BULLETIN NO. 9—NEW SERIES.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY.

PROCEEDINGS

OF THE

NINTH ANNUAL MEETING

OF THE

ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1897.

DIVISION OF ENTOMOLOGY.

Entomologist: L. O. Howard.
Assistant Entomologists: C. L. Marlatt, Th. Pergande, F. H. Chittenden, Frank Benton.
Investigators: E. A. Schwarz, H. G. Hubbard, D. W. Coquillett.
Assistants: R. S. Clifton, Nathan Banks, F. C. Pratt, A. Busck.
Artist: Miss L. Sullivan.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., September 10, 1897.

SIR: I have the honor to transmit herewith the manuscript of the secretary's report of the Proceedings of the Ninth Annual Meeting of the Association of Economic Entomologists, which was held at Detroit, Mich., August 12 and 13, 1897. The proceedings of this association are of the greatest economic importance, and the secretary's reports have hitherto been published in bulletins of this division. I therefore recommend the publication of the present report as Bulletin No. 9, new series.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. JAMES WILSON,
Secretary of Agriculture.

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* Withdrawn for publication elsewhere. † Read by title only.

NINTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

MORNING SESSION, THURSDAY, AUGUST 12, 1897.

The association met in room 212, Central High School Building, Detroit, Mich., August 12–13, 1897, immediately following the adjournment of Section F, American Association for the Advancement of Science.

The following members were present: President, F. M. Webster, Wooster, Ohio; W. H. Ashmead, Washington, D. C.; W. B. Barrows, Agricultural College, Michigan; W. S. Blatchley, Indianapolis, Ind.; L. O. Howard, Washington, D. C.; H. G. Hubbard, Washington, D. C.; A. H. Kirkland, Malden, Mass.; C. W. Mally, Wooster, Ohio; R. H. Pettit, Agricultural College, Michigan; F. W. Rane, Durham, N. H.; P. H. Rolfs, Lake City, Fla.; E. A. Schwarz, Washington, D. C.

A number of visitors at the four sessions increased the attendance to an average of about 35. Among these visitors were Dr. Anton Dohrn, of Naples, Italy; Prof. E. B. Poulton, of Oxford, England; Dr. T. N. Gill, of Washington, D. C.; Dr. C. P. Hart, of Cincinnati, Ohio; Dr. C. S. Minot, of Boston, Mass.; Mr. John Craig, of Ottawa, Canada. The association was called to order by the president, and in the absence of Secretary Marlatt, A. H. Kirkland was chosen secretary pro tempore. The annual address of the president followed.

THE PRESENT AND FUTURE OF APPLIED ENTOMOLOGY IN AMERICA.

By F. M. Webster, *Wooster, Ohio.*

My predecessor gave you a year ago a very clear and concise history of the evolution of economic entomology, and it occurred to me that some statements and suggestions respecting the present status of the science we love so well, as also of its future prospects, might not be devoid of both interest and value. It is a good plan in a society, as well as in business, to take occasionally an invoice of stock, and ascertain as near as possible where we really stand as well as where we think we stand; whether we are estimating ourselves above, below, or exactly at our true value to the world at large, and to America in particular. I say the world at large, because the science of entomology, whether pure

or economic, is becoming more and more cosmopolitan, and will continue to do so in the future.

I do not believe it is possible to study thoroughly the insect fauna of any country independently of the others, whether these others be closely adjoining or separated by the broadest of oceans. In other words, nothing but comparative entomology can be scientific. It is as if the world were to be enveloped in a close-fitting covering of the most finely wrought lace, and each one of us were to take up and attempt to untangle a single thread, each commencing his work at the exact point, geographically speaking, where he resides and following it out independent of his fellows. I venture to say that in time we should find that others, possibly several, were tugging away at the same thread, the one perfectly ignorant of what the other was accomplishing. I remember preparing, when a boy, a couple of tempting baits, connecting them by a fine thread and throwing them to young ducks. Each bait was sure to be seized and swallowed by a different individual, and then the tug of war began. In later years I have sometimes thought that I witnessed a similar phenomenon, except that the baits were displaced by species names more or less invalid, and the ducks by entomologists. The pages of our scientific publications are far too often marred by that which is unworthy the name of science; and our children will find recorded in many of them, controversies that will live on in our literature long after we have passed away, and that contain little to which they can turn with feeling of respect or veneration; for, in the light of another century, these controversies will have much the same aspect as the struggle of the young ducks, or the much more lamentable appearance of two blind men, each engaged in attempting to pummel the other's face.

The bringing together of all of the economic entomologists of the world, though distantly separated and expressing their thoughts by the aid of many different languages, is one of the greatest strides toward placing ourselves on a working basis that has ever been attempted, and can but result in the most satisfactory and encouraging results. We shall come to know one another better, and in this way be better able to judge of our own importance and usefulness. We shall get broader instead of narrower, and learn to criticise each other kindly, even though severely—and this is really the highest compliment that we can possibly pay to the works of our fellows. But we have not yet quite reached this point to which we aspire, and this leads me to the question of our present standing both at home and abroad.

We have for several years been saying many nice things of ourselves, and our English, French, and German friends have been saying some very encouraging and complimentary things about us, for which last we are correspondingly thankful. I believe we to-day stand at the head in the matter of applied entomology. I believe this, because other nations want our men and women to come to their countries and work out their entomological problems for them. They want our books and reports to

help educate their own people in this direction, and this could not be the case if they were our superiors. We have a world-wide reputation for being an energetic and ingenious people, and I do not believe it is our scientific abilities they want so much as that mixture of science—ingenuity, and activity—that we are known to possess. They want entomologists that have not had their stock of common sense educated out of them in their preparation for their work. Some of our educational institutions are sending out just such men, and some are not. In some cases it is apparently a source of annoyance to an institution to have that sort of a man get away and out into the world. But some of them are not only getting away, but actually doing pretty good work in the sacred institutions themselves.

In many cases the entomologists connected with our agricultural colleges are doing their very best work at the expense of their holidays, vacations, and during the time when most people are asleep. Not only this, but they furnish their own books and scientific journals, while their gratuitous labor adds not a penny to their salary. I believe that justice to those who are working in this way demands this explanation, because, aside from a few among our agricultural colleges it is absolutely impossible to do this kind of work creditably with the facilities furnished by these institutions and under their present management. * * *

The entomological work done in this country is both good and bad, and I am free to say that in that respect we do not appear to differ materially from other countries, except that possibly the proportions are not the same. The mania for manufacturing species, or such so called, appears to be almost a disease, very contagious among freshly graduated students, but nevertheless not wholly confined to these nor, in fact, to the New World. There has long been an unsettled question as to which is the more important, the man who first describes a species or the one who first works out the life history of that species and its interrelations with other species. Now, I have come to look upon this question in this light: We can not conveniently refer to a form without that form having a name, hence the description and naming of a species is the first thing in order. Without this name we can do but very little in the way of biological studies. But it is these same studies that frequently decide whether or not the species is a valid one.

All great armies, I believe, have attached to them what is known in our country as a pioneer corps, whose business it is to move in advance, build bridges and roads, dig intrenchments, and otherwise facilitate the movements of the army from whose regiments the members of the corps had been detailed. It seems to me that the systematic entomologist, or, in fact, any person who is engaged in purely descriptive work, belongs to just such a corps. These workers are the pioneers whose labors make further investigations more practicable, if not, indeed, possible. But the highest ability and most thorough training is to be found where it is most necessary, viz, in the army which follows behind But let us

carry our illustration a little further. Suppose that an army is encamped on the bank of a river which it is necessary to bridge in order that the army may cross. The pioneer corps puts in its appearance and constructs the bridge; but it is faulty, for the builders lack experience, and the result is a delay and possibly a failure. Again, the members of this corps disagree among themselves, one faction no sooner having constructed a portion than another faction tears it down and builds after its own ideas. In both of these cases has there not been almost as much harm as good done by those who should have given the necessary aid? I am afraid that some of our pioneer corps of systematists are doing work that twenty-five years hence will afford them but little satisfaction. Some people are by nature peculiarly adapted to the work of the systematist. To them it is the most pleasing and fascinating labor in which they can engage; but they have no literature and have no access to the types of species already described, and for lack of these are unable to determine what has been done by those who have gone before them. Work done under such disadvantages must of necessity be crude and of questionable value to the morphologist or the biologist, and it would be far better, both for themselves and others, if those placed in such positions would turn their attention to other phases of the science.

Science is facts classified, and the science of entomology is simply a collection of facts relating to insects; whether they are biological, morphological, or anatomical does not matter. The man or woman who goes into the field and accurately observes the habits of insects, and records such observations clearly and truthfully, has done just as much for science as the one who named and described the species. The systematist draws up descriptions more or less intelligible, and adds names to our check lists of species, and probably flatters himself that he has added that many species to our described fauna; but the fact is, these names are only placed there on probation; they become a part of the science of entomology only when the species has been proven to be a valid one, and in nine times out of ten this is the work of the entomologist who studies life in animated objects and not the one who studies dried corpses. I will not say, with Dr. Tutt, that all species must be reared before their validity can be fully established, but I will go this far and say that their validity should be tried, either by this tribunal or by another—a thorough study of the sexual organs. I believe that in the latter we shall, some day, find the one great barrier that prohibits the interbreeding of species, and hence, in reality, makes distinct species possible. I think we are all convinced that there is such a thing as a species, and that it is the product of evolution. What a grand field this offers for the study of the evolution of a species up to the point where interbreeding is physiologically impossible! I have known entomologists, and, unfortunately, not all of them young or inexperienced, to construct a species from three or four legs, a wing, and perhaps a head,

and I may add that they very soon afterwards apologized for having done so. This is not science, and but adds strength to the impression that some of our so-called species do not represent a desire on the part of the describer to add to the sum total of exact information, but rather an effort to add to his own personal notoriety; and when the validity of such species is questioned, as is often the case, we sometimes have presented, with painful reality, the spectacle of the two blind men.

I say these things because they are subjects of just criticism, and because all over the country are men who have the most sincere desires to produce something that will benefit and add to the sum total of our science, but the institution with which they are connected will not, and they themselves can not, furnish the required equipment: and I simply wish to urge such to make a virtue of their necessities and direct their energies and thought in another direction, and to a field that is absolutely without limit, and the workers therein few and far between. I am very well aware that the economic entomologist is apt to be looked upon as a sort of a half-breed—a cross between a scientist and a farmer—too practical to be accepted to fellowship by the former, and too scientific to please the latter; but I believe that ere the next century is as old as this one, the honest, conscientious labors of the economic entomologist will have been found to have a value not alone as a means of enabling the husbandman to "grow two blades of grass where but one grew before," but in solving the great problem of life and its diffusion over the face of the globe.

The first move to be made in any investigation is to see something, and the next is to learn what that something is and what it means. For this reason field and laboratory work must, of absolute necessity, go hand in hand and inseparable. Where one can not have the laboratory, or if he is so situated as to be denied the field, it is a good plan to form a sort of partnership with someone who is in a reverse situation, and to work together. I am, myself, in doubt about purely systematic work being justifiable among economic entomologists, except in connection with species and groups having an economic significance. For instance, a work on parasitic hymenoptera, with descriptions of newly discovered forms, is fully justified by the value of this group from an economic standpoint, but a revision of the butterflies would not be thus justified. On the other hand, I question the propriety of including the spraying of crops in the domain of economic entomology, as I believe it properly belongs with horticulture and agriculture. In other words, I question the right of an economic entomologist to demand or expect that he shall be allowed to devote the major part of his time in this manner, but I do believe he is justified in demanding facilities for the careful study of the feeding and breeding habits of nearly if not quite all species of insects. I would not confine such studies exclusively to those known to be injurious or beneficial, because we can not say how soon some species, not previously injurious or beneficial, may suddenly

come to have a decided influence in one or the other of these directions. Where an agricultural college is separate from the experiment station, the case is different, and the fitness of the teacher of entomology should, largely at least, decide which branch of the science he should follow. Generally, however, such teachers are already bending under the burden of too many other sciences to be able to follow their inclinations to any great extent, and, as a result, the work that they do accomplish is done at the expense of their vacations, or of the hours largely devoted to rest by the mass of mankind.

I do not believe it is possible for an official entomologist to do as good work as an independent investigator, if the latter is honest, truthful, and has had a reasonable amount of scientific training. Say what we will, the position of an official economic entomologist becomes more or less of a treadmill, and necessarily so, because of the vast amount of correspondence, a very large portion of which is simply a repetition of old and well known facts that have been repeated again and again, year after year, often several times to the same persons. This will probably always continue, as the economic entomologist must of necessity be a teacher, not necessarily of children, youths, or maidens, but of men, and many of these more or less illiterate. But the chief difficulty comes from the impossibility, almost, of taking up a problem and following it wherever it may lead—the only true method of carrying out investigations in natural science. Every naturalist knows full well that he must become the willing slave of his subject—must "study nature where nature is," or content himself with more or less defective, if not inaccurate, results. How many of us can recall instances where we have been obliged, on account of some comparatively insignificant matter, to discontinue entirely or temporarily studies and observations of the greatest interest and value. Generally speaking, I believe that the results of the work of an investigator will depend more than anything else on his absolute freedom while thus engaged, and I fully believe that this will account for many of the shortcomings of our economic entomologists of to-day. The mass of mankind can not seem to comprehend that the naturalist, in order to secure results of value, must work out his problems in a natural way and not as a part of a machine, and that this condition is universal and one which no power on earth can change. It is possible for men especially fitted for the task to organize corps of investigators; but above and beyond this, and in fact overshadowing every other element, stands the fact that the individual must be free from every care except his subject of investigation, and to this he must bend his whole energy of body and mind or not expect success.

I have referred to the station bulletin as a conveyance for placing the results of studies and investigations before the public, but there is still another, and what appears to me to be a still better one, viz, the daily and weekly press. Station publications, like all public docu-

ments, appear in a most deliberate manner, months often elapsing between the time the manuscript is written and the time the printed bulletin appears, and not unfrequently the conditions which called it into being or the emergency which it was expected to meet has come and gone while the manuscript was yet in the hands of the state printer awaiting a slack time in his office when it could be taken up and published. The daily press can scatter information broadcast over the land within the space of twenty-four hours and, within a week, place it in the hands of every person who takes even the most isolated weekly paper. But the trouble here is that the condition of the press is such that few people who deal with facts or desire absolutely reliable statements go to the public press to find them. No one unhesitatingly expects either truthfulness or exactness from this source. In fact, the greater the exaggeration, the more sensational and flippant an article can be made, the more likely it is to appear in the columns of our daily papers and the more widely will it be copied. Even if the author take the precaution to prepare the manuscript in the most careful manner, it will likely present itself at his breakfast table the next morning in his favorite paper dressed up and, though with no intent to wrong, yet edited in a way that would cause the ashes of Darwin to become restless in their seclusion, while the author would be totally unable to recognize his production.

The agricultural press, while affected in this way to a far less degree, still offers a wide field for improvement. The situation would be less serious but for the fact that an occasional entomologist, mistaking notoriety for a reputation, rushes into print on every possible occasion, and in as many widely distributed publications as possible. While it may be thought very desirable by college presidents and their lieutenants, the station directors, to have men of this sort about them, there is no more unfailing indication of a lack of the first elements of a scientific man than for him to go about seeking a newspaper reputation. If he wishes to do this, well and good; but he had better let science alone. Newspapers are published for the profit that is to be gained thereby. They are printed to sell, and the editors and publishers, like all other business men, must offer for sale what people will buy and pay for, and not what may be always pleasing to even their own tastes. But the scientific man has no business to pander in this respect to the tastes of the worst instead of the better elements in public desire, and if he can not be true to his calling where he is, let him go elsewhere or find another, for these two are utterly incompatible.

Of all the ill-matched and mismated combinations possible, that of science and politics is the worst. If there is a single element common to both, it certainly has never been introduced into this country, if, indeed, its habitat is or ever has been discovered. Yet the attempt to harness the two together is becoming altogether too frequent in experiment stations. Not long ago an assistant of mine applied for a

technical position in another State. One of the leading questions, put to him in reference to his application, was, "What are your politics?" and the information was offered that if he belonged to one of the two parties named he had better put it mildly, as the managing board had some decided opinions in regard to that point. A part of my title refers to the future of our profession, but I want to say that if we are to have any future, this sort of thing must end somewhere near its beginning, and what is true of our own science is true of all. I hope this association will take the initiative, and pass resolutions protesting against the appointment on the basis of political prejudices of men or women to fill scientific positions. In agricultural colleges and experiment stations there have been within the last year or two some revolutions that bode no good to the entire system. Political interferences with such institutions should result in the prompt withdrawal of all financial aid from the Federal Government. No man with a reasonable amount of self-respect and a reputation to lose can remain long under such influences as will naturally result from such changes.

International conferences for various purposes are being held with constantly increasing frequency—conferences for the purpose of discussing and adjusting monetary matters, postal regulations, boundary lines between nations, and for the protection of the seals in their native haunts. Several years ago a couple of entomologists were sent by this country to Australia, and the monetary benefits to this country growing out of that act of our Department of Agriculture have continued and increased until this day, while I believe the Australian people have also derived some benefit from the innovation. I know at least one of those entomologists has been able to serve his country and state better since his return. An American entomologist is now the official entomologist of Cape Colony, South Africa, and another is at present in the Argentine Republic, engaged in the investigation of some injurious insects of that country. Last March, there was held in the city of Washington a convention for the purpose of taking measures to secure national legislation in regard to the inspection of nursery stock, not only such as is grown in this country but also that imported into this country from abroad, and the American Association of Nurserymen, at a meeting held still more recently in St. Louis, Mo., drafted and indorsed a similar bill. It is safe to say that Congress will probably enact a bill during the coming winter that will not only place large horticultural interests in our keeping, but bring us in direct coöperation with other countries in the matter of applied entomology. Upon our faithfulness and capabilities large financial interests will depend, for we shall meet and measure up, so to speak, by the side of the entomologists of other countries whose training and environment have been such as to necessitate an exactness which our institutions do not, at least many of them, either demand or encourage.

If in one State a political and steamboat manager is to be appointed

State geologist, and in another a political manager and lawyer is to be made inspector of mines, why may not in a third State a politician be made the official entomologist? If a political party is to reorganize the technical staff of an experiment station to suit its own political complexion, if other States are to use these technical positions for State, local, or institutional politics, what sort of hands will these interests be likely to fall into?

I speak of all these matters here, not with the idea of complaining, or with feelings of envy or jealousy, and certainly not from political motives, but because the influences of such actions are far-reaching, and go far beyond institution or State, and throw every scientific man in the country into more or less disrepute, so that when we come to stand up by the side of our fellows in other countries, where such irregularities are not permissible, we are at a serious disadvantage. Therefore, instead of offering a tirade against these objectionable features, I am simply pleading for a higher standard of applied scientific work, because, as I have said, the term science stands for accuracy, exactness, and truthfulness, and without these no economic investigations, in whatever science, can be of permanent value, but are sure to be vague and misleading. Instill the same scientific exactness into our economic studies that characterizes similar studies elsewhere, and to these add our push, energy, and ingenuity, and we need not fear to face the best that the world can bring to match us.

The complaint is often made that entomologists frequently duplicate the work of each other. In the case of inexperienced men this is doubtless to some extent true, but with trained workers, located in places differing in almost every respect from each other, there is much to be done that at first may appear unnecessary. If the entomologists of every State were to set to work on the same species, we should have results that would more than doubly repay any slight duplication. Proof is only secured by duplication, and variation can only be studied by uniform and systematic work carried on over large areas. The same insect differs radically in the North and the South, in the East and the West, and, as we all know, a measure for its suppression may be effective in one section and entirely ineffective in another.

Now, while, as I have stated, we probably lead the world in applied entomology, unless we can have such a condition of environment as will enable us to do as good or better work than in the past, we shall not long hold this precedence. There is too much work purporting to be scientific (and by the word scientific I mean truthful) that is misnamed, and is being put forth merely for effect.

I have sketched, truthfully, I believe, the present condition of economic entomology in America. It would be manifestly unjust to give such an explanation without accompanying it with a statement of the conditions which govern our movements and investigations. If scientific work is to be done in experiment stations, these must be under the

control of men who are able and, above all, have the will to look beyond the present, and thus make possible the accomplishment of investigations which in years to come will reflect credit not only on the investigator, but on the institution with which he was connected.

Now, as to the future of our science. I do not believe we are to fall into a decline, but rather the reverse. But there is one point which I would impress upon all, and that is this: He who brings to light a new fact, whether it be in field or laboratory, has erected a monument for himself that will live as long as science itself. Go into the fields and work out the development of a single species, carefully and well, and record your observations faithfully and honestly, and you will leave the world that much better than you have found it, and your work will live on and command respect long after you have passed away. Here, it seems to me, the economic entomologist has an advantage. The very nature of his work compels him to study life, and it will be strange indeed if the study of life in insects does not throw light upon the problem of life in general. I believe we need not go out of our own domain to wrestle with the foremost biological problems of the day. Not only this, but our work actually demands that we do so, and find out the relation which one organism sustains to another, and this to the third. The first step in economic work is to learn the habits of the species with which we are dealing. This is a bridge, precisely like the one that I previously mentioned, and must be built strongly and well before the husbandman is to derive any benefit from our work. Thus we shall be driven into the very field where we shall be able to do the best work and accomplish the greatest good. There is one very discouraging element in our American civilization which does not seem to me to appear in that of the older countries, and that is the universal desire and expectation of immediate results. Here, in America, if an investigator can not take up a problem and soon after begin to publish results, we become restless, lose faith in him, and ere long attempt to displace him. In other and older countries he may disappear entirely and remain so until he has not only found out something, but has proved it again and again. Our people need educating in this sort of patience, because many of the institutions with which we are connected are very sensitive to public opinion, especially during the time that State legislatures are in session.

I have occasionally referred to our fellow-workers in England, Germany, France, Italy, and elsewhere in complimentary terms, because their civilization is older, stronger, and better established than ours, and not patronizingly or because I see in them anything to idolize; but rather as a younger worker will look upon an older and more experienced one, with a determination to profit alike by his mistakes, failures, and successes, and outdo him whenever and wherever it is possible.

I can see that within the last fifteen years public opinion in regard to us and our work has been changing for the better, and I expect this

evolution will continue. But if these hopes are to be realized, we must do better work, the results of which will be far-reaching and permanent, thus gaining and holding the respect and confidence of our fellows and the world at large. The "powers that be" among and over us must be brought to understand that science is truth and not something that is to be trifled with and debauched or made to answer for cheap advertisements or used for the purpose of paying political indebtedness. Every member of this association can aid in doing this by allowing nothing to go out from his hands until he has given it his very best efforts—has made it as nearly perfect as he is able. If he is so situated as to be denied the privilege of doing this, then let him place on record, somewhere, proof that the blame lies not at his own door. But whatever we do let it be done honestly, faithfully, and well, and the future will most surely speed the right.

Following the address of the president, elections to active membership in the association were made as follows:

George B. King, Lawrence, Mass., proposed by Mr. Howard.
Gerald McCarthy, Ralcigh, N. C., proposed by Mr. Howard.
A. T. Britton, New Haven, Conn., proposed by Mr. Howard.
Ephraim P. Felt, Albany, N. Y., proposed by Mr. Kirkland.
Albert F. Burgess, Malden, Mass., proposed by Mr. Kirkland.

The following foreign members were proposed and elected:

Claude Fuller, Perth, West Australia, proposed by Mr. Webster.
Richard Helm, Perth, West Australia, proposed by Mr. Webster.
W. W. Froggatt, Sydney, New South Wales, proposed by Mr. Howard.

