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DESCRIPTION OF THE PREPARATORY STAGES OF ARGE GALATHEA, LINN., WITH NOTES ON CERTAIN SATYRINÆ.

BY W. H. EDWARDS, COALBURGH, W. VA.

(Continued from page 71.)

How then can Mr. Scudder claim that this feeble relic of the tertiaries, stranded, as he tells us, on the loftiest peaks at east and west at the close of the glacial period, unchanged in all respects since that, its imago showing itself but once in two years, the individual living at most but a few days, always in tribulation and peril, saved only from extinction by its acquired habits of dropping into a crevice, or of clinging to the rocks by the feet, its wings of scarcely any use whatever, but a constant source of danger—that this miserable creature stands at the head of its genus, its sub-family, its family, of the American fauna, and in fact of the world, the ideal butterfly !*

The mere statement of the proposition that such a tribe, creepers along the ground, avoiding sun-light, allied to the moths at every stage, often with habit of moths rather than butterflies, have high rank in the order, and that the weakest member of the tribe—the one which has suffered most by isolation and privation—is the highest of all, carries its own refutation.

When a process of reasoning leads to an absurd conclusion, there is a flaw somewhere. The facts may be mistaken, or wrongly presented, and, in either case, the inferences attempted to be drawn from them may be without justification.

Mr. Scudder is compelled to allow, that in three stages out of four, the Satyrinæ are nearer the Hesperidæ and the moths than to other butter-

* We have the expression "the highest butterflies," meaning the Satyrinæ, repeated endlessly, sometimes twice on one page, when "Satyrinæ" would answer every purpose. It seems to me the author of the work, appealing to the reason of his readers, makes a mistake in thrusting his opinions before them so persistently. If the arguments fail to convince, what he calls by one name, will be thought to deserve quite another.

flies, namely: in the egg, larva and pupa. "In certain features, the Satyrinæ show some *curious resemblances* to those of the Hesperidæ. * * * The eggs of the ribbed species *closely resemble* those of the Hesperidæ in general appearence. The caterpillar, at birth, has a *similarly large and striking head*, and occasionally the terminal segments of the body *are armed with much longer cuticular appendages* than elsewhere—a common feature among the Pamphilas; the mature caterpillar is sluggish, with a somewhat flattened belly and short pro-legs, giving a limaciform body, which is clothed with pile only; the chrysalis *is unusually rounded*, and *occasionally is not suspended*," &c.—But. N. E., p. 120. In his "Butterflies," N. Y., 1881, he says:—"It is one of the *most curious features* in the structure of butterflies *that its highest*," and here he means the Satyrinæ, "*and its lowest should resemble each other in so many minor points.* For instance, the *tone and colouring on the wings* of many Satyrinæ, as well *as the position and general nature of the sexual marks on the front pair* (of wings) of some males, find a close counterpart on the wings of some Skippers (Hesperidæ). So also the chrysalids of the Satyrinæ are among *the simplest, most rounded and compact in the whole family, approaching in this respect the lowest butterflies.*" That is, not only are there "curious resemblances" in the three stages, but very important ones in the fourth stage. Speaking of the same things in But., N. E., p. 120:—"That these peculiarities have some phyletic meaning it is impossible to doubt;" but what it is, the author does not venture to conjecture. To me the meaning is plain enough. They indicate the close affinity of the Satyrinæ with the "lowest" butterflies. "Nevertheless," we are told, "in all the prime features of their organization, the Satyrs outrank all others." They must be extraordinary features to outweigh all these "curious resemblances," these "peculiarities," with their "phyletic meaning," and to raise the nearest relatives of the Moths to the head of their order. As is natural, the author of these volumes is inclined to make the most of every point that can be construed to tell in favor of his hobby, and to make little of whatever tells the other way. If nothing else can be said, we shall hear that any given case which presents itself obstructively "is entirely explainable as an instance of reversion." In this way are got rid of, or slurred over, some very important facts; thus, "the only case among the higher butterflies" (higher this time means above the Hesperidæ), "where a cocoon, properly

speaking, is made, is in the sub-families most closely allied to the Hesperidæ, among the groups of Parnasinæ and Anthocharinæ." (I very much doubt any cocoon in an Anthocharis, myself); quite ignoring the cocoon of *Semele*, as figured on our plate. "And, again in exceedingly feeble instances, where the necessities appear to be overwhelmingly great, among the higher Nymphalidæ, which have lost even the last remnant of the cocoon of moths, viz., in some of the Satyrinæ, which lack cremastral hooks and undergo their transformations ordinarily in the rudest form of a cell, which they can construct above or at the surface of the ground by the mere movements of the body and the spinning of one or two threads of silk." The "necessities" may have been overwhelmingly great in the case of *Semidea;* but what of *Jutta*, a species of the same genus, living in Maine, and of *Semele* and *Galathea*, at the level of the sea, in temperate Europe! Among the great sub-family Satyrinæ, with its multitude of genera, of nearly all of which the habits at pupation are unknown, it is probable enough that the heterocerous style of pupation is common. To refer such cases, in a group claiming to be farthest removed from the moths, to atavism from the moths, will not do. There are too many of them. And the same sort of ancestral traits crop out in the color and sexual markings of the imago, in the egg and larva, as well as in the pupating habit.

In the "Butterflies" three "prime f[illegible]ures," as they are called, are given, viz: The pupating habit, with the flat ventral surface of the pupa among the Nymphalidæ, the papillae on tongue, and the atrophy of the fore legs. In the But. N. E., so far as I see, the papillae prime is dropped, as well it might be. We are told in the former work, p. 255, that this feature consists in the complication of the structure of the papillae of the tongue. In the Papilios and Skippers "these are merely minute tubercles, * * * seldom rising much above the surface. In the Lycænidæ they are longer and more frequent, while in the Satyrinæ they are often half the breadth of the tongue in length, closely crowded together, and often trifid at their tips." (Of course this feature can only be made out by a powerful microscope.) How one of these conditions is an advance on the other is not explained, and I will venture to say is not explainable. Each species of animal, mammal, butterfly, or what not, has a tongue suited to its habits. A cow or a sheep has that organ adapted to grass feeding, a giraffe has one that is half a yard long, and prehensile at that, and feeds off the tree tops; but whoever heard that the

giraffe was exalted because of its tongue, or of the sensitive papillae! If a Lycænid butterfly, expanding half an inch, has papillae on his tongue twice as long in proportion as his great neighbour Papilio, he probably has need of them, and it is pleasant to think he has got them, and is comfortable, and his gastronomic enjoyment big for his size. Surely that "prime feature" does not outweigh the "curious resemblances" spoken of as running through the whole life history.

The resemblance between the pupating habit of the Papilionidæ and the Hesperidæ must be a very obscure and distant one, if, as is stated in B. N. E., 72, it has been observed by no author save Mr. Scudder. The facts have been known from the day of Linnæus to every systematist; but no one has thought of any particular resemblance between the styles of pupating. And now that Mr. Scudder expatiates eloquently upon it, I, for one, fail to see the point. There are attachments of the pupæ that are clear, but they are very different. But allowing all that the author claims, inasmuch as he denies that he has ever said that the Papilionidæ were evolved from the Hesperidæ, one of these modes of attachment cannot have grown out of the other; one is no advance on the other. It is held that both families were evolved out of a "common stock," but what feature that stock had no man can tell.* It may not have been a moth; but the moths and butterflies may both have arisen independently from something else and now unknown. Any resemblance, therefore, whether distant or near, must be charged to the conditions and environment when the types of these families first appeared, and of that we can and shall know nothing. "The necessities" may as well have been "overwhelmingly great" in this case as in the one cited by Mr. Scudder, and being the same for both types, there may have resulted a form of attachment suited to each, and bearing some resemblance. But this involves no relationship. In other words, resemblance is not identity, nor does it imply identity.

As the argument runs, the moths pupate inside a cocoon, with no

* I am informed by Prof. J. A. Lintner that suspension of pupa is very rare among the moths, but that cases occur in which certain members of a family are suspended by the tail alone, and others of same family by both tail and girdle. "In the Geometridæ, the pupa of the Ephyridæ is suspended by the tail, and in some of the species there is also a transverse girdle as in the Papilionidæ." That is a queer state of things if one mode of suspension is more advanced than the other, or than none at all. Among the moths what are called the higher families are not suspended. Some pupate naked, some in cocoons, and neither mode implies rank.

attachment, or with no cocoon, in or on the ground; the Hesperidæ in a folded leaf, or in two or three leaves brought together, having the tail of the pupa attached to the end of the case by a Y-shaped thread, and the body held by another Y-shaped thread (But. 256). The Papilionidæ and Lycænidæ weave "a carpet of silk" by which the hooks of the tail are held fast, and spin a real girdle of many threads, into which they thrust head and anterior segments. But, in the Nymphalidæ, there is no girdle, and the pupa hangs by the tail from the carpet of silk. Finally, as we have seen, many of the Satyrinæ weave no carpet, indeed have no hooks by which the pupa could hang, and so pupate naked in or on the ground, or in some cases, as in *Semele*, in a cocoon Others that do not make a cocoon, spin threads by which leaves are girded about them, a style which Mr. Scudder calls a cocoon "by courtesy," as Erebia *Epipsodea* and some examples of *Galathea*. All these last, therefore, behave in the manner of the moths.

Oddly enough, Mr. Scudder has got himself in a state of mind to claim that these unattached pupæ have reached the greatest advance of all. "We see, therefore, a regular progression from the lower to the higher butterflies, in the loss, first, of the cocoon, next, of the girt; and, as if this were not enough, some of the highest butterflies have even lost the last remnant of silk and fallen to the ground." That is to say, a reversion to the habits of the moths is an advance in grade. Continuing: "As if to show that the suspension by the tail alone is a stage beyond that of hanging by tail and girdle, we have a clear proof that all the Suspensi have passed through the stage of the Succincti, since *the straight ventral surface of the abdomen*, assumed perforce by the Succincti when they left the cocoon stage, and became attached to hard surfaces, *still remains in the chrysalids of the Nymphalidæ*" (these italics are Mr. Scudder's), "where it no longer serves any purpose—as clear and striking an indication that the Suspensi outrank the Succincti, as that the pupa is higher than the larva."—But., 258.

I deny the fact alleged, that the pupæ of the Papilionidæ, which being the first to leave the cocoon stage, and "perforce assumed" a flat ventral surface, have that sort of a surface. I never saw such a thing in one of the Papilioninæ; they are all rounded, as in *Turnus*, or rounded and bent back in the middle, as in *Asterias*, *Troilus* and *Philenor*. In many, as the whole of *Turnus* group, the dorsal side is straighter and flatter

than the ventral. Among the Pierinæ, the pupæ of some of Piéris, as *Rapæ* and the *Napi* group, have a tolerably flat ventral surface, others of the same genus do not. And Neophasia, Anthocharis, Callidryas, Terias, Colias, Nathalis, all which I know well, have anything but a flat ventral surface. Among the Nymphalinæ, many of the genera have no such surface, as Argynnis, all the Vanessinæ, Limenitis, etc., etc. The Heliconinæ do not. And, admittedly, the Satyrinæ have pupæ "among the most rounded in the whole family." Moreover, among many of the Satyrinæ the dorsal side is as much flattened as the ventral. The supremacy of the Satyrinæ, and with them the Nymphalidæ, cannot be proved from the shape and conditions of the pupa any more than from the papillae.

The third prime feature consists in the extreme degree of atrophy of the fore legs of the imago. The Hesperidæ have six walking, useful legs; the Papilionidæ the same number. The Nymphalidæ, however, have in both sexes but four walking legs, the first pair being deformed, atrophied, useless for walking, and, so far as is known, for any purpose whatever. It is exactly the sort of phenomenon not very infrequently seen in the genus Homo, but here a crippled or atrophied limb has never become a hereditary character. It certainly would not be regarded as a mark of elevation. How atrophy of the legs originated in the butterflies no one can tell, but perhaps by accident in a single member of the type form, and became perpetuated in a family. In the Lycaenidæ, we are told, But., 254—"All the legs of the female are alike, but the front legs of the male are variously aborted." In the But., N. E, 203:—"As soon as we approach the Lycaenidæ, we notice signs of an approaching abortion of the fore legs, but only in the male;" described as slight; but is greater in the Lemoniinæ. It affects both sexes in the Nymphalidæ, but not in one of the sub-families, the Libytheinæ. These have six good legs in both sexes. And, in the Satyrinæ, the deformity is the most extreme of all. Indeed, unless the front pair of legs should drop off, it is not easy to see what more could be done in that direction. A disfigurement is not generally regarded as a sign of beauty, though tastes do differ. In certain valleys in Switzerland, he who can show the most enormous goitre is the pride of the district. Atrophy of limb, if it prevails throughout a family, may properly be held to be a mark of degradation. It is a phenomenon not confined to any particular order of

insects. There are moths with atrophied wings and legs, carried to a surprising degree; and plenty of instances among the Coleoptera, but few persons would call the loss of essential organs a mark of "aristocratic distinction," as Mr. Scudder does on p. 74, But. N. E. One great family of butterflies is neither fish nor flesh. One sex of a Lycaenid (including the Erycinids) has six useful legs, and is, therefore and thereby a degraded creature, almost, or quite as "low" as a Papilio; but, its mate has its fore-legs always deformed, often utterly crippled, and, therefore and thereby, it is separated from its female, fit company for the "aristocratic" Satyrs! The argument on legs is not tenable. In fact it seems remarkably like nonsense. Deformity can have no ranking value, unless to mark degrees of degradation, and no argument based on the legs of the imago, no matter what their condition, can outweigh that based on every one of the four stages of the insect.

I put the question to a great authority on biology, one whose praises are sounded in both hemispheres, who, moreover, is thoroughly acquainted with Mr. Scudder's argument: "Is atrophy of legs a mark of development?" and the answer came: "Atrophy is not a mark of development." On that rock I stand.

Mr. Scudder's hypothesis of the evolution of these families is obscure, because the language used in different places conveys very different meanings, and, anyway, the hypothesis is peculiar. In But., 244, we read: "Doubtless the Skippers first separated from the common stock; the other families appear to have diverged simultaneously from each other soon after their common separation from the Skippers;" and a diagram presented on page 246 is explained thus: "The position of the main branches and their divisions is supposed to indicate the relative time at which the groups diverged from each other, or from the main stem, and *the height which each branch attains the relative perfection of the highest members of that group.*" In accordance with the author's prepossessions, the stem which is terminated by the *Satyrinæ* is highest of all, in fact six and a-half inches long, evidently limited only by the length of the printed page, and goes straight up from the base (that is, from the "common stock," while the Skippers diverge from the stem at half an inch from the base, and the Papilionidæ and Lycænidæ at another half inch simultaneously, one on one side of the stem, the other on other side. (That is, as if from a setting of hens' eggs were to issue humming birds and eagles.)

The Nymphalidæ begin to branch at an inch and a-quarter above the Papilio, first coming the Libytheinæ; then at another inch the Nymphalinæ, and above them the Satyrinæ, at two and a-half inches. This two and a-half inches "indicates the relative perfection" of the Satyrinæ over the rest of the Nymphalidæ. The "perfection" of the Satyrinæ to the Papilionidæ is as 6.5 is to 1. Truly a parlous elevation for the giddy *Semidea* and its peers! Anyone can draw a diagram, and if I were to use the one made by Mr. Scudder, I should put the Satyrinæ at the first branch above the Skippers, and the Papilioninæ at the top, and the proportion of perfection would be for the latter as 6.5 to 1 of the other. Mr. Scudder assures us that all the Suspensi have been Succincti, and that the evidence "is clear and striking," but his only witness to the fact is discredited. As the moths, in general, have no attachment at all, if the moths are indicated by "the common stock," it is not clear why the Papilionidæ were "perforce" obliged to assume the girdle and button on leaving the main stem. The next stage to no attachment would seem likely to be the single attachment, but whether that was *perforce* assumed we have no means of knowing. It would also seem that the double attachment is the widest departure from the condition of no attachment at all, to be reached after the longest period of time, instead of the shortest. That from no attachment a sudden leap should be made to a double one and then come back to a single one, to culminate in none at all, as it began, is an unreasonable proposition. To me it seems clear that the condition of no attachment found in so many Satyrinæ is closest to the habits of the moths; the single attachment or button comes next, and the double attachment is the final outcome, "showing the perfection of the highest members of the group," namely, the Papilionidæ. Mr. Scudder tells us, and this time we concede the reasonableness of the proposition, that "it is unphilosophical to accord high rank to any group for a single characteristic, especially when, in nearly all its other peculiarities, it evinces its low origin."—But., 250. On this ground the scheme of elevating the Satyrinæ very properly fails.

But, while the diagram cited and the language sometimes used, would give the impression that the author did not intend to make one family evolve from another, other language certainly implies that this did take place, that what are called the higher families all passed through the stages of the lower, and in evolving sloughed off the lower class of habits

more or less completely, till an "aristocratic" perfection was reached in the Satyrinæ. "The Hesperidæ have epiphyses; the Papilioninæ the same; in the closely allied sub-family, Pierinæ, the epiphyses disappear." —But. N. E., 73. "*There is the series, leading from the Hesperidæ in a direct and unbroken course through* the Papilioninæ, Pierinæ, Lycæninæ, Lemoniinæ *to the Nymphalidæ*, and *culminating* in the Satyrinæ" p. 74. That can mean nothing else than a sort of fishing pole style of evolution, in which every joint proceeds from and was inclosed in a preceding one. That involves greater difficulty, even than the other plan. The big Papilio is to come out of the little Hesperian, the tiny Lycæna from the big Papilio, the robust and often great Nymphalid from the tiny Lycænid, and the series is to culminate in a weakling Satyrid, aristocratic, if at all, only in the sense of being effete, exhausted, "petered out."

Mr. Scudder insists strongly on the two evident series—one, of the style of pupating; the other, of the condition of the legs. But, what if these series are imaginary? The pupation begins and ends with the moths, and is in a circle, as I have shown, and, therefore, is not in a series. Let us see about legs; first, six good legs; next, slight atrophy in the fore-legs of one sex; then a little farther atrophy; next, six good legs in the Libytheinæ; then complete atrophy in both sexes, and at last extreme atrophy. Using the diagram before referred to, in which "the height which each branch attains, indicates the relative perfection" of the several groups, the whole length of the stem being 6.5 inches; we find the Papilionidæ at 2 inches, the Lycænidæ at 3, the Erycinidæ at 3.25; the Libytheinæ, having six legs, must be rated at 2; the Nymphalinæ 4.25; the Satyrinæ 6.5. This will then run 2, 3, 3.25, 2, 4.25, 6.5. The mathematical name for this sort of series I do not find, but I think it is what is called the illusive—such stuff as dreams are made of. Not substantial enough to base an argument on!

Another thing one would like to have an explanation of. If there ever did arise a tendency towards deformity, and the deformity was a development, why, in the Lycænidæ, it halted at a slight degree, and left all the species of this great family, divided into hundreds of genera, in exactly the same condition? Why it advanced a bit farther in the Erycinidæ and halted, and why both these families have halted for these myriads of years? Why they are not as perfect, in all respects, as the Nymphalidæ, with but four good legs in both sexes—four legs being

the test of perfection? Why, in the Libytheinæ, part of the Nymphalidæ, there are six good legs in both sexes, though they evolved from the tainted Lycænidæ? These little difficulties will thrust themselves into notice when surveying Mr. Scudder's great scheme. It is very odd that the disease we are talking of should have burst out with virulence one step beyond the healthy Libytheinæ, and have swept all before it to the Satyrinæ, who yet have managed somehow to live through the 800,000 years.

There is no trace of butterfly life back of the tertiaries. The formation, next below that, is the cretaceous, adverse to butterfly beginnings. Now, the beginning of the tertiaries is estimated by geologists as somewhere about 800,000 years ago. All of a sudden the shales are full of insects, and we learn by Mr. Scudder's "Fossil Butterflies," 1875, and by his later papers, that the very earliest butterflies, whose remains are found, were closely like what we see to-day, the same families and subfamilies, so far as the examples go, which are recognized now. In the Fossil Butterflies, nine species are treated of from the Eocene and Miocene. Of these nine, two belong to the Pierinæ, one to the Parnassinæ, four to the Nymphalidæ, and two to the Hesperidæ. Of the four Nymphalidæ two belong to the Satyrinæ, and one of them is stated to be very close to Debis (Enodia) *Portlandia* of the United States. The other to be nearly allied to an existing Bornean species. We read, page 83 :—"Our present knowledge places the apparition of butterflies towards the end of the lower tertiaries." It appears then, that on the earliest horizon the "highest" butterflies, as Mr. Scudder esteems them, were living side by side with the "lowest." In the next horizon we find a Hesperid, a Pierid of a genus used in the Butt. N. E., viz., Pontia, and a Nymphalid, also belonging to one of Mr. Scudder's genera, Eugonia, which he created for Grapta *J. album*. Since 1875, the American tertiaries have yielded seven other butterflies, of as many species. One is a Pieris nearly allied to *P. Rapæ*; five are Nymphalinæ, and one is a Libythea; this last is so well preserved that its legs are clearly to be seen, and Mr. Scudder says that "the fore leg is of the same structure as in the genus to-day."—B.N.E., 759. That is, it has six walking legs, though all the rest of the Nymphalidæ have but four. Evidently on the leg classification it is a black sheep, and should be hustled out of the Nymphalidæ. Further, we are told that in one of the Nymphalinæ the legs show that "the atrophy of the fore legs had reached the same

stage which it now possesses."* It appears, then, that while some genera are extinct, others are represented by modern genera very near them, and two belong to genera in use to-day. But the families and sub-families, even to the aberrant Libythea, were as sharply defined as they are to-day. Every family recognized by Mr. Scudder is represented, except the Lycænidæ, but their absence is accounted for by reason of "their exceedingly delicate structure and small size;" and it is added, "but there are intimations of the presence of some of their caterpillars in amber," which is a product of the tertiaries. And there is not a species about which there is a doubt as to what family and sub-family it belongs. The neuration of wings, the legs, palpi and antennæ were just as now. It is proved, therefore, so far as there is any evidence at all, that since the Eocene, the families and sub-families of butterflies have not changed an iota. Mr. Scudder is happy in the poetical quotations prefixed to his chapters, and he might have put over the one on fossil butterflies, "Such as creation's dawn beheld, we see thee now." New species have been evolved and new genera, but no new families. Of sub-families we miss *that of the Papilioninæ*, whose absence, considering their size and stout texture of wing, and especially if they were among the first to evolve from the "common stock," and, therefore, were always present when any butterfly at all was flying, is remarkable. If they were really the latest to develop, we can understand their absence.

From the beginning of the tertiaries there was a steady advance in the grade of mammals and birds. The supposed ancestors of existing species in these classes are found there, new types manifesting themselves as the period progressed. The families are not those of to-day, but one has developed into many. This very week there is going the rounds of the papers a description of the mammal Phenacodus-primevus, an animal both herbivorous and carnivorous, from the Eocene of Dacotah, which Dr. Cope considers the ancestor of the elephant and giraffe, the plantigrades, the carnivora and hoofed animals of to-day. But, in the butterflies, there is no evidence of any change whatever.

The hypothesis, advanced by Mr. Scudder, calls for a duration of time which is inadmissable. It is a problem in the Rule of Three; if butter-

* If, as I have supposed, the atrophy of legs originated suddenly and to full extent in the type, and was perpetuated by descent, we can understand why it appears on the earliest horizon; otherwise, not. But if it was a malformation from the first, no degree of perpetuation would change its character.

flies, in the family and sub-family characters, have not changed in 800,000 years, how long time would be required to bring them out of the "common stock" to the grade they had reached in the Eocene? Perhaps the advocates of leg classification can solve it.

Mr. Darwin, in his fourth chapter, gives a diagram explaining his views as to how varieties appeared, and how, from simple variation, genera and families might come to be formed. Starting with several species of a widely distributed genus, which resemble each other in unequal degrees, he represents their offspring by divergent lines—the divergency in each case showing the variation in the descendants of the original species. Many variations appear in one or more of the groups, some of which go but a little way; others flourish, and in their turn give permanent varieties. Some of the original species die out, and, at length, after many thousands of generations, the surviving descendants of the original species are separated into distinct groups of unequal value, and which may be regarded as families and sub-families. The branches, that is, the descendants of the original species, do not evolve one from the other, but are all advancing in their own way, unequally. That kind of evolution is intelligible, at least. One group of butterflies, starting from the "common stock," whatever that may have been, would come to have one manner of pupating, or its bodily organs of a particular pattern; another group a different manner and pattern. The groups are not departing in every respect, or at all equally from the parent form. No matter how far removed in time from the parent, one feature or other may be retained through all the history. Evidently, no such duration of time is required to bring the order of butterflies to their present condition, as is called for by the other scheme treated of. Whether, of the several groups existing at any given period, one were higher in the scale of existence than another, would depend, not on the deformity of a pair of legs, nor the style of pupating, or the papillæ on the tongue, or the presence of a 'tibial ephiphysis," but, in the harmonious development of the whole organization. There can be no ascending scale, because one family did not develop out of another, but each separately, and according to the surrounding.* If there is a highest family among the butterflies, as among mammals, the quadrumana,

* There is no evidence whatever that a butterfly sprang from a moth, and it is a fair proposition that all families of the Lepidoptera, diurnal, crepuscular, nocturnal, came from a common parent, and were developing at same time, each in its own way. This calls for vastly less time than the fishing-pole style of evolution.

birds, the thrushes, it is the Papilionidæ, and the Satyrinæ must go to the bottom, carrying the Nymphalinæ with them.

This matter of relative rank was discussed by Mr. Alfred Russell Wallace, a man who "sees clear and thinks straight," in 1864, with a treatment worthy his high standing as a naturalist, and the argument then advanced has proved unanswerable. It is based on general principles, and no special pleading from diseased legs, or papillæ, