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The Canadian Entomologist.

VOL. III.

LONDON, ONT., JULY, 1871.

NO. 3.

REPORT OF MESSRS. W. SAUNDERS AND E. B. REED, ON
THE COLORADO POTATO BEETLE-

Doryphora 10 lineata- Say.

LONDON, ONT., June, 1871.

*To the Honorable John Carling, Commissioner of Agriculture and Public
Works for the Province of Ontario :*

SIR--In compliance with instructions from your Department, dated June 10th, 1871, "to visit, without delay, as many of the localities on the Western frontiers of this Province as are most affected by the ravages of the Colorado Potato Beetle: to examine the nature and extent of the attack; to make such experiments, with a view to the cure or arrest of the malady, as our observations and judgment might suggest, and to report to your Department the result of our labors, that the same might be submitted to the public forthwith, for general information:" we beg leave to submit the following Report: -

LOCALITIES.

We have visited a large portion of the Western frontier of the Province, and have also procured reliable information from many other localities throughout Western Ontario, and are thus enabled to form a tolerably accurate estimate of the spread of the insect, and also of the present state of the potato crop in those regions now affected by this pest.

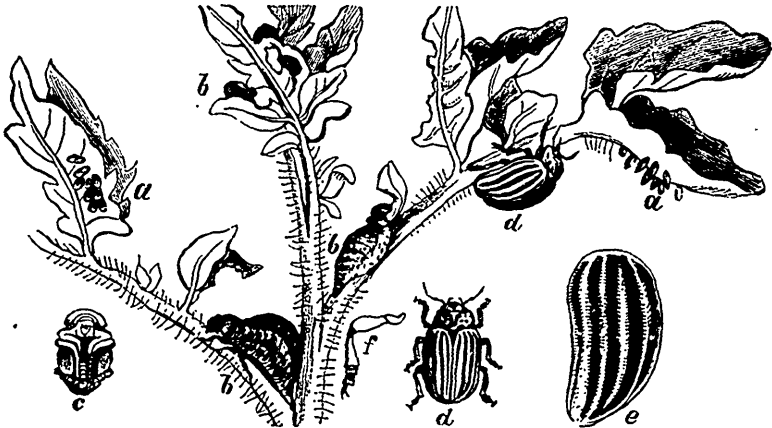
NECESSITY FOR INVESTIGATION.

We are fully satisfied, from personal observation, that the current newspaper reports respecting the enormous numbers of these insects which have crossed into Canada from the State of Michigan are but little, if at all, exaggerated; and that the evils resulting from this invasion are already of sufficient magnitude to excite serious alarm respecting the safety of a crop which is so indispensable to all classes of the community; and we

apprehend that before the close of the season the natural increase of the insect will have extended the mischief throughout the greater portion of Ontario. The prompt action, however, of the Department, in endeavoring to acquaint the agriculturists of the Province with the best remedial measures to be used in this instance, will, we trust, result in effecting a saving of a material portion of the crop, even in the badly-affected districts. In making this Report, we have endeavored to condense it as much as is compatible with the objects we have in view, and to lose no time in placing it in your hands in a plain and popular form. It is intended, in the next annual report of the Entomological Society of Ontario, to give a complete history of the Colorado Potato Beetle from its earliest appearance, with a more detailed account of the mischief it has caused throughout the country; and also to treat at large of the various other insects injurious to the potato.

THE COLORADO, OR 10-LINED POTATO BEETLE.

FIG. 1.



Colors—(a) deep orange; (b) and (c) venetian red, inclining to cream color; (d) and (e) cream color and black.

The accompanying fig. 1 represents the insect in all its various stages, and will enable the reader readily to recognize it when found; *aa* the eggs, which are of a deep orange yellow, and are laid in patches usually containing from thirty to forty on the underside of the leaves; *bbb* the larvæ at different ages; *c* the chrysalis or pupa; *dd* the perfect beetle; *e* one of the wing cases enlarged, to show the lines more plainly.

The larva, which is at first dark reddish brown, becomes paler and

brighter in color as it matures. The head is black, and there is a ring of the same color on the second segment. There are also two rows of black spots along each side.

The perfect beetle is of a yellowish cream color, with ten black lines or stripes, running lengthways, and a few black dots on the head and thorax. There are three broods of this insect during each year, the last of which remains in the ground during the winter. Some idea of its enormous rate of increase may be gathered from the fact that each female deposits from 700 to 1000 eggs, and that these attain to the perfect beetle state within fifty days, so that the results from a single pair, if allowed to increase without molestation, would, in one season, amount to over fifty millions. The insect, in its several forms of egg, larva and perfect beetle, may frequently be found in company on the same potato vine.

ITS NATURAL FOOD.