Prefacing his remarks with a brief review of the damage by the larvæ of *Orgyia leucostigma* in Washington during the summer of 1895, and the important influence of parasites in controlling this outbreak, Mr. Howard presented the following paper:

ADDITIONAL OBSERVATIONS ON THE PARASITES OF ORGYIA LEUCOSTIGMA.

By L. O. Howard, *Washington, D. C.*

In Bulletin No. 5, Technical Series, Division of Entomology, United States Department of Agriculture, entitled "A study in Insect Parasitism," it was shown that following an extensive attack by *Orgyia leucostigma* upon the shade trees of Washington, which culminated in August, 1895, there was an extraordinary development of parasites. Thirty-five true parasites were reared, of which 15 were primary hymenopterous parasites and 6 primary dipterous parasites, 14 species being hymenopterous hyper-parasites. In the autumn of 1895 about 90 per cent of the caterpillars were destroyed by primary parasites, the vast majority of these being hymenopterous and the bulk of the work

being done by *Pimpla inquisitor* and *Chalcis ovata*. In the spring of 1896 so many of these primary parasites had successfully hibernated that they were in position to almost annihilate the first brood of caterpillars, already weakened greatly in numbers by the extensive parasitism of the previous autumn. In the later months of 1896, however, an extensive hyper-parasitism began to be effective, and the principal primary parasite, *Pimpla inquisitor*, was almost killed off by its own hymenopterous parasites and principally by *Dibrachys boucheanus*. Tertiary parasitism was noticed at this time, but was not especially effective, and the Orgyia had begun to recuperate in numbers at the close of 1896. Several careful accounts in July, 1896, showed the percentage of parasitism to be 98.8 per cent, and the numerical details of the parasites concerned were found in one instance to be as follows:

On June 30 and July 8, 1896, 624 cocoons of the tussock moth were collected without discrimination from the trunks of trees in the United States Department of Agriculture park. From these 624 cocoons issued the following parasites:

	Specimens.
Pimpla inquisitor	729
Bathythrix pimplæ	13
Limneria valida	1
Theronia fulvescens	1
Chalcis ovata	69
Dibrachys boucheanus	50
Asecodes albitarsis	1
Frontina aletiæ	7
Frontina frenchii	14
Tachina mella	12
Euphorocera claripennis	15
Exorista griseomicans	4
Total	916

The part played by dipterous parasites up to the winter of 1896, when the bulletin in question was published, had not been great, only 187 specimens in all having been reared. All the species were well-known Tachina flies of wide distribution and general parasitism.

A recuperation in numbers of the Orgyia was quite marked in the spring of 1897, and additional and heretofore unreported observations were made. So great had been the destruction of *Pimpla inquisitor* that in these observations this species did not appear in a single instance! Another hymenopterous parasite, *Chalcis ovata*, became prominent, and it is worthy of note that while secondary parasites of this species are strongly suspected, it is not absolutely known to have any. A striking feature, however, was the great increase in the number of the dipterous parasites. The rearings were conducted on a large scale, and the following table affords an interesting comparison to the one just given.

Five thousand larvæ and pupæ of *Orgyia leucostigma* were collected

July 6 to 9, 1897. From these there had issued up to August 2 the following parasites:

	Specimens.
Tachina mella	220
Frontina frenchii	355
Euphorocera claripennis	464
Exorista sp	13
Helicobia helicis	4
Phorocera sp	45
Chalcis ovata	551
Apanteles parorgyiæ	3
Dibrachys boucheanus	10
Total	1,665

Of these it will be noticed that more than two-thirds (1,101) were dipterous, while the previous summer dipterous parasites had constituted only about one-twentieth of the number reared.

From the 5,000 cocoons there issued also 321 male moths and 764 female moths; 146 of the caterpillars or chrysalids died from a disease which we have for convenience called "black rot," and 33 from another disease which for the same reason we have called "red rot."

In percentages the result may be expressed as follows:

	Per cent.
Moths	21.07
Dipterous parasites	22.02
Hymenopterous parasites	11.02
Disease	3.58
Total	57.69

This leaves about 2,000 chrysalids dead from causes not yet ascertained. From careful examination of a small proportion of them it seems probable that from 400 to 500 have been killed by parasites which have died without emerging. There still remain also about 200 dipterous puparia in the rearing cages, from which the adults may still emerge. That the majority of the remainder have died from disease seems probable. The mortality ratio was, therefore, 79 per cent, as against 98.2 per cent at a corresponding time last year; and, while last year hymenopterous parasites were responsible for nearly the whole of the mortality, this year they brought about not more than 15 per cent.

These additional observations only accentuate the extraordinary features of the parasitism of this lepidopterous insect. The multiplicity of factors upon which its increase and decrease depend and the important interrelations of the species concerned are astonishing to one who has not especially studied this phase of insect life.

In commenting upon the preceding paper, Mr. Poulton spoke of its great interest from a biological standpoint, and made inquiry concerning the oviposition of the secondary parasites. As an explanation of

the death of so many larvæ from disease, he suggested a possible overcrowding of the larvæ. This, it had been his experience, was responsible frequently for the death of lepidopterous larvæ where the latter were being reared in large numbers.

Mr. Howard stated that the mortality was not due to overcrowding, since only spun-up larvæ and pupæ were collected, and these were kept under normal conditions. The chief cause of death was probably a contagious disease, the nature of which is now being investigated by the Division of Vegetable Physiology and Pathology. As yet no extensive observations have been made upon the egg-laying of the secondary parasites. These parasites, however, were known to be secondary, for the reason that their cocoons were found closely attached to or within the cocoons of the primary Pimpla parasite, in which cases there was ample evidence that the Pimpla larvæ had been destroyed. When these small cocoons of the secondary parasites (Apanteles, Meteorus, et al.) were separated and placed in vials, in some cases chalcidids appeared, thus affording almost incontrovertible evidence of a tertiary parasitism. These tertiary parasites, as a rule, probably lay their eggs in cocoons of hymenopterous insects, and the fact of the parasitism being tertiary rather than secondary is probably accidental to a large degree.

Mr. Howard then presented the following paper:

TEMPERATURE EXPERIMENTS AS AFFECTING RECEIVED IDEAS ON THE HIBERNATION OF INJURIOUS INSECTS.

By L. O. Howard, *Washington, D. C.*

It is a well-known fact among agriculturists and horticulturists that winter weather of a steady degree of severity is more favorable to plant growth than an open winter with alternating freezes and thaws. With regard to certain injurious insects it has become an accepted idea among economic entomologists that this same principle will hold, yet the question comes to all of us from farmers and others with a considerable degree of frequency as to whether a given winter which has been unusually severe will not have resulted in the destruction of injurious insects to such an extent as to promise comparative immunity the coming season. We have been obliged, or at least the writer has been obliged, to answer such questions theoretically. There has been no exact experimentation, so far as he is aware, along this line. It is, therefore, with pleasure that he calls attention to the results of recent experimentation by Dr. Albert M. Read, of Washington, the manager of the cold storage department of the American Security and Trust Company, and the same gentleman who conducted the experiments on the effect of cold storage upon household insects referred to in a paper read by the writer before the last meeting of this association. Dr. Read has found in the course of his experiments, which have now

extended over two years, that a consistent temperature in the neighborhood of 18° F. will not destroy the larvæ of *Tineola biselliella* or of *Attagenus piceus*, but that an alternation of a low temperature with a comparatively high one invariably results in the death of the larvæ of these two insects. For example, if larvæ of either which have been kept at a temperature of 18° F. are removed to a temperature of from 40° to 50° F. they will become slightly active, and when returned to the lower temperature and kept there for a little time will not revive upon a retransfer to the warmer temperature.

It is thus rather satisfactory to have experimental proof in support of previously accepted but more or less theoretical ideas.

Mr. Poulton stated that he had long held the opinion that an alternation of high and low temperatures frequently played an important part in the outbreaks of injurious insects.

Mr. Rolfs had noticed that after severe frosts and cold in Florida there was an abundance of northern insects, especially Orthoptera.

Mr. Craig described the severity of the winter of 1896–97 in Canada, when there was severe cold but little snow. This year, throughout southern Canada, plant-lice were present in tremendous numbers on apple, plum, cherry, and other trees.

In the general discussion which followed the fact was brought out that plant-lice had been particularly abundant throughout Canada and the United States during the past summer.

Mr. Howard pointed out the fact that this abundance was probably due to the wet weather of late spring and early summer, which had checked the feeding and multiplication of the natural enemies of the plant-lice.

Mr. Minot stated that in the vicinity of Milton, Mass., injurious insects had been quite scarce during the past summer; fewer potato beetles had been noticed than for many years, while rose-chafers and tent caterpillars were equally scarce. He also had noticed the great abundance of plant-lice early in the season, but after the extreme hot weather of the first week of July their numbers greatly diminished.

Mr. Howard emphasized the fact that hot weather played a very important part in controlling plant-lice. He cited an instance where, several years ago, Mr. Barrows had called his attention to the extraordinarily large number of plant-lice upon certain shade trees of Washington, D. C. The following day the temperature reached the maximum of 101° F., and as a result the plant-lice disappeared like magic.

Mr. Ashmead called attention to the fact that the family of plant-lice was not extensive in the Tropics, thus supporting the theory previously discussed.

Mr. Barrows stated that the condition in Michigan regarding plant-lice was probably the same as that in Canada. He was of the opinion

that the great abundance of these insects in Michigan during the past summer was probably due to the large number present last year. While examining the orchards for the San José scale last winter his attention was attracted by the remarkable quantities of plant-lice eggs deposited on young nursery stock and on orchard trees. So numerous were these eggs in some cases that the trees had the appearance of being varnished. His experience agreed with that of Dr. Howard, that hot weather was a most important factor in controlling the increase of plant-lice. Referring to Mr. Howard's first paper, Mr. Barrows spoke of the general lack of appreciation of the value of such experiments as those described and the lack of careful observations concerning the relation of temperature effects to the increase or decrease of injurious insects in connection with the abundance or absence of their natural enemies. A man might have observed a decrease or increase over the normal of the temperature for the winter of 1895–96 and arrived at the conclusion that this had been the chief factor in checking the outbreak of the Orgyia caterpillar, thus neglecting to take into account the action of the parasites. There was great need for careful and exhaustive observations whenever temperature effects are associated with the abundance or scarcity of any insect.

Mr. Webster called attention to the fact that the great numbers of aphides in Ohio nurseries this year had seriously injured a large quantity of young, rapidly growing stock.

In the absence of Mr. Chittenden, the secretary pro tempore read the following paper:

NOTES ON CERTAIN SPECIES OF COLEOPTERA THAT ATTACK USEFUL PLANTS.

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

The following notes are selected from a number of observations that have been made during the past year or two upon certain species of Coleoptera, most of which attack rather exceptionally cultivated or other useful plants:

Orsodacna atra Ahr. on pear and cherry.—In the Proceedings of the Entomological Society of Washington, published in June, 1892 (Vol. II, p. 262), I mentioned the occurrence of this chrysomelid on the willow when in bloom. A year or two later it made its appearance as usual with the willow blossoms early in April, and a few days afterward when the fruit trees blossomed it was found also on pear and cherry, feeding upon the anthers of the flowers.

In the National Museum collection is a specimen from Mr. J. G. Barlow, collected in Missouri in March, 1883, and presumably at Cadet, labeled "Feeding on catkins of hazel and alder."

This chrysomelid was not known as an injurious species until 1891, when Miss M. E. Murtfeldt observed it destroying the anthers of peach

at Kirkwood, Mo. (Bull. No. 26, Division of Entomology, U. S. Dept. Agriculture, pp. 38, 39).

THE GRAPEVINE COLASPIS ON BEANS.—Throughout July *Colaspis brunnea* Fab. was found on the foliage of beans in the District and in neighboring portions of Maryland. At Kensington, Md., it was present in larger numbers on beans than the bean leaf-beetle, and the holes in the leaves there and in Washington were in the main probably the work of this Colaspis.

This species, as its vernacular name sufficiently indicates, is better known as a depredator upon grape, but the beetles and larvæ also infest the strawberry, whence it derives its other name of strawberry root-worm. The adult has also been observed to attack the leaves of clover and LeConte pear, and quite recently Mr. F. M. Webster has stated that it was reported to him to be eating the tops of potatoes and destroying beans and corn (Bull. No. 2, n. s., Div. Ent., p. 90). The writer also has collected this species on potato.

An immature larva very closely resembling the larva of this beetle was found at the roots of bean, but was unfortunately too much injured for positive identification. I have noticed a partiality of this beetle for the foliage of tick-trefoil (*Desmodium* [*Meibomia*] spp.) but have failed to find the larvæ at the roots of this genus of plants.

As the egg of this species has apparently not previously been observed a description is submitted. The eggs are probably deposited in much the same manner as are those of allied species, such as the grapevine Fidias. In confinement they were laid in masses of from thirteen to considerably more and were deposited rather irregularly but many were placed side by side.

The egg is elliptical, nearly two and a half times as long as wide, not perceptibly flattened at any point, just perceptibly narrower, and less rounded, usually, at one end than at the other, and stramineous in color. The surface is perfectly smooth without visible sculpture and moderately shining. Length, 0.5–0.54^{mm}.; width, 0.21–0.23^{mm}.

This beetle has been collected in Maryland and Virginia in the vicinity of the District from June 24 to July 31. It is abundant on the New Jersey tea plant (*Ceanothus americanus*), on flowers and leaves.

THE HORSE-RADISH FLEA-BEETLE IN WISCONSIN.—In February Dr. E. G. Love sent specimens of *Phyllotreta armoraciæ* Koch, the horse radish flea-beetle, with the statement that they were taken in July, 1896, at Okauchee, Wis., a little place on Oconomowac Lake, about 30 miles almost due west of Milwaukee. They were found abundantly on horse-radish. It will be remembered, perhaps, that the author in the article on this species published in Volume VII of Insect Life (p. 405), and in which Chicago, Ill., and Guttenberg, Iowa, were given as American localities, surmised that it had "already invaded Wisconsin and Indiana," and that it would soon spread to Missouri and perhaps to southern Minnesota and Michigan. In other words, it will in

all probability establish itself in a very few years in the upper austral and perhaps a portion of the transition region in the vicinity of its present known range. It would be interesting to learn whether it first reaches Nebraska in the West or Ohio in the East. The natural course of progress of insects imported from Europe is westward, but three would seem nothing to prevent the species traveling eastward, as in the case of the Colorado potato beetle.

PSYLLIODES PUNCTULATA MELS. ON RHUBARB.—This flea-beetle occurred in 1896 in abundance in the neighborhood of the Department of Agriculture on rhubarb, the leaves of which it perforates with minute holes. It was observed throughout the month of April of that year, but the present season could not be found.

CORN AND GRASS-FEEDING CHÆTOCNEMAS.—The brassy flea-beetle, *Chætocnema pulicaria* Cr., and *Ch. confinis* Cr. have both been recorded as affecting corn. The former does considerable injury by feeding, when in the adult condition, upon the blades of corn, but the latter, in the writer's experience and that of Prof. J. B. Smith, who has given the species the name of sweet-potato flea-beetle, is far more often found upon sweet potato and other convolvulaceous plants. Some time ago the writer found the adult of *Ch. parcepunctata* Cr. feeding upon the leaves of corn at Kennett Square, Pa., in June. At this time it could be found only upon corn. *Ch. denticulata* Ill. is very abundant in Maryland and Virginia in the vicinity of the District of Columbia on the common barnyard grass, *Panicum crus-galli*, and will probably be found later to be injurious to some of the useful Graminaceæ. The larvæ of the latter species probably feed at the roots of the grass mentioned, but this is probably not the original larval food plant, as it is not indigenous to this country, whereas the beetle is native, so far as known.

THE LOCUST LEAF-MINER ATTACKING HERBACEOUS PLANTS.—A list of new adult food plants of *Odontota dorsalis* Thunb. was given in the Canadian Entomologist for October, 1896 (Vol. XXVIII, p. 248), all trees on which the beetle was observed to feed, by Mr. A. D. Hopkins, who remarks that this indicates the possibility of the species changing its normal habits and becoming destructive to the foliage of fruit-bearing and other trees. The possibilities are still greater as regards the range of plants that the insect is liable to attack, as I have had occasion to observe the beetles in considerable number feeding upon the foliage of red clover which grew under locust trees upon which the larvæ had originally fed. The explanation is simple. The insects had been blown and washed off the locust leaves by storms, and had fallen to the ground, where they had been too well contented to fly back to the trees. This observation was made at Cherry Dale, Va., in July. In August the beetles were found at work on the leaves of hog peanut (*Falcata comosa*)* growing under locust trees at Glen Echo, Md.

It is not easy to account for a second occurrence of this species upon

*_Amphicarpæa monoica_ of Gray's Manual.

soja beans on the grounds of the Department of Agriculture. Throughout the month of August the beetle was observed feeding upon the foliage of this plant on an experimental plat, and on the 12th of that month it was reared from the larva, which was found in considerable number mining the leaves. Locust trees were growing no nearer than 200 yards from the soja beans. The species was still present on the latter plant as pupæ and beetles during the first week of September. At 11 a. m. of August 5 a larva taken from its mine was found to have transformed to pupa within two or three minutes, the change having taken place while it was being taken from one room to another and returned. August 12 the imago was found fully colored early in the morning, the pupal period having been passed in about six and a half days. Temperature: 75°–80° F.

CHELYMORPHA ARGUS LICHT. ON SWEET POTATO.—This species was recently observed at Cherry Dale, Va., during the first half of July on the leaves of sweet potato, feeding freely and in one instance laying eggs.

As far as I am aware, this tortoise beetle has not previously been recorded as attacking sweet potato, although specimens were received at this Department in 1884 from a correspondent at Touch Key, Monroe County, Fla., that were found destroying the foliage of this vegetable. The larvæ, as is well known, feed upon Convolvulus and Asclepias, preferably, in the writer's experience, on the former, and the beetles were reported many years ago by Dr. Packard (Guide, p. 504) as abundant on leaves of raspberry.

EPICAUTA TRICHRUS PALL. ON SWEET POTATO.—This blister beetle occurs often in great numbers during July in the vicinity of Washington on various species of Convolvulaceæ, including the sweet potato, the leaves and flowers of which it devours. One of its food plants, the hedge bindweed (*Convolvulus sepium*), was recorded for it half a century ago by F. E. Melsheimer, who evidently mistook the black form for *atrata* Fab. and the more typical form with reddish front for a variety of *atrata* to which he gave the MS. name of *convolvuli* (Proc. Ac. Nat. Sci. Phila., 1846, Vol. III, p. 53). It is also recorded in Illinois "on May-weed (*Maruta* [*Anthemia*] *cotula*) in August, but not common" (A. S. McBride, Can. Ent., Vol. XII, p. 107).

HABITS OF THE FALSE ROSE-CHAFER.—*Macrodactylus angustatus* Beauv., which very closely resembles the rose-chafer (*M. subspinosus*), is very abundant in the District of Columbia and in neighboring portions of Virginia and Maryland, often occurring in great swarms like its more common congener. The males can not be separated from the true rose-chafer by superficial scrutiny, but the females may readily be distinguished. In this vicinity it is much more abundant than the rose-chafer and makes its appearance about the time that the latter species disappears, being present throughout the month of July. In its imaginal food habits it differs from the rose-chafer. It does not

appear to touch either the rose or grape, and can scarcely be called a general feeder as compared to that species. In the writer's experience it prefers the foliage of the black or sour gum (*Nyssa multiflora*), chestnut (*Castanea dentata*), oak—particularly chestnut oak (*Quercus prinus et al.*)—and sassafras. Specimens were beaten from dogwood, hickory, and persimmon, but the leaves of these did not appear to be fed upon to any noticeable extent.

THE POTATO-BUD WEEVIL ON EGGPLANT.—The little black *Anthonomus nigrinus* Boh., to which the writer applied the name of potato-bud weevil in the article on that species published in volume VII of Insect Life (pp. 350–352), was this year reported by Mr. Bernhard E. Behrend as attacking the eggplant at Seat Pleasant, Md. Specimens of the severed buds and of the beetles found upon the plants were received July 6. The larva was found in the buds and the beetle was reared from them. This species, it may be remembered, has the habit of cutting the buds of horse-nettle and potato in the course of its oviposition in practically the same manner as the strawberry weevil cuts those of strawberry and other plants.

As to damage Mr. Behrend wrote that over half of the first buds were cut, and as a consequence the species was injurious in the early part of the season as it destroyed the earliest fruit and that which would have brought the best price in the market. The eggplant, however, sends out buds continually until frost, and it is, therefore, difficult to estimate the total damage. At first Mr. Behrend applied a remedy, "slug shot," which he states checked considerably the work of the beetles. Later, July 25, our correspondent expressed the opinion that the severing of the buds was, perhaps, on the whole beneficial, as, if the buds all developed there would be more fruit than could reach maturity. The pruning of about half the buds seemed desirable.

September 1 the work of this species was observed on eggplant at Tenleytown, D. C., severed buds being found from which the beetles had made their escape. Beetles were still present in numbers on the plants at this date.

Mr. H. W. Wenzel writes that this species occurs as far northward as Philadelphia, Pa., but is very local there and does not spread. About the District of Columbia it can always be found in numbers on horse-nettle, but is almost never taken at any distance from its wild food plants.

The known range of this species may be extended to Cadet, Mo., whence specimens have been received from Mr. J. G. Barlow. This range appears to be somewhat limited to the territory lying through the lower portion of the upper austral and the upper portion of the lower austral zone, from the Mississippi Valley in the West and south of central Pennsylvania and New Jersey.

The following paper from Mr. Cockerell was read by the Secretary pro tem.:

AN EXPERIENCE WITH PARIS GREEN.

By T. D. A. Cockerell, *Mesilla, N. Mex.*

We have in Mesilla, N. Mex., a serious pest of the peach known as *Allorhina mutabilis*. These beetles, although very like the eastern *A. nitida*, appear to subsist in the larval state on decaying vegetable matter and we do not find them injuring the living roots of plants. The beetles do not appear on the wing in time to attack the early peach crop, but in July they become excessively abundant, destroying the later peaches as they ripen. Often a peach will be so covered with beetles as to be hardly visible.

Mr. Frank Burke, living near here, had suffered from the attacks of the Allorhina; and after picking all his peaches that were not spoiled, he proceeded to wreak his vengeance on the beetles by putting some Paris green on the raw surfaces of the overripe and half-eaten peaches. So far as the beetles were concerned this did not produce much effect, as the baited fruit was little or not at all visited, and soon shrivelled up. After a few days, however, the trees showed signs of being locally poisoned. Without exception, every twig on which was a baited peach had died, and all of the leaves had turned brown. The damage in some instances had gone farther, and, following the route of the sap, had affected twigs on the same branch farther up, but always on the same side as the poisoned twig. On each branch that was affected all of the leaves of the affected twigs were dead, but those of neighboring twigs, not in the route of the sap, were unaffected, showing that the results could not be due to any fumes given off, but were wholly due to the absorption of the poison.

That a comparatively insoluble poison like Paris green, applied to an overripe and rotting peach, should pass into the circulation of the tree like this is a thing I could hardly have believed had I not seen the results myself. The weather being very hot, and the climate dry, the circulation of sap must be rapid in this region, to make up for the evaporation. It may well be, therefore, that like results would not be produced so readily in the Eastern States.

After the reading of this paper the meeting adjourned until 2 p. m.

AFTERNOON SESSION, THURSDAY, AUGUST 12, 1897.

The joint session with the Society for the Promotion of Agriculture was opened at 2 o'clock with President Webster in the chair, and the following economic entomologists were elected to active membership:

W. B. Barrows, Agricultural College, Michigan.
R. H. Pettit, Agricultural College, Michigan.
W. S. Blatchley, Indianapolis, Ind.

