

PSYCHE.

ORGAN OF THE CAMBRIDGE ENTOMOLOGICAL CLUB
EDITED BY GEORGE DIMMOCK AND B. PICKMAN MANN.

Vol. II.] Cambridge, Mass., Jan.—Feb., 1878. [Nos. 45–46.

Recent Progress of Entomology in North America.

FIRST ANNUAL ADDRESS OF THE PRESIDENT.

In selecting a subject for the first address from this chair, I have had in mind the principal objects of our Club. We have favored the biological side of our science — taking biology in its broadest sense — as the most important, the most interesting, and yet on the whole the least known. Anatomical studies also enter into our plan, but mere descriptive entomology, so far at least as it relates to perfect forms, and all vexed questions of nomenclature, have been almost wholly ignored, both at our meetings and in our journal. For, however important these latter subjects may be — to which, indeed, our members have elsewhere given a fair share of attention — we have desired, in the formation of our Club, and the establishment of our journal, to uphold the superior value of questions which have a more direct philosophical bearing. If, from time to time, we pause, and consider the work already accomplished, we shall be stimulated to better and more earnest endeavor for the future; we shall see the direction in which we need to advance, and can draw comparisons which are not without value. I propose then a general review of recent progress in this country, in the direction of our favorite studies. By proper grouping we may obtain a better idea of what has been accomplished. A separate reference to each paper by name will hardly be necessary, since the review is confined to the publications of a single year (1877), and the admirable record of our diligent Secretary will soon place the complete series in our hands.

Histories of insects furnish the fundamental data upon which

will be based much of the future progress of entomological science. In this direction Mr. W. H. Edwards has this year contributed some of the most important facts. In the continuation of his admirable work on North American butterflies, the transformations and imaginal variations of *Papilio turnus* are represented on three plates executed with the rarest fidelity. Eleven drawings of the perfect insect appear, nine of the caterpillar in all its stages, and one each of the egg and chrysalis. Without enlarging on the beauty of these plates, we can safely say that in no country have butterflies been so generously illustrated. Mr. Edwards finds three broods of this butterfly in West Virginia, and, as in *Papilio ajax*, the spring brood is not made up solely from the produce of the last brood of the preceding year, but also, in part, from wintered chrysalids of both the earlier broods. The distribution of the butterfly, its habits, as well as those of the caterpillar, the food and the natural enemies of the latter, and the peculiar partial dimorphism of the butterfly, are fully discussed; the latter will be referred to again.

In the "Canadian Entomologist," Mr. Edwards has given us also the life history of *Phyciodes tharos*, with descriptions of the insect in all its stages. Although one of our commonest butterflies, whose early stages had been sought with care, we have, until recently, known nothing of its history. The eggs are laid in masses, on Asters; the caterpillars feed in clusters, and are at no period protected by a web; the winter is passed in the larval stage, and there are, annually, several broods of the butterfly; in the Catskills two, in West Virginia four. In the Catskills, the autumn brood is the form described as *P. tharos* proper, while the spring brood, the form *P. marcia*, is made up from both the broods of the previous year, a portion of the caterpillars from the former brood passing into premature hibernation. In West Virginia there are four broods: the first, from wintered caterpillars, is *P. marcia*, the second and third *P. tharos*, and the fourth both *P. tharos* and *P. marcia*; a large proportion of the larvæ hibernating. The first brood, however, is wholly made up of the remnant of the fourth brood of the previous year, no lethargy or premature hibernation of caterpillars being noticed in this southern station; it might therefore

be proper to speak of only three broods, the produce of a portion of the last of which is prematurely developed, and then gives birth to a mixed progeny, cold effecting the change to *P. marcia* at both the beginning and end of the season. A curious fact was elicited by Mr. Edwards' experiments, viz.: that caterpillars maturing in one season moult only four times, while those hibernating moult three times before winter, and twice afterwards.

Mr. Edwards gives us also the history of an allied form, *Phyciodes harrisii*. I also traced the complete history of this insect ten years ago, and my unpublished observations agree almost entirely with those of Mr. Edwards. The eggs are laid in masses, on *Diplopappus*, and the larvæ feed in company. Mr. Edwards reared them in confinement, and "no web at any stage was spun for protection or other purpose"; in nature, however, a close web, resembling that of *Euphydryas phæton*, is made, but is deserted on the approach of winter, when the caterpillars hibernate, doubtless under sticks and stones in the vicinity of their feeding spots. Mr. Edwards describes every stage of the insect previous to the imago.

He has also given us some scattered facts and experiments upon several species of *Brenthis* and *Argynnis*, supplementary to those he has previously published.