This insect was originally confined to a comparatively small extent of country, in the region of the Rocky Mountains, where it fed on a species of wild potato, *Solanum rostratum*; but having suddenly acquired a taste for the cultivated potato, and adopting that as its principal food, it has gradually spread eastward, until it has invaded our shores. It feeds also readily on many other plants belonging to the order *Solanaceæ*, which includes the tomato and egg-plant as well as the potato—all of interest to the agriculturist—as well as many species of wild plants, such as Black Henbane, *Hyoscyamus niger*, and Thorn-apple, *Datura Stramonium*.

THE THREE-LINED POTATO BEETLE.

FIG. 2.



Colors—Pale yellow & black.

The Colorado, or ten-lined beetle, must not be confounded with the smaller three-lined potato beetle, *Lema trilineata*—Oliv. See figure 2—which has been common throughout Canada for many years past, and is, at the present time, unusually abundant in some districts, especially in the neighbourhood of Kincardine.

The larva of this beetle (see fig. 3) is smaller, and may be readily distinguished by its disgusting habit of carrying its excrement on its back.

FIG. 3.



Colors—Dull white.

EXTENT OF DAMAGE.

We found that the districts most affected by the insect were those portions of the Province situated on the frontier, between Sarnia and Amherstburgh, and extending inland from twenty to forty miles; but we have obtained undoubted evidence of the fact, that in smaller but rapidly increasing numbers this pest has spread over a very large portion of the Province, embracing Bayfield to the North, the neighborhood of Toronto to the east, and over almost the entire portion of the western section of the country. It must be remembered, however, that those insects we have seen are of the first brood only, and as the season advances we shall, without doubt, receive reports of great injury sustained in many districts by the succeeding broods. Already several instances have come under our notice of parties who have been so discouraged by the utter destruction of their potato vines, that they have ploughed up entire fields and sown other crops in their place. We anticipate that the large amount of shipping daily passing down the Detroit river, and the continual movement of railway cars from affected districts, both in Ontario and the United States, to the eastern portions of the Provinces, will, by affording shelter and means of transport to the beetle, distribute this insect shortly over the entire coast line and portions of the country through which the railways pass.

ITS PROBABLE CONTINUANCE.

From all the information we have been able to obtain from competent observers in those Western States which first suffered from the depredations of this foe, we deem it highly probable that we shall have to contend with it for many years to come. In the course of three or four summers our agriculturists may expect that the insect enemies of this beetle, of which we already know some nine or ten to exist in Canada, and which prey upon the eggs and larvæ, will, in the natural order of things, so multiply as materially to check the further increase of the Colorado Beetle.

IS IT POISONOUS?

As many stories are current relating to the supposed poisonous character of this insect, we made it a special point to obtain all the information possible on this head, and we were unable to find the slightest evidence to sustain this popular belief, although we conversed with many persons who had handled and destroyed many thousands of the insects in their different stages, and also handled them freely ourselves with impunity.

We do not know of any insect belonging to the family *Chrysomelide*, of which this beetle is a member, possessing poisonous properties, hence we deemed it highly improbable, from the first, that there was any truth in the stories so widely circulated, and which have created so much unnecessary alarm.

ARTIFICIAL REMEDIES—PARIS GREEN.

The many Entomologists and Agriculturists who have experimented on this insect, with various poisonous and other substances, in those portions of the United States where it has been so destructive for some years past, concur in recommending the use of *Paris Green*, diluted with flour, ashes or air-slacked lime, as the best remedy known for destroying the insect, both in its larva and beetle state, without injuring the plant. The results of our experiments and investigations confirm this opinion, and this remedy is, no doubt, a reliable one, provided the *Paris Green* be of good quality. Our experience has also satisfied us that flour is a much better substance to mix the green with than either ashes or lime, as the insects eat it more readily, and, at the same time, it adheres more tenaciously to the surface of the plant, and hence is not so easily washed off by rain. We found good effects from a mixture of one part, by weight, of *Paris Green*, with 10 or 12 parts of flour, dusted lightly on the vines early in the morning, when the dew is on the foliage.

HOW BEST APPLIED.

Where only a small patch is cultivated, the mixture can be readily applied by means of an ordinary flour-dredger; but where larger quantities are grown, we would suggest the use of a round tin box, about nine or ten inches in diameter, and four or five inches in depth, with a tightly-fitting lid, and with a bottom either perforated with small holes, or covered with fine wire gauze. This should be attached, by means of a hollow handle, to a stick of any convenient length. With such an instrument, which may be obtained at a very trifling cost, a large piece of ground can be gone over in a short time, and the mixture applied almost as fast as the operator can walk.

QUANTITIES REQUIRED, AND PROBABLE COST PER ACRE.

After a careful estimate, we consider that three pounds of the *Paris Green*, mixed with its due proportion of flour (30 to 56 pounds), will, if economically used, be found sufficient for one acre of potatoes. Assuming fifty cents to be the ordinary retail price per lb. of *Paris Green*, every

application of the mixture would cost from two to three dollars per acre, exclusive of the labor. If the insect is very abundant, two or more applications may be required, as exposure to wind and rain will eventually remove the powder entirely from the leaves, rendering them liable to further attacks. Some discretion should be exercised in selecting a suitable time for using the mixture, which should not be applied during high winds, or immediately before a rain storm.