Upon motion of Mr. Howard it was voted that the chair appoint a committee of three to nominate officers for the ensuing year.

The following letter from Miss E. A. Ormerod was read:

One of the first observations of this year was barley infested with Angoumois moth, *Sitrotroga cerealella* Oliv., in cargo from Tripoli. I never had it before, but the grains gave me a beautiful set of specimens for figuring. I should hope we need not fear its being troublesome here out of doors, but I hope to get some notes about it from north Africa.

The most interesting observations which I have had are, I think, about the *Lipoptena cervi* (the deer forest fly). I had quite a good number sent me early in the year, some *in situ*, on a roebuck's hide sent me on April 2. These enabled me to see that in every instance there was some amount of wing present. In some cases the little growth was quite obviously an abortive wing, but in some, from the structure's being torn across, it was impossible to say but that there might have been a fully formed wing. I secured a few puparia, but none developed. I hope in due time you will like the figures I had taken to show the two states, and another winglet attached by a little bit of thorax to the leg, so as to show the relative proportion. I sent some over to Professor Mik at Vienna, and I think he was a good deal interested.

Another infestation that we do not often have is the lesser earwig (*Labia minor*), since it flies in great numbers in the evening, but I never had it before.

Xyleborus dispar has reappeared to a very undesirable amount at Toddington, and just lately we have had a visit in this neighborhood of a great number of the *Harpalus ruficornis*, the ground beetle which did so much mischief to strawberries in 1895 (*vide* my nineteenth annual report). The beetles came tumbling or flying down in one place from the roof of a house, to the astonishment of the family below. I hoped to get some insight into some special point of life history from this, but as yet I have not secured it.

Just now I have a nice quantity of turnip-seed pods from Fyvie, in Aberdeenshire, with the larvæ of the *Centorhynchus assimilis* working at the seeds, and also the larval Cecidomyia, presumably, from characteristics, the *C. brassicæ* Winnertz. This is very interesting, for the weevil larvæ are so greedy that one can watch them with just their head inside the emptied seed shell, working to get every remaining available morsel, like a kitten or puppy licking a saucer quite clean. The shrunken seeds, blighted by the sucking of the Cecidomyiid larvæ are in great contrast to this, and I was very much pleased to have the specimens, and am taking great pains with a view to the rearing of the imago.

Several other rather nice observations of not quite common infestations have come in, which I try to make the most of.

I do not know whether you will think me very venturesome, but I am meditating bringing about a leaflet (or pamphlet, not too large to go into a letter envelope, for gratuitous distribution) on that destructive pest, the house sparrow, *Passer domesticus*. The mischief it does in many ways is really beyond what ought to be allowed, and it is unfortunately still on the list of our protected birds.

It seemed to me that our only hope to make any advance was to work on the lines of your United States of America Board of Agriculture, so I have been compiling (duly acknowledged) records of results of examination of stomach contents, and I greatly hope that I shall have the invaluable cooperation of Mr. W. B. Tegetmeier, who has given such attention to bird life.

After the reading of this paper, Mr. Rolfs presented the following:

A FUNGUS DISEASE OF THE SAN JOSÉ SCALE.

By P. H. Rolfs, *Lake City, Fla.*

[Withdrawn for publication elsewhere.]

The next paper, treating of the same insect, was presented by Mr. Barrows:

THE PRESENT STATUS OF THE SAN JOSÉ SCALE IN MICHIGAN.

By Walter B. Barrows, *Agricultural College, Michigan.*

So far as we have any knowledge, the San José scale first came to the notice of the State Experiment Station May 14, 1896, when it was found on a single fruit tree in Jackson, and the tree was destroyed soon after. The origin of the affected tree was not ascertained, and as no other occurrences were reported from the vicinity it was supposed that no further trouble would result. In December following, however, it became evident from its invasion of the States adjoining Michigan on the south that our own State was in serious danger, and on application to the New Jersey nurserymen who were supposed to have sent out infested stock, a list of several hundred Michigan addresses was received by the horticulturist of the station, and a circular letter describing the scale and its work was sent to each address. Comparatively few replies to this letter were received, but among them were some which indicated the presence of the scale, and further inquiries showed its presence in several places.

During the winter many different parts of the State were visited in quest of the pest, but the severe weather, the lack of time, and especially the number and extent of the suspected orchards, made anything like thorough inspection impossible. The scale was located in greater or less abundance at half a dozen widely separated points, and this number has been increased by as many more through correspondence and the transmission of specimens. At present the scale is positively known to have existed in the following counties, and in no case is there positive proof that it has been entirely eradicated:

	Localities.		Localities.
Allegan County	1	Oceana County	1
Berrien County	1	Ottawa County	1
Ingham County	2	St. Joseph County	2
Jackson County	1	Van Buren County	1
Kent County	2	Wayne County	1

In Ottawa County the infested stock was received from New Jersey in the spring of 1890, and thus had been established almost seven years before it came to the knowledge of any entomologist. During this time

it had killed all or nearly all the trees on which it was brought and had spread to all the other fruit trees in the immediate vicinity, some of which also had succumbed. Probably at this place several acres were badly infested, and of course it is to be feared that the scale has been carried to other orchards in the neighborhood.

In Ingham County one locality was found in the city of Lansing where the fruit trees about two houses and in their gardens were badly affected, and the scale had overrun rose bushes, currant bushes, grape vines, and even one or two shrubs of Spiræa. In this case the scale was originally brought on pear trees which were bought from a resident dealer in 1888 or 1889. The trees were said to have been obtained in New York State, but, as the dealer is known to have been unreliable and as very few trees were true to name, it is not likely that any dependence can be placed on the statement. It is more than probable that the stock came from New Jersey and that other parties in the vicinity have introduced the scale through the same dealer.

In still another case (and county) a dealer is known to have handled stock which was infested with the scale, and that at least five or six years ago, so that it is fair to assume that this pest is now pretty widely and thoroughly distributed through the fruit-growing parts of the State, and we may expect to find it in large quantities in all the counties of the four southern tiers, and yet farther north along the west side of the State.

Since the scale thrives in Ingham and Ottawa counties it is likely to winter safely still farther north, and as yet the life zones in Michigan are so poorly defined that it is impossible to draw any line beyond which we may safely predict that the scale can not live. The larger part of the Lower Peninsula of Michigan consists of the upper austral and transition life zones, of Merriam, and it has been believed that elsewhere in the United States the San José scale is limited on the north by the line which separates these two life zones. In this State, however, the criteria which serve to separate these areas elsewhere do not appear to serve. There seems to be a more complete mingling of the forms of life which should characterize these zones than occurs elsewhere, and before we can define their limits it will be necessary to find other test species than those which have been relied upon in New England and New York. As an illustration of the complexity of this question, it may be stated that in the same regions where such characteristic austral trees as the redbud and papaw abound we find also the boreal black spruce and arbor vitæ; in fact, the latter tree occurs, in favorable places, in every county in Michigan, with the possible exception of the four eastern counties of the southernmost tier.

The contrasts of animal life are equally surprising, for, with practically no variation in altitude, we find the porcupine and northern hare—both boreal species—within a few hundred yards of the fox squirrel, gray fox, and less often the opossum, all three belonging properly in

the austral life zone. When we know more of the geographical distribution of life in Michigan, it may be possible to define with precision the limits beyond which the San José scale will not become established, but at present we must consider the entire southern half of the Lower Peninsula as in danger of serious infestation, together with a strip of uncertain width bordering Lake Michigan at least as far north as Grand Traverse Bay.

It is too early yet to make any predictions as to the ultimate success or failure of attempts to limit by legislation the spread of the scale in Michigan. The last legislature passed a bill which takes effect late in the present month (August) requiring the inspection of all nursery stock offered for sale in the State, whether home grown or from outside, and compelling inspection and treatment of all suspected orchards or fruit trees wherever found. The bill as originally drawn was not, of course, altogether satisfactory either to the nurserymen or the fruit growers, and during its passage through the legislature its strength was still further impaired by sundry concessions which seemed to be necessary in order to secure its adoption. It is hoped, however, that its provisions may be thoroughly enforced and its efficacy tested during the coming year, so that, if necessary, better measures may be provided by our next legislature.

In the discussion which followed these two papers, Mr. Craig stated that the condition in Canada relative to the San José scale was quite similar to that of Michigan. This insect had been found in British Columbia and in Ontario. In the latter Province there were seven well authenticated occurrences, these being probably in the upper austral region. Mr. Craig's investigations showed that the San José scale had been present in Canada for at least four years and came originally from two New Jersey nurseries, whose proprietors had kindly enabled him to trace the shipments of infested stock. Mr. Craig was of the opinion that the scale would do the greatest damage in the peach-growing region where, as early as July 1, 1897, he had found the young scales securely fixed on young, growing wood. Fungus cultures, received from Professor Rolfs, had been used in inoculation tests in the laboratory, but with no practical results as yet. It seemed probable that an endeavor would be made to obtain legislation with a view to preventing the shipment of infested nursery stock to Canada.

Mr. Howard inquired as to the known geographical distribution of the fungus disease. Mr. Rolfs said that, to the best of his knowledge, this disease was chiefly confined to the southern part of the United States. It had been found in Alabama, Georgia, South Carolina, and in one instance in Pennsylvania. It was most abundant at Auburn, Ala. The synonymy of this fungus had not been cleared up and it seemed probable that the same form has been described as separate

fungi. Generally speaking, the infection from cultures must be made under favorable conditions of warmth and moisture. As yet, it is not known that this fungus occurs in California, yet it has been detected in scales on citrus trees, and it seems highly probable that it may occur wherever citrus trees are cultivated.

After President Lazenby, of the Society for the Promotion of Agricultural Science, had been called to the chair, the following paper from Mr. C. P. Gillette was read:

LEPIDOPTEROUS INSECTS AT LIGHT AND AT SUGAR.

By C. P. Gillette, *Fort Collins, Colo.*

[Withdrawn for publication elsewhere.]

Mr. Webster presented the following paper:

ON THE ORIGIN AND DISTRIBUTION OF THE CHINCH BUG.

By F. M. Webster, *Wooster, Ohio.*

[Withdrawn for publication elsewhere.]

Mr. Howard stated that it seemed probable that the immediate ancestor of both the long winged and the short-winged forms of the chinch bug was a long-winged form, since abbreviation of wings is a degradational character. Referring to the uncertainty of the original home of the insect, he expressed the opinion that this home would be found in the place where this insect is the most mimicked by other species.

Mr. Ashmead agreed with Mr. Howard in the belief that the original type of the chinch bug was a long-winged form, and cited parallel cases of dimorphism in the Fulgoridæ and Capsidæ. In certain water bugs we have long-winged, short-winged, and apterous forms, the length of the wings, apparently, being due to seasonal influences. Parallel cases occur in Isosoma and in one of the parasites of the Hessian fly. The work which has been done in Europe upon the Cynipidæ throws much additional light on the subject of dimorphism, and, as a result of careful investigations made both here and in Europe, we are beginning to understand the laws which govern the appearance of dimorphic forms. Mr. Ashmead referred to an exchange of specimens of Heteroptera made with Mr. Montandon several years ago, when he obtained the European *Blissus doriæ* and found it to be somewhat smaller than our American *B. leucopterus*. In Florida, if Mr. Ashmead's recollection served him rightly, the majority of the specimens which he had taken were of the short-winged form. Referring to the distribution of the chinch bug, he stated that it had been found in Mexico.

Mr. Webster, previous to the past year, had generally considered that hot weather favored the development of the long-winged form, cold weather retarding it. Last year there was much very hot weather, yet the majority of chinch bugs taken were of the short-winged form.

Mr. Howard expressed the opinion that the true micropterous form occurs only along the coast, and that the occurrence of a short-winged form in the interior is due to frequent failure of the wings to extend, owing to dry atmosphere, showing in support of this view that in the series exhibited by Mr. Webster great variation existed in the length of the wings.

Mr. Mally called attention to the fact that the long-winged form was the most common in Iowa, while the short-winged form was the most abundant in Ohio. As a connecting link between the short and long winged forms, Mr. Mally recalled the capture of a single specimen having one long and one short wing.

Following the above discussion the Association adjourned, to meet at the close of the general session the following morning.

MORNING SESSION, FRIDAY, AUGUST 13, 1897.

The association met at 12 noon, immediately following the adjournment of the general session. The chair appointed L. O. Howard, H. G. Hubbard, and P. H. Rolfs as a committee to nominate officers for the ensuing year. The following report of the secretary and treasurer was read and accepted:

Financial report of secretary-treasurer.

Balance from 1896		$0.58
Received from dues to July 1, 1897		27.00
Total receipts		27.58
Paid for stamps, foreign correspondence	$2.50	
Paid for stamps, United States correspondence, to July 1, 1897	2.50	
Paid for stamps and envelopes	1.70	
		6.70
Balance on hand		20.88

Upon motion of Mr. Barrows, it was voted that the "Secretary of Agriculture be requested to publish the proceedings of the present meeting of the Association of Economic Entomologists."

The committee on nominations made the following recommendations:

For president, Herbert Osborn, Ames, Iowa.
For first vice-president, Lawrence Bruner, Lincoln, Nebr.
For second vice-president, C. P. Gillette, Fort Collins, Colo.
For secretary-treasurer, C. L. Marlatt, Washington, D. C.

These officers were unanimously elected.

Upon motion of Professor Rolfs, the meeting adjourned to meet at 1.30 p. m.

Upon motion of Mr. Howard, it was voted that at the close of the present session the meeting be adjourned to convene at Boston, August 19–20, 1898.

Upon motion of Mr. Rolfs, the following resolution was adopted:

Whereas the Association of Economic Entomologists is familiar with the efforts being made by the State of Massachusetts to exterminate the gypsy moth; and

Whereas on two former occasions it has indorsed this undertaking by public resolution; and

Whereas the existence of the gypsy moth in Massachusetts is a standing menace, not only to the agricultural and forestry interests of that State, but to those of the country at large: Therefore be it

Resolved, That this association would urge upon the people of Massachusetts the danger of dilatory measures, and the wisdom and great importance of providing liberally for the work of exterminating the gypsy moth.

In the absence of Mr. Gillette, the secretary pro tem. read the following paper:

VERNACULAR NAMES OF INSECTS.

C. P. GILLETTE, *Fort Collins, Colo.*

As a member of the committee on nomenclature of common names of the American Association of Agricultural Colleges and Experiment Stations, I wish to recommend only such names or regulations as will receive the support of the members of the Association of Economic Entomologists and of other entomological writers of prominence in the country.

All who have written very much upon our insects, using vernacular names, must have been unable at times to decide what was the best name to use or the proper way to write it. One writes "codlin moth" and another "codling moth;" we see "chinz bug," "chinch bug" and "chinch-bug" all written by good authorities, and we may write "clover-hay worm," "clover hay worm" or "clover hay worm," and in any of these cases there will be no confusion as to the insect referred to, but it seems to me that all will admit that it would be better to have a uniform method of writing each of these names. I know of no better guide in the writing of common names than the examples set by our ornithological brethren. While we write "lady-bug," "bed-bug," "cut-worm" and "clothes-moth," they are writing "blackbird," "hummingbird," "sparrowhawk," and "bluejay." The botanists, having a liking for both hyphens and capitals, write Wire-Grass, Pond-Lily, Indian-Corn, etc., but they combine many compound words into one, as Whortleberry, Strawberry, Ragweed, etc. There seems to be no reason why one method should be chosen in one branch of natural history and a different method in another branch. In fact, it can hardly be said that botanists or entomologists have a method. In both sciences the present workers seem simply to be following in the foot steps of those

who have preceded them. The ornithologists, however, have fixed upon the common names of birds and the manner of writing them through the work of a committee appointed for the purpose. As a result, the names are similarly compounded and capitalized throughout. Class or group words, such as hawk, sparrow, wren, jay, and the like, are capitalized always or they are written with the modifying word without a hyphen, as Nighthawk, Kingfisher, etc.

I give below a list of common names of insects in which each name is written in three different ways in parallel columns. In the left-hand column the hyphen is used in each case, and the word following is written with a small letter. In the middle column the hyphen is dropped and the word following it is capitalized. In the right-hand column both hyphen and capital are dropped and the two words are written as one. A glance at these columns will convince anyone that no one of these methods will do for all cases.

I have italicised the method of writing the different names that I like best, except in a few cases where there are two methods that I like equally well, and then I have italicised both. If these names were chosen they would correspond to the method of writing common names of birds by the American Ornithologists' Union.

I have tried to make the following list a representative one, so that if the best method of writing this list could be decided upon it would serve as a guide to the writing of nearly all other common names. Would it not be well to have a committee of the Association of Economic Entomologists appointed to consider the matter of vernacular names and report at the present meeting?

LIST OF VERNACULAR NAMES.

Aphis-lion.	*Aphis Lion.*	Aphislion.
Ant-lion.	*Ant Lion.*	Antlion.
Apple maggot.	*Apple Maggot.*	Applemaggot.
Apple-weevil.	*Apple Weevil.*	Appleweevil.
Angoumois Grain-moth.	*Angoumois Grain Moth.*	Angoumois Grainmoth.
Bag-worm.	Bag Worm.	*Bagworm.*
Black-fly.	*Black Fly.*	Blackfly.
Bee-flies.	*Bee Flies.*	Beeflies.
Bee-louse.	*Bee Louse.*	Beelouse.
Bed-bug.	Bed Bug.	*Bedbug.*
Blister-beetle.	*Blister Beetle.*	Blisterbeetle.
Bark-louse.	*Bark Louse.*	Barklouse.
Bot-fly.	Bot Fly.	*Botfly.*
Bud-moth.	*Bud Moth.*	Budmoth.
Black Swallow-tail.	Black Swallow Tail.	Black Swallowtail.
Boll-worm.	*Boll Worm.*	*Bollworm.*
Bristle-tails.	Bristle Tails.	Bristletails.
Cut-worm.	Cut Worm.	*Cutworm.*
Caddice-fly.	*Caddice Fly.*	Caddicefly.
Carpenter-bee.	*Carpenter Bee.*	Carpenterbee.
Chinch-bug.	*Chinch Bug.*	Chinchbug.
Cabbage-butterfly.	*Cabbage Butterfly.*	Cabbagebutterfly.

LIST OF VERNACULAR NAMES—continued.

Cabbage-worm.	*Cabbage Worm.*	Cabbageworm.
Cabbage-root Maggot.	Cabbage Root-maggot.	Cabbage Rootmaggot.
Cave-cricket.	*Cave Cricket.*	Cavecricket.
Clover Hay-Worm.	Clover-hay Worm.	Clover Hayworm.
Codling-moth.	*Codling Moth.*	Codlingmoth.
Colorado Potato-beetle.	*Colorado Potato Beetle.*	Colorado Potatobeetle.
Corn Plant-louse.	*Corn Plant Louse.*	Corn Plantlouse.
Currant-borer.	*Currant Borer.*	Currantborer.
Dragon-fly.	*Dragon Fly.*	*Dragonfly.*
Flesh-fly.	*Flesh Fly.*	*Fleshfly.*
Fish-moth.	*Fish Moth.*	*Fishmoth.*
Flea-beetle.	Flea Beetle.	*Fleabeetle.*
Grain-moth.	*Grain Moth.*	Grainmoth.
Gall-fly.	Gall Fly.	*Gallfly.*
Guest-fly.	*Guest Fly.*	Guestfly.
Hawk-moth.	Hawk Moth.	*Hawkmoth.*
Ichneumon-fly.	*Ichneumon Fly.*	Ichneumonfly.
Lady-beetle.	Lady Beetle.	*Ladybeetle.*
Lady-bug.	Lady Bug.	*Ladybug.*
Leaf-roller.	Leaf Roller.	*Leafroller.*
Leaf-folder.	Leaf Folder.	Leaffolder.
Leaf-hopper.	Leaf Hopper.	*Leafhopper.*
Pine-leaf Scale.	Pine Leaf Scale.	Pineleaf Scale.
Plant-louse.	*Plant Louse.*	Plantlouse.
Red-legged Locust.	Red Legged Locust.	Redlegged Locust.
Saw-fly.	Saw Fly.	*Sawfly.*
Silk-worm.	Silk Worm.	*Silkworm.*
Span-worm.	Span Worm.	*Spanworm.*
Scurvy Bark-louse.	*Scurvy Bark Louse.*	Scurvy Barklouse.
Squash-vine Borer.	Squash Vine Borer.	Squashvine Borer.
Tussock-moth.	*Tussock Moth.*	Tussockmoth.
Two-lined Prominent.	Two Lined Prominent.	Twolined Prominent.
White-ant.	*White Ant.*	Whiteant.

In discussing the preceding paper, Mr. Hubbard spoke of the difficulty in deciding upon so large a number of names. Had but a few type names been offered, the solution of this problem would be more readily accomplished.

Upon motion of Mr. Ashmead, the chair appointed Mr. Howard, Mr. Fernald, and Mr. Lintner as a committee to consider the recommendations made by Mr. Gillette, and also the whole subject of vernacular names of insects, this committee to report at the next annual meeting.

The following paper was read by the secretary pro tempore:

NOTES ON CAPE OF GOOD HOPE INSECTS.

By Chas. P. Lounsbury, *Cape Town, South Africa.*

Among the insect pests injurious to general agricultural crops, the red-winged locust (*Acridium purpuriferarum*), a locust fully as large as *A.* (*Schistocerca*) *americanum*, has attracted by far the greatest attention

in this colony during the past eighteen months. This locust is nearly omnivorous and is credited with being particularly fond of tree foliage. It is not frightened by smoke, nor does its flight seem much affected by the prevailing winds. The natives will not eat it, as they do the ordinary migratory locust (*Pachytylus migratorius*). Small swarms have been observed along the east coast of the colony as far back as 1893, since which time the species has been continuously abundant in the neighboring colony of Natal. A previous invasion of much magnitude is said to have occurred between 1840 and 1845. In November, 1895, immense and numerous swarms appeared from the direction of the Kalahari Desert, where the species is presumed to be endemic, and from Natal. From the north and east these swarms soon spread over two-thirds of the area of the colony, but were most numerous and caused greatest loss in the thickly settled native territories along the coast south of Natal and in the long, narrow belt of coast land at the south of the colony. The invasion reached its height about the 1st of February, 1896. By the end of March the swarms had greatly dwindled in size and had ceased to advance.

In April immense swarms of nymphs, called "voetgangers" (the term "locusts" being usually applied only to the winged insects), appeared in most situations where rain had fallen subsequent to the passage of the swarms. For a time the outlook was most disheartening to the farmers, but the voetgangers over large areas were soon observed to be rapidly disappearing and reports of damage became infrequent except from the eastern sections. The cause of the disappearance was soon found to be a fungus disease identified as *Empusa grylli* Fres. This disease appeared in all sections where the conditions necessary to the spread of such fungi obtained. The Bacteriological Institute of the Department of Agriculture at once endeavored to aid in its dissemination by distributing artificial cultures; but while some benefit has undoubtedly been derived by this course, artificial propagation of the disease has been a failure in the majority of cases owing to the absence of favorable weather conditions. All the swarms now appear to be restricted to the district east of Port Elizabeth, and though not large or numerous, they are still responsible for much destruction in the native territories.

A pyralid moth which Lord Walsingham has identified as *Loxostege frustalis* Z. has attracted considerable attention during late years by its ravages over extensive tracts of territory in the middle sections of the colony. Farmers complain of it as an annual pest of increasing importance, but it is more likely that its increasing importance arises from the fact that the land is becoming more heavily stocked than from an increase in numbers on the part of the pest. Moreover, the nightly herding of the stock, necessary because of the presence of wild Carnivora, is practiced, and the herbage is thus deprived of a large part of the fertilizing elements which it would otherwise receive; in consequence, the herbage steadily decreases in luxuriance and the inroads

of insects become more evident. The pasturage in this part of the colony consists almost exclusively of low bushes, the most valuable of which is the Karroo bush, a species of Pentzia, and it is to this bush that the insect is most injurious.

