and only flushed by occasional heavy rains. These could be treated by the local boards of health in their ordinary process at very small expense. So rain pools in vacant lots could be temporarily made harmless until the owner had been compelled to either fill or drain them. Judiciously used, even a barrel of such material as "Puraline" would keep a large area clear of breeding places, while if an equal amount of Phinotas oil were added and used where it could be safely done, the area could be much more than doubled. Cesspools would stand the same sort of treatment, but cisterns and water barrels could not receive anything that might render them dangerous to life or health. But these can be reached in an entirely different and equally effective way, as is elsewhere shown.

DISTRIBUTION OF THE SALT MARSH MOSQUITO IN NEW JERSEY.

By J. B. Smith, *New Brunswick, N. J.*

[Withdrawn for publication elsewhere.]

THE PERIODICAL CICADA (*Cicada septendecim* Linn).

By J. B. Smith, *New Brunswick, N. J.*

[Withdrawn for publication elsewhere.]

VERNACULAR NAMES OF INSECTS.

By Edwin W. Doran, *Champaign, Ill.*

The subject of vernacular names of insects has been discussed briefly before this body on two former occasions, but otherwise scant attention has been given it and the discussions mentioned seem to have been barren of direct results. In 1897 Prof. C. P. Gillette presented a paper before this association on vernacular names and included in his paper a list of about fifty species written in accordance with his views. At the next meeting of the association the writer presented a brief discussion of the matter and suggested certain corrections in Professor Gillette's list.

I know of nothing else which has been published on the subject except an article which I published in Entomological News for November, 1902. The matter seems worthy of further consideration. Every

one must have noticed the utter confusion which prevails among entomologists as to the correct form in which to write many of the names of the commonest insects, especially as to the proper compounding of these names. Some writers seem to have an antipathy for the little character called a hyphen, and avoid the use of it on all occasions.

Nevertheless there is a place for the hyphen, and most entomologists use it far too sparingly, while many others use it without due consideration of the principles that underlie the compounding of English words. In the study of this subject and in the preparation of a list of 3,500 of the compound vernacular names of insects, I have worked out a system of simple rules, easy of application, yet in accordance with language principles and the usages of the highest authorities.

While it is not easy to present a subject like this before an audience, still I think it can be made so plain that I submit some rules and principles for guidance in the compounding of insect names, together with numerous illustrations of their application.

We may start with this general principle, taken from the Standard Dictionary: "*Abnormal association of words generally indicates unification in sense, and hence compounding in form.*" From this principle we derive the following rules, the first one being general, the succeeding ones more specific:

Write in compound form—

1. Any pair of names or words in joint arbitrary use.

Examples: Currant-borer, leaf-roller, walking-stick.

2. A general name used with any other name prefixed for specification denoting (*a*) food-plant, (*b*) host, or (*c*) prey.

Examples:

a. Food-plant: Apple-louse, cabbage-worm, fruit-worm, onion-thrips, potato-beetle, plum-curculio.

b. Host: Dog-flea, horse-fly, ox-warble, turkey-gnat.

c. Prey: Ant-lion, bee-hawk, mosquito-hawk.

3. A general name used with any other names prefixed for specification denoting (*a*) similarity, (*b*) habit, (*c*) habitat, (*d*) characteristic.

Examples:

a. Similarity: Buffalo-gnat, comma-butterfly, ichneumon-fly, lady-bird, mole-cricket, zebra-caterpillar, walking-stick.

b. Habit: Army-worm, burying-beetle, cut-worm, flea-beetle, kissing-bug, measuring-worm, migratory-locust, soldier-bug, saw-fly (or sawfly), tent-caterpillar, tumble-bug, web-worm.

c. Habitat: Ground-beetle, house-fly, tree-cricket, tree-hopper, water-boatman.

d. Characteristic: Blister-beetle, bot-fly, canker-worm, gall-fly, scale-insect.

4. A phrase consisting of an adjective and a noun used as a mere name should be generally written as one word.

Examples: Bluebottle, clearwing, grayback, longsting, orangetip.