NOT DANGEROUS, IF CAREFULLY USED.

As this mixture is of a poisonous character, ordinary care should be used in handling it, to avoid inhaling much of the dust when applying it, to wash the hands after each application, to keep it out of the reach of children, and to exclude live stock of all kinds from fields where the poison is used. With these precautions no danger need be apprehended; it does not injure the leaves to any appreciable extent, unless very heavily applied, and cannot possibly affect the potato itself. We make these remarks because we have met with several individuals who entertain a foolish prejudice against the use of this mixture, for fear that it might injure the potatoes.

OTHER REMEDIES TRIED.

We did not content ourselves with the use of *Paris Green* only, but experimented with as many other substances as the limited time at our disposal would admit of; and, although we would not have the results here given to be considered as final in reference to the materials used, we trust they will be of value as indicating the most promising remedies for further trial.

ARSENIOUS ACID (Arsenic).—This chemical being much cheaper than *Paris Green*, and more uniform in its composition, we hoped it would have proved a practical and safe remedy. We tried it in the proportions of half-ounce, one ounce and two ounces to a pound of flour; and while we are not prepared, from the few trials we have made, to entirely disapprove of its use, the results we have obtained point to the conclusion that where it has been used in sufficiently large proportions to destroy the insect, it has caused more or less injury to the leaves. In cases where *Paris Green* is not obtainable, this might be used as a substitute, in the proportion of one ounce to one pound of flour, which should always be colored with some black powder, such as charcoal or black antimony, so as to lessen the risk of accident from its use.

Another arsenical compound was also tested, known in commerce as *Powdered Cobalt*, or *Fly-Poison*. This was used in the same proportions as the last-mentioned, and with similar results, but owing to its higher price we do not recommend it for general use.

SULPHATE OF COPPER (Blue Stone).—A strong solution of this salt was tried in the proportion of two ounces to one gallon of water, and showered on the vines with a watering pot, without damage to either the insect or the plant.

BICROMATE OF POTASH.—This is a poisonous substance, largely used in dyeing, and one which has attracted some attention in France of late, as a remedy for insects. We used it dissolved in water in the proportion of two ounces to three gallons of water. This killed the insects effectually, but, at the same time, destroyed the plants. Whether, in a more diluted form, this remedy could be effectively used without injury to the foliage, we are unable at present to say, but shall experiment further with it.

POWDERED HELLEBORE.—This powerful irritant, which is so effectual as a remedy for the *Currant Worm*, we tried without perceptible effect, both in powder and also mixed with water. Several other poisonous substances were also used with like results.

CARBOLATE OF LIME.—There are several preparations sold under this name, which we found to vary much in composition and character, and equally so in effect. We tried an article known as *Dougall's*, without any good result, but succeeded better with one prepared by *Lyman Bros.* of Toronto, a black powder manufactured, we understand, from coal tar.—This destroyed a large proportion of the larvæ, but we doubt whether it would kill the perfect insect; it is, moreover, used in an undiluted form, which would render its cost greater than that of the *Paris Green* mixture, so we see no advantage in using it, although the fact of its being less poisonous may induce some to try it who are prejudiced against *Paris Green*.

ASHES and AIR-SLACKED LIME, we found, had been extensively used by many of the farmers on the frontier districts, but, as far as we could see or learn, without any perceptible results.

HAND-PICKING.

This has been, thus far, the chief means employed in lessening the numbers of the beetle, and, where perseveringly followed, has proved

very successful ; but it needs to be almost daily repeated, and is, therefore, exceedingly troublesome, and quite impracticable where a large quantity of potatoes are under cultivation. The usual method is to knock the insects off the plant with a piece of shingle, into a dish or small pail containing a little water : as they readily fall when struck, both larva and beetle may thus be collected in large numbers.

ARE ALL POTATOES ALIKE LIABLE TO ATTACK ?

During the course of our inspection, we frequently met with gardens and fields containing two or more kinds of potatoes, and observed that in many instances one sort was very much more affected by the insect than the others. The *Meshannock* is particularly liable to attack, while the Early Rose and Peach Blow are less so ; but where the latter are the only varieties planted, the insects do not hesitate to devour them. The only practical suggestion we can make in reference to this point is, that it might be well to plant a few of such sorts as are most liable to be injured, so as to attract the larger proportion of the insects to one spot, and thus enable the cultivator to destroy them with less labor and expense.

NATURAL REMEDIES.

American Entomologists enumerate fourteen insects which prey upon the Colorado Potato Beetle in some one or other of its stages. Eight of these we know to be common in Canada, and probably some of the others will also be found here. Of the insects we are now about to describe, the first four feed on the eggs and larvæ, the fifth upon the larvæ only, and the last two on both the larvæ and perfect beetle.



FIG. 4.