From the horticultural standpoint, the peach maggot (*Ceratitis capitata*) ranks first in importance among injurious insects of the past season. This pest is always one which attracts much attention, and its ravages this year have been greater than usual. It survives the winter as the mature insect and becomes more and more numerous as the season advances, there being a succession of broods. December apricots were much infested this year, and in most parts of the Western Province late peaches and nectarines were almost all maggotty. Other deciduous fruits suffered to a lesser extent. At the date of writing, infested guavas are not uncommon, and numerous flies may be found in most orange groves; only a small percentage of the fruit of the orange, however, is attacked in this vicinity. In the eastern parts of the colony the ravages of the pest are more severe. Oranges are there more subject to it, and in some groves most of the fruit is said to be spoiled. Late peaches are said to be almost unobtainable, and I have myself seen nearly half the loquats on a large tree in full bearing infested by this pernicious pest at Graham's Town. Loquats, however, do not seem to be generally attacked, and I have heard of no occurrence of this kind in the western fruit-growing sections of the colony. The destruction of infested fallen fruit is practised by some of the most enterprising fruit growers. The utility of this course is questioned by some who have adopted it, but from personal observation I am inclined to believe that the trouble lies in lack of thoroughness; too often a tree in some odd corner is not visited or some worthless fruit is allowed to remain on the trees after the crop has been gathered.

Growers of citrus fruits would unhesitatingly pronounce the red scale (*Aspidiotus aurantii*) by far the worst of their insect foes for the year now brought to a close. Though for many years a pest of the first rank, the injury wrought by this scale during the past year has been phenomenal. Complaints of its ravages are of almost daily occurrence and come from nearly all parts of the colony where citrus fruits are grown, even from the only favorable spot in dry and barren Namaqualand. It is reported that the infestation spreads through large orchards in the course of a few weeks and that the trees become almost worthless at once. While such statements are not at all credited, they serve to show the severity of the attack. The virulence of the insect during the past season has probably been due to a number of causes. A diminished rainfall in most sections coupled with locust ravages in the east and south undoubtedly decreased the vitality of the trees and left them less able to withstand the drain by the scale insects, and it would seem as if the weather conditions throughout the season have favored the multiplication of the species. No important insect foes of the scale are

known in the colony. A number of small ladybirds prey upon it, but with little effect. Efforts are being made to introduce exotic species; a number were imported about twenty months ago, but only one, *Orcus australasiæ*, survived the first three months. Many of this species may now be found in the orchard where their predecessors were liberated, but the scales are still as abundant as before. To encourage remedial treatment a fumigation outfit has been operated by the government since September last. Upward of 6,000 trees in orchards scattered through many towns have been successfully treated, and an illustrated pamphlet fully describing the process is being printed; this will be distributed among the fruit growers all over the colony. It is believed that the best orchards will hereafter be fumigated systematically.

The abundance of the ptinid beetle, *Sitodrepa panicea*, in Cape Town and other important centers of the colony is worthy of remark. This insect was discussed by Miss Ormerod as a serious pest to boots and shoes in her South African Insects, published in 1889. Several merchants dealing in boots and shoes have told me that the insect is not now responsible for more than a fraction of the damage it formerly caused, but is still a source of much annoyance to them. Other leather goods in which paste was used in the process of manufacture are also subject to infestation. The decreasing importance of the insect as regards boots and shoes may be taken as evidence that some of the manufacturers now use nonnutritious or poisoned paste. It is also probable that the retail dealers do more than formerly to check it. A prominent chemist informs me that he frequently supplies carbon bisulphide as an insecticide for the purpose. Within a few months the insect has attracted attention by its injuries to the binding of valuable documents in the colonial archives, and a search has proven its presence in the book rooms of the different government departments. It is, however, unknown at the public library. Entomological specimens in this office are frequently injured, and a prominent botanist complains that, do what he will, this insect maintains its hold in his specimen room.

The ravages of the grape phylloxera (*Phylloxera vastatrix*) in Western Province vineyards is yearly increasing. Eradicative methods have been abandoned by the government, but carbon bisulphide may be obtained by owners of infested vineyards at one-half the actual cost. Very little has been sold of late. The carriage of agricultural produce from infested to clean vine-growing areas is restricted, and parties infringing the regulations are liable to severe punishment. The infested area steadily enlarges, but the Constantia vineyards, where the finest wines of the colony are produced, are still entirely free of the pest, although some of them lie within 5 or 6 miles of where the first occurrences were discovered over ten years ago. The leaf-infesting form of the insect appears to be wholly unknown in the colony. The vine growers have at last awakened to the necessity of reconstituting

their vineyards on American stocks, and a number of coöperative nurseries for the grafting of the vines have been established during the year. The government encourages the movement by a grant of one pound sterling for each pound subscribed by the members. The government also distributes cuttings of American vines to applicants at a nominal price. The applications for the past year were, however, for nearly four times the available supply.

The injurious insects of Cape Colony appear to be much fewer in point of numbers than those of the United States. For instance, there is a marked absence of the numerous lepidopterous enemies of fruit trees. But our pests, if few, are formidable, and perhaps the loss sustained through them is quite as much, comparatively, as that sustained through insects in the United States.

Mr. Hubbard then presented a paper entitled

THE GIANT CACTUS OF ARIZONA AND ITS FAUNA.

By H. G. Hubbard, *Washington, D. C.*

[Withdrawn for publication elsewhere.]

Mr. Howard, prefacing his paper by brief remarks concerning the value of cochineal, lac, and Japanese white wax insects, presented the following:

A USEFUL AMERICAN SCALE INSECT.

By L. O. Howard, *Washington, D. C.*

There are, or have been, three commercial interests of greater or less importance derived from certain scale insects. For many years the cochineal or cactus scale insect, now called *Coccus cacti*, was used as the basis of an important red dye, until practically superseded by the introduction of aniline dyes. In the same way the European Porphyrophora was used in the production of a purple dye.

Aside from the dye insects, we have the lac insects, of which a single species, *Tachardia lacca*, produces practically all of the shell-lac, stick lac, and button lac of commerce. This species is Asiatic in its distribution, but there seems no reason why it should not be introduced into this country. We have, however, in the southwest, upon the very abundant creosote bush, a lac insect occurring in an enormous quantity, the commercial possibilities of which have not been developed. This is the congeneric species, *Tachardia larreæ* Comstock. This insect has been known to science only since 1881, but was long prior to that time known to the Indians, who for many years have been in the habit of collecting the scale insects and forming them into more or less elastic

balls, which their runners were in the habit of kicking before them as they journeyed from one point to another. There are other species of the same genus inhabiting North America, notably *T. mexicana* Comstock, *T. gemmifera*, *T. pustulata*, *T. fulgens*, and *T. cornuta* Cockerell. None of these, however, occur in the same abundance as *T. larreæ*, and therefore do not offer the same possible commercial interests.

The third substance of commercial importance derived from scale insects is a pure white wax, which is secreted by the Chinese and Japanese *Ericerus pé-la* and by the Indian *Ceroplastes ceriferus*. On account of its expense, and on account of more or less available substitutes, this wax has not become of great commercial importance in Europe, but is much used in the Eastern countries, both in the making of wax candles and in medicine. The Chinese wax is said to have ten times the illuminating power of other waxes. It is a beautiful wax, resembling beeswax in its chemical composition more nearly than the vegetable waxes, and is clear white in color. We have in this country, as well as in other parts of the world, species congeneric with the Indian wax insect, and a very common form in the South, occurring abundantly on the gall berry, is the *Ceroplastes floridensis* Comst. The amount of waxy secretion of this species is not so abundant as in the Indian species.

In the far Southwest, however, there is a wax insect which apparently needs very greatly careful investigation from the commercial standpoint. This insect is *Cerococcus quercus*, described by Comstock in the Annual Report of the Department of Agriculture for 1881–82, from several specimens found upon twigs of oak in the old collection of the Department of Agriculture, and which came originally from Arizona. Professor Comstock also saw specimens in the Museum of Comparative Zoology at Cambridge, which were collected in California by Osten Sacken. Three species of oak are recorded by Comstock as offering food for this insect, viz, *Quercus oblongifolia*, *Q. undulata* variety *wrightii*, and *Q. agrifolia*. "Judging from the specimens before me," said Comstock, "this insect occurs in sufficiently great numbers to be of economic importance if the excretion can be utilized as is the excretion of an allied insect which produces the true white wax of commerce. The matter is now being investigated by the chemist of the Cornell University Experiment Station, and will probably be discussed in the next report of that institution." Like so many promises, this seems never to have been fulfilled, since, at any rate, the Cornell institution has never published the results of the chemical examination.

Last January the writer received specimens of this insect from Mary C. B. Watkins, teacher in the Indian school at Mesa Grande, Cal. They were not sent in position on the twigs, but had been removed from the twigs and mashed together by hand into a more or less pliable lump, somewhat resembling a lump of india rubber, but not possessing the same elasticity. The specimen was referred to the chemist of the

Department, Dr. Wiley, who soon reported that its chemical composition interested him extremely and asked for a larger sample. Miss (or Mrs.) Watkins was applied to and promptly sent on about a pound, with the information that it made an admirable chewing gum, taking and retaining flavors better than any she had seen. The supply, she reported, was practically inexhaustible, and stated further that if it has any commercial value it will be a godsend to the Indians of her region. The chemical examination of this large sample has been unavoidably delayed, but it has been found that about one-half of the substance is soluble in chloroform. On cooling, it separates into beautiful yellow crystals. This part is evidently a true wax and is partly soluble in glacial acetic acid. The part which is soluble in glacial acetic acid separates when cool into pure white scales. The portion which is insoluble in chloroform is black and tough, and in general resembles rubber in its physical properties. Dr. Wiley expresses great interest in the product from a chemical standpoint, and the outcome may very possibly be one of practical value, since, as previously stated, the supply is well-nigh inexhaustible. The insect occurs mainly upon small oaks in the San Jacinto Mountains and also in the western foothills of the San Gabriel Mountains, California.

Mr. Hubbard called attention to the fact that lac insects around Tucson were considered by the Indians of that vicinity to possess medicinal properties.

The following paper was read by Mr. Mally:

INSECTS OF THE YEAR IN OHIO.

By F. M. Webster and C. W. Mally, *Wooster, Ohio.*

The present year has not been characterized by any new or disastrous outbreak among insects in Ohio, though several of the older and better known species have caused considerable uneasiness among horticulturists and farmers. The periodical cicada (*C. septendecim*), Brood XV, appeared over the larger portion of the eastern half of the State. The chinch bug (*Blissus leucopterus*) seemingly did not flourish during the early part of the hatching season, but later, in the southern part of the State, the young have developed in considerable numbers, being of course from the later deposition of eggs.

The San José scale (*Aspidiotus perniciosus*) continues in the front rank of destructive insects demanding constant attention. More infested orchards have been reported during the late spring and summer than during the corresponding season of any other year. Usually, the pest is observed during the winter, while the foliage is off the trees, but this year there seems to be no cessation in the discovery of new cases of infestation. In connection with the kerosene experiments, carried on

against this species, it might be stated that a section of apple tree thickly covered with the oyster-shell bark-louse (*Mytilaspis pomorum*) was sent to the Station in April, as having been treated with kerosene, by a correspondent. On receipt of the twig there was a perceivable odor of kerosene, but how thoroughly it had been applied we were unable to tell. Many of the eggs appeared quite fresh and healthy, and, later, larvæ in abundance and one parasite issued from the scales on the twig. Whether this is a case of resistance on the part of the insects, or of carelessness on the part of the man who applied the kerosene, we are unable to say.

The Colorado potato beetle (*Doryphora 10-lineata*) has been excessively abundant. The adults appeared quite early, and as soon as the young plants appeared these were attacked and in many cases eaten to the ground and kept there. There was a widespread complaint of the ineffectiveness of Paris green in destroying the adults, and acres of potatoes were given up in despair by farmers. So little of the plant was left to catch the poison that the beetles did not get a sufficient amount to prove fatal. Later, the results of spraying were more satisfactory. In the autumn of 1896 the adults were unusually abundant, and after the potato vines were unfit for food they sought out the tomato vines and ate the leaves, the epidermis of the stem, and the green fruit. Tobacco (*Nicotiana longiflora*), planted for ornamental purposes, also suffered from their attack.

The asparagus beetle (*Crioceris asparagi*) continues to spread to the westward, especially along Lake Erie. It is now known to occur in nine counties in northeastern Ohio, as follows: Ashtabula, Columbiana, Cuyahoga, Geauga, Lake, Mahoning, Portage, Trumbull, and Summit.

The canker worm, *Anisopteryx vernata*, was more especially destructive over a limited area in northeastern Ohio, though we occasionally heard of their depredations elsewhere. As usual the reports from the use of Paris green were conflicting, some people claiming a total failure and others an entire success. On some trees bands of coal tar were applied about 6 inches in width to the rough bark, and in one instance a careful estimate showed that over 500 adult males and females in about equal numbers had been entrapped and destroyed on a single tree.

The boll worm (*Heliothis armiger*) caused considerable injury last summer in Lawrence County, the larvæ burrowing into the ripening peaches while the fruit was still hanging on the trees, the depredators working in the same manner as in ripe tomatoes. In autumn it depredated upon geraniums in the station greenhouses.

Brachyrhynchus granulatus Say occurs in southern Ohio during winter in all stages of development, except the egg, under loose bark of trees, and was almost universally mistaken there for hibernating chinch bugs.

Coriscus ferus Linn. was observed to attack *Leptoterna dolobrata*

Linn., which was feeding quite abundantly on timothy heads about East Cleveland, June 28, 1896.

The tarnished plant-bug (*Lygus pratensis*) has this season varied its bill of fare on the grounds of the experiment station at Wooster by attacking the tender flower-buds of china asters, causing them to wither.

The bagworm (*Thyridopteryx ephemeræformis*) seems to be slowly but steadily working northward. From a lot of larvæ received from Mr. R. H. Warder, superintendent of parks in Cincinnati, we reared in July a tachinid parasite, *Sturmia distincta* Wied. In our breeding cages, where no males were present, the females in two cases worked themselves out of their sacks from below and dropped to the ground before having oviposited. One of these females finally oviposited without pairing.

The common mealy-bug (*Dactylopius adonidum*) was observed to be preyed upon by *Limax campestris*, which devoured both eggs and young larvæ, thus emphasizing the fact of its carnivorous tendencies, as shown by Mr. Webster in Insect Life (Vol. IV, p. 348, and Vol. V, p. 128). Besides, it seemed, in the insectary, to prefer mealy-bugs and plant-lice to vegetable food.

On September 19 we received a section of Osage orange post, 1½ feet in length and 4 inches in diameter, with the complaint that a worm was eating up a lot of fence posts of this kind of timber, some of these posts having been set in the ground, the others merely piled together. In the case of the latter the dust was stated to be 2 inches thick underneath the pile. In the specimen section received the sapwood was badly eaten and tunneled by the larvæ, some of these larval chambers extending directly into the heartwood. The section was placed in a breeding cage, but nothing appeared therein until the following February (February 4), when a single example of *Cyllene picta* Drury emerged. We were well aware that the borer was that of a cerambycid, but did not expect this species. From this small section there emerged in all 27 individuals of this species, the greatest number appearing during any one day being 4. The record of appearance of adults is as follows: February 4, 1; 10, 1; 13, 2; 15, 1; 17, 1; 19, 1; 23, 3; 24, 4; 26, 1; March 4, 4; 6, 3; 8, 1; 10, 1; 23, 1; April 12, 1; 14, 1; the period of issuance thus covering two months and ten days. Nothing else appeared with these adults except a small mite, thus showing the absence of natural enemies. The section of wood was kept continually in the insectary, and, hence, under greenhouse conditions.

Allorhina nitida Linn. is usually not abundant, at least in Ohio and the neighboring States to the westward. In 1896 it was reported as working considerable injury to tomatoes at Sheep Run, Brown County, in the southern part of the State. The present year it was reported as being very abundant at Sugar Grove, in the central portion of the State.

A tachinid parasite, *Euphorocera claripennis* Macq., was reared from

a larva of *Cœlodasys unicornis* sent from Lenox, Ohio, August 18, with the complaint that they were doing considerable injury to plum foliage.

Conotrachelus nenuphar was reared July 19 and 21 from sweet cherries taken from an orchard near Wooster June 19. In sour cherries the species seemed much later, and the larvæ entered the ground July 15 from fruit purchased from a Wooster market July 12, and an adult appeared August 8. From the larvæ infesting the sweet cherries four examples of *Sigalphus curculionis* Fitch were reared.

From a lot of Japan walnuts and chestnuts received by the Storrs & Harrison Company, Painesville, Ohio, April 4, direct from Japan, a species of mite was found in immense numbers. Through the courtesy of Dr. Howard it was determined at the United States Department of Agriculture by Mr. Banks as belonging to the genus Tyroglyphus, but was not *siro*, *longior*, nor *agilis*.

Larvæ of *Papilio troilus* were found at East Cleveland, Ohio, July 31, 1896. These pupated on the following dates: August 5, imago issued August 22, 1896; August 1, 1896, imago issued April 10, 1897; August 15, 1896, imago issued April 23, 1897; the pupal period covering, respectively, 17, 253, and 251 days, all pupæ having been kept under the same conditions during the entire time. Larvæ of *Papilio cresphontes*, taken while feeding upon rue (*Thalictrum*), gave imagoes April 14, 1897, and July 6, 1897, showing a variation, under precisely like conditions, of fifty-two days.

The larvæ of *Onectra distincta* Wlsm. (probably) worked serious injury during the present year to young plum grafts in nursery rows on the grounds of the George Peters Company, nurserymen at Troy, Ohio. These larvæ would fasten together the terminal leaves of the young shoot, that was intended for the leader and expected to form the trunk of the future tree, and, living within this inclosure, not only devoured the leaves but the tip of the young, tender growth, thereby destroying the tree. Adults issued from these June 5 to 10, and these moths deposited eggs for a second brood.

A section of apple twig was received from Arlington, Ohio. June 8, 1896, containing a larva of *Oberea bimaculata*, boring longitudinally therein. This twig was spliced upon another of a similar size growing upon a small tree in the insectary. The larva continued its course downward in the living wood, eating out the heart and leaving only a thin cylinder of wood and bark. Round holes were eaten through the walls of this cylinder, at intervals, through which the excreta was ejected in filiform masses made up of oblong sections, usually of about one-sixteenth of an inch in length. Sometimes these would fall to the ground detached from each other and at other times they might be observed in sections of several, amounting in length to about one-fourth of an inch. On July 24 a similar larva was found in a twig of witch-hazel (*Hamamelis virginiana*), in the woods, and brought into the insectary. The voidings of the two larvæ were collected between the hours

of 11 a. m., July 27, and the same time on the following day. In the case of one the aggregate length of the voidings was $24\frac{3}{8}$ inches and the weight 0.05 gram; in the other the excreta was not in a shape to be measured, but the weight was exactly the same. The pupal stage was passed within the twig, the escape of the adult having been previously provided for and the cavity closely packed with chips at either end. The adult issued in the insectary, March 17, 1897.

Conotrachelus posticatus was reared in great numbers from a lot of acorns of *Quercus alba*, collected November 10, 1896. Many of these acorns were already perforated and the larvæ had presumably escaped, while very many others were still infested. The acorns were kept in the insectary, and on examination July 19, 1897, adults were found among them in great numbers, some having evidently quite recently emerged, while others had died, thus showing that the adults had been developing for some time. Several larvæ and a couple of pupæ were also found in small cells in the earth at the bottom of the cage in which the acorns were kept. These larvæ varied much in size, some of the smaller being not more than one-fourth the size of the larger and what appeared to be full grown. In the adults the size was very nearly uniform.

The grape root-worm, *Fidia viticida*, has still to be subjugated in the vineyards along Lake Erie, the increasing number of parasites notwithstanding. Some experiments were carried on last fall with tobacco dust, and also kainit, placed about the base of the vines to determine the possibility of destroying the larvæ in the ground. A small depression was excavated about the base of the vine, varying from 12 to 18 inches in radius. Tobacco dust, ranging in amount from one-half pound to 4 pounds, was placed in those shallow excavations and the surface lightly covered with soil. The vines were subjected to treatment July 29, 1896, and examined October 8 of the same year. The tobacco had almost entirely disappeared, no trace being left except a thin, dark-brown layer near the surface of the soil. No dead larvæ could be found about the roots of these vines, while the living ones were present as numerously as about those that had not been treated. The kainit was applied in the same manner, and also scattered over the surface of the ground along the rows of vines. In the excavations the strength varied from $\frac{1}{2}$ pound to 8 pounds, but was applied October 8, 1896, and the examinations were not made until April 5, 1897. The larvæ were apparently not affected in any way whatever, no dead ones being found, even on close examination, while living ones were as abundant as about the roots of untreated vines. In one case especially, where an application of 4 pounds had been made, and the kainit piled up directly about the crown of the vine, the larvæ were observed working apparently uninjured in soil among which the kainit was clearly perceivable, numerous masses of the size of a pea being found. Samples of the soil from about the roots of some of these treated vines were secured and tested to determine the penetrating power of the kainit.

The samples to be tested were taken in four series—the first from the strongest application, the second from the weakest, and the third to serve as a check, from untreated soil, while the fourth was taken from the special 4-pound application previously mentioned. Each series was composed of three samples, the first being taken at the surface, the second from a depth of 4 or 5 inches, and the third from a depth of from 10 to 12 inches from the surface. The tests were made by Mr. L. M. Bloomfield, assistant chemist of the Ohio Agricultural Experiment Station.

Of each sample 500 grams was digested in 1,000 cubic centimeters of distilled water for twenty-four hours, and in 50 cubic centimeters of the filtrate, equal to 25 grams of soil. The chlorine was determined volumetrically by a solution of silver nitrate, 1 cubic centimeter of which was equal to 0.003546 gram of chlorine. The result of these tests is shown in the following table:

Series.	Weight of kainit.	Sample.	C. C. of AG. No. 3.
I	8 pounds	1	4.00
		2	5.00
		3	6.5
II	½ pound	1	1.1
		2	1.3
		3	1.2
III	Check	1	0.3
		2	0.5
		3	0.2
IV	4 pounds	1	8.2
		2	9.5
		3	11.1

These tests show that while there was a slight trace of chlorine in the check soil the treated samples tested very much higher, the strength increasing with the depth from which it was taken in the vineyard, except in case of the weakest; so that none of the larvæ observed, which in all cases were found above and not below sample No. 3, could have escaped whatever action the kainit might have had as it penetrated the soil.

These experiments and tests clearly show that the kainit will penetrate the soil to a depth sufficient for all practical purposes, but that it can hardly be made strong enough to be effectual against this pest, and, besides, it passes far beyond the limit of practicability in point of expense at the maximum strength given in the foregoing.

In discussing this paper Mr. Howard called attention to the great interest attaching to the negative results from experiments with kainit. These results were entirely contradictory to those obtained by other experimenters, and indicated the need of having the subject gone over thoroughly and exhaustively.

Mr. Hart spoke briefly concerning an experience in destroying potato

beetles which had attacked the blossoms of tomato plants. By using white hellebore most excellent results were obtained.

Professor Rolfs inquired concerning the effect of kainit upon the vines. Mr. Mally stated that as yet no reports had been made on this feature of the experiments.