A fourth species of butterfly whose history we owe to the same investigator is *Satyrus nephele*. Descriptions of all the early stages are given; the eggs are laid on the stems and blades of grass, but, in confinement at least, many are dropped loosely on the ground. The eggs hatch late, and the young larvæ hibernate without feeding, as is generally the case in this sub-family. The larvæ mature slowly, only one brood being produced annually, and that late in the season.

Mr. C. V. Riley has given us two or three fine histories of unusual interest. The first is a complete life-history of another of the genera of *Meloidae*, only that of *Meloe* and *Sitaris* having been known hitherto—genera remarkable for their habits and extraordinary metamorphoses. More recently, Lichtenstein has shown a similar hypermetamorphosis in *Cantharis*. All these three genera undergo parallel changes; they first

appear as active larvæ on flowers frequented by bees, and attach themselves to the body of the bees, thus gaining access to the hives, where they assume a maggot-like shape, and feed on honey. While digging for eggs of *Caloptenus spretus*, Mr. Riley found many pseudo-pupæ of blister beetles, and it occurred to him that there might be some connection between the two; which seemed the more probable since these, and other beetles of the same family, abound in the dry western regions where Acridians are so prolific. Following up this clue, he discovered the early larva or "triungulin" of two species of *Epicauta* and one or two species of *Macrobasis* in the eggs of the common destructive locust, and also in those of *Caloptenus differentialis*. He has, as yet, completely followed the history of only *Epicauta vittata*, the eggs of which are laid in masses in the ground. On hatching, the larvæ scatter in search of eggs, burrow into the pods, and feed upon the contents; one larva requiring an entire pod; if two enter the same pod, only the fittest survives. The young larva, before entering the eggs, has the triungulin form common, so far as is known, to all Meloidæ, but after sucking a single egg it undergoes a moult, and assumes a form resembling the ordinary coleopterous grub — the second larva; this form, however, differs so much in its earlier and later life, a moult intervening, that Mr. Riley has aptly termed the earlier the carabidoid, and the later the scarabæidoid stage. These differences have not been observed in other Meloidæ. After another moult, the antepenultimate or pseudo-pupa stage is reached; this Mr. Riley prefers to call the coarctate larva, as it merely becomes rigid and dormant, in which state generally it hibernates. In the spring another moult takes place, and the larva returns to the scarabæidoid form; but then, partaking of no food, burrows in the ground, changes to a pupa, and, in less than a week, to a full-fledged beetle. In *Meloe* and *Sitaris* the later transformations take place in the skin of the coarctate larva.

Following up his studies upon the Meloidæ, Mr. Riley has discovered a remarkable insect of this group, hitherto unknown, to which he has given the name of *Hornia*, and which differs from other Meloidæ by some remarkable characteristics, being

a degraded form. It lives in the burrows of *Anthophora sponsa*, a mason-bee building in clay-banks, and probably spends most of its time in the bee-gallery. The triungulin has not been discovered, but the other forms of the larva exhibit the ordinary characters of the family.

Another discovery by Mr. Riley is that of the curious egg-mass of *Corydalus cornutus*, an insect extremely interesting from its relationship to carboniferous types found both in this country and in Europe. The larva and pupa have long been known, but the place of deposition and the nature of its eggs have remained unknown; or rather, eggs of another insect, which Mr. Riley believes to be a *Belostoma*, have been accredited to it, on the authority of the late Mr. Walsh. Haldeman's figures of the eggs have been very generally overlooked. As it now appears, the eggs are laid in oval masses, upon leaves of trees overhanging the water, or upon rocks; the mass is composed of two or three thousand eggs covered with a common white or cream-colored albuminous secretion. The young leave the egg-mass at night and in company.

Of precisely similar interest is the allied genus *Pteronarcys*, living specimens of which Dr. Hagen has studied to good purpose. He observed that the male taps upon the surface on which it is seated, with its abdomen, as Barnston had observed in the case of another Perlarian. He witnessed also the remarkable union of the sexes. Oviposition he did not see, but the eggs, probably dropped in the night, were laid in little heaps in the grass or in the water. He studied the curious gills with which Newport has made us acquainted, but which in life are more bag-shaped, with the fringe less widely spread than preserved specimens would lead us to suppose. No motion was seen in these gills after the most careful observation; and the whole appearance of the gills, on internal examination, was that of an organ unfitted for breathing, although the tracheæ were very abundant in their immediate vicinity; on the other hand the abdominal spiracles, at least as far as the seventh segment, were perfectly formed for respiration. Moreover the creatures not only did not seek the water, but on falling into it, or being placed in it, they scrambled out with all

speed. These observations rectify, in many important particulars, the statements of Newport, based of course on an examination of alcoholic specimens. Dr. Hagen noticed, moreover, a remarkable degree of individual variation in these insects, especially in the form of the head and prothorax and in the female organs of generation.