LADY-BIRDS.—The commonest of these is called the nine-spotted Lady-Bird (*Coccinella 9 notata*—Herbst.) See fig. 4.—

It is a small, round beetle, of a brick-red color, with nine black spots on the wing cases, and may be found in almost every part of Canada.



FIG. 5.

Hippodamia maculata (De Geer.)—The spotted Lady-Bird ; see fig. 5. This is a small, pinkish beetle, marked with large black blotches.



FIG. 6.

Hippodamia 13 punctata (Linn.)—The thirteen-dotted Lady-Bird (see fig. 6) is somewhat larger than either of the preceding species, and has thirteen black spots on a brick-red ground.

Hippodamia convergens (Guer.)—The convergent Lady-Bird,

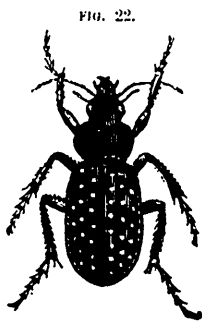
whose color is orange red, marked with black and white, is said to have been of immense service in checking the ravages of the Colorado beetle in some of the Western States. The larvæ of all these species are very fierce, and feed on both the eggs and young larvæ of both the Colorado and three-lined potato beetle.



The next insect belongs to the order *Hemiptera* (half-wings), the true *bug* family. It is the rapacious Soldier Bug *Reduvius raptatorius* (Say)— See fig. 21. Its color is light brown, and it attacks the larvæ only of the Colorado beetle.

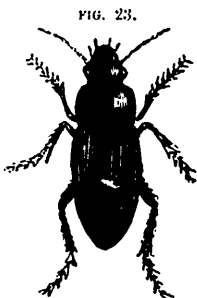
We have detected another insect friend belonging to this family in the act of extracting the juices from the body of a young Colorado larva, into which it had thrust the long rostrum, or beak, with which all the members of the family are furnished. Its name has not yet been determined by us.

The next two friendly insects are known as *Carabidae*, or Carniverous Ground Beetles.



Colors—Black, with coppery dots.

Calosoma calidum (Fabr.)— The glowing calosoma (see fig. 22) is so called from the appearance of its wing-cases, which are shining black, with six rows of sunken coppery spots. This beetle is easily found under stones or logs, in moist weather, in May and June. It is exceedingly active in its movements, and a valuable friend to the agriculturist.



Color—Dull black.

The murky ground beetle, *Harpalus caliginosus* (Say)—see fig. 23—is the last one on our list. It is of a dull black color, and may be readily recognized from the drawing. All the insects belonging to this family are carnivorous in their habits, and we shall doubtless find among them some other species attacking the Colorado Potato Beetle.

In some of the figures we have used, the insects have been enlarged, and in such cases the correct size is represented by a hair line at the side of the drawing.

POULTRY.

There is a great diversity of opinion as to whether poultry will, or will not, eat the larvæ of the potato

beetle, and if they do eat it, whether any injurious effects will follow. We obtained much contradictory evidence on this point. A few people asserted that some of their poultry had suddenly sickened and died, after eating freely of the insect, while others stated that their turkeys, ducks and fowls had eaten the larvæ greedily, and with perfect impunity. The evidence is so evenly balanced, that we are unable to give any decided opinion. We hope some further experiments will shortly be made, and a definite conclusion arrived at.

SUGGESTIONS.

Paris Green, which we regard as the most practical and efficient remedy for this insect pest, is, unfortunately, as found in commerce, a substance most variable in its composition. It is an arsenite of copper, and the best qualities contain about 60 per cent. of arsenic, on which its activity depends; but the inferior grades contain a much smaller percentage, and are proportionately less effective, and sometimes almost worthless for this purpose. It is highly important that the public be supplied with a good quality of this useful material, and at as low a price as possible, as an encouragement to its use; and we would strongly urge on the Department the expediency of making such arrangements with the wholesale dealers in Toronto as will enable farmers and others to obtain a reliable preparation at a stated uniform price. We would further suggest, that, for convenience sake, the *Paris Green* be made up in packages containing one pound each, with printed directions for its use, and cautions regarding its poisonous qualities.

We would also recommend the department to strongly urge upon farmers to plant in future only such quantities of potatoes as they can well look after. One acre, carefully cultivated and watched over, will probably yield more gross results than four or five acres, if neglected; indeed, wherever the beetle is numerous, negligence will be sure to be repaid by the utter destruction of the crop.

ACKNOWLEDGMENTS.

We cannot conclude our report without acknowledging the valuable assistance we received, during our tour of inspection, from many persons to whom we applied for information. Much anxiety appeared to be felt for the safety of the potato crop, and great satisfaction was expressed at the action of the Department in causing an investigation to be made. The officers of the various agricultural societies in the districts we visited

were most obliging, and did all in their power to aid us. In our annual report, to which we have before alluded, we purpose to acknowledge more in detail the individual services which were rendered. We would, however, here especially express our thanks to W. Wallace, Esq., Assistant-Superintendent G.W.R.R., for his kindness in obtaining much useful information for us from the various station masters on the line.

We have the honor to be, Sir,

Your obedient servants,

WILLIAM SAUNDERS,

Vice-President Entomological Society of Ontario.

EDMUND BAYNES REED,

Sec.-Treas. Entomological Society, Ontario.

[NOTE.--Seeing the importance of taking immediate action in carrying out the suggestions made in the above Report, the Department has effected such arrangements with a wholesale drug house in the city of Toronto as will enable farmers and others to obtain a reliable quality of Paris Green there, at 30 cents per pound. It will be put up in one pound packages, as suggested, with full directions for use, and may be purchased in quantities of not less than ten pounds, by remitting the amount of its cost to Messrs. Lyman Bros. & Co., of Toronto.]

DESCRIPTION OF HESPERIA CONSPICUA (EDW.).

BY PROF. H. W. PARKER, AMHERST, MASS.

Mr. Edwards describes and figures a female of this large species, from Michigan, in Proc. Ent. Soc., Phil. 1863. The following is a description of the male, collected by me in Iowa, July 4. The spots are numbered as in Mr. Edwards' account:--

The secondaries, above and beneath, are like those of the female. Above, from the border of the primaries to near the base, the color is yellow, except the sexual dash and dark veining; an oblique line at end of the cell, from which a dark shade extends to the outermost spot; resting midway on this, a narrow shade runs from the first three spots along the subcostal vein. The sexual dash, with its spots, is formed of two confluent patches of black: the outer one is oblong, parallel and contiguous with the cell, its outer end slightly separated from the oblique cross line; the other patch is smaller and more oval, touches the basal

fourth of the first patch (in one specimen only the corner), and extends obliquely to the internal vein; outside of this the eighth yellow spot is not obsolete, but large, squarish, and confluent with the seventh.

Beneath, the smoky tinge of the inner margin of the primaries is replaced by dark brown between the base and the seventh and eighth yellow spots; the seventh is sharply defined, and the eighth shades off exteriorly. This dark-brown area (made up in part of a sub-triangular spot, its darker part oval, and representing the outer sexual dash above) cuts sharply against the cell. The costal border, the cell, and the whole of the secondaries, have a strong tawny tinge in a fresh specimen. The cross line at the end of the cell is visible, and a dark shade reaches outwardly to both the fourth and fifth spots; the cell is bisected lengthwise by a dark line. Ex. males 1-4- 1-5. Females 1-5.

In a female specimen, likewise from Iowa, the secondaries beneath are suffused with the same tawny color as in the male. My males unquestionably belong to my female, and the female agrees well with Edwards' description and figure, whereas Mr. Scudder confesses that his does *not* in particulars that seem important.

HOW TO DISTINGUISH BETWEEN LIMENTIS DISIPPUS-- Godt. AND L. URSULA, Fabr., IN THEIR PREPARATORY STATES.

BY C. V. RILEY,

State Entomologist of Missouri, St. Louis.

It is not, I believe, generally known that, closely as these two insects resemble each other in the larval and pupal states, they may, nevertheless, be readily and invariably distinguished by the constant differences in the anterior horns of the former and in the hump of the latter. I was fortunate enough, the present summer, to have several larvæ of each species feeding, as also several pupæ of each hanging, at one and the same time; and with the exception of the characters here given, I do not think there are any other distinguishing features to be relied upon. On an average, the mature larva of *Ursula* is larger, the head is somewhat smother, and the mamma-like warts on joint 5 more prominent, while the average size of its pupa is also greater; but, when a sufficient

number of individuals are examined, each species is found to vary so much in itself, as to render these unreliable as distinguishing traits.

FIG. 24.



The accompanying diagrams (Fig. 24), which are sketched from memory, are, perhaps, a little inaccurate and exaggerated; but will serve to illustrate the true distinguishing traits at a glance - a' a^2 showing the larval horn and pupal hump of *Disippus*, and b' b^2 the same of *Ursula*. In the full-grown larva of *Disippus*, the horns on joint 2 are, on an average, but 0.20 inch long; while in *Ursula* they average 0.40, or double the size: in *Disippus* they are heavy, decidedly club-shaped, and generally covered with granulations or prickles to the base; while in *Ursula* they have a more uniform diameter, are more slender, with fewer prickles at the end, and with the basal half generally quite smooth and highly polished. In the pupa of *Disippus* the hump is less regular, with the upper edge less rounded than the lower, so that an imaginary line run through it as at a^2 leaves the larger portion below. In the pupa of *Ursula*, on the contrary, the hump is quite regular, the upper edge being, in outline, almost the counterpart of the lower, so that the same imaginary line would leave the larger portion above.

I have not my library at hand, and cannot tell whether Boisduval, Smith and Abbott, or any other authors have pointed out these distinguishing characters; but I have an impression that they have not, and more modern authors certainly have not.

London, Eng., July 13th, 1871.

[Mr. Riley's friends will no doubt be glad to learn, from the date of the foregoing article, that he has safely crossed the Atlantic, and that, though amongst old friends and old haunts, he has not lost his interest in the investigation of the insects of this continent. We wish him much enjoyment in his visit to his native land, and a safe return to his valued labours in the Western world.--Ed. C. E.]

MICRO-LEPIDOPTERA.

BY V. T. CHAMBERS, COVINGTON, KY.

LITHOCOLLETIS.

(For the generic characters, see Stainton's *Nat. Hist. Tineina*, vol. 2, or Dr. Clemens' Paper in the *Proc. Acad. Nat. Hist., Phila., Nov., 1859.*)

This genus comprehends a large part of the genus *Argyromiges* Stephens, and is one of the largest among the *Tineina*. The number of described European species is very great: but in this country, so far as I am advised, but 27 species have heretofore been described. Of these, Dr. Fitch (*Reports*, vol. 5) describes 7, one of which, *L. (Argyromiges) robinella*, is re-described by Dr. Clemens (*loc. cit. supra*), it having been originally described by him in an English publication. Dr. Clemens (*loc. cit.*) describes also 17 new species; and Dr. Packard, in his "Guide," describes 3 additional new species. I propose, in these papers, to catalogue such of the above-described species as I have met with in Kentucky (near to Cincinnati, Ohio), with notes upon their habits, variations, &c., and to describe such new species as I have met with.

The genus presents, in the larval state, two distinct forms.

GROUP 1st.—Larva cylindrical, with distinct thoracic, ventral, and anal feet. It mines the *under* surfaces of leaves, and the complete mine is tent-like, and the leaf more or less drawn or folded.

GROUP 2nd.—Larva flat; apparently, but not really, apodal. It mines the *upper* surfaces of leaves, and the mine is usually flat, or simply a little drawn or puckered along the centre, and a little tent-like. But the rule is not invariable that the mine and miner of the upper surface is flat, and the miner of the lower surface cylindrical, and the mine tent-like. There are exceptions to both sorts of mine and miner. And from not being aware of these exceptions, Dr. Clemens (*Proc. Ent. Soc. Phila., 1863, v. 2, p. 8*) criticises a species (*Anacamptis robinella*) which he says does not exist. But I have now before me as I write numerous specimens of the larva as described by Dr. Fitch. The mine, however, is *as yet* flat. And I have other instances of the other case, cylindrical larvæ in a flat mine on the upper surface. These larvæ are usually marked with a translucent spot on top of each side of each of the first three segments following the head, and with a transverse spot on those and the following segments. This *macula* is, in form, a thin double convex, an ellipsoid, or a parallelogram, and is

either hollow or not, according to the species. These markings change at the moultings sometimes, but I have never found any variation in the markings of the full-grown larvæ of a species among themselves, though sometimes they differ in larvæ from different species of plants which yet produce the identical imago. The mines, likewise, of the same species, do not vary essentially upon the same plant, nor usually upon different plants; yet sometimes different mines upon different kinds of leaves produce the same imago. Examples of these variations will be given further on. Usually, the larva of a species is confined to a single species of plants, or if it mines the leaves of more than one species they are generally closely allied ones; but sometimes it happens that the same larva—or one producing the same imago—mines the leaves of widely different plants.

It frequently happens that the same plant or even the same leaf is mined by more than one species of larva, and I have seen upon the same locust leaf (*Robinia pseudacacia*) the mine of *Lithocolletis Robiniella*, Clem., *Parectopa Robiniella*, Clem., and another mine, which is, perhaps, that of *Anacampsis Robiniella*, Fitch, though I have not bred the imago; and there is still another miner (of the upper surface) which makes a white, tent-like mine, but with the imago of which I am not acquainted as yet.

Usually a mine is tenanted by only a single larva, but as the mines spread they frequently unite. There are, however, among the larvæ of the 2nd group, some which occasionally, and others which almost invariably, have several larvæ even in the very young mine, and I have seen fifteen larvæ in a mine scarcely a line in diameter.

With very few exceptions, the pupa state is passed in the mine, the exuvia being left partly within and partly without the mine by the emergent imago. A few instances only are recorded in which the larva leaves the mine to become a pupa; and Dr. Clemens has recorded a single instance, that of *L. crataegella*, in which the larva sometimes leaves an old mine and forms a new one.

SECTION A.

SPECIES WITH THE GROUND COLOR WHITE.

Dir. 1st.—Some portion of the wings of some shade of yellow.

Sub-dir. a. No apical spot—no basal streak.

* Wings marked with fasciæ.

1.—*L. hamadryadella*, Clem., *Proc. Acad. Nat. Sci., Phila.* 1859.

There is considerable variation in the distinctness and disposition of

the markings of this species, especially about the basal portion of the wings, where the black markings vary from mere dusting to distinct narrow lines or fasciæ. Perhaps Clemens' variety No. 3 is the most distinctly marked form, but there is no such thing as a distinct and separate *variety*, as the variations are of all kinds between the extremes.

The larva is of the second group, and the mine is an irregular whitish blotch on the upper surface of the leaves of different white oaks (*Quercus Alba* and *obtusiloba*). The pupa lies on the upper surface under a thin coverlet of silk. Imago in April, May and July. *Alar. ex.* nearly $\frac{1}{3}$ inch. Common—Pennsylvania—Kentucky.

There is another mine of a very distinct species, hereafter to be described, on the upper surface of the leaves of the same plant, and sometimes both occur upon the same leaf. Seldom more than one larva in a mine.

2. *L. tiliacella*. *N. sp.*

Glistening, snowy white; middle portion of the anterior wings from near their base to the base of the ciliae pale golden, which is produced along the costa to the base—three broad silvery white fasciæ dark margined internally; the dark margin of the third fasciæ widely interrupted in the middle, and the pale golden very indistinct, sometimes not visible, behind it; the second fasciæ is about the middle of the wing. *Al. ex.* $\frac{1}{4}$ inch. Kentucky—rare. Larva of the *first* group, white, covered with dispersed longish hairs. Mine on *upper* surface of *Tilia Americana* (the Linden). Small, circular or ovate, brownish, mottled with whitish; not visible underneath until the lower cuticle dies. This is one of the anomalous mines and larvæ before referred to.

3.—*L. luctiella*, Clem., *loc. cit. supra.*

Besides the markings mentioned by Dr. Clemens, nearly all my specimens have the silvery band dark margined strongly by a dorsal black streak, and have also a distinct black costal spot at the base of the ciliae. *Al. ex.* $\frac{1}{4}$ in. nearly. Pennsylvania and Kentucky. Common larva of the 1st group—pupa in thin whitish silken cocoon.

Mines the under surface of leaves of *Tilia Americana*. It first separates the lower cuticle, between two veins, over the whole surface of the mine, and then picks out the parenchyma in specks above, so that the incomplete mine resembles and may be mistaken for that of *L. tiliacella*, but the perfect mine is white upon both surfaces.

Sub-dir. b. With an apical spot - no basal streak.

* Costal and dorsal streaks, but no fasciæ.

4. *L. Clemensella*. *N. sp.*

Silvery or glistening white. Antennæ annulate above with brownish. Apical half of the anterior wings pale golden, with four silvery white costal and two dorsal streaks all dark-margined internally. The dark margin of the first costal streak distinct, oblique, and produced along the costa towards the base. The first dorsal streak opposite to the second costal, oblique, pointing to the third costal. *No basal streak.* Apical spot black, nearly circular. Hinder marginal line at the base of the dorsal ciliae brownish, broad, continuous with the hind margin of the second dorsal streak, and reaching to but not passing around the apical spot: ciliae silvery-tinged with pale golden. *Al. ex.* $\frac{1}{4}$ inch. Kentucky—common. Differs from the next species, *L. lucidicostella*, in the points indicated by the italics, and is, perhaps, a little smaller. Though the imago is common in April and May, and I have made diligent search for the mine, I have never found it.

I have taken the liberty of naming this pretty species in honor of the late Dr. Clemens, who has done so much for this branch of American LepidopteroLOGY.

Sub-dir. c. Both apical spot and basal streak.

* No fasciæ, but both dorsal and costal streaks.

5. *L. lucidicostella*. Clem., *loc. cit. supra.*

Larva of first group. Tent mine on the under surface of the leaves of Sugar tree (*Acer Saccharinum*) and sycamore? (*A. pseudo-platanus*).—Imago in April, May, July and August. Abundant. *Al. ex.* $\frac{1}{4}$ inch, large. Pennsylvania, Kentucky and Alabama.

L. Argentifimbriella, Clem., is described *loc. cit. supra* and *L. quercii albella*, by Dr. Fitch, in vol. 5 of his *New York Reports*; and both are said to mine the leaves of oaks, but I have never found either in Kentucky, nor have I ever seen them at all. Are they the same? From the descriptions I cannot see wherein they differ.

L. Argentifimbriella and *L. lucidicostella* are described by Dr. Clemens in the same paper, and no doubt they are different species. Yet the differences indicated by the descriptions are differences of degree, that is, of intensity and extent of the markings rather than of kind, that is, of location and pattern of coloration; and I have species of *L. lucidicostella*, which seem to me to meet the requirements of either description.

6.—*L. Caryae-albella*. *N. sp.*

Head palpi, tuft, antennæ and thorax silvery white: basal portion of the wing (within the costal and dorsal streaks) silvery white, *with a wide pale golden basal streak along the costal margin from the base to the first costal streak*. The basal white portion in some lights suffused with pale golden. Apical two-thirds or more of the wings pale golden, with four silvery costal and two dorsal silvery streaks, all dark; margined internally. The first dorsal large oblique, opposite the first costal, which is smaller; *their dark margins uniting at an acute angle on the fold*, the streaks themselves being scarcely confluent. Second dorsal opposite to and larger than the second costal; its dark margin wide. Third and fourth costal streaks small. Apical spot small, black; hinder marginal line at the base of the ciliæ, brown. Ciliæ pale, fulvous. *Al. ex.* $\frac{1}{4}$ inch. Larva unknown. Mines the under surface of the leaves of hickory trees (*Carya-alba*). Mine ovoid, tent-like. The parenchyma is eaten off of the upper cuticle in a ring, leaving a green spot in the centre, which is then eaten off. The pupa is contained in an oval cocoon made of frass. Imago in July—rare.

Very distinct from *L. lucidicostella*, the main differences being indicated by the italics above.

BOOKS RECEIVED.

It is now several months since we have had space to acknowledge the various publications that have been kindly sent us by authors and publishers; this omission has arisen, not from any want of appreciation of the kindness of the donors, or the slightest intention of being discourteous, but from the fact that our journal has been published at longer intervals than previously, and consequently the pressure upon its limited pages has been greater than ordinary. Our observations now must necessarily be brief, as we have fallen so deeply into arrears.

Characters of Undescribed Lepidoptera Heterocera, and A List of Hymenoptera, collected by J. K. Lord, Esq., in Egypt, in the neighbourhood of the Red Sea, and in Arabia. By Francis Walker, F.L.S. London: Janson. 1869-71.

THE former of these works, by our diligent friend, Mr. Walker, contains descriptions of 196 new species from various parts of the world, including

several from North America : the latter gives descriptions of new species and references to nearly 300 species, chiefly of Aculeate Hymenoptera.

Record of American Entomology for the Year 1869. Edited by A. S. Packard, jun., M.D. Salem: Naturalists' Book Agency. (8vo. pp. 62. \$1.)

We were very glad, indeed, to receive this second issue of a most useful work, and trust that we shall soon have the pleasure of announcing the publication of the third volume containing the "Record" for 1870. The part before us contains references to the articles or notes of fifty-two American Entomologists, and to the descriptions of no less than three hundred and thirty-five new species of North (and Central) American insects. Among the Entomologists we notice the names of ten Canadians, whose articles, together with those of several of our friends in the United States, have for the most part appeared in the pages of the CANADIAN ENTOMOLOGIST. We cannot but feel highly gratified at the success which our little publication has achieved as shown in the pages of the "Record;" and we trust that future issues will manifest no falling off in the numbers and zealous work of our friends and correspondents. The "Record for 1869" contains notices of the Hymenoptera, Lepidoptera (Heterocera), Arachnida and Myriapoda, by the Editor, Dr. Packard; Lepidoptera (Rhopalocera) and Orthoptera, by Mr. Scudder; Diptera, by Baron Osten Sacken; Coleoptera, by Dr. Horn; and Hemiptera and Neuroptera, by Mr. Uhler,—all well-known and eminent Entomologists.

MISCELLANEOUS WORKS.

"Le Naturaliste Canadien," vol. iii., No. 6, May, 1871; "The Canadian Journal," Toronto, May, 1871; "The Canadian Naturalist," Montreal, Sept., 1870; "Proceedings of the Boston Society of Natural History," vol. xiii., 1869-71; "Newman's Entomologist," No. 90 (from Mr. Reeks); Hardwicke's "Science Gossip," May, 1871; "Nature," No. 80, vol. iv., May 11, 1871; "The American Agriculturist;" "The Rural New Yorker;" "The Prairie Farmer;" "The Maine Farmer;" "The New York Sun;" "Arthur's Home Magazine" and "The Children's Hour;" "The Horticulturist;" "The Canada Farmer;" "The Churchman's Magazine;" "The Canada Bookseller;" "The Journal of Education;" "The Canadian Poultry Chronicle."

ERRATUM.—In the last number of the CAN. ENT., vol. iii., p. 23, 7th line from the bottom, for *C. Susinella*, Higa, read *C. Susinella*, Heyden.

EXCHANGES, &c.

COLEOPTERA, LEPIDOPTERA, &c. Expecting soon to return to Europe, I should like to receive in exchange Lepidoptera or Coleoptera of Canada and the United States for European. As a corresponding member of the Royal Entomological, Malacological and Linnean Societies of Belgium, and an honorary member of the Silk Supply Association of London, I am desirous to procure such species as can be obtained from the United States and Canada. I should especially like to obtain specimens of Silk-worm Moths; and should also be thankful to receive birds' skins, eggs and nests for Europe. Early correspondence is solicited, in order to effect agreeable exchanges. Specimens may be sent packed or pinned in cigar-boxes.—
J. Q. A. WARREN, Chicago, Ill.

LEPIDOPTERA, &c. - I have a collection of Birds' Eggs, Lepidoptera (including some from Florida) and Coleoptera, duplicates of which I should like to exchange, giving preference to the two first named.—
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UNITED STATES.—The American Naturalist's Book Agency, Salem, Mass.; J. Y. Green, Newport, Vt.; W. V. Andrews, Room 17, No. 137 Broadway, New York.