The following paper was then read:

ON THE PREPARATION AND USE OF ARSENATE OF LEAD.

By A. H. KIRKLAND, *Malden, Mass.*

Since spraying with arsenate of lead has become an important measure in the control of certain injurious insects, a brief statement of the methods followed in preparing this poison for use against the gypsy moth may be helpful to those who use large quantities of arsenical insecticides.

In our spraying operations of the past summer we have used nearly 3 tons of arsenate of lead mixture, made from the granulated white acetate of lead and from arsenate of soda of 50 per cent purity. The cost of these ingredients, from figures kindly furnished me by Messrs. William H. Swift & Co., manufacturing chemists, of Boston, Mass., are at present $7\frac{1}{4}$ cents per pound for acetate of lead, and 5 cents per pound for arsenate of soda. These figures, of course, are subject to more or less variation according to market conditions. To make 10 pounds of arsenate of lead, as used in our spraying operations in 150 gallons of water, there are required approximately 13 pounds $2\frac{1}{5}$ ounces of acetate of lead and 5 pounds $7\frac{2}{3}$ ounces of arsenate of soda. In preparing this mixture it should be borne in mind that the relative amounts of these two salts must be governed by their purity, and that in all cases there should be a slight excess of the lead salt.

As indicated by the writer in a paper read before the association at its last meeting, the best results are obtained by dissolving both salts separately and mixing the solutions in the spraying tank or in the supply tank where the latter is used. If the salts are mixed dry, the ordinary moisture of the air serves to bring about an incomplete reaction, and particles of the salts become coated with arsenate of lead and are transformed into minute, hard lumps, which clog the nozzles. Thus in order to gain the best results the necessary amounts of the two salts are placed in separate bags and the two bags tied together and labeled. To facilitate the work of weighing the salts, our chemist, Mr. F. J. Smith, makes use of two ballasts of the same weights as the required quantities of salts. By using these ballasts on balance scales two men can daily weigh, bag, and tie 1,000 pounds of the poison. For dissolving the acetate of lead and arsenate of soda preparatory to spraying, the salts are placed in separate baskets and each basket is then suspended in a 10-gallon keg filled with water. From fifteen to twenty minutes are required for the dissolving of the salts. When this quantity has

been dissolved and precipitated, the dissolving of a new lot is commenced, and in this way there is no delay in the preparation of the poison.

The cost of arsenate of lead mixture at the figures given is brought down to $131.69 per ton, or about 6½ cents per pound, exclusive of freight, labor, bags, etc. These latter factors should not increase the cost of the poison over one-half cent per pound, making the total cost of the arsenate of lead mixture in quantity about 7 cents per pound, against 12½ to 15 cents per pound, the price commonly charged for the dry mixture of the salts.

For ordinary use in woodlands or in places not readily accessible, the 150-gallon tanks have proved too cumbersome, and their use, with that of the heavy pumps which accompany them, has been abandoned. Our assistant director, Mr. E. C. Ware, has very satisfactorily demonstrated that much more and better work can be accomplished with a galvanized iron tank of about 25 gallons capacity, to which a Johnson pump has been attached. To prevent clogging, a strainer made of wire gauze, having 70 meshes to the inch, is attached to the base of the pump, while the flow pipe is removed and a hose coupling substituted. A Siamese connection is fastened to this coupling, thus enabling one to use two lines of hose. These tanks can be easily handled by two men, while the modified Johnson pump is of ample capacity for two lines of hose.

One factor of considerable importance in extensive spraying operations is the delay caused by the frequent clogging of the nozzles. In the tank I have mentioned the strainer at the base of the pump sifts out any foreign matter which may get into the tank, but even then the frequent coupling and uncoupling of the hose allows more or less rubbish to find its way into the nozzle. To overcome this difficulty, our machinist, Mr. John Hancock, has prepared a nozzle involving the cyclone principle, but containing a wire-gauze strainer of the same mesh as the pump strainer. This strainer is cylindrical in form and is contained in the posterior part of the nozzle, while the cyclone heads are attached to the outer part of the nozzle. Our first Hancock nozzles contained but a single head. A few days of practical use in the field, however, suggested the advantage to be gained from increasing the number of heads, and the pattern finally decided upon bears one head at its extremity and three at equal distances around the side. With this nozzle a fine mistlike spray may be thrown in all directions to a distance of from 8 to 10 feet.

To show the permanency of arsenate of lead when applied to the foliage in this manner, I have here samples of leaves sprayed June 1, 1897, on which the poison is still in an effective condition. These leaves were taken at random from trees in the infested woodlands August 5, 1897. On these trees the caterpillars were dying as late as July 26. While we can not consider spraying with arsenate of lead to

be an exterminative measure in the case of the gypsy moth, it certainly ranks as one of the very best control measures. Where infested woodland was sprayed the past season in the manner indicated, notwithstanding an abundance of very unfavorable weather, from 60 to 80 per cent of the larvæ were destroyed, and under favorable climatic conditions a thorough spraying soon after the eggs hatch will probably destroy 90 per cent of the larvæ.

Against ordinary leaf-eating insects it would be unnecessary to use the great amount of poison required in the case of the gypsy moth or elm leaf-beetle. Mr. Harold L. Frost, of Boston, Mass., who has had considerable experience in spraying trees to prevent the ravages of the cankerworm, tussock moth, and tent caterpillar, has found that from 3 to 4 pounds of arsenate of lead mixture to 150 gallons of water gives most excellent results in destroying these insects; and this is about the rate at which it would seem necessary to use the poison for effective results in ordinary cases. A comparison of the results of a large number of experiments and field tests which we have made show that from 3 to 4 pounds of arsenate of lead mixture are necessary to equal the effect of 1 pound of Paris green. With Paris green retailing at from 20 to 25 cents per pound, the cost of arsenate of lead mixture necessary to accomplish equal results would be somewhat greater than the cost of Paris green. But the arsenate of lead has many advantages over all other arsenical insecticides, prominent among which are its low specific gravity (being scarcely heavier than water), which renders it easily suspended in the spraying tank; its characteristic color, by which its presence on the leaves can be readily detected, and its great permanency on the foliage. Of course the chief merit possessed by this poison is the fact that when properly prepared it will not injure the foliage if applied at any ordinary strength.

Another arsenate of lead—the di-plumbic arsenate—has been prepared by Mr. Smith, at a somewhat less cost than the preceding, from nitrate of lead and arsenate of soda. Upon this insecticide our chemist is now at work, and from field tests made this summer quite promising results have been obtained. So far as is now known, there are no by-products available for use in the manufacture of arsenate of lead; hence the cost of this substance must be governed by the cost of the raw materials plus that of the processes involved in bringing them into available forms. From the economic as well as from the scientific standpoint the subject of the arsenates of lead offers a wide and interesting field for research—a field in which the chemist and physiologist must labor together.

At the conclusion of this paper, Mr. Kirkland made a brief statement concerning the appearance of the European brown-tailed moth in eastern Massachusetts, and exhibited specimens. The insect was apparently confined to four or five cities and towns. Most unfortunately,

however, at the height of the flying season there was a strong southeasterly gale, which probably scattered the flying females a considerable distance. Replying to inquiries which had been made concerning the present condition of the territory infested by the gypsy moth, he stated that the work had been carried on along the lines of previous years with good results. An early appropriation permitted an extensive preparation for the larval season, and over 300 acres of badly infested woodland were cut over and put in order. In spite of the season, which greatly favored the increase of the insect, and an insufficient appropriation, marked progress had been made along the lines of extermination. The city of Cambridge was cited as one case where over 1,200 infested estates had been cleared of the moth. The outlying region still contains scattered colonies, but in each town the number of these colonies is less than that of previous years. The infested region has been thoroughly examined and is now under control. The great need is for funds with which to carry on an aggressive campaign over the whole district. In 1891 the problem was, Whether or not the gypsy moth could be exterminated. This is a problem no longer. The moth can be exterminated, as has been proved in countless instances. A more serious problem, however, confronts the committee having the work in charge, viz: How to obtain sufficient funds for the needs of the work. The protection which Massachusetts is giving other States was touched upon, and the statement made that there seemed to be a growing feeling on the part of the people throughout the State that other States should share in the expense of combating this insect.

Upon request of Mr. Howard, Mr. Kirkland stated that the present year there had been a marked disposition on the part of the caterpillars to remain away from the burlap, possibly as a result of natural selection, but more probably explained by the fact that the damp weather of the past season has led to an abundant growth of foliage, thus affording the insects ample shade, and, to a certain extent, protection from their natural enemies.

The following paper was then read:

NOTES ON THE MALODOROUS CARABID, NOMIUS PYGMÆUS, DEJ.

By Walter B. Barrows, *Agricultural College, Michigan.*

In the summer of 1895 my attention was called once or twice to a peculiarly offensive odor which appeared suddenly at night and lasted only a few moments, disappearing as suddenly and mysteriously as it came. This was on the grounds of the Michigan Agricultural College, Ingham County, and the odor was noticed while sitting on the piazza of my own house. Mentioning it to my neighbors, I found that they had noticed the same thing occasionally, but had attached no importance to the matter. One lady, however, stated that while sitting on

her piazza one evening a "little bug" flew into her face and became entangled in her hair. While trying to remove it she was almost overcome by the sickening stench which seemed to be emitted by the insect, and which clung to the fingers for hours afterwards in spite of repeated washings. The crushed remains of the "bug" were placed in a little bottle with the intention of showing them to me, but had been forgotten until my inquiries recalled the matter, perhaps a month later. By that time they were so few and so badly decomposed that I was only able to see that they must have belonged to a very small carabid beetle, but as no odor whatever remained, and as some doubt existed as to these being the veritable remains of the original "bug," the matter was dropped.

During the summer of 1896, however, the same disgusting odor appeared in various parts of the campus with a frequency which was extremely disagreeable, and it became so noticeable and occasionally so overpowering on the piazza that the family found little pleasure in sitting out of doors on warm evenings, and I was sorely puzzled. An incandescent electric lamp hung from a tree about 25 feet from the piazza, and among the many insects attracted by it were many lacewings (Chrysopa), with whose odor I was perfectly familiar, and for some time I endeavored to connect our mysterious affliction with these insects, but without success. The dog, the children, the neighbors, the privy, and the sewer, all fell under suspicion in turn, and all but the last were speedily exonerated. The roof pipes and all other openings leading to the sewer were examined and sniffed at without result. The lattice about the base of the piazza was opened by day and by night and the space beneath was thoroughly searched for offensive matter, animal or vegetable, all to no purpose. The attic and walls of the house being inhabited by several families of red squirrels and flying squirrels, it was thought possible that some of them had died, or possibly had carried young birds into their nests and left them to decay. It is no uncommon thing to see the red squirrels carrying off young robins from the nest, or eating them in the sight of the enraged parents. With this in mind, holes were bored in the box posts of the piazza and the most susceptible noses applied, but without the detection of anything unusual. I circumambulated the foundations of the house on all-fours, with nose to the ground, to the edification of the spectators, but without any nearer approach to a solution of the problem.

Early in August last year, and while still puzzled by the continuance of the nuisance, I received the following letter from Mr. Charles Hebard, of Pequaming, Baraga County, Mich.:

PEQUAMING, BARAGA COUNTY, MICH., *August 9, 1896.*

SUPERINTENDENT AGRICULTURAL COLLEGE,
Lansing.

DEAR SIR: For the past two years we have been frequently annoyed by an insect that emits a horrible odor. One live one will scent a whole room.

At first we thought there were dead rats under the veranda, but finally discovered

this insect. I inclose two very imperfect specimens that were found dead and have lost most of their charm. Can you give me any information about them? I am unable to get a living or perfect specimen.

Yours, respectfully,

CHARLES HEBARD.

I was able with some certainty to identify the fragments which accompanied this letter as those of the carabid *Nomius pygmæus*, but having no specimen of this species in our collection for comparison, one of Mr. Hebard's specimens was sent to the Entomological Division of the Department of Agriculture, at Washington, and the identification confirmed by Mr. E. A. Schwarz, who also sent me several references relating to its previous capture in the United States.

It was by this time September, and the odor was less often noticed and finally disappeared entirely without my securing a single specimen in my own locality, and it must be confessed that I still had a lingering doubt as to this explanation of the nuisance from which we had sufferred so long. True, it accounted satisfactorily for all the observed phenomena except the magnitude of the smell itself, but it did not seem possible that such a minute beetle—hardly a quarter of an inch in length—could be the author of such a volume of odor. During the present season, however, I have satisfied myself on this score completely, and have taken the beetle "in the act" at least half a dozen times. Some of these specimens are here for examination by anyone interested, and one—a captive for the past three weeks—is still alive and presumably able to demonstrate the strength of his position. As little seems to be on record regarding this species, and as it appears to be nowhere very common, the few facts which have come to my knowledge lately may be of interest.

That the species is by no means uncommon in this locality, Ingham County, is proved by the fact that during hot, damp weather an evening seldom passes that we do not smell it, and sometimes the odor is noted a dozen times in a single night. Very often it becomes necessary to go into the house and close the doors and windows until the smell has disappeared. Not only is this true of my own residence, but the same facts have been noticed about several other houses on the campus, and recently at a lawn party in Lansing the smell became so bad that guests were constrained to leave the grounds. In one instance I was awakened in the middle of the night with a choking sensation and found the room filled with the well-known effluvia, which streamed in through the window screen.

Sometimes the stench lasts only a few seconds, sometimes comes and goes at short and irregular intervals, sometimes lasts for half an hour or more. The beetles seem to fly only at night and to throw out the smell only when attacked or at least threatened by an enemy.

After a long hunt I discovered my first specimen struggling in a spider's web in a corner of the piazza, and since that time have obtained many more by looking in all the webs near the point at which the

stench is strongest. Many times, no doubt, when caught in a spider's web, the beetle succeeds in disengaging itself by struggling, at the same time emitting its powerful scent in the hope of keeping off its adversary. This will account for the fact that in many cases no beetle can be found on examining all the likely places, but in such cases it is noticeable that the smell usually disappears after a moment or two, indicating, it would seem, the escape of the prisoner.

In one case I took a struggling Nomius from the web of a small spider in my wood shed where the stench was almost unbearable. The spider was actively engaged in winding up his victim and the latter was already so enveloped as to be entirely invisible. I took him out with the end of a match, slightly injuring the web, but not touching the spider at all. Next day on looking at the place I found the spider hanging limp and dead in the web. Distrusting my eyes at first, I removed and examined her carefully to make sure that I was not deceived by a moulted skin, but there was no mistake. Of course it may have been a simple coincidence, but it is hard to understand how any spider or insect could long resist such a stench, and I am inclined to believe that this spider actually was killed by the secretion of the Nomius. Since this occurred I have taken but few specimens, and these mainly in a dying condition, so that I have had no good opportunity to experiment in this direction. However, I have not found any more spiders dead in their webs, and certainly all the spiders in whose webs I have seen specimens entangled seemed to be using all their powers to capture the victims, apparently anticipating a glorious feast.

The presence of electric lights may have drawn these insects about the houses in larger numbers of late years, but I have never yet taken one very near a light and have found—or at least smelt—nearly as many about the unlighted sides of the house as in front where the light is brightest. It seems to me more probable that the electric lights have simply increased the number of spiders' webs about our houses, thus offering more frequent opportunities for Nomius to become entangled, after which our attention is naturally attracted by the odor. Whatever may be the explanation of their presence, it is clear that a very simple way to avoid most of the disagreeable results of their coming is to keep the piazzas, window casings, blinds, and corners free from spiders' webs.

I have collected many species of carabids under sticks, stones, leaves, and rubbish of all kinds, and have kept a sharp lookout for this species in all situations, but with a single exception all my specimens have been taken from spiders' webs outside the house; and the single exception was that of an individual which probably had escaped from such a web and was resting on the piazza floor when found.*

*Since the above was written I have taken many more about the same piazza, most of them entangled in spiders' webs or resting on the floor, steps, or ground, and in these latter cases almost invariably engaged in freeing themselves from bits of the web, from which they evidently had just escaped.

Of the geographical distribution of *Nomius pygmæus* I know nothing except what I have learned from Mr. E. A. Schwarz. In his annual address as president of the Entomological Society of Washington for the year 1888, he says (p. 182):

> The following are examples of remarkable distribution, of which I am unable to offer a satisfactory explanation: *Nomius pygmæus*, a neat looking carabid beetle, but justly dreaded by those who have had an opportunity of finding it, on account of its overpowering fœtid odor, occurs in Washington Territory, Oregon, at Lake Superior, and on the high mountains of North Carolina, a distribution participated in by several species of distinctly Arctic origin. The same species occurs as an extreme rarity in southern Europe, specimens being occasionally found in southern France, Hungary, and Greece. An importation of this species, which is by no means common even in North America, by the agency of man is utterly inconceivable.

Under date of July 29, 1897, Mr. Schwarz writes me that it has also been found in the mountainous regions of Georgia and Alabama, in Ottawa, Canada, Marquette, Mich., Colorado, and (probably northern) California. He also informs me that in one case it took possession of a boarding house in western Pennsylvania and rendered it temporarily uninhabitable.

The life history of *Nomius pygmæus* is entirely unknown, but it is believed to pass its larval existence in very wet places, probably among the vegetation of swamps.

Mr. Schwarz, in discussing the previous paper, remarked that from his own experience in handling living specimens of *Nomius pygmæus* he could fully corroborate Professor Barrows's statement regarding the powerful stench emitted by this beetle. In company with Mr. H. G. Hubbard he had found this species quite abundantly at Marquette, Mich., where it had been washed ashore by the waves of Lake Superior. He also pointed out that as long as the habits and real habitat of the beetle remained unknown nothing could be done to abate this nuisance. He thought it probable that the beetle and its larva would be found to inhabit very wet, swampy places. Another carabid, *Psydrus piceus*, which with *Nomius pygmæus* constitutes the tribe Nomiini, lives under moist bark of prostrate pine trees throughout the more western portion of boreal America, and also emits an unpleasant though much less powerful and less persistent odor than Nomius. The latter species does not have the body flattened as in Psydrus, and for this reason is not likely to live under bark.

Upon motion of Mr. Ashmead, a vote of thanks was passed to the local committee for their kindness and many courtesies in providing for the meeting. After passing a vote of thanks to the president and secretary, the final adjournment was taken.

A. H. KIRKLAND,
Secretary pro tem.

In the absence of the authors the following papers were read by title:

NOTES ON INJURIOUS INSECTS OF FRANCE, ALGIERS, ETC.

By PAUL MARCHAL.

[Withdrawn for publication elsewhere.]

THE PEACH TWIG-BORER.

(*Anarsia lineatella* Zell.)

By C. L. MARLATT.

[Withdrawn for publication elsewhere.]

NOTES ON INSECTICIDES.

By C. L. MARLATT, *Washington, D. C.*

The following notes are in part reports of experiments which are continuations, as a rule, of older work, some of which has already been presented before this association, and include also some notes on insecticide operations in California, based on an examination of the situation and methods there during October and November, 1896. (See Yearbook, Dept. Agric., 1896, pp. 217–236.)

SOAPS AS INSECTICIDES.

There is no more unsatisfactory substance to work with against insects than soap, for the reason, previously pointed out, of the extreme uncertainty of the composition and characteristics of any brand that is secured. The most earnest efforts on our part to get manufacturers to make a definite brand of soap which approached our ideal, and to keep the stock at a uniform and reliable strength and character, have been entirely unsuccessful, and we have not been able to get any two consecutive lots of soap having the same characteristics or value for insecticide purposes. Perhaps the best soap which has been put on the market recently is "Good's No. 3." This is a soft soap, shown by analysis of the sample which we purchased to be a true potash soap, but containing perhaps from 27 to 28 per cent of water. The amount of this brand of soap which Mr. Good is now making may be indicated from the fact that up to March 26, 1897, he had sold upward of 25 tons. Mr. Good tells me that in the making of it he combines at one time 8 50-gallon barrels of fish oil and about 650 pounds of potash, or the equivalent of a barrel and a half more in bulk of potash, making $9\frac{1}{4}$ barrels of material, not including the water. From this he gets from 12 to 13 barrels of soap. This indicates about 30 per cent water, and our

analysis shows about the same amount. This soap, however, is never absolutely alike, and sometimes, as shown by extended work conducted by Captain Emory, is very unsatisfactory. The coarse waste fish oil or "foots" which he uses varies greatly at different times, and there is probably also a variation in the lye used, but, for that matter, I am not at all sure that his statement that he invariably uses caustic potash can be relied on from our earlier experience with him and his soaps.

In connection with the subject of the water percentage in soaps, I wish again to call attention to the fact that various publications intended for the practical farmer continue to give formulas for making soap which promise several or many times more soap in weight than the amount of lye and oil used. In other words, the formulas call for the use of a very large quantity of water. In our notes on soaps last year it was shown that in the best brands of hard soap the water did not exceed 12 to 15 per cent, and therefore any formula which necessitated the presence of 50 to 75 per cent or even greater percentage of water meant a soap already diluted with water to that extent when purchased, and not to be employed except at correspondingly greater amount in the formulas for washes based on standard hard soaps.

In the experiments of last year also it was seen that the nature of the lye used, whether a soda or potash lye, did not seem always to offer a means of explaining the behavior of the soaps, in that some of them would be fluid in strong solution while others would solidify or become gelatinous. We have during the past year tested a great many formulas for making soaps, repeating them often several times, with slightly varying portions of ingredients, with the intention of determining if possible the secret of making a soap which will remain fluid when dissolved at the rate of 2 pounds or thereabouts to the gallon of water. Our work of last year having apparently indicated that the lye used did not always explain the difficulties in this direction, experiments were first made with caustic soda (sodium hydrate), which is the lye commonly used by soap makers, with the addition of various quantities of salt and lime. With salt nothing satisfactory was gained, but it was early found that the addition of lime to a soap in sufficient quantity would break it up in such a way that it remained of a fluid consistency when cold even in very strong solution. Not only could the lime be added to soaps in the process of making and bring about this result, but any soap which in dilution hardened on cooling if intermixed when dissolved with the proper amount of lime would remain semi-fluid. The amount of lime necessary is considerable, however, and it was evident that the apparent fluidity of the soap with lime was merely due to the formation of the lime-soap salt precipitate seen in the use of soap with hard water, and the soap so broken up has more of a granular consistency than a real fluid and its value as an insecticide is very doubtful. The amount of lime necessary for the breaking up of hard soap which solidified in dilution on cooling was about at the rate of 1

ounce to the quart of diluted soap. This was true of the Leggett brand of soap now on the market, which in the matter of solidifying in dilution has lost the characteristics of the old brands and seems no better than any other soap in this particular.

The possibility of making soap with caustic soda suitable for spraying purposes as a winter wash by the addition of lime was now abandoned, and a number of formulas were tried for making soap with caustic potash (potassium hydrate). With this lye and fish oil we secured good soaps for spraying purposes, not very hard but behaving admirably in solution. Caustic potash and oil, as we have pointed out in former papers, yields ordinarily a soft soap, unless there has been a very considerable admixture of hard fats with the oils. We found that without considerable boiling a potash oil soap would ordinarily retain about 25 to 30 per cent water, as in Good's No. 3. This amount can be reduced by prolonged boiling to almost any extent, but the expense of boiling after two or three hours becomes a considerable item. The soap thus obtained agrees practically with Good's No. 3, the composition of which was verified for us by a chemical analysis kindly made by the Department chemist, Dr. Wiley. Our examination of the soap question up to the present time seems to indicate that we will have to insist on a potash soap made with a fair quality of fish or menhadden oil, and that the water should be eliminated by boiling so as not to exceed at the outside 25 per cent of the weight of soap. Such soap can be used at the rate of 2 pounds to 2½ pounds or more to the gallon of water as a winter wash without difficulty. In buying soap the manufacturer should be given to understand that unless the soap comes up to the requirements payment will not be made, and he should be required to deliver it subject to the test at his own risk. Without taking some positive stand like this, and making the manufacturer suffer when the character of his product warrants it, it seems impossible to teach them any lesson which remains very long in mind. The constant temptations on their part, from the standpoint of profit, is to use refuse oils and fats of all sorts and inferior grades of potash, if potash be used at all, which is very rare, and the result is a thorough uncertainty in the product.