Many insect names are formed in accordance with two or more rules. Examples: Apple-tree tent-caterpillar (1, 3b), nine-spotted ladybird (1, 3a), blood-sucking cone-nose (3b, 3a), case-making clothes-moth (3b, 2a), East-Indian meal-moth (1, 2a), sooty corn-root web-worm (1, 3b).

As to whether a compound name should be written as one word or with the hyphen, it is difficult to determine, as it is difficult to construct definite rules for governing such cases. Old and very familiar names like ladybird, cutworm, and bedbug are generally written as single words, while newer words like cone-nose and kissing-bug are hyphenized; but age and familiarity alone can not determine. Some very old forms are still hyphenized and probably always will be, while some newer forms are written as single words. Space will not allow here a full discussion of this part of the subject.

There is also a negative phase to this question; that is, When should the parts of a name not be united? For present purposes it is sufficient to give two general principles, quoted from the Standard Dictionary:

1. All words should be separate when used in regular grammatical construction, unless they are jointly applied in some arbitrary way.

2. No expression in the language should ever be changed from two or more words into one (either hyphenized or solid) without change of sense.

From the preceding discussion two things ought to be apparent to all: First. That the subject is worthy of further consideration; and, second, that in the main the subject lends itself readily to definite and fixed rules which are based upon established language principles. Moreover, to ignore or violate these rules and principles is as great a sin against good usage as to misspell in any other way, or to trample upon the laws of grammar and rhetoric.

One reason for the general lack of the application of principles to the compounding of insect names is that the whole subject of the compounding of English words was not reduced to a system till one or two decades ago; and those who blindly follow the ancient lack of system of Webster's Dictionary, instead of the more definite system of the Standard, Century, or Murray's New English Dictionary, are likely still to be a law unto themselves, but a law founded upon no fixed principles of the English language.

The writer hopes further to elucidate the subject of vernacular names by publishing an extensive list of the names of insects along with a complete list of the vernacular names of mammals, birds, and

other groups of higher animals, together with a discussion of the rules and principles which govern in the formation of compound names of animals.

In closing allow me to suggest the appointment of a committee by this body to whom the whole subject of vernacular names of insects shall be referred and reported on one year hence.

NOTES ON THE LARGER SUGAR-BEET LEAF-BEETLE.

(*Monoxia puncticollis* Say.)

By F. H. Chittenden, *Washington, D. C.*

Since the publication of a note by the writer in Bulletin No. 18 of the present series, page 95, we have obtained additional specimens of this leaf-beetle, together with an account of its injuries in Colorado.

During May, 1902, living beetles were received with report that the species was destroying young beet plants at Rockyford, Colo. Our correspondent, Mr. W. K. Winterhalter, who furnished this information, stated May 7 that where the beetles had appeared they kept the leaves eaten down to a stage where the beet was unable to make any growth. They were most numerous on very warm, loose land, rich in lime, and a rapid increase under the then favorable climatic conditions was anticipated. They were quite gregarious, occurring "in swarms like blister beetles." May 24 our correspondent again sent beetles, with eggs and half-grown larvæ, stating that while the beetles had not done extensive damage they had prevented beets from growing in quite a few fields through their continual inroads on the foliage. In one instance 5 acres had to be replanted. After the beets were irrigated they grew more rapidly and thus kept ahead of the beetles, and serious damage was apparently averted for that season.

The receipt of this material enabled a study of the egg and larva, and the following descriptions of the stages, except the pupa, which is as yet unknown, are presented:

The eggs are rounded oval, somewhat variable in form, but averaging about 0.9 mm. in length and 0.7 mm. in width. They are strongly convex above and moderately flattened where attached to leaves. In the egg masses received there was an average of about 20 eggs in each cluster. They were deposited closely together, as shown in figure 3, *b*. The color of the individual egg is dull brownish gray, and the areas as seen through a lens are strongly indicated, a septagonal arrangement predominating, although hexagons also occur. It will be noted that although this species is related to the imported elm leaf-beetle (*Galerucella luteola*), the eggs and their manner of deposit is decidedly different, those of the latter insect being placed on end.