During the summer of 1876, Rev. Henry C. McCook studied the habits and architecture of the wood-ant (*Formica rufa*), whose mounds are abundant in the mountains of Pennsylvania; and has just given a very interesting account of his observations. He camped for a week in the immediate vicinity of a large colony of nearly seventeen hundred hills, covering an area of twenty hectares. Although Huber, Forel, and others have already given long accounts of the habits and architectural skill of this ant, the independent testimony of an observer on this side of the Atlantic has a peculiar value, and appears at first sight to indicate some diversity in the habits of this species on the two continents. I am not aware whether any differences between the ants themselves have been observed; but as differences, at least varietal, do occur in American and European examples of *Formica sanguinea* and *Lasius flavus*, two other common ants found in both countries, the distinction of habits found by Mr. McCook in *Formica rufa* has an important bearing.

The mounds made by these ants are cones of greater or less regularity, generally three or four metres in circumference at the base, and seven and a half to nine decimetres high; one double hill — the blending of two hills — was found measuring more than seventeen and a half metres in circumference, and considerably more than a metre in height. Not only do the hills appear to be grouped in large colonies, but each colony is made up of family clusters, probably the work of a single republic. The hills are mostly composed of earth brought from beneath, but the surface is strewn, to a greater or less extent, with bits of decayed wood, pine needles and fragments of straw, though apparently not to the extent that is described in the nests of the European ant. This surface material is brought in by surface foraging. The nest is honeycombed

through and through with galleries, most of which lie in horizontal strata, but show no such enlargement into chambers at special points as occurs in European hills. The nests when injured are repaired immediately, not by adding grain to grain, to make a solid mass, afterwards to be mined by galleries, but by constructing these galleries at once with little pellets formed of a few cemented grains of earth, fastened to the parts already in place; in this way arches are sprung at needed points, and galleries are formed by filling in the spaces between the arches. Wherever great damage has occurred, the work goes on simultaneously from many centres by the springing of arches from piers erected at symmetrical intervals. In the same way stories are added to the structure.

The work often goes on with surprising rapidity, so that mounds half the average size of the mature hills may be built in a single year; but when once they have reached the normal size, a period of thirty years may show little change, the multiplication of the colony being provided for by the construction of new mounds. Mr. McCook estimates that usually nearly thirty cubic decimetres of material are raised by new communities in a single year. As all this has to be brought from beneath the ground, through galleries in direct connection with the interior of the mound, the extent of these underground passages must be very great. By stamping on the ground, one such gallery was traced, just beneath the surface of the soil, for a distance of eighteen metres, and it is probable that there are as many subterranean galleries as there are superficial paths. A curious fact was noticed in the orientation of the mounds; that while they were nearly conical, the longest face of the cone lay toward the west and its steepest slope toward the east; this peculiarity was only noticed in the mountains and was not invariably true, but obtained as a general rule, whatever the slope of the ground.

Huber states that these ants close the approaches to their nests at night and open them again by day. Forel says that they seem to close them only when they appear to have no further use for them; and Mr. McCook always found them open. Huber states further that the ants are inactive during

the night ; Forel, that they may seek their food by night as well as by day, but do not then occupy themselves in building, and remarks that their activity in general depends upon temperature, and they are often quiet at night simply because it is too cool for them to work. McCook's observations point to the same conclusion, but he found the ants both feeding and building at night, their activity in building clearly depending upon the moisture of the ground ; when the nights were cold he found the ants torpid on the trees, beside their aphid flocks, just as the cold had surprised them. Here they would resume their activities with returning warmth. Observations in mid-winter show that the colonies then remain still active in the galleries directly beneath their mounds ; at the same time the interstices of the mounds may be occupied by the hardier white-ants and by cockroaches. No colonies of Aphides nor any source of food were found within reach ; but in this connection it may be mentioned that Dr. Leidy has this year found in a single formicary of *Lasius flavus* two large herds of Aphides and one of Coccidae, sufficient, no doubt, to feed the colony for an entire winter.

The paths diverging from the ant-hills invariably lead to plants or trees occupied by colonies of Aphides. These are visited by immense numbers of ants, who gorge themselves with honey-dew and return to feed the occupants of the nest. Mr. McCook was astonished, however, to see how few of these "repletes," as he calls them, actually returned to the nest ; and thus was led to the discovery that many of them were stopped on their return, by hungry workers, "pensioners" he calls them, emerging from the openings of the subterranean galleries, and were compelled to disgorge, so that the queens, males and young ants at home must have fared ill.

Mr. McCook has made the interesting discovery of another source of honey-dew for ants. At former meetings I have called your attention to the description given twelve years ago, by Guenée, of peculiar organs on some of the hinder segments of Lycænid larvæ, which may emit a drop of fluid. This is the new pasture which Mr. McCook has independently discovered by seeing the ants stroke the larvæ with their antennæ, in the

familiar manner in which they solicit honey-dew from Aphides. Although search was made for beetles, only a single specimen of *Tmesiphorus costalis* was found in the nests.

Mr. McCook was unable to obtain any show of fight between these ants, excepting that individuals which had fallen into water (which is supposed to destroy their odor) were always attacked violently by their *confrères*. Every expedient was tried : colonies from distant hills were thrown upon a nest while it was covered with a swarming and nervous mass of ants, without the least effect ; not the slightest sign of hostility could be induced ; the imported ants always melted away into the general community as if at home. These are the principal observations offered by Mr. McCook, which we hope he may continue in the same spirit. Our ants offer a fruitful field of observation to those who have the leisure to observe them.

The only remaining insect, whose history has this year been given in full, with the exception of injurious species, which I reserve until the end, is our common *Platysamia cecropia*, of which Mr. T. G. Gentry has given a detailed description in all its stages.

In a paper on the classification of butterflies I have given generalized histories, as it were, of the different family groups, of which four are recognized ; and I have attempted to exhibit the comparative inferiority of structure of the swallow-tails, bringing forward several considerations hitherto unnoticed, some of which may be briefly stated : the four-branched median nervure, supposed to be peculiar to the swallow-tails, exists also in the skippers ; the osmateria are paralleled by similar organs in all other butterfly larvæ, and these being exceptionally developed, as tentacles or caruncles, in several special groups of insects, have no structural significance ; the swallow-tails are most nearly allied to the Pierids, but the latter group possesses none of the characters on account of which high rank has been claimed for the swallow-tails ; on the other hand the swallow-tails are directly allied to the skippers, the lowest family of butterflies, by the form of the egg, the dorsal shield of the first thoracic segment in the larva, the character of the silken attachments of the chrysalis, and by various

points in the structure of the imago, such as the antennæ, the papillæ of the tongue, the folding of the inner border of the hind wing, the perfect development of the forelegs and the presence of a fore-tibial epiphysis. The chrysalids of the brush-footed butterflies are also shown to have passed through the "succincti" stage by the persistence of a form of abdomen then of use, but, in the "suspensi" stage, no longer serving any purpose. Several features in other groups of butterflies, such as the loss of the cremaster in the Lycænids, the procession of pupal characters in passing from the lower to the higher groups, and similar details concerning the atrophy of the forelegs and the structure of the tongue, are brought forward for the first time or in a new connection.

Passing now to partial histories and miscellaneous notes upon habits, we have descriptions of the larvæ and mines of various Tineidae by Mr. V. T. Chambers; of the larvæ of some Noctuid and Geometrid moths, five in number, by Mr. L. W. Goodell; of two species of *Deilephila* by Mr. Wm. Saunders; of the egg, larva and pupa of *Smerinthus modestus* by Mr. R. Bunker; the larva and pupa of *Euchaetes collaris* by Mr. G. H. Van Wagenen; the larva and pupa of *Meganostoma eurydice* and *Heterocampa salicis*, the former feeding on *Amorpha*, by Mr. H. Edwards; the larva and larval habits of *Megathymus yuccae* by Mr. C. V. Riley; the larva of *Exyra rolandiana* by Mr. R. Thaxter, and of *Thyreus nessus* by Mr. W. V. Andrews. We have notes on the oviposition and cocoon-making of *Herpyllus* and *Epeira* by Mr. J. H. Emerton, a notice of finding six chelifers beneath the elytra of a single *Alaus* by Dr. J. Leidy, and notes by Dr. Anderson on the habits of the trap-door spider of South Carolina, and my own on those of the tube-constructing ground spider of Nantucket—a species of *Lycosa*. Dr. H. A. Hagen, by the aid of notes from Baron Osten Sacken and Mr. H. S. Treherne, gives us an account of the habits of *Termitina* in Colorado, Nevada and Manitoba. In the former places they were found up to a height of two thousand one hundred metres. Mr. C. R. Dodge describes the habits of *Rhomalea microptera* in captivity, with notes on the eggs and young. Messrs. H. A. Brous and S. W.

Williston give their experience in hunting *Amblychila*, showing that it has subterranean and crepuscular habits, and noticing briefly the eggs and larva. Mr. W. H. Dall gives us an entertaining account of the movements of "educated" fleas, which he shows to be simply due to their struggles to escape when tied together, a ludicrous parody on education. Mr. C. V. Riley defends his theory of the pollination of *Yucca* by *Pronuba*, from the criticisms it has called forth, and Mr. H. Edwards gives some interesting notes on the larvæ of *Psychidae* which construct curious nests of various vegetable fragments, within which they live and undergo their transformations. He mentions three new forms of these nests from California. Mr. Wm. Edwards describes a flight of butterflies, probably of *Danaïda plexippus*, near Natick, Mass.

Concerning the food of insects and insects as food, we have notes on the plants which nourish *Hemileuca maia*, by Messrs. R. Bunker and O. S. Westcott, and *Saturnia io*, by Mr. L. W. Goodell, besides the scattered notices which usually accompany general lists. Mr. C. R. Dodge gives a curious account of the perforation of a minie ball, which had lodged in a tree, by the larva of a borer, and Dr. H. A. Hagen supplements the account by a long list of lead-boring insects. Dr. A. S. Packard, Jr., notices the preference that white butterflies show for white flowers, and Mr. T. G. Gentry, in his *Birds of Eastern Pennsylvania*, gives a long list of insects which serve each bird as food, showing on his part remarkable industry, and demanding, on our side, a certain amount of credence.

With regard to the seasons of insects, Mr. F. B. Caulfield publishes some facts to show that *Meloe angusticollis* is a spring, and *M. americanus*, an autumn species, which Mr. W. Brodie's observations do not confirm, if he has rightly determined his species. Mr. F. B. Caulfield believes that *Vanessa J-album* does not appear later than other *Praefecti*; and I have attempted to illustrate the harmony of tints in nature by showing how closely, in New England, the colors of the prevailing butterflies, at any one season, correspond to the hues of the landscape.

Experiments have been made upon the vitality and longevity of insects by several persons. Mr. H. C. McCook, in his observations upon ants, found *Camponotus pennsylvanicus* capable of enduring exposure to extreme cold without permanent injury. A formicary was broken open in midwinter and left three weeks in the open air, in the mountains; when carried to a warm house, the ants resumed their activity. He also proves their power to endure extreme heat by relating an instance in which ants were not destroyed nor driven away from their nest by frequently making a fire upon the stone beneath which they dwelt; his own experiments in burying ants for twelve hours in mud and water to the depth of twelve centimetres demonstrate their immunity from dangers of flood. Messrs. S. S. Rathvon and N. Coleman each relate instances, similar to many already known, of supposed longevity in the larvæ of longicorn beetles. Dr. A. S. Packard, Jr. records a number of experiments on the vitality of decapitated or otherwise mutilated insects, mostly Hymenoptera and Coleoptera; several of them, especially an *Agrotis*, a *Hylobius* and a *Leptinotarsa* living several days after beheading. Mr. G. Dimmock has given a series of well-recorded experiments upon the effects of certain gases on Arthropods, particularly on Coleoptera. It appears that carbonic dioxide, whether alone or mixed with air, is poisonous to them; hydrogen is not poisonous, and oxygen generally seems to be a stimulant. Nitric oxide acts as a quick poison, from which they do not recover.

In some notes on the circulation of insects, I have attempted to show that the fluids of the body are forced, by the movements of the dorsal vessels, into the peritracheal cavities, whence, after becoming aerated, they pass into the tissues of the body to perform their functions; are thence received into the general cavity, and, mingling with the fluids newly expressed from the alimentary canal, join the general currents which flow toward different parts of the dorsal vessel, to enter again the initial points of the circulation.

We have one or two papers on the functional use of various organs. Mr. L. Trouvelot has made experiments on the use of the antennæ. Several insects were deprived of antennæ;

their eyes were then covered with a thick coating of india-ink, and in this condition they were set free or placed near sweets, or with their mates. From these experiments he concludes that the sense localized in the antennæ cannot be regarded as simply that of touch, of hearing or of taste, nor can it be regarded as uniting the complex functions of these senses; he would rather regard it as a sense of direction or orientation.

The observations of Mr. Trouvelot led Dr. Packard to make somewhat similar experiments, especially upon Hymenoptera and Lepidoptera; but they were not sufficiently extended for him to draw any general conclusions, and were in some instances so contradictory as to need repetition; but it would appear that the nervous centres are permanently affected by deantennization.

Dr. J. G. Morris has observed, what Charpentier recorded many years ago, the action by which an earwig opens its tegmina by means of its forceps before flight.

Concerning unusual and unexpected variations of form, we have an exquisite colored plate of *Papilio calverleyi*, and figures of hermaphroditic specimens of *Papilio asterias* and *P. turnus* by Mr. W. H. Edwards. Mr. Edwards also announces that he has raised *Limenitis arthemis* from eggs of *L. proserpina*. Mr. H. Edwards describes an apparent dimorphism, possibly phytophagic, in the larva of *Halesidota agassizii*. Mr. C. G. Siewers describes some curious variations said to occur in *Arctia isabella*, and Mr. W. V. Andrews describes the variations of *Dryocampa rubicunda*. Mr. C. E. Worthington reports finding two pupæ of *Platysamia cecropia* in one cocoon, and Mr. W. H. Edwards gives us a continuation of his experiments upon the effect of cold in changing the form of certain butterflies. His experiments were made upon *Phyciodes tharos*, *Papilio ajax* and *Lycaena pseudargiolus*. These species were selected because they have a spring form differing from the forms appearing later in the season. Chrysalids were placed in an ice-box, to simulate the conditions of the winter season; but the experiments lost a part of their value, because he was obliged, at times, to leave them in the care of others. The result, however, proved the possibility of producing in all three

species the spring form, or something resembling it; and specimens of this form were not rarely accompanied by specimens such as are called suffused when they occur naturally. Mr. Edwards suggests that the chrysalids producing such specimens in nature may have been subjected to such extreme cold, over a long period, as would be produced by a snow or ice envelope, — a suggestion which is rendered more probable from the fact that these examples of suffusion are most common in cold or mountainous countries, and, so far as I am aware, are unknown in the tropics.

In this connection we may again refer to Mr. Edwards' exquisite illustrations, where he discusses the melanism of the female of *Papilio turnus*. He notices that the dark form of the female is restricted to districts where a summer generation is possible, and is thus inclined to think the cause of its original appearance "in some way climatal," and brings forward some evidence against Dr. A. Weismann's theory that the dark female has superior attractions for the male. Mr. Edwards does not find the dark form more prevalent in one brood than in another, and has obtained dark females from a yellow mother and *vice versa*; not however with the same frequency, having found only one instance of the former, which, as the male is always yellow, he does not think surprising; but that more yellow females are not produced from dark mothers — he has reared two out of twenty-three — indicates, he believes, an amazing energy in the dark form, and implies a time when the yellow female will wholly succumb to the other, throughout the region now inhabited by both. He would further explain the probable greater abundance of dark forms in the west than in the south, by the larger proportion of insectivorous birds in the prairie region, and the association of this butterfly with a larger number of yellow-colored swallow-tails in the south.

This insect, possessing two forms of female, one differing from the male and the other resembling it, is only one example of a large class, which I have recently discussed, attempting to show, in the first instance, that sexual dimorphism, or antigeny, is of two kinds, colorational and structural; the first prevailing in females, the latter in males. Colorational antigeny is divisi-

ble into partial and complete, the former being confined to the phenomena of albinism and melanism. Melanic antigeny is more common in this country at the south, and albinism at the north; while, in apparent contradiction to this, albinic females of a partially antigenic species, as *Eurymus philodice*, never appear in the spring brood, but increase in numbers throughout the hot season. So far as we know (*Cyaniris pseudargiolus* is an instance¹), the opposite is the case with melanic females. Structural antigeny is found in the antennæ, legs and wings, affecting especially the contour of the wings, or the direction of their veins, and showing itself in peculiar patches of scales or rows of special hairs (of which the discal dash of our smaller skippers is a good example) or in folds of the wings, as seen in other skippers. But one of the most extraordinary cases, extraordinary both in its nature and in its concealment, is found in the presence of peculiar scales, called plumules or androconia, which occur in nearly every group of butterflies, although often entirely hidden by the ordinary scales. In endeavoring to account for them, the theory of sexual selection, put forth by Darwin, appears to fail just where we most need its aid.

Baron Osten Sacken has given us an important paper on the distribution of Diptera in this country, based, in great measure, upon the large collections made by him in the western territories. He contends for the essential unity of the entire western region of this continent, from the eastern limit of the dry plains to the Pacific Ocean, a region characterized by its extreme dryness in summer. Adducing his examples from all orders, he compares the organic forms of this region with those of the Mediterranean and central Asiatic regions of the old world, a district possessing very similar meteorological conditions; he recalls especially the prevalence in both of Heteromera among the Coleoptera and of Bombyliidae among the Diptera, and remarks that the resemblance between the faunas of these two vast regions is an analogy, not a relationship.

¹ Since the delivery of this address, Mr. Edwards, to whom we owe our knowledge of the melanic form of this insect, and who has heretofore stated that the melanism was peculiar to the female, finds that all melanic individuals are males.

The general distinction between the western and eastern half of this continent, and the resemblance of the insect fauna of the former to that of Europe, is shown by the citation of a large number of important genera which do not occur in eastern America, but are found in both the other regions.

In an analytical comparison of the butterfly faunas of eastern North America and of Europe, I have shown the greater richness of the European fauna, and have pointed out some curious disparities in the proportions of the numbers of members belonging to different groups. Europe proves to be peculiar for its wealth in brush-footed butterflies, America in skippers; and this difference is largely due to the fact that there are more than four times as many Satyrids in Europe as in America, and five times as many small skippers in America as in Europe. Other minor groups, which are much better represented in Europe than in eastern America, are the blues (38 to 13), orange-tips (7 to 2) and Parnassii (6 to 0); while the groups disproportionately abundant in eastern America are the hair-streaks (20 to 10), the yellows (20 to 10) and the swallow-tails (9 to 3). A minuter analysis shows similar or even greater disparities, so that we find only one-fourth of the North American genera represented in Europe. The derivation of our present fauna is believed to be largely from the south.

Mr. V. T. Chambers has published some remarks on the distribution and geographical peculiarities of the Tineina of Colorado. He shows that the range of the species is generally dependent upon that of the food-plant, and that they scarcely occur above timber line. He also finds them rather plainer or more obscurely colored in Colorado than in the Mississippi Valley, Colorado having in fact an unusually large proportion of uncolored species.

Dr. A. S. Packard, Jr. has made us acquainted with a new cave-fauna at the southern extremity of Great Salt Lake, nearly as characteristic as that found in the caverns of Kentucky, Indiana and Virginia. In a straight gallery less than one hundred metres long, in which the darkness was not total, he found a bleached Poduran, of a species which is widely distributed in this country and in Europe, but which occurs in this

condition only in caverns ; a myriopod of the genus *Polydesmus*, also white ; and an arachnid, belonging to the group of harvestmen, and to a genus, *Nemastoma*, not before known to the new world. Besides these there occurred a small white mollusk of a form hitherto unknown. He also explored a cave near Manitou, in Colorado, and found there a beetle, *Dictidia laetula*, which occurs near the mouth and also in the open air under stones ; and a fly, *Blepharoptera defessa*, which had been taken before in Kentucky caves.

This brings me to the final division of my subject, the biological results of the investigations of injurious insects. A proper analysis of all that has been done in this field is manifestly a work of great difficulty, for over three hundred octavo pages have appeared during the past year in official documents or scientific journals on the destructive locust alone, without counting Mr. Riley's book of two hundred and thirty-one pages, which is a reprint of a part of the material above estimated, together with some taken from his previous reports. I cannot attempt to treat this portion of my subject in detail, but will content myself with a simple statement of what insects have been discussed, and close with a brief account of what has been done upon the natural history and ravages of *Caloptenus spretus*.

With the exception of Mr. A. R. Grote's account of a species of *Nephopteryx* which injures pine trees by boring into the bark and wood and thus causing an exudation of the pitch, all papers which pretend to offer anything new upon injurious insects, other than the locust, were written by the members of the U. S. Entomological Commission. Of these three naturalists, however, Mr. Cyrus Thomas, in his Illinois report, has contributed no new observations that I can discover, excepting upon the army worm, *Leucania unipuncta* ; this he regards as normally a cut-worm, believing that he has found it living in early life upon the heads and blades of grain, and at its final stage "working beneath the grass and remaining hid from view." The evidence upon which he bases this extraordinary statement is, however, as his own words show, purely a matter of inference, and has no scientific basis.

Mr. Riley has given us, in his final report on the insects of Missouri, the complete life-history and full notes on the ravages and general habits of *Nematus ventricosus*; a nearly complete account of *Lophyrus lecontei*; has supplied the desiderata in the history of *L. abbotii*; and has added, from his earlier publications and those of Walsh, histories of *Pristiphora grossulariae* and *Emphytus maculatus* — all Tenthredinidae. He has also given a full account of *Eufitchia ribearia*, has added the most important parts of the history of the army-worm, and has furnished the history of an allied form, *Leucania albilinea*. Notes on the Colorado potato-beetle are also given, but these are taken from his work on potato-pests published the previous year. Perhaps the most interesting parts of the report are the account of the second species of Leucania (*L. albilinea*), which confines its attacks principally to heads of wheat, and the discovery of the mode and place of oviposition of both the species of Leucania.

Dr. Packard's account of injurious insects in the west, while largely relating to the destructive locust, includes histories of over one hundred other insects. These histories have been collated, in large measure, from his earlier publications and those of others. In addition to what was already known, he gives full notes upon the red-legged locust (*Caloptenus femurrubrum*), *Donacia proxima*, the northern army-worm (*Heliophila unipuncta*), the cabbage web-moth (*Plutella xylostella*), *Gastropacha californica*, *Phryganidea californica*, the two latter contributed by Mr. H. Edwards, and *Pieris rapae*; as well as brief notes on *Oedipoda pellucida*, *Acridium americanum*, *Blissus leucopterus*, *Bruchus fabae*, *Eurytoma hordei*, *Cecidomyia destructor*, *Aletia argillacea*, *Clisiocampa americana*, *Aegeria cucurbitae* and *Nematus ventricosus*; figures of the early stages of most of these are given, with maps showing the distribution of the Cecidomyia, Blissus, Heliophila, Aletia and Eurytoma, as well as of *Cecidomyia tritici* and *Heliolithis armigera*; he also gives some new accounts of the journeyings of the notorious Colorado potato-beetle and original figures of the early stages of a Harpalus, of *Plectomus pallens*, of *Dryocoetes affaber* and of *Tomicus pini*.

Articles upon the destructive locust have appeared during

the last year from Messrs. Riley, Packard and Thomas, of the Entomological Commission appointed to examine into this evil; all these articles, however, have been contributed independently of that appointment. Other papers have been published by Messrs. G. M. Dawson, Allen Whitman, J. B. Phillips, Geo. Gaumer and H. H. Godfrey. Mr. Thomas' paper is only a reproduction of what he published several years ago. Mr. Dawson's paper is a clear, well-digested account of the migrations of this insect and the extent of the region infested by it in Manitoba and in the adjoining parts of British America, in 1875. Mr. Whitman's is a good account of the invasion of Minnesota in 1876, with valuable notes on the habits of the insect; it appears that the state suffered more that year, and had a larger part of its territory invaded, than was the case during the three previous years, when the insects were wholly confined to the southwestern part of the state. Mr. Phillips, not an entomologist, but the Commissioner of Statistics in Minnesota, fills most of his report with a rather useless account of the Asiatic destroyer, but adds some tables of estimates of the damage done in his state. Mr. Gaumer's and Mr. Godfrey's reports relate the experiences of these assistants of Mr. Riley in observing the locust in southeastern and northeastern Kansas.

By far the most important of all the papers upon the locust are those of Messrs. Riley and Packard. The former, in his ninth Missouri report, adds to our previous knowledge of the history of *Caloptenus* an account of the method by which the young escape from the egg, reports additional parasites, and gives the result of some valuable experiments upon the vitality of the eggs. He subjected the eggs to alternate freezing and thawing, to different degrees of moisture, to the open air, and to burial at various depths. By his experiments it appears that neither moisture nor sudden alternations of freezing and thawing have much injurious effect upon the eggs, that simple frost is actually beneficial, but that exposure to the free air is decidedly injurious; so that thorough harrowing will prove an effectual means of destruction. Mr. Riley also gives a very full history of the locust in 1876.

Dr. Packard gives a similar history for 1876, and gives general histories of the ravages of the locust in Colorado and Utah, collecting evidence from a great number of sources. He also cites proof of the appearance of these insects in California, and discusses the probable extent of their natural breeding grounds. In connection with the theory of their enfeeblement in moist regions, he gives some curious experiments, made by Prof. Samuel Aughey, on the comparative strength of the hind legs of individuals from Nebraska and Utah, clearly to the advantage of the natives of the latter state. He also discusses the relation of their migrations to meteorological phenomena, and publishes some interesting tables furnished for the purpose by the Weather Bureau. He adds some interesting notes on the habits of the locust, and describes the insects from life, at every stage, making out that it has three larval and two pupal stages, by considering the penultimate stage, before the acquisition of full-grown wings, a pupal rather than a larval condition.

This review gives an account of the observations, during 1877, of forty-one different writers, including seven who have discussed injurious insects only. This seems to me a sorry number for the whole of North America; but, on the whole, I believe we may fairly congratulate ourselves that the biological side of entomology has made a considerable advance; at least we will hope that another year will show an increase of earnest work, with promise of greater progress.

Samuel H. Scudder.

[On account of a prevailing unfamiliarity, especially amongst the European subscribers to *PSYCHE*, with the English names used for butterflies in the foregoing article, the editors deem it advisable to say that the blue butterflies are the *Adolescentes* of Scudder or a part of the *Lycaeninae* of Edwards; the brush-footed butterflies are the *Nymphales* of Scudder or the *Nymphalidae* of Edwards; the hair-streaks are the *Armati* of Scudder or the *Theclinae* of Edwards; the orange-tips are the *Frugalia* of Scudder or genus *Anthocharis* of Edwards; the skippers are the *Urbicolae* of Scudder or the *Hesperidae* of Edwards; the swallow-tails are the *Equites* of Scudder or the *Papilioninae* of Edwards; the yellows are the *Fugacia* of Scudder or a part of the *Pierinae* of Edwards.]



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