THE RESIN WASHES OR COMPOUNDS.

The resin wash is distinctively a California insecticide, used there much more generally than kerosene emulsion and ordinarily employed in the important citrus districts extending from Los Angeles to Redlands. It is often prepared, and the work of spraying is often done by contractors, who agree to clear orchards from scale at a given charge per gallon, usually 4 cents. For small trees, 5 years old and under, 1 gallon is sufficient per tree. Trees of twenty or thirty years' growth require from 6 to 8 gallons.

The formula for this wash varies in different sections. The summer wash usually contains 20 pounds of resin, 5 pounds of crude caustic soda (78 per cent) or 3½ pounds

of the 98 per cent, and 2½ pints of fish oil. The winter wash contains 30 pounds of resin, 9 pounds of crude soda, and 4½ pints of oil. The ingredients are boiled in about 20 gallons of water for two or three hours, hot water being occasionally added until 50 gallons of solution are made. This, for both formulas, is diluted to 100 gallons before application to trees. Greater efficiency is believed to come from long boiling of the mixture, and it is preferably applied hot.

It is used on deciduous trees for the black and San Jose scales and on citrus trees for the red and black scales; but the dense foliage of the latter renders thorough spraying difficult except for young trees, and fumigation is much preferred. An improperly made resin wash is also apt to spot the fruit of the orange.

During the last few years the resin wash has been made the subject of some experiment by some agents of the Division of Vegetable Pathology in Florida and some new formulas have been given in a recent bulletin by Mr. Webber on the sooty mold of the orange. I have tested these various formulas very carefully in connection with the formulas ordinarily given in entomological publications. The objection which was made to the California formula in Florida was the prolonged boiling which it required—from two to three hours—and in the formulas suggested by Messrs. Webber and Swingle the boiling is merely sufficient in most cases to dissolve the ingredients.

In connection with the testing of these formulas the California resin wash was also made after the old rule and with some variation as to the length of time of boiling. So far as these experiments went there seemed to be no advantage attaching to the new formulas for the wash. The Florida resin wash on cooling presented a very objectionable, doughy deposit, which necessitated reheating before it could be diluted. The Florida stock solution of the same did not leave such deposit. Webber's resin compound yielded a great deal of objectionable sediment, and this is also true of the Swingle formula. The California resin wash, however, described in our publications can be made with long or short boiling. The long boiling—two or three hours—is considered in California to give additional merit by effecting a more intimate combination of the ingredients. By boiling merely enough, however, to melt and thoroughly incorporate the resin and oil with the lye a solution is produced differing not at all in apparent characteristics from the one obtained by long boiling and at the same time not presenting the objectionable deposits on cooling noted in the case of several of the Florida washes. We are therefore inclined to adhere to the formula which we have hitherto used for the preparation of this wash. For some purposes the prolonged boiling is probably unnecessary, which may apply to its use as a means of removing the sooty mold.

PURE KEROSENE.

The discussion of this substance at the last meeting of the association led to some additional experiments on our part with the use of pure coal oil or kerosene on plants. Various trees, including young

and vigorous peach, pear, cherry, and apple trees, euonymus bushes, and some old bearing peach trees, were thoroughly sprayed with pure kerosene early the past spring, with one exception, before the buds had begun to swell. In the case of two large bearing peach trees the blossom buds were swelling and opening and these trees were also badly infested with *Diaspis lanatus*. The other plants, with the exception of the euonymus bushes, were healthy and free from all insects. Much to my surprise and astonishment, no ill effects of any moment resulted in the case of any of the trees sprayed with kerosene. In the case of all the trees spraying was continued just long enough to moisten the plants thoroughly, but not to cause the oil to run down the trunks and collect about the base, and with the young trees the soil was carefully mounded up and pressed about the crown to avoid all danger of the oil collecting at that point.

The pear trees treated, and also the peach, came out in full bloom, the opening of the blossom buds not being at all interfered with by the oil bath. After the bloom fell the peach trees treated with pure oil made much finer growth than untreated trees. This may have been in part due to the more favorable location of the trees, and possibly also to the fact that in the treatment with the coal oil the eggs of Aphides on the trees had been entirely killed, whereas on the untreated trees a very bad infestation with plant lice developed early and checked the growth of the trees, killing some of them. No Aphides, however, appeared on the sprayed trees. In the case of the pear trees particularly, and also the apple, the unfolding of the leaf buds was very noticeably delayed as compared with untreated plants, the buds seeming to open up much more slowly, and for two weeks at least the difference was very marked. Very soon thereafter, however, the treated trees overtopped the others both in abundance of foliage and amount of new growth, and at the present writing, July 20, there seems to have been no injury whatever as a result of the treatment.

The large peach tree sprayed showed no ill effects, and all of the scales on the tree were killed except where they had been protected in a few instances by masses of leaves webbed about the limbs. At least 99 per cent of the scales were killed. On the euonymus a similar result was shown, at least 99 per cent of scales having also been killed by the oil.

These results are so greatly in contrast with those previously attained in the experiments conducted in practically the same way that it seems difficult to account for them. That spraying with pure oil will often kill trees can not be doubted, even when applied in the dormant condition in winter, as demonstrated by experiments on a number of apple and peach trees two or three seasons ago. It is possible that with these earlier experiments the same care was not employed to prevent the collection of oil about the trunks of the trees and the trees were not mounded up, but the work was as carefully done as would ordinarily

be the case in actual practice, and probably much more so. It is possible, therefore, that the death of the trees in some instances was due to the collection of the oil in the cavity formed about the trunk by the swaying of trees in the wind, which, as will be shown later, has had disastrous results in California with the emulsion even. Others have reported the use of oil on trees without injurious effects in some instances and in others with injurious effects, so that pure oil as an insecticide is one to be used with caution and with full appreciation of the fact that the death of the plant may result.

In this connection I wish to call attention again to the lastest perfected spraying apparatus made by the Deming Company for the mixing of oil and water in the act of spraying. This apparatus, which is a slight improvement on the old and made to use with a bucket pump, we have experimentally tested, and it seems to give with considerable regularity the proper percentages of oil and water called for by the indicator. As one of our principal objections to this contrivance as formerly constructed was the fact that it was not uniform in this particular, the present apparatus seems in a measure to have invalidated this objection. Kerosene mixed with water, however, is not nearly so powerful an insecticide as the kerosene soap emulsion. It does not remain nearly so long on the plant and is not nearly so effective an insecticide at the same strength of oil. The heavier soap or milk emulsions kill more effectively, which perhaps is explained by the heavier liquid actually bringing more oil in contact with the insect and also by its greater permanency.

USE OF KEROSENE EMULSION IN CALIFORNIA.

This insecticide is used to a very considerable extent in California, much more so in recent years than formerly. It is the principal insecticide used in the district about San Diego, and is also used extensively at Santa Barbara and to a less extent elsewhere in the State. The necessity for the use of very large quantities of insecticides in California has led to the establishment by private parties in several instances of steam or gasoline plants for the wholesale production of this insecticide. Probably the first extensive manufacturing plant of this sort was set up by Mr. W. R. Gunnis, county horticultural commissioner, of San Diego, who manufactures the emulsion by the aid of a small engine, doing all the work of heating, churning, etc., by this means. With coal oil at 11 cents per gallon, he is able to produce the emulsion at a charge of 13 cents per gallon in the undiluted state, which makes the wash as applied to the trees, diluted 7 times, cost a little over 1½ cents per gallon. In his district, Mr. Gunnis claims that the loss from scale insects has been reduced from 79 per cent. to 7 per cent., chiefly by the use of this wash.

At Santa Barbara the superintendent of the Las Fuentos ranch, Mr. Frank Kahles, has set up a very large plant for the manufacture of

kerosene emulsion for the use of this ranch alone. The plant is similar to that devised by Mr. Gunnis, and the capacity is such that the emulsion can be made in quantities of 150 gallons at a time and very rapidly. He uses a formula slightly different from the Hubbard. The proportions are 35 gallons of whale-oil soap, 100 gallons of kerosene oil, and 50 gallons of water. This is diluted for application to trees with 7 parts water, costing in the diluted state $1\frac{3}{8}$ cents per gallon.

Kerosene emulsion has probably been given its most extensive trial on the Pacific Coast at the Las Fuentos ranch. Two years since Mr. Gunnis sent his excellent spraying apparatus to Santa Barbara, together with some 8,000 or 10,000 gallons of emulsion, and thoroughly sprayed the lemon plantings, comprising upward of 25,000 trees.

In some of the earlier work many trees were killed, owing probably to the accumulation of oil in the bottom of the reservoir or tank, so that the last three or four trees with each filling received an unusually heavy dose, which, running down the trunk, collected in the cavity about the crown caused by the swaying of the trees in the wind. The accumulation of oil in this way may be prevented by giving the tank a conical bottom, so that the liquid may be thoroughly exhausted each time before refilling, and as a further precaution, before treating, the trees may be mounded up about the base and the earth thoroughly compacted. With these precautions no injury has resulted from the later sprayings. The treatment kills the young of the black scale and the fungus breaks up and soon peels off.

LIME, SALT, AND SULPHUR WASH.

As the members of the Association are aware, this is the almost invariable remedy for the San José scale on the Pacific Slope, and as a rule it is undoubtedly effective. Our experience with this wash in the East had thrown doubt on its real efficiency as an insecticide, and it has been clearly demonstrated that under the climatic conditions east of the Alleghanies it is almost valueless. In California, however, after a careful study of the facts in the field, I am compelled to admit that the demonstration of its usefulness against the San José scale is complete and the benefit of its application to orchards is most manifest. In the vicinity of Pomona, Cal., unsprayed orchards were badly infested with San José scale, while in adjoining sprayed orchards the scale was entirely killed and the trees were rapidly recovering and showing vigorous and healthy new growth. In contiguous orchards, also, of the same kinds of trees, similarly treated so far as cultivation is concerned, the trees which had been subjected to yearly spraying were at least one-third larger than untreated trees. This wash is of value also as a fungicide, protecting stone fruits from leaf fungi, and is also a protection against birds, the common California linnet doing great damage to buds in January and February. The wash is almost invariably made and applied by contractors, and costs about 5 cents per

gallon applied to the trees. It is a winter application, being applied in January and February.

Along the coast region and in northern California, where moister conditions prevail, this wash is very much less successful, bearing out somewhat the experience of the East, and doubtless explained by the similarity of climate in the districts mentioned with that of the Atlantic Seaboard. In making this wash the chief consideration seems to be prolonged boiling. The wash itself is practically a sulphide of lime, with much free lime and salt carried with it. Prolonged boiling will result in taking up temporarily additional sulphur, and will perhaps add to its caustic properties if it is applied very hot; on cooling, however, it reverts to the simpler tri- or bi-sulphide of lime. The proportions of the ingredients and the method of combining them vary slightly in different sections. The following is the ordinary formula: Unslaked lime, 40 pounds; sulphur, 20 pounds; salt, 15 pounds; one-fourth of the lime is first slaked and boiled with the sulphur in 20 gallons of water for two or three hours; the remainder of the lime is slaked and together with the salt is added to the hot mixture and the whole boiled for half an hour or an hour longer. Water is then added to make 60 gallons of wash. This wash is applied practically every year, or as often as the San José scale manifests itself in any numbers. In the coast region and in the northern part of the State it is necessary to apply it with greater frequency than in the interior districts.

HYDROCYANIC ACID GAS.

During the past year a number of trees and plants have been treated with this gas at the Department, both as a means of disinfecting stock to be sent out by the Division of Pomology and against scale insects on the Department grounds. The method of using this gas as at present practiced in California has been fully described by the writer in the last Yearbook of the Department, the details differing little from the old description, except in the fact that pure cyanide is used—at least 98 per cent, instead of the old brand of 58 per cent—and the treatment is always continued about forty-five minutes, whatever be the size of the plant. The experiments that we have made here have shown that the cyanide must be used, in our drier and colder climate, at one-third greater strength than used in California, and for winter work on leafless trees double strength can be used without danger to the plant, and will give much greater assurance of effectiveness against the insect. We have employed this gas against the euonymus scale and against the *Diaspis lanatus* on large peach trees, in addition to the treatment of young orange and lemon trees for the white fly, which were to be sent out to various parts of the country, and the disinfection of miscellaneous stock. All of this has been very successful, and has demonstrated the superior effectiveness of the gas as an agent of thorough work. The comparative results with gas and

spraying were especially demonstrated to the decided advantage of the former in the work against *Diaspis lanatus* on large, bearing peach trees. In the case of trees sprayed with pure kerosene, as noted above, all the scales were killed except where they had been protected by adhering masses of leaves, which in a number of instances were attached to the limbs by insect or spider webs. In such situations the scales were not touched by the kerosene and escaped injury. In the tent treatment, however, not a living scale could be found, and the death of the scales was just as complete under the protections noted as where exposed.

In connection with the use of this gas attention may be called to the experiments made with "formaldehyde" gas, which was experimented with at the suggestion of Dr. E. A. de Schweinitz. This gas, which is a well-known germicide and disinfectant, it was thought might have some value as an insecticide. The generation of the gas is not difficult, and if it had proven to be of any service against scale insects it would have been a valuable addition to known means. It is, however, very irritating to the nose and mucous membranes, and hence would have had this objection. Scale-infested shrubs of euonymus were subjected to this gas for forty minutes, the gas being generated at the maximum quantity for the size of the tent. No results whatever were obtained, however, with this gas in the killing of these scales, it apparently not having injured them in the least, and its use as an insecticide, therefore, is not worth considering in comparison with hydrocyanic acid gas. It is, however, stated to have killed young ticks subjected to it in laboratory experiments, but not the adults, nor will it kill roaches, and even as a germicide it is not effective against all disease germs.

STEAM AND SUPERHEATED WATER.

The use of steam for destroying insects is not a new method, but has recently been extensively experimented with by Dr. S. M. Woodbridge, of South Pasadena, and the writer had the pleasure of assisting in a practical demonstration of the process and of noting the results of earlier experiments. The method is very simple and practically identical in operation with the gas treatment. The steam is generated in a boiler, the one employed carrying 80 pounds, and is introduced into the tent by means of a hose. As practiced by Dr. Woodbridge, the hot steam is first directed by hand over the trunk and larger limbs; the end of the hose is then inserted in a box which has been perforated with inch auger holes, the object being to so distribute the steam in the tent as to prevent its burning the foliage by striking forcibly in one direction. The steam is left on until the temperature, determined by an inclosed thermometer, rises to 120° F. in the tent. Two degrees higher will not injure the tenderest growth, but a temperature of 125° and upward will kill every blossom, bud, and leaf.

The time required to bring the tent to the proper temperature varies with the day and prevailing winds. A tent covering a tree 10 feet in

diameter by 12 feet high can be brought to the temperature named in from five to ten minutes. When the necessary degree of heat is reached, the steam is partly shut off and the mercury maintained at the desired point for seven or eight minutes. The tent is then removed. On the trees treated to the limit of safety, as described, the red scale is killed on the leaves and twigs, but is not affected on the fruit. It is claimed for this process, on which there is no patent, that it is much cheaper than the use of gas, and that a 25-horsepower boiler will furnish steam in ten hours for 100 trees averaging 25 feet in height. The further advantage claimed for this treatment is that it is said not to affect beneficial insects. The objections to the treatment are the necessity of carrying a cumbersome steam apparatus through the orchard, and the fact that the tents are liable to become wet from the steam and difficult to handle. It is also less successful than gas, which kills the scales on fruit as well as on leaves and twigs. The experiments, however, have demonstrated that good results can be obtained, and it is possible that in the future something practicable in the destruction of scale insects may be accomplished with steam.

In connection with the experiments with steam a demonstration was given of the use of superheated water. This also necessitates the use of a boiler, as in the former case. The water which may contain an insecticide or be used merely as a hot spray, is raised to a temperature in the boiler indicated by 40 pounds pressure. This, when liberated through a nozzle at the extremity of a long hose, is equivalent to a pressure of about 150 pounds. The liquid escaping from the hose breaks up into a forcible half-steam spray even with a very simple nozzle formed by a compressed gas pipe, and is directed onto trees as in ordinary spraying operations. The principal advantages are that the spray pump is dispensed with and that the liquid is applied at an elevated temperature. The spray is, however, cool to the hand in the center of the stream at a distance of 18 inches, and on the edges at a distance of 8 inches from the nozzle, and is not too hot to be borne by the hand at a distance of 6 inches from the nozzle. This indicates that the temperature of the liquid itself will not ordinarily be sufficient to kill the insects. This experiment with superheated water was especially interesting as indicating the futility of attempting to kill insects by means of hot sprays. The difficulty of recharging the apparatus and the cost of the steam plant will probably render this, as a method of applying liquid insecticides, impracticable in comparison with the gasoline-spray engines and ordinary spray pumps now in use.

ARSENICALS AND LIME.

The advantage of the employment of lime with Paris green or London purple having been called in question at the previous meeting of this association, the matter was again made the subject of experimental test, and the old belief of the decided protective value to the foliage of the addition of lime was fully and strikingly demonstrated.

THE BEAN LEAF-BEETLE.

(*Cerotoma trifurcata* Forst.)

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

The discovery the present season of a small leaf-beetle related to and somewhat resembling, superficially, the twelve-spotted cucumber beetle (*Diabrotica 12-punctata*), and known in collections and in literature generally as *Cerotoma caminea* Fab., upon beans in portions of Maryland and Virginia, makes it probable that this species is on the increase as an enemy to beans, and that it is liable to become a pest of some importance to the bean crop, at least in this portion of the United States.

LITERATURE AND HISTORY OF THE SPECIES.

Recent research shows that this species was described by Forster in 1771 (Nov. Spec. Ins., p. 29) under the specific name of *trifurcata* and later in 1801 by Fabricus as *caminea*, Forster's name antedating the Fabrician one by thirty years.

What appears to be the first notice of the occurrence of this species on the bean, in fact the first mention of any sort of the habits of this species, is that published by Prof. E. A. Popenoe, in the Transactions of the Kansas Academy of Sciences for 1876 (p. 35). It was first recognized in 1875 in Shawnee County, Kans., "in great numbers, eating the leaves of dwarf beans to such an extent as to destroy the plants." Later the species was noticed by the same writer in greater or less abundance in other localities.

Our next account of damage was published in the report of this Department for the year 1887 (p. 152). The species was found by Mr. F. M. Webster, at that time a field agent of this Division, at Ashwood, La., during April of that year infesting beans in gardens. The beetles first attacked the plants by eating holes in the leaves and later by eating out the whole leaf between the larger veins. They were also observed to attack the cowpea in great numbers in the same manner. June 22 this insect was detected by the same gentleman at Princeton, Gibson County, Ind., also destroying beans.

There is in the divisional records a still earlier report of injury by this species. June 30, 1885, Mr. M. S. Crane, an entomologist of considerable experience, wrote that this insect, specimens of which were sent, was eating holes in the leaves of string beans in a garden near Caldwell, N. J. The beetles were said to be found on the under side of the leaves, and their depredations were mostly confined to one end of the patch. Injury was not reported to be serious, but it was surmised that the species might prove a pest under circumstances that would favor its increase.

The species was next reported by Professor Popenoe, who found it injurious to the bean in Kansas in 1889 (see Second Rept. Exp. Stat.

Kans. St. Agl. Coll. for 1889, pp. 210-212), and called it, after its food plant, the bean leaf-beetle.

May 20, 1890, Mr. M. H. Beckwith sent specimens from Newark, Del., with the statement that they were found feeding upon lima and wax beans.

In the year 1892 the writer published some brief notes on this species, with a short review of its past history and mention of two of its wild food plants, viz, the different species of bush clover (*Lespedeza* spp.) and the hog peanut (*Amphicarpæa monoica* Ell.)* (Proc. Ent. Soc. Washington, Vol. II, pp. 263, 264). During the same year Mr. H. E. Weed reported this insect as very injurious to beans throughout Mississippi, and furnished also brief notes on the oviposition and development of the species (Insect Life, Vol. V, p. 110).

In 1894 Mr. Webster again reported this leaf beetle injurious to the foliage of the bean in the southern part of Ohio, and a few days after this discovery, which was in May, he observed the same insect in Licking County feeding on the leaves of a species of Desmodium, which he states, in the North at least, is probably the natural food plant (Insect Life, Vol. VII, p. 204). Mr. E. A. Schwarz, of this Division, found the species during the third week of August of the same year injurious to cultivated beggar weed (*Desmodium tortuosum*) at Baton Rouge, La. This plant, which is also called beggar lice and tickweed, is of considerable value as a forage crop and soil renovator in the South.

An unusual feeding habit of this species was observed by Mr. A. D. Hopkins, who took the beetle feeding on sap flowing from wounds in green bark of yellow locust (Bull. 32, W. Va. Agl. Ex. St., p. 201).

OCCURRENCE IN THE YEAR 1897.

The present year, Mr. W. G. Johnson informs me, this insect was very injurious to pole and string beans at College Park, Md., May 19, and on a visit to this office on the 28th of the same month stated that the species was still present in injurious numbers in the garden where first observed. June 19 the writer's attention was attracted to the unusual number of holes in pole beans growing on the banks of the Chesapeake and Ohio Canal at Glen Echo, Md. Observation showed the beetles of *Cerotoma trifurcata* in considerable numbers, mostly on the under sides of the leaves. They had evidently been at work for some time, judging by the numerous holes in the foliage, but had considerably decreased in numbers when the same place was visited a week later. At the same time that this discovery was made Mr. F. C. Pratt collected the insect at Woodstock, Shenandoah County, Va., where it was destructive to the bean.

A special effort was made this year to learn more of the habits and injuriousness of the bean leaf-beetle, with the result that the species or its work was found in nearly every place visited in the vicinity of

* Now known as *Falcata comosa* L.

Washington. Cowpeas growing at Colonial Beach, Va., showed the work of this species, and a considerable number of patches of cowpeas and beans growing three miles from the beach were all infested. About the roots and stems of the plants quite a number of beetles were obtained. A few beetles collected July 12 had just transformed, their elytra being still soft in texture and pale in color. These individuals undoubtedly represent the new generation.

It was noticeable that the beetles, as well as the signs of their work, were most numerous in the particular patches that were poorest. These patches showed the effects of the dry weather, but were apparently injured in some other way. Some of the stalks had apparently been gnawed underground by insect larvæ, although only a single specimen of this larva could be found upon them or in the earth around them. The farmer, on whose place these beans grew, was of the impression that the beetles and their larvæ had injured them, and it would appear that the combination of drought and insects had effected their destruction. The worst-affected variety of beans were "Best of all" string beans that grew on a slope on slightly lower ground than the others.

At Kensington, Md., this beetle occurred on beans, but not in sufficient numbers to have injured many leaves. It was outnumbered by *Colaspis brunnea*. The same was true at Marshall, Md., where it was found eating holes into the leaves August 2. Beetles were more numerous, however, on Meibomia* growing near the beans.

At this same date Mr. Pratt found the species near Poolesville, Montgomery County, Md., on beans, as also evidence of its larval work on the underground stems.