The larva (fig. 3, *c*, *d*) resembles, in general contour, both as seen from above and from the side, that of the elm leaf-beetle, but here the superficial resemblance ends, as this species is nearly uniform dark olive brown in color and the piliferous tubercles are rather pale yellow, but strongly marked. They are arranged as shown in the illustration, those of the anterior half of each segment coalescing near the center. The head is moderately shining black and portions of the legs are of the same color. The hairs are of two kinds, pointed and truncate, and some are pale and some dark in color, all being rather short. The head is about half as wide as the first thoracic segment and the body gradually tapers till the third or fourth abdominal segment when it is widened, tapering again toward the anal extremity, the last segment being quite narrow. The segmentation is strongly marked, the tubercles on the sides prominent.

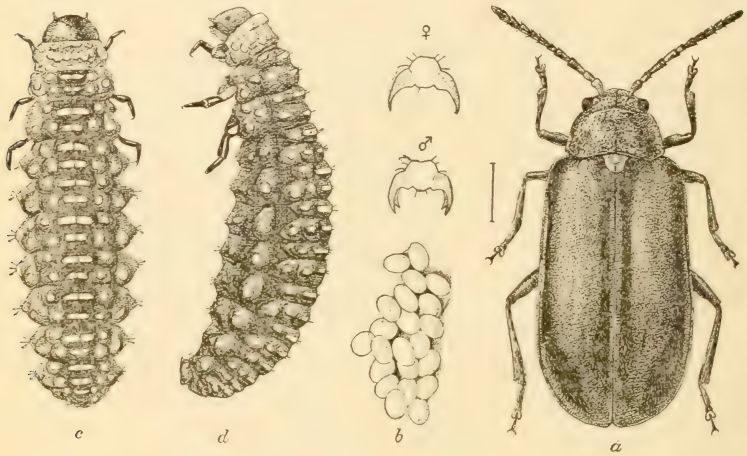

FIG. 3.—*Monoxia puncticollis:* *a*, female beetle; *b*, eggs; *c*, larva, dorsal view; *d*, larva, lateral view; ♂, claw of male; ♀, claw of female—all much enlarged, male and female claws more enlarged (original).

The length in somewhat contracted natural position is about 8.5–9.03 mm. and the greatest width 2.8–3.0 mm.

The young larva when hatched measures about 1.5 mm, and differs from the mature form in having a more prominent head, dark brown thoracic shield, and in being of a dull gray color, the tuberculous areas showing as darker brown. The legs are more prominent, and the hairs are relatively longer.

Thus far injuries by this species have been reported only from Colorado and New Mexico, and only to sugar beet. The species as defined by Horn includes four or more varieties. The typical form is the one under consideration. It is one of the larger ones, measuring five or six sixteenths of an inch in length; is dull grayish brown in color, with dull blackish stripes on the elytra, present in all individuals

examined near the exterior margin, while others show indication of more or less striation near the sutures, as shown in figure 3 *a*. The species differs from others of the same genus in having the fifth joint of the antennæ nearly one-third shorter than the fourth, and usually just perceptibly shorter than the sixth.[a] To facilitate further recognition of the particular form under discussion, it should be said that the elytra are very finely and densely punctured, and pubescence is scarcely evident save at the apices. The head is more coarsely punctate, and the thorax still more deeply and roughly punctured.

REMEDIES.

Unless remedial measures are instituted, there is probability of this species becoming an important enemy of sugar-beet culture in the United States. Paris green or arsenate of lead applied in the form of a spray is all that is necessary to destroy it, and where irrigation can be practiced this enables the plants to recuperate from moderate attack.

SOME INSECTS RECENTLY INJURIOUS TO TRUCK CROPS.

By F. H. Chittenden, *Washington, D. C.*

The fall army worm (*Laphygma frugiperda* S. & A.).—September 8, 1902, Mr. L. Donner, Seabrook, S. C., sent a series of this species in different stages of larval growth, with report that some time earlier it had done considerable damage, and had virtually stripped asparagus plants of their foliage and eaten the skin off the stalks. His asparagus plants had been sprayed ten times with the Bordeaux-resin mixture, beginning immediately after the crop and applying the spray at intervals of two weeks and after rains. But in spite of this the fall army worm ate the foliage clean, and in some parts of the plantation even peeled the stumps.

White grubs (*Lachnosterna* sp.).—June 2, 1900, Miss Eliza A. Blunt, New Russia, N. Y., stated that white grubs did great damage to asparagus as well as grasses. An asparagus bed that was planted the previous year with two-year-old roots 3 feet below the surface showed that the grubs worked at that depth, as not a sprout had appeared during the season of writing.

The Southern leaf-footed plant-bug (*Leptoglossus phyllopus* Linn.).—September 8, 1902, Mr. L. Donner, Seabrook, S. C., sent

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[a] It should be stated at this point that the genus Monoxia is separated from Galerucella, with which it was formerly united, by a sexual character, which consists in the male having the claws nearly bifid; see fig. 3 ♂. In Galerucella both sexes are as shown at ♀.

numerous specimens of this species, with information that they were very abundant on asparagus plants nearly all summer. He had also found the bugs and their young on cowpea. The same species was reported on asparagus in South Carolina in 1897 (Bul. 10, n. s., p. 62).

A note furnished by Mr. F. W. Thurow, Harvester, Tex., is of interest. May 26, 1900, he reported finding this insect in considerable abundance on Irish potato and that it appeared to be "stinging" the plants, causing the parts attacked to wither. July 1 our correspondent sent adults and nymphs in next to the last stage, and stated that after the potatoes were dug up the insects took to a clump of spring wheat as well as to a large bush of prince's feather (*Polygonum orientale*), which latter was threatened with its life until rescued. The potato is a known food plant of this plant-bug, but wheat and Polygonum do not appear to have been previously observed.

It has been noticed by the writer that this species has the same habit as its congener *L. oppositus* of hiding when in the nymph stage in the folded or wilting leaves of its food plants, shedding its skin usually in such sheltered locations. A summary of food and other habits of this species has been given on pages 46–48 of Bulletin No. 19 of this series.

THE TWO-SPOTTED BLISTER BEETLE (*Macrobasis albida* Say.).—Blister beetles of several species were prominent as vegetable pests during the season and from among the many reported instances of injury and attack to useful plants a few examples of new food habits that have been unrecorded will be noticed.

July 15, 1902, Mr. S. E. Russell, Duncan, Ind. T., reported that this species was eating garden vegetables and had devoured his stock of sugar beet in a single day.

We have many earlier records of injury by this species which do not appear to have been published. In 1882 it was destructive to tomatoes, and also fed on *Solanum elaagnifolium* at Corpus Christi, Tex. The following year it injured potatoes at Gonzales, Tex. In 1892 injuries were noticed to potatoes and peas at Stowell, Hamilton County, Kans. In 1896 it was troublesome at Alice, Tex., where it was described by Dr. J. D. Westerveldt, jr., as a migratory species coming in swarms of thousands, remaining a few days, and disappearing very quickly. In 1897 it was again destructive to potato at Kearney, Kans. The following year it devoured the foliage of tomato at Fruitland, Tex. The occurrence of the insect has also been reported at Georgetown, N. Mex., as well as in other localities in the States that have previously been mentioned. Injury at Gonzales, Tex., was noted as early as June 14, but the principal damage appears to be accomplished in that State through the month of July and the first part of August. In Kansas injury extends also through the month of August.

THE BLACK-STRIPED BLISTER BEETLE (*Macrobasis atrivittata* Lec.).—August 6, 1902, Mr. J. M. Johnson, Cottage Grove, Ind., reported injury by this species to tomato and cucumber in that vicinity. We have an earlier note on its occurrence in Texas on various plants (Insect Life, Vol. IV, p. 395), but with no specific mention of the particular plants affected.

THE IMMACULATE BLISTER BEETLE (*Macrobasis immaculata* Say).—During June and July, 1902, Mr. W. K. Winterhalter, Rockyford, Colo., reported the occurrence of this species quite frequently during the year on potato, tomato, and sugar beet. July 7 it was increasing in alarming numbers, and was rapidly doing away with the potato crop. He had tried without success in every possible way to drive the beetles from the fields in which they were present by thousands. They also occurred in practically every beet patch in the valley, and while they did not destroy the beets, owing to the rapid growth of the plants, they were stripping them badly. A spray of one pound of Paris green and the same of lime to 45 gallons of water was tried without success.

This species has not hitherto been recorded as a beet insect. In fact, little or nothing appears to have been published in regard to its food habits. We have, however, an earlier record of injury, received July 17, 1897, when it was reported to be destroying beets as well as cabbage and tomato in the vicinity of Coats, Pratt County, Kans.

THE THREE-LINED BLISTER BEETLE (*Epicauta lemniscata* Fab.).—Mr. P. J. Schuur, Miami, Fla., writing of this species October 11, 1902, stated that it attacked beets, tomato, eggplant, turnip, cabbage, potato, sweet potato, and cowpea, and that it rejected onions and celery after tasting them. Another plant, okra, was not eaten, because the leaves were too high for the beetles to readily reach. Low plants were preferred, the beetles usually remaining in the shade during the heat of the day. Beet tops were the favorite food and preferred to other vegetables. A number of the food plants above mentioned have not been recorded for this species.

It seemed impossible to drive the blister beetles, but our correspondent got rid of them by means of boiling water. Another correspondent, in Texas, reported success with hot water as a remedy for the same species in 1892. Several "millions" noticed on cut pea vines disappeared overnight while preparations were being made for their destruction.

THE LEAN BLISTER BEETLE (*Epicauta strigosa* Gyll.).—June 24, 1902, Mr. C. W. Steele, editor Florida Agriculturist, Switzerland, Fla., wrote that this species was very destructive to ornamental Hibiscus by eating the blossoms, beginning first upon the anthers and pollen, and then destroying the entire substance of the petals. As many as a dozen beetles could be picked from a single flower. They were also destroying blossoms of Zephyranthes and Cooperia.

This is a common species in the South and a familiar object from its occurrence on the blossoms of cotton. It is, however, not known to injure this last-mentioned crop.

NUTTALL'S BLISTER BEETLE (*Cantharis nuttalli* Say).—July 21, 1902, Prof. L. R. Waldron, Agricultural College, North Dakota, sent specimens of this beetle, with report that it was injuring oats and barley at Minot, in that State, and attacking plants about 6 inches above ground.

THE CHANGA OR PORTO RICO MOLE CRICKET (*Scapteriscus didactylus* Latr.).—Several forms of crickets, more especially the large fossorial mole crickets, were prominent as garden pests during the past year. Of these, the above-mentioned species (fig. 4) was most con-

FIG. 4.—*Scapteriscus didactylus;* adult, somewhat enlarged (reengraved).

spicuous. It was described, in fact, as by far the most serious insect pest that the Porto Rican agriculturist had to encounter. January 21, 1903, Mr. S. W. Goodyear wrote in regard to the occurrence of this species in Brunswick and Glynn counties, Ga. In that region it was commonly known as the "ground puppy," a somewhat appropriate name considering its peculiarly tawny, puppy-like appearance. These insects burrow into the earth and are quite destructive to different forms of vegetation, and especially to cabbage, collard, and kindred cruciferous plants. They were unknown in that vicinity until about 1899, but since then they had caused all who raised vegetables much annoyance and considerable loss of money.

This appears to be the first report of this species doing damage to useful plants in the United States; indeed we have at present no available record of the insect's previous occurrence in the State of Georgia.

This mole cricket has been given considerable attention during the past year by Mr. O. W. Barrett, entomologist and botanist of the

Porto Rico Agricultural Experiment Station, and a 20-page publication has been issued as Bulletin No. 2 of that station, in which various remedies are duly recommended and discussed. Like others of its kind, it is subterranean and nocturnal, feeds largely on the roots of plants, and extends its depredations over the entire year.

As to remedies, clean cultivation, "hilling up," winter and spring plowing, trap lights, and poisoned baits are the best that are recommended. Mr. Barrett's bulletin can be obtained by application to the Secretary of Agriculture, and it is not necessary to make further mention of remedies here.

THE SOUTHERN SHORT-WINGED MOLE CRICKET (*Scapteriscus abbreviatus* Scud.).—During November and December, 1902, we had correspondence in regard to this species with Mr. J. A. McCrory, Miami, Fla. It was described as eating all fruits that fall to or touch the

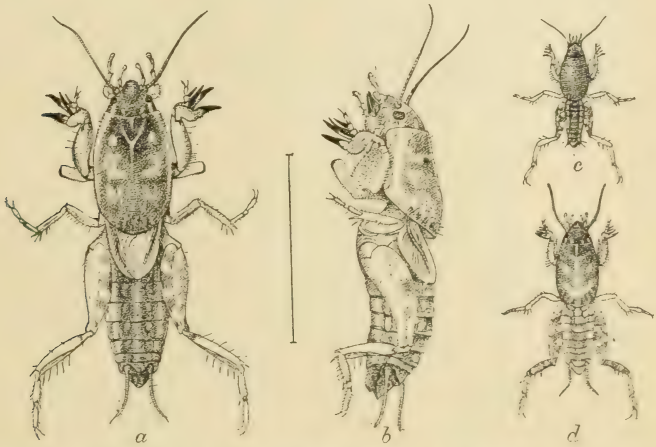

FIG. 5.—*Scapteriscus abbreviatus*; *a*, winged adult, dorsal view; *b*, same, lateral view; *c*, young nymph; *d*, older nymph—somewhat enlarged (original).

earth, and injuring all kinds of vegetables as well as seeds, including Irish potatoes, sweet potatoes, beans, and tomatoes; also as eating dried blood and ground bone in commercial fertilizer. Whole fields of tomatoes were devastated, and the insect even gnawed the roots of orange trees. Young tomato plants were gnawed off as fast as set out, and the insects were described as working up the earth like thousands of chickens scratching it. Injury began when the crickets were "no larger than a flea." They were more numerous along the Miami River and more or less scattered over the southern portion of Dade County, and were multiplying rapidly. Our correspondent stated that it was almost impossible to grow a crop of any kind on account of the destructiveness of this pest. Seed beans were devoured as soon as they became soft after planting. Of 100,000 tomato seeds scarcely one had come up on account of the ravages of these insects.

As soon as a furrow was plowed and the fertilizer and seed distributed, the crickets started in the furrow on a mission of despoliation.

This mole cricket is common to South America and the Gulf region. It was first described by Scudder[a] in 1869 from Pernambuco, Brazil. From all other species of its genus that were known at that time, also inhabitants of South and Central America, this is distinguished by its very short tegmina or outer wings, hence the name *abbreviatus*. Its general appearance is shown, enlarged, at figure 5, *a*, *b*, for comparison with the Porto Rico form (fig. 4). It is one of the darker species, the thorax being brownish fuscous and ornamented with paler fulvous about as shown in the illustration. It is somewhat variable in length, but appears to average about an inch.

As to remedies, it seems probable that those which have been found most successful against the Porto Rican mole cricket are applicable, with the possible exception of lights, as the short-winged species is incapable of flight. A mixture of cotton-seed meal and Paris green was tried by Mr. McCrory, which checked the insects somewhat but not sufficiently to stop their depredations.

THE MINUTE FALSE CHINCH BUG (*Nysius minutus* Uhl.)—July 12, 1902, Mr. W. K. Winterhalter, Rockyford, Colo., wrote that this species destroyed almost half of the beet-seed crop of the company of which he is agricultural superintendent, during 1901; the injury being accomplished by the insect sapping the green seed, which in consequence dried up and became black before maturity. In 1902 this same pest bred in seed-beet fields, but the precaution had been taken of planting a few rounds of yellow mustard as a trap crop, which proved excellent, as all of the bugs lived on the mustard until it was entirely gone. After this, however, they turned to the beet seed, and at the time of writing were doing tremendous damage. The only drawback to the mustard is that it becomes a weed as soon as the seed drops on the ground.

Mr. D. V. Burrell, of the same locality, reported similar injury due to this insect, stating that it was found in large numbers the previous season on table beets grown for seed; but after flooding the part that was attacked thoroughly, and repeating in two days, he found that all the insects left the field.

A NEW PLANT-BUG ENEMY TO TOMATO AND LETTUCE.—September 6, 1900, Mr. Samuel Cliff, Creston, Cal., sent specimens of a plant-bug, *Corizus hyalinus* Fab., in different stages, with report that the insect was very destructive to tomato and lettuce in that vicinity. The material received included samples of the tomato plants that had been killed down and leaves of lettuce-seed stalk that the insects were working upon. There is little doubt that our correspondent is correct

[a] Revision of the large, stylated, fossorial crickets, 1st Memoir Peabody Academy of Science, Salem, Mass., pp. 14, 15, Pl. I, figs. 8–20.

in his conclusions that this species is injurious, although on one occasion *C. hyalinus* was mentioned[a] "among predaceous insects" as natural enemies of the fluted scale (*Icerya purchasi*).

A PLANT-BUG ATTACKING TURNIP, MUSTARD, AND SWEET POTATO.—December 1, 1902, Mr. F. W. Thurow, Harvester, Tex., sent numbers of adults and nymphs of *Nezara viridula* Linn, found attacking turnip tops and mustard greens, killing some plants or causing their leaves to turn yellow. The same bug was stated to attack sweet potato.

A MEALY-BUG ON PEANUTS.—So few insects are known as enemies of the "goober," or peanut, that the following note on the occurrence of *Dactylopius* sp. on that esculent is of interest. September 20, 1902, Mr. W. T. Hubbell, Philo, Ohio, sent specimens of peanuts taken from hills which were more or less withered when pulled up. He found a great many with cottony patches where this mealy-bug had developed. At this time most of the insects had disappeared. Some of the larger nuts were discolored, and our correspondent stated that some were so badly infested as to rot.

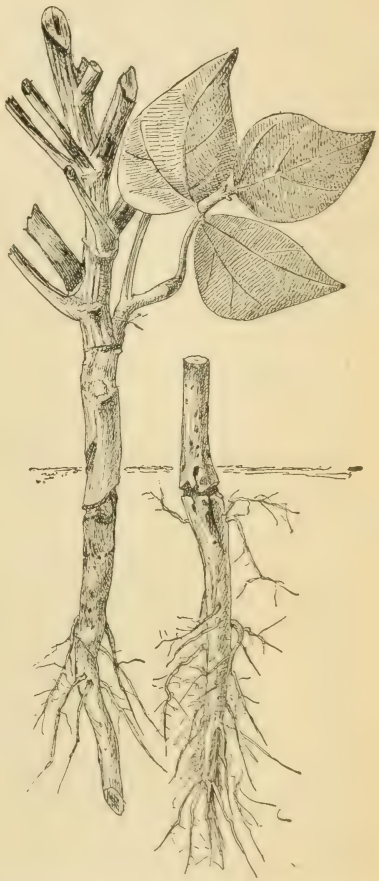

FIG. 6.—Work of larva of *Elasmopalpus lignosellus* on cowpea—reduced (original).

The SMALLER CORN STALK-BORER (*Elasmopalpus lignosellus* Zell.).—August 30, 1902, Mr. W. D. Hunter, Victoria, Tex., sent larvæ of this species, as also numerous stems of black-eyed cowpea which had been killed by it. The insect was infesting a field of 2 acres, and at that time fully 2 per cent of the plants had been killed, with the prospect that others would die shortly. September 9, 1902, Hon. G. W. Koiner, commissioner of agriculture of Virginia, Richmond, Va., sent specimens of the larvæ in cowpea, with report that it was damaging the cowpea crop in Spottsylvania County, around Fredericksburg. The species has been observed in both States in earlier years, but this is the first instance of injury in either. A general account of it is

[a] See Insect Life, Vol. I, p. 130.

given in Bulletin No. 23, (n. s.). The method of work of the larvæ in cowpea is shown in figure 6.

THE STRAWBERRY WEEVIL (*Anthonomus signatus* Say).—This, our most pernicious strawberry pest, has continued to make destructive appearances in States not previously known to have been injuriously infested. April 15, 1902, Mr. T. M. Emerson, Wilmington, N. C., reported the occurrence of this insect in that vicinity, where it had made its first appearance two or three years previously. April 27, Mr. D. B. Faison, Baltic, N. C., stated that this weevil did great damage in the eastern portion of that State. May 9 Mr. Ed. C. Sappenfield, Byrneville, Ind., reported considerable damage in that locality. Injury was noted at Rose Hill, N. C., by Mrs. F. L. Johnson, in a letter dated May 26. December 2 Mr. Ernest Walker reported considerable damage in the vicinity of Van Buren, Ark. In some instances specimens of the insect and of buds which it had injured were received, while in other cases the description of the character of the injury, which consists briefly in the puncture of the stalk bearing the strawberry bud by a minute snout-beetle and the dropping of the buds, left no doubt as to the author of the attack.

REPORT OF COMMITTEE ON RESOLUTIONS.

The report of the committee on resolutions was next called for, which is as follows:

Resolved by the Association of Economic Entomologists, That we appreciate most fully the past favors of the Department of Agriculture in publishing the proceedings of the association, and respectfully request that the proceedings of the present meetings be published as heretofore.

Resolved, That the thanks of the association be tendered to the Columbian University for the courtesy extended in the use of their building.

Resolved, That our thanks be extended to the local committee on arrangements for their successful efforts in behalf of the meeting.

Resolved, That we hereby testify to our appreciation of the hospitality of the Entomological Society of Washington.

Resolved, That our thanks are due and hereby extended to the Cosmos Club for their courtesy in entertaining members of the association.

Resolved, That we hereby acknowledge our indebtedness to the various members of the association who have contributed so largely by their papers to the success of the meeting.

F. L. WASHBURN.
AUGUST BUSCK.
W. E. RUMSEY.

It was moved and seconded that this report be adopted, and the motion prevailed.

The committee on nominations made the following report:

For president, Prof. M. V. Slingerland, Ithaca, N. Y.; for vice-president, Prof. C. M. Weed, Durham, N. H.; for second vice-president, Dr. Henry Skinner, Philadelphia, Pa.; for secretary-treasurer, Prof. A. F. Burgess, Columbus, Ohio.

To represent the Association of Economic Entomologists at the meetings of the council of the American Association for the Advancement of Science: Dr. James Fletcher, Ottawa, Canada; Dr. E. P. Felt, Albany, N. Y.

A. D. Hopkins,
H. T. Fernald,
A. N. Caudell,
Committee.

Upon motion of Mr. Weed, it was decided to hold the next meeting in connection with the American Association for the Advancement of Science, as heretofore.

Just before adjourning, Mr. Hopkins made the suggestion that the old Entomological Club of the American Association for the Advancement of Science should be resurrected. This subject was discussed at some length, and it was decided to have a meeting of the entomologists some time during the following week, to give the matter proper consideration.

There being no further business to transact, the association adjourned.

A. L. Quaintance, *Secretary.*

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