Mr. B. E. Behrend wrote this year that he had observed the work of the bean leaf-beetle at Seat Pleasant, Prince George County, Md., on the foliage of the cowpea, and that a third of his planting failed to make a good stand, presumably on account of this insect. The beetle was found in cowpeas there by Mr. Pratt, August 10, and later in the month evidences of its work were observed at Forestville, in the same county. Here, however, it was rare, its scarcity being no doubt due to the almost entire absence of wild food plants.

The occurrence of the bean leaf-beetle in so many Northern localities this year suggests certain questions. Is the species on the increase? Is its occurrence the present year on beans exceptional? Is this occurrence only local? To what extent is it injurious?

In the writer's opinion this species has probably been present on the bean in this portion of the country for many years, perhaps for two centuries before its first discovery on this plant in Kansas in 1875, as beans have probably been cultivated here for upward of two hundred years. It will naturally increase on beans, although slowly if the above theory be accepted. I am scarcely inclined to believe the present an

* *Meibomia* Adans., tick-trefoil or tickseed, is considered in Gray's Manual under the genus *Desmodium* Desv.

exceptional year, as it has not been unusually abundant on its wild food plants, and in previous years it was not sought for on cultivated plants. An effort was made to determine the extent of the injuries by this species in this vicinity but without success. Mr. H. E. Weed writes, September 6, in response to inquiry, that it is at all times a very injurious insect in Mississippi, and perhaps this condition will hold for all the Gulf States, if not for the entire austroriparian life zone.

The present outbreaks are not local, except as the occurrences of all species are limited to certain localities in different seasons. The beetles are reported to be injurious by their work in the foliage of beans and cowpeas, and the larvæ are also apparently inimical to the plant from their work upon the underground stems; but the precise amount of damage done it is difficult to determine.

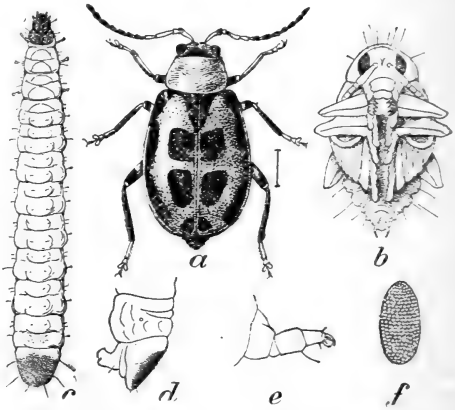

FIG. 1.—*Cerotoma trifurcata*: *a*, adult beetle; *b*, pupa; *c*, larva; *d*, side view of anal segment of larva; *e*, leg of same; *f*, egg—*a*, *b*, *c*, enlarged about six times; *d*, *e*, *f*, more enlarged (original).

DESCRIPTION OF THE INSECT.

The adult beetle, as previously stated, resembles superficially *Diabrotica 12-punctata*, being a member of the same tribe of Chrysomelidæ, the Galerucini, to which also belong the corn root-worm, *Diabrotica longicornis*, the striped cucumber beetle, *D. vittata*, and the elm leaf-beetle, *Galerucella luteola*. Not infrequently it occurs on the same plant with *D. 12-punctata*, from which species it may be distinguished by its smaller size, more robust form, and different elytral coloration.

The beetle measures from a seventh to a fifth of an inch (3.5–5^{mm}) in length, and is nearly twice as long as wide. The prevailing color of the dorsal surface varies from pale yellowish or buff to dull greasy red. The head and ventral surface are black, the terminal joints of the antennæ and portions of the posterior and middle legs are more or less marked with black; and the elytra, in what appears to be the typical form, are marked with black, as shown at figure 1, *a*. The base of the elytra, a triangular space about the scutellum, and two spots near the apices of the suture of the elytra are nearly always black, but individuals often occur in which other elytral markings are entirely wanting.

In the genus Cerotoma, of which *trifurcata* is the only American representative, the antennæ are slender, with the first joint rather long, the second short, the third nearly as long as the first, the fourth shorter, and the fifth to eleventh joints are nearly equal. The slender tibiæ are each provided with a single spur, and the claws are broadly appendiculate at the base.

A technical description of the beetle is furnished by Dr. Horn in the Transactions of the American Entomological Society for 1893 (p. 129).

DESCRIPTION OF THE EGG.

The egg (fig. 1, *f*) is subfusiform in shape, twice as long as wide, and each end tapers to a large nipple, which is more prominent at one end than at the other. The color when fully matured is almost perfect orange, which is slightly darker toward the ends. The surface is nearly opaque, and rather thickly covered with small, rather deep, hexagonal pits, of which there appear to be thirty-two or three, rows in its entire length. Length, 0.70–0.76 mm; width, 0.35–0.38 mm.

The larva is like that of Diabrotica, consisting of thirteen segments. It is nearly cylindrical in form, milk white when mature, with darker head and anal segment, fleshy, but not quite so delicate as that of *D. vittata*. From the latter it differs in being a little stouter proportionally when mature, and in certain obvious structural and other characters. The younger larvæ are of very nearly the same proportions as the full-grown ones of *vittata*. The full-grown larva is shown in the illustration at *c* enlarged about six times.

The following is a more detailed description:

DESCRIPTION OF THE LARVA.

Form subcylindrical, strongly convex above, somewhat flattened below, elongate, being when mature and extended in natural position seven or eight times as long as wide, tapering toward the head and toward the last segment.

The texture of the body is soft, delicate, and fleshy, the surface less wrinkled, and the wrinkles not so deep as in Diabrotica.

The general color is milk white, but is sometimes slightly yellowish, with the head, thoracic plate, anal segment, and legs darker.

The head is rounded in outline, about a fourth wider than long, and the two hemispheres are separated posteriorly by a nearly semicircular space. The vertex is separated from the two hemispheres by two pale, narrowly defined and nearly straight sutural lines, which converge from near the insertion of the antennæ and curve externally toward the middle, forming a V-suture, with the angle just perceptibly wider than a right angle. At the middle they are joined by a similar median long longitudinal line which separates the hemispheres. The surface gives rise to a few rather strong hairs. The color above is dark brown, which becomes still darker in most individuals just before the median sutural line and particularly at the sides. The lower surface is pale. Antennæ 3-jointed, pale.

The first thoracic segment is twice as wide as long and somewhat less than twice as wide as the head. The thoracic plates are slightly corneous, very light brown in color, and separated by a median longitudinal white line. The second thoracic segment is wider than the first, and the third is wider than the second in about the same proportion, so that there is a gradual tapering from the first abdominal segment toward the head.

The legs are small, jointed, and more or less slightly infuscated. They are best described by the figure (see *e*).

The first eight abdominal segments are less strongly separated and of nearly equal width and are not strongly rugose. The anal segment is considerably narrower than the preceding and irregularly rounded apically. On its dorsal surface it bears a brown corneous plate which is darker apically, but there is no trace of tubercles. On its ventral surface it bears a prominent teatlike proleg (see fig. 1, *d*).

Length of mature larva: 7–8 mm; width, 1–1.1 mm.

The pupa also strongly resembles that of Diabrotica. It is of the same milk white color as the larva, delicate in texture, and, like the larva also, is more robust than Diabrotica. The illustration (*b*) leaves little for description.

DISTRIBUTION.

This species is native to North America, and a perusal of literature and the examination of labels in local collections show that it is widely distributed from Canada southward to the Gulf States and westward to Kansas and Minnesota. In addition to the States mentioned it has been recorded, or specimens have been seen by the writer, from New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, Ohio, Indiana, Illinois, Florida, Alabama, Mississippi, Texas, and Nebraska.

It will thus be seen that the species ranges through the transition, upper and lower austral life zones, being most abundant and injurious in the lower austral or austroriparian zone.

FOOD PLANTS; NATURE OF DAMAGE.

At Glen Echo, Md., in the immediate vicinity of the infested beans, were numerous plants of tick trefoil (*Meibomia* spp.), but only three or four of the beetles could be found in June upon these in spite of continued search, although this appears to be the favorite food plant in this latitude. Later in the season, in August, the beetles were more abundant on Meibomia, and the species which appeared to be preferred at this place was identified as *Meibomia lævigata* DC. The garden in which this insect was observed at College Park, Md., Mr. Johnson says, was planted in cowpeas the year previously. From what has been reported it would appear that the natural food plants are Meibomia and Lespedeza, and more rarely Falcata, and that, where beans and cowpeas are available, these are attacked, at least by the beetles, with equal relish.

The species feeds indifferently on cowpeas and beans, and, everything considered, we are not yet justified in the assertion that it prefers any particular variety of bean. Of several patches of different varieties growing at Glen Echo the beetles were noticeably more abundant upon pole beans, although all the other varieties were attacked. At Poolesville and Marshall Hall they were rare on pole beans. Professor Popenoe states that the beetles affect "principally the low-growing or bush varieties." I believe it is safe to say that the low-growing or dwarf varieties are most injured, since their period of growth is shorter, while the pole beans put out new leaves after injury has ceased.

The work of the beetles on different plants appears to be somewhat different. On bush clover, where the species was first observed at Ithaca, N. Y., the beetles were found to attack by preference the unexpanded leaf buds or freshly expanded leaves at the heads of the plants. Of hog peanut they also prefer the fresh, young leaves. Beetles that were confined with leaves of this plant selected the edges of the young.

tender leaves and ate rapidly away to the midrib, sometimes consuming this also. The foliage of the bean and cowpea they perforate with large, rounded holes. When very abundant, the beetles strip the leaves to their veins and midribs. The beetles themselves would seldom attract attention, as they feed and rest during the greater portion of the day almost exclusively on the under side of the leaves. On wild plants, on the contrary, the beetles are often to be seen on the upper surface near the tops. Injury to the foliage of beans is most noticeable, when observed late in the season, on the lower leaves.

The only other leaf-feeders that have been observed about the neighborhood of the District, that are at all likely to be mistaken for this species by the nature of their work, are the grape-vine Colaspis (*Colaspis brunnea*) and the twelve-spotted cucumber beetle. The latter, however, works in a much different manner. On beans and soja beans it was observed feeding on the upper surface of the leaves, but the holes that it makes are very small and irregular and scarcely likely to be mistaken for those of Cerotoma, except perhaps a long time after they have been eaten out.

The beetles are rather sluggish and seldom seen in flight, nor are they easily disturbed, and hence may be readily captured by hand. When alarmed they drop to the ground, but soon reascend to the plant.

LIFE HISTORY.

The life history of the species, it is superfluous to remark, is not yet very fully known. Undoubtedly it passes the winter in the adult condition. Few exceptions to this rule are known in the Chrysomelidæ.

As might readily be surmised from its known distribution, it exhibits considerable variation in the periods of appearance. In the Gulf States the hibernated beetles appear as early as April, Mr. Webster having sent specimens to this office collected at least in the second week in the month; in Shawnee County, Kans., it was also observed in April; in Gibson County, Ind., and in Shenandoah County, Va., it was observed June 22 and 26, respectively; while at Ithaca, N. Y., the writer collected the beetles no earlier than July 6. In the vicinity of the District of Columbia thes pecies has been noticed as early as the middle of May and as late as the fourth week of August. A larva and a pupa, evidently stragglers, were collected as late as September 4, but no beetles could be found at this time.

The eggs are laid around the stem just below the surface and in clusters, according to Mr. H. E. Weed, of from six to ten, and the larvæ eat around and within the stem. In Mississippi he has further stated that there are two generations a season, which overlap, however, so that the beetles are to be found at most any season, though they are more abundant in April and July. The first generation is said to be produced upon garden beans and the second upon cowpeas, and the habit of the mature insects of eating holes in the leaves is especially notice-

able with the first generation upon beans. In a letter of September 6, 1897, Mr. Weed states, in answer to the writer's inquiry, that the species is probably three-brooded in his State, and that he has noticed the beetles very numerous in September and October on cowpeas.

At present the periods of development can only be conjectured. From analogy and the crude data available it may be surmised for the latitude of the District of Columbia that the parent beetles begin oviposition upon their appearance, about the middle of May, continuing probably through the month of June. The eggs hatch in from five to eight days, the larvæ complete their growth in from four to six or seven weeks, and the pupa state lasts from five to eight days, all these periods varying with the conditions of heat, dryness, or moisture. The entire life cycle would in the same manner require from six to nine weeks. Individuals obtained August 2 to 16, undoubtedly of the new generation from their fresh appearance and plump, round abdomens, laid eggs at this time, indicating a second generation. Farther northward in the transition zone we would expect only a single generation annually.

REMEDIES.

At present this species, although of apparently very common occurrence on beans in the upper austral regions about the District of Columbia, can not be regarded as a first-class pest here, and has not yet justified any elaborate experimentation with remedies or preventives. As the species is more injurious southward, however, some suggestions looking to its suppression may be made.

The sluggishness of the beetles indicates hand-picking as of value in small gardens in cases of excessive abundance early in the season.

The beetles occur rather more numerously on the under surface of the leaves than above, and a thorough spraying, particularly an underspraying, with the arsenicals will destroy them. This remedy should also be employed upon the first appearance of the insects in order to stop them at the very outset and to avoid possible poisoning of the bean pods if these are to be eaten green.

Professor Popenoe is authority for the statement that pyrethrum "puffed over the plants in ordinary weather is a measurable check to the work of the insects."

More important than any other measure is clean culture and the careful weeding out of the wild food plants in the immediate neighborhood of the cultivated ones. Tick-trefoil is a pest in itself, so this should operate as an additional incentive for its eradication.

NOTES ON ANARSIA LINEATELLA, ZELL.

By A. B. Cordley, *Corvallis, Oreg.*

June 9, 1896, Mr. Hugo Garbers, of Hugo, Oreg., reported to the entomological department of the Oregon State Experiment Station that the twigs on his peach trees were being destroyed by a small

"worm" boring in at the tips. A few days later Mr. H. E. Dosch, horticultural commissioner for the first district, reported the same injury to prunes as very common throughout his district. Up to and including the 18th of June many similar reports were received, some of which were accompanied by injured twigs each of which contained a single larva.

Unfortunately none of these larvæ were preserved, all being consigned to the breeding jars. However, my recollection is that they were reddish pink in color with the head and shield of the first segment pale brown, and that they corresponded in every particular with Mr. William Saunders's description of the larvæ of *Anarsia lineatella* as quoted by Dr. Lintner in his first report on the "Injurious and Other Insects of New York." At least I compared them with that description and unhesitatingly identified them as belonging to that species.

June 22, 1896, some of these larvæ were observed to have left the twigs and to have pupated in various parts of the breeding jars, the pupæ being held in position by a very slight cocoon consisting only of a few silken threads. July 3 four moths issued from these pupæ. These moths agreed perfectly with the description of *A. lineatella* as quoted by Dr. Lintner in the article referred to above.

No further reports of injury to prune trees were received, and nothing more was observed concerning this insect until October 2, 1896, when the strawberry plants on the college grounds and in a neighboring patch were found to be very badly infested by reddish-pink larvæ which were not to be distinguished from those that had attacked peach and prune twigs in June. Several infested plants were removed to the insectary, and together with plants out of doors were examined from time to time throughout the winter, with the result that it was found that the larvæ pass the winter in their burrows in the strawberry crowns in a nearly dormant condition. During the winter infested strawberry crowns were received from several localities and in every case the burrows were found to contain the larvæ.

May 19, 1897, one moth issued in a cage in the insectary, although an examination of plants out of doors showed that the larvæ were just beginning to pupate, and it was June 1 before any considerable number of pupæ could be found. At the present time (July 6) moths are still continuing to issue. These moths are exceedingly similar to, if not identical with, those reared from peach and prune twigs last July.

From the fact that there was a somewhat extensive attack by the twig-borer last June, and still no evidence throughout the summer, fall, and early winter months of any attack on prune trees by a second brood of these larvæ, and since in early fall strawberry plants were so generally attacked by great numbers of apparently identical larvæ, I have been led to infer that the first brood of moths deposits its eggs almost entirely upon the strawberry, although that inference is somewhat opposed to the statement made by Professor Comstock that "the fruit-

inhabiting larvæ are found (in peaches) during the latter part of July and August and mature during September."* and is entirely opposed to the statement of two prominent California authorities, that the small larvæ bore into the bark of infested trees and there pass the winter in the larval stage.†

April 20, 1897, larvæ of a twig-borer were received from Halsey, Oreg., and between that time and May 25, when the last specimens were received, the work of this insect was reported from Halsey, Hugo, Lookingglass, Oakland, Dundee, Yoncalla, Junction, Bellefontaine, and Granger, and was observed at Corvallis, Liberty, and Rosedale. Mr. H. E. Dosch, horticultural commissioner for the First district, also writes me that he has numerous letters regarding this pest from various parts, and Mr. C. L. Dailey, commissioner of the Second district, writes that the "pest is everywhere, and small trees are literally denuded of terminal buds." Mr. Morrison, of Dundee, Oreg., not only sent larvæ in growing twigs, but also sent sections of bark containing burrows in which the larvæ had wintered, and several larvæ that he had taken from the burrows. This, of course, corresponds with the published accounts of Craw and Woodworth, above referred to, except that they have unquestionably referred to the larvæ that winter in the bark and attack the young twigs of various trees as the larvæ of *A. lineatella*, and have failed, so far as I can learn, to call attention to the great difference between these larvæ and the larvæ of *A. lineatella* as found in strawberry crowns.

The first twig-borers received were slightly more than one-fourth inch long, and were of a dirty brown or dull grayish-black color, with head, first and last segments, and true legs shining black. In general appearance they so closely resembled the larvæ of the bud moth (*Tmetocera ocellana*) that at first I mistook them for that insect. I soon noticed, however, that the habits of the two species were entirely different, and that every larva of the twig-borer was readily distinguished by its shining black terminal segment. But this character, together with the general color of the larvæ, rendered them so unlike the larvæ of *Anarsia lineatella* (?) as described, and as seen in strawberry plants and in prune twigs last June, that it did not occur to me that they could belong to that species until May 17, when four of the moths issued. One of these moths was at once sent to Dr. C. H. Fernald, who wrote that it is *Anarsia lineatella*.

The mounted specimens greatly resemble the moths reared from the larvæ in strawberry crowns, but are slightly larger and darker in color. The habits of the living moths are quite different. Those reared from the strawberry crowns crawl down among the vines even into crevices in the soil, apparently for the purpose of depositing eggs upon the

* Report of the Commissioner of Agriculture for 1879, p. 255.

† Alexander Craw, Fourth Biennial Report California Board of Horticulture; C. W. Woodworth, Report California Experiment Station, 1894–95, p. 244.

crowns, and when disturbed run or flutter about with wings half spread. On the other hand, the moths of the twig-borer invariably take an elevated position in the breeding cage, and, with the fore part of the body slightly raised and the labial palpi held rigidly upright in front of the face, they present a very characteristic and alert appearance. When disturbed, they dart rapidly about, suddenly alighting again in the same characteristic attitude upon another portion of the cage. When out of doors upon the trees, it must be nearly impossible to distinguish them from buds. The moths began to appear in our breeding cage May 17, and continued to emerge until June 5, when all had apparently issued. On the other hand, moths from strawberry crowns have continued to emerge in our breeding jars until the present time (July 6), and an examination of infested plants out of doors shows a few full-grown larvæ and some pupæ still in the burrows.

The larva is brownish-black or dull, dirty black in color, with head, shield, anal segment, and true legs black, and is covered sparsely with light-colored hairs which arise from minute elevations. When full grown, the larvæ are nearly one-half inch long. They then spin, wherever they may be feeding, a very loose, silken cocoon, in which they pupate. The first pupa was seen May 8, and as the first moths appeared May 17 the pupal stage lasts about ten days.

The half-grown larvæ pass the winter in minute burrows in the bark of infested trees. In spring, soon after the buds begin to open, some of the larvæ leave their winter quarters and bore directly into the center of the buds in a such manner as to destroy the terminal ones. The shoot, therefore, fails to develop, although often the dead terminal leaves may be surrounded by a whorl of well-developed leaves. Later they attack the rapidly growing shoots, entering them either at the tip or in the axil of the leaf, and boring in the pith. As soon as the fruit begins to develop, it is also attacked, the larvæ usually boring directly to the pit, upon which they seem to prefer to feed.

If Dr. Fernald's determination is correct (and there can be no reasonable doubt of its accuracy, since he is without doubt the best American authority on the microlepidoptera), we are brought face to face with the peculiar phenomenon of a well-known insect—one which was described in Europe nearly sixty years ago, and which has been an important insect pest in this country for nearly forty years—being bred, in May, from twig-borers which are entirely different from those which are supposed to produce it; while on the other hand a very similar but evidently quite distinct insect is bred from apparently normal larvæ of *A. lineatella*, which winter in strawberry crowns, and the second brood of which occasionally attacks the twigs of peach and prune, and bark of prune trees in June. Either two species must be involved in this phenomenon or the larvæ of *A. lineatella* must exhibit a double dimorphism due to different food plants and seasons. It appears to us very probable that hitherto two very similar but entirely distinct species have been united

under the name *Anarsia lineatella;* that one of these species breeds normally in strawberry plants, but may occasionally attack young shoots of the genus Prunus in June and July, while the other, so far as known, breeds only upon trees of the same genus, wintering in the half-grown larval condition in shallow burrows in the bark. If this supposition proves true, the interesting question arises. Which of the two is *Anarsia lineatella*, and what is the other species? May it not, after all, be the *A. prunella* Clem., which has been discarded as a synonym of *A. lineatella* Zeller? The proper answers to these questions are of considerable scientific and economic importance, since they have a direct bearing on the efficiency of certain remedial measures. But, situated as I am, away from extensive libraries and collections, I can only state the facts as I see them and leave to others the agreeable task of determining the specific identity of the subjects considered.

A SUCCESSFUL LANTERN TRAP.

By C. P. Gillette, *Fort Collins, Colo.*

The accompanying illustration shows the outline of a lantern trap that I have used for two summers with a good degree of success. The trap is in three pieces, which are shown in the illustration (fig. 2) a little separated. All parts are of bright tin. The funnel is 22 inches in diameter at the open end and 15 inches high to the stem. The latter is 5 inches high and 2½ inches in diameter. This fits snugly inside of the neck of the reservoir, which is 6 inches long, and the body of the reservoir is 8 inches high and 5 inches in diameter. The reservoir has a removable bottom, which is about 1 inch in height. There are loops in the margin of the rim of the funnel by means of which the latter is tied to the trunk of a tree or a post driven into the ground for the purpose, and the bottom of the trap is either set upon the ground or upon a platform made for it. A large lantern is then hung in over the top of the funnel so that the blaze will be a little above the top of the funnel.

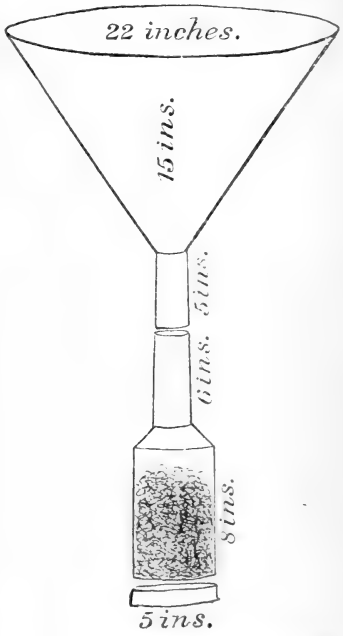

Fig. 2.—Lantern trap for insects (original).

In the bottom of the reservoir is placed a 3-ounce wide-mouthed glass bottle about half full of cyanide of potassium. The potassium is moistened occasionally and the mouth of the bottle is covered with wire gauze. Finally, a very important thing to do is to fill the reservoir

loosely to within about 2 inches of the shoulder with a good quality of excelsior. The most delicate moths will bury themselves in the excelsior and die uninjured, while without the excelsior everything taken will be ruined for preservation in the cabinet. We have taken as high as 2,000 moths and 3,000 beetles, besides many other insects, in one of these traps hung under an electric arc light in one night before 12 o'clock, and the majority of the specimens were uninjured. In some cases, where insects are coming in very large numbers, it is necessary to take the trap down about once an hour to empty it. To do this, slip the reservoir off the funnel, put in a teaspoonful of chloroform, and cork for five minutes. Then remove the bottom and take out the excelsior and shake the insects into cyanide bottles. It is better, however, to put fresh excelsior in the reservoir and take the excelsior from the trap with the insects in it to a room to look over the catch and keep the delicate, easily injured specimens separate from the others. It is almost necessary, where insects are coming freely at all, to empty the trap once at least, at about 9.30 p. m. We have found that nearly all of the beetles come before this time and that the moths come more freely later.

The funnel can be left continually at the light, the reservoir with its contents being taken each morning and emptied. As soon as it is emptied, the cyanide bottle and excelsior should be put back and the top of the reservoir corked so as to gain strength during the day for the work of the night.

OVIPOSITION IN YOUNG FOREST TREES BY TETRAOPES FEMORATUS, FAB.

By C. P. Gillette, *Fort Collins, Colo.*

On July 27 last Professor Crandall, of the department of horticulture and botany of the Colorado State Agricultural College, called my attention to the work of some insect that had been cutting into the stems and leaves of young forest trees that had been set out by the Division of Forestry of the U. S. Department of Agriculture on the college grounds, and brought me a specimen of the above insect that he said he suspected to be guilty of doing the injuries.

I visited the experimental forestry plot and found that there was an occasional specimen of *Tetraopes femoratus* on the trees, and did not have to look long to find a female in the act of cutting a slit across the petiole of a leaf of soft maple. She very soon turned about and applied the tip of her abdomen to the cut as if to deposit an egg. In just three and one-half minutes she removed the tip of her abdomen from the cut, wiped it from side to side a few times on the petiole and then took a few steps forward and began cutting another cross slit with her mandibles. She was one minute cutting the slit and nine minutes depositing the eggs in it. Four of these cuts were found on the petiole,

and in three of them there were two eggs each and in the other one. In some cases the eggs were side by side, and others end to end, but always laid lengthwise with the stem. The slits made for the eggs were not closed in any manner by the beetle, yet the eggs were not visible in them until some of the tissue was torn away.

The work of the beetle was not confined to the soft maple nor to the petioles of leaves, but the incisions were common upon small twigs and shoots also, which nearly always died as the result, and were often found broken over. The twigs were all small, seldom more than one-eighth inch in diameter, and where one cut was found there were usually several, from a quarter to a half inch apart. In most cases the cuts extended about halfway around the twig. The dead twigs gave the trees the appearance of having been struck by a blight of some sort.

The injuries were found upon maple, honey locust, elm, ash, birch, aspen, and oak. Nearly all of the smaller trees of the above varieties, those under 2 feet in height, have suffered seriously from the injuries, a good proportion of them seeming perfectly dead at this writing.

A FEW INSECTS THAT HAVE BEEN UNUSUALLY ABUNDANT IN COLORADO THIS YEAR.

By C. P. Gillette, *Fort Collins, Colo.*

I wish to call the attention of the Association of Economic Entomologists to a few insects that have been unusually abundant in Colorado the past spring and summer.

The peach twig borer (*Anarsia lineatella* Zell.).—For three years past there has been some complaint among the peach growers of the western slope of a small worm eating into peaches about the time that they ripen. On the 7th of May of this year I received three letters and as many packages from parties in western Colorado, who complained of a small worm that was doing a large amount of damage to peach, plum, apricot, and almond trees by eating into the buds and young twigs causing both to die, and many letters have been received since concerning the same insect. The three men who wrote, so that I received their letters the same day, were, Mr. A. V. Sharpe, Fruita, horticultural inspector for Mesa County; Mr. B. C. Oyler, Grand Junction, ex-inspector of the same county; and Mr. W. M. Hastings, Delta, an extensive fruit grower. Mr. Hastings estimated that one-third of all the young shoots on his peach trees were bored into and destroyed by this insect. I advised Mr. McGinty, horticultural inspector for Delta County, to put cloth bandages about the trunks of the trees to see if the larvæ could be trapped under them, and he afterwards sent me a large number of pupæ taken thus, from which moths began to appear June 1. No parasites were bred. Moths sent to Dr. Fernald were determined as the above species. This insect probably came to Colorado in California peaches which were wormy.

Haltica punctipennis Lec.*—About the 20th day of May this beetle began appearing in large numbers in northern Colorado upon numerous native and cultivated plants, and many complaints have been received concerning its injuries, especially to small apple trees in nursery rows. It has also been quite abundant upon grapevines and the foliage of red raspberry, and it has attacked strawberry plants to a small extent.

The native plants upon which it has been most abundant here are species of Œnothera, two of which, *Œnothera biennis* and *Œ. pinnatifida*, have supported the beetle in great numbers.

Plant-lice.—The present summer has been the most favorable for the increase of plant lice of any that I have yet known in Colorado. The cause seems to be the lack of sufficient predaceous enemies to keep them in check.

There are two species of which I wish to speak in particular. The first of these, *Hyalopterus pruni* Fab., has not attracted special attention in Colorado previous to the present summer so far as I can learn. The attack this year has been widespread, complaints having come to me from the west slope and, on the east of the mountains, from Rocky Ford to Fort Collins. The complaints concerning these lice have nearly equaled all other complaints concerning insects the present summer.

The injuries have been chiefly to American varieties of the plum, but it has also been reported upon prunes. Trees heavily set with plums have dropped their entire crop of fruit and nearly all their leaves and are now putting out new leaves. Plums and their stems, as well as the leaves, were literally covered with green lice before the predaceous insects, chiefly Syrphus larvæ, began to get them under control. Complaints are now coming (August 5) that the lice are rapidly increasing again, and it is feared that they will destroy the new leaves that have appeared. The photograph marked 1, which I send with this, shows wilted leaves and blasted fruit upon a twig of a plum tree that was badly attacked by the lice. The photograph marked 5 shows the lice upon the plums and plum stems. One can readily understand how plums thus infested soon wilt and fall.

In our experiments, whale-oil soap, in the proportion of a pound to 8 gallons of water, has been more effectual than the ordinary kerosene emulsion in destroying the lice. The powdery excretion upon the surface of these lice interferes greatly with any successful treatment unless the application be made with much force.

The most common lady-beetle among these lice was *Hippodamia convergens* Guer., but it was not very abundant. Syrphus larvæ destroyed many more lice than the Coccinellid larvæ, and most of them were of the one species, *Eupeodes volucris* O. S.

Schizoneura americana Riley, on white elm.—This louse has been

*A careful comparison of the beetle with its description and with specimens determined for me by Mr. Charles Liebeck and Mr. E. A. Schwarz show them to be this species and not *foliacea* Lec.

gradually on the increase in Colorado for several years until the present season, when it was very abundant. The attack begins with the opening of the first buds, when the little, wrinkled clusters of leaves begin to appear from the terminal buds of small twigs upon the trunk and large branches of the tree. When these clusters reach a diameter of from 3 to 5 inches, they die and the lice migrate to other leaves, where they locate on the underside and cause them to turn yellowish or reddish in color and to roll under. These lice were abundant enough in many places, so that a large proportion of the leaves during July were rolled sufficiently to mar greatly the appearance of the trees. On some trees large numbers of the lice were seen accumulated upon the thin bark surrounding injuries to trunk or limbs. At this date (August 5) the lice have nearly all disappeared, chiefly through the attack of Syrphus larvæ of one species, *Syrphus americanus* Wied.

NOTES ON INSECTS OF NORWAY AND SWEDEN.

By W. M. Schöyen, *Christiania, Norway.*

I have the honor to present to the Association a few brief notes relating to some of the more important noxious insects which have been observed the past year in our country.

The cereal crops have, as usual, suffered more or less throughout the country from wireworms, especially *Agriotes obscurus* and *Diacanthus æneus*, which seem to be the most troublesome species here in Norway. *Agriotes lineatus*, elsewhere in Europe recorded as the chief mischief-maker among the Elateridæ, is not so common with us as the other two species named.

Oscinis frit did considerable damage in 1895 upon oat fields, especially in the western districts, but in 1896 was little heard of.

Chlorops pumilionis (*tæniopus*), which usually here in Scandinavia attacks only the heads of barley, has now also been found attacking the wheat in just the same manner.

Cecidomyia destructor has been observed infesting barley in different places, but fortunately not yet in an alarming manner.

On grass fields the grubs of *Phyllopertha horticola* have been troublesome here and there, and in a single place also the larvæ of a species of Crambus. In the spikelets of *Alopecurus pratensis* the maggots of *Oligotrophus alopecuri* have occurred, and in those of *Phleum pratense* the maggots in considerable numbers, of *Cleigastra* (*armillata?*), were found destroying the seeds.

As the chief enemies of cabbage the past year may be named *Diacanthus æneus*, *Tipula oleracea*, *Anthomyia brassicæ*, *Silpha opaca*, *Pieris brassicæ*, and *Meligethes æneus*.

Carrots, parsley, and celery have suffered from the attacks of *Psila rosæ*, onions from *Tipula oleracea*, and rhubarb from *Syromastes marginatus*.

As a curiosity it may be noted that *Cetonia metallica*, by attacking potato stalks and leaves, caused alarm and was sent in for examination, as it was suspected to be "the terrible Colorado potato-beetle" from America. We have, however, another beetle which occasionally attacks the potato plant in our country, viz, *Adimonia tanaceti*.

Besides many of the well-known apple pests, such as *Anthonomus pomorum*, *Carpocapsa pomonella*, several leaf-destroying tortricids, *Phyllobius pyri*, *Phyllopertha horticola*, *Psylla mali*, *Aphis mali*, etc., we have, especially in the western "fiord districts," a most serious enemy to the apple trees in *Telephorus obscurus* (and some allied species), which occurs in immense numbers and totally destroys the apple blossoms by eating them away as soon as they begin to open. Spraying with Paris green kills a great many of them, but their numbers are often quite overwhelming.

The chief enemy of the pear is *Phytoptus pyri*, which is often most troublesome, "bladdering" the leaves to such an extent that not a single one can be found untouched.

Gooseberry and currant have suffered very much from the attacks of *Nematus ribesii* (*ventricosus*), which in the past year occurred in unusually great numbers throughout the country, defoliating, especially, the gooseberry. The berries of the latter have also been damaged by *Zophodia convolutella*.

Rose leaves have been to a great extent sucked and discolored by *Typhlocyba rosæ*. *Aphis rosæ* and *Tetranychus telarius* are common pests.

Among the insects on forest and shade trees may be named as having caused injuries in different parts of the country:

PINE: *Hylurgus piniperda*, *Lophyrus rufus*, *Bupalus piniarius*, *Cecidomyia brachyntera*, *Tetranychus* sp.; LARCH: *Orgyia antiqua* and *Bombyx rubi;* BIRCH: Two different species of Nematus larvæ (from Finmark): SORBUS AUCUPARIA: *Hyponomeuta variabilis;* PRUNUS PADUS: *Hyponomeuta padi*; and ALNUS INCANA: *Apoderus coryli*.

NOTES FROM MARYLAND ON THE PRINCIPAL INJURIOUS INSECTS OF THE YEAR.

By WILLIS G. JOHNSON, *College Park, Md.*

The first insect of the season that attracted any considerable attention throughout the State was the clover-leaf weevil (*Phytonomus punctatus*). The larvæ were first observed by me here at the station on crimson clover April 14, but no complaints of injury by them were reported to me until April 22, at which time Mr. H. O. Devries, of Marriottsville, Howard County, wrote that they had appeared in the clover fields in his vicinity "with renewed vigor." Other reports came almost daily of their arrival, in great abundance, in the counties of Montgomery, Howard, Washington, Frederick, Carroll, Harford, Baltimore, Anne Arun-

del, and Prince George. April 19, here at the station, I found several larvæ of a creamy color attached to leaves; although still living, they were unable to move. I made a careful examination of them and came to the conclusion that they were being destroyed by the fungus *Empusa* (*Entomophthora*) *sphærosperma* often found on this species. My identification of this disease was afterwards verified by Mr. B. M. Duggar, of Cornell University, who has given much study to the subject of insect diseases. From April 19 to May 12 the contagion seemed to increase in intensity, and it was not an uncommon thing to find four or five dead larvæ flat on the surface or curled about the edges of a leaf. They were also on the heads of clover, stems of timothy, weeds, grass, in fact, on anything that projected above the surface of the ground. By May 15 it was almost impossible to find a single living, healthy larva, and by the 20th they had disappeared. The disease was widespread throughout the counties above mentioned, as shown by personal inspection or the examination of material sent to me.

Next in order of succession came several species of flea-beetles. A little blackish species (*Chætocnema pulicaria*) was particularly abundant and destructive to young corn from May 6 to May 25. They were more numerous on sugar corn than field corn, and almost completely ruined the first planting in parts of Prince George, Anne Arundel, Howard, Montgomery, Kent, and Worcester counties.

Epitrix cucumeris was very destructive to young potatoes, and was observed as most abundant from May 15 to the 21st. Tobacco was injured slightly by *Epitrix parvula* the first ten days in June.

The potato stalk-borer (*Trichobaris trinotata*) has been reported from upper Baltimore County as doing much injury. I collected several beetles from eggplants here at the station June 19.

The tobacco worm, *Sphinx* (*Protoparce*) *carolina*, or "hornblower," as it is called in this State, has been unusually destructive to tobacco in Anne Arundel, Prince George, Charles, St. Mary, and Calvert counties this year. The tobacco growers of this section have greater fears of the second brood than of the first.

The melon plant-louse (*Aphis gossypii*) early this season was very abundant on cantaloupes in Somerset, Wicomico, and Dorchester counties. As noted in Bulletin 48 of the Md. Agr. Exp. Sta., we have found kerosene emulsion, applied with the Success kerosene emulsion sprayer, very effective in the destruction of this pest. *Aphis brassicæ*, *A. persicæ-niger* and *Myzus cerasi* were also prominent among the plant-lice this spring on account of their numbers.

The striped cucumber beetle (*Diabrotica vittata*) and the harlequin cabbage bug (*Murgantia histrionica*) have both occasioned much correspondence. The former has attacked cantaloupe, watermelon, squash, and cucumber very seriously in many sections of the State. The latter has confined its depredations principally to cabbage and kale.

The strawberry weevil (*Anthonomus signatus*) has made its usual

attack upon strawberries, and in many parts of Anne Arundel, Prince George, and Caroline counties cut the crop fully one-third.

Graphops marcassitus and *Typophorus* (*Paria*) *canellus* were found on strawberries at Lake Shore May 1. Much injury had been done to the leaves by the adult beetles, and the plants were in bad condition. Regarding the former species Mr. F. H. Chittenden, who kindly examined my specimens, says: "*Graphops nebulosus* is said to be the strawberry root-borer in the West, but your specimens found on strawberry are evidently not that species but *marcassitus*."

The most prominent orchard pest with us this season has been the plum curculio (*Conotrachelus nenuphar*). The peach crop of the Eastern Shore of Maryland is almost an entire failure on account of the attacks of this insect. Last year many small peaches and cullings containing larvæ were left in the orchards, and as a consequence the pest appeared this spring in unusual numbers. It also stung pears and apples, as well as plums and peaches.

The pear midge (*Diplosis pyrivora*) has been reported to me from one locality in Kent County, and has done considerable damage.

The San Jose scale (*Aspidiotus perniciosus*) is still present in alarming numbers in the orchards of our State. It has been destroyed in several places by the destruction of the trees; but beyond this, we have found nothing to eradicate it in old orchards. August 3 I discovered this pestiferous insect in the heart of the largest peach orchard (planted fall of 1890 and spring of 1891) in the State of Maryland. The orchard contains 28,311 trees, 13,000 of which are now dead or dying. This entire orchard, covering nearly 300 acres, will be uprooted immediately and burned. New localities where the scale has gained a foothold are coming to light every week. Under the present conditions it is doubtful if we can ever exterminate this the prince of orchard pests in our State.

In the course of my investigations, I have discovered a new food plant for the San Jose scale. I have found it thickly colonized and in all stages of development upon the common milkweed (*Asclepias syriaca*), which was growing between two badly infested peach trees about 20 feet apart and surrounded by ragweeds. This was the only milkweed in the vicinity so far as I could ascertain. It was about 3 feet high and consisted of five stalks, all of which were thickly spotted with the scales. Many young were crawling. The mature females were most abundant at the base of the plant. The attack produced the characteristic purplish tinge of the bark around the scales. The tinge, however, was a little darker than that usually found on apple and pear. From these observations it is clear that this scale can breed continuously throughout one season on the milkweed; but it is hardly likely that it would remain alive on that plant over winter.

Last fall I found partially matured insects of the same scale thickly clustered on crab grass (*Panicum sanguinale*) under a badly infested peach tree in Carroll County.

NOTES ON SOME LITTLE-KNOWN INSECTS OF ECONOMIC IMPORTANCE.

By Willis G. Johnson, *College Park, Md.*

I present herewith some notes on seven little-known injurious insects that have come under my observation during the past year.

Hydræcia marginidens.—The first is a moth belonging to the little-understood genus Hydræcia (Gortyna). Dr. J. B. Smith, who kindly examined my specimen, says: "I have never had sufficient material to make me feel satisfied as to the limitation of species. It is one of those genera in which the species vary, not only in ground color, but in the presence or absence of white spots. It may be mouse-gray with white spots, or it may be either of the ground colors without any white spots, and yet be the same species. Just what range of variation there is in the lines we do not know. It would be a desirable thing to breed a large lot of specimens from some one plant in order to get the range of variation, if possible. As material goes, your species is *marginidens*, or, as it used to be called, *limpida*."

I found the larva boring into the main stems and larger branches of Cosmos plants (*Cosmos bipinnatus*) at the Maryland Agricultural Experiment Station. Two larvæ were obtained from the heart of the main stem of a plant August 22, 1896. All the branches had been burrowed out, so weakening them that they were easily broken off. In fact, a slight wind readily broke the plants, and it was this condition that first attracted my attention. The two larvæ were placed in a breeding cage, where one of them pupated August 25. The other one died August 27, and was removed. The adult insect emerged September 30, 1896. The Cosmos plants have been attacked by the same insect this season, but not to such an extent as last year. The hollowing out of the stems and branches does not seem to injure the plants, so far as growth and blooming is concerned, the difficulty arising from the weakening effect indicated above.

Pyrausta ferrugalis.—I found the larva of this beautiful little moth injuring the young, tender, lower leaves of tobacco in a hotbed here at the station. The larvæ were abundant from July 1, feeding usually on the underside of the leaves, cutting them full of irregular holes. When full-grown, many larvæ would cut two slits in the side of a leaf, fold it over, and pupate within, while others would transform between the leaves that happened to be close together. The moths emerged in my breeding cages from July 6 to July 13, the greatest number having appeared July 9. They were most abundant on plants in the beds July 13. They hide on the underside of the leaves and are easily disturbed, flying quickly when approached, and running rapidly to the underside of the leaf when alighting.

Uranotes melinus.—While examining some lima beans July 13, 1897, growing at the experiment station, I discovered two somewhat slug-like larvæ cutting holes into the pods and feeding upon the beans. One

was of a greenish tinge, while the other was decidedly pinkish above and greenish below. Many pods were found that had been perforated and the beans excavated, but no other larvæ were seen. The larvæ are very sluggish and not easily disturbed. The greenish one pupated July 16, and the adult butterfly emerged July 29. Two other larvæ were found feeding on beans July 28, in the same plot from which the others had been taken. Both were pale green and apparently full-grown, being five-eighths of an inch in length. From one of these a number of parasitic grubs emerged July 31. Small snow-white cocoons were spun to the side of the cage, almost completely embedding the larva. The parasites emerged August 7.

In an illustrated article in Insect Life (Vol. VII, pp. 354, 355) Dr. Howard gives a résumé of what is known of this beautiful little butterfly.

Referring to injury to beans, Dr. Howard says that the Department received a larva of this insect from a correspondent in New Jersey in August, 1886, who wrote that it was feeding upon lima beans. It is stated also that Mr. Coquillett and Mr. Pergande had made similar observations, the former having found the larva feeding on beans at Los Angeles, Cal., September 5, 1889, and the latter observed it on beans near Washington, D. C., July 6 and October 18, 1892.

Dr. Howard is of the opinion that this insect is not likely to become a serious enemy to the bean crop, but calls attention to the fact that in Harris's time some farmers are said to have been obliged to abandon hop cultivation on account of the work of these larvæ.

Cerotoma trifurcata.—This insect, better known, perhaps, as the bean-leaf beetle, *C. caminea*, was observed by me May 19, 1897, in a patch of wax and lima beans near the station. My attention was attracted to the ragged appearance of the leaves, and upon examination I found this insect in great abundance on the plants. The wax were more severely injured than the lima beans, nothing but the midrib and the larger veins being left on some leaves. The insect is easily disturbed, and drops quickly to the ground and hides when approached. The attack in this patch was local, as no beetles were found in other bean patches in the vicinity. The garden patch where the outbreak occurred was surrounded last fall by cowpeas, and it seems quite possible that the beetles bred there in considerable numbers, appearing this spring and concentrating upon the beans near by. Beetles, presumably of the second brood, have been common on plants in the garden since July 16. The beetles vary greatly in markings and color.

Crambus caliginosellus.—This insect has been very destructive to young corn this season in Prince George, Cecil, Kent, Queen Anne, and Dorchester counties. July 20 I examined a large cornfield, belonging to Mr. F. H. Eldridge, near Cecilton, Cecil County, and found that about 25 acres had been completely ruined by this pest, even after the fourth planting. The young corn was perforated and eaten

just below the surface of the ground, and in many instances was cut entirely off. At the time of my visit the larvæ had completed their growth and were pupating. They were usually found in the ground about 1 inch below the surface and from 4 to 6 inches from the stalk. Two pupæ were found and several hundred larvæ taken that were just transforming. Nine larvæ were collected from around one stalk, which had been almost entirely eaten off. The first adult moth emerged in my breeding cage August 7, and others continued to emerge until August 16. August 12 I removed thirteen hymenopterous parasites (not yet determined) from one of my cages. This pest is known in some sections of this State as the "corn-bud worm," from the fact that it cuts the young corn so that the terminal shoot or bud can be lifted out.

Tribolium madens.—This insect has been sent to me recently in mill products from the State of Washington. Previous to this I have had it in flour from Montana and Utah. It is quite likely that it breeds in mill products, and to distinguish it from the flour weevils, *T. confusum* and *T. ferrugineum*, I have proposed to call it the "black flour weevil."

Aspidiotus forbesi.—I have this season found this scale quite abundant on 2-year-old apple, pear, and cherry trees in this State. I reported it at the meeting of this association at Buffalo last year (U. S. Dept. Agr., Div. Ent., Bul. 6, n. s., pp. 74, 75), stating that it was a dangerous species on account of its wide range of food plants and the nature of its attack. At that time it was known only from Illinois, where I discovered it on cherry in December, 1894. Professor Cockerell has recently found it on apple trees at Mesilla, N. Mex. (U. S. Dept. Agr., Div. Ent., tech. ser. 6, p. 5). It is, therefore, a widely distributed species, and, no doubt, will be found in many other places. At first glance it is not easy to distinguish this species, popularly known as the cherry scale, from the San Jose scale. The purplish tinge of the bark is also quite conspicuous on some varieties of apple and pear where the cherry scale has established itself. The general appearance of the last segment of the female very closely resembles that of the San Jose scale; but it can readily be distinguished from that species by the presence of the spinerets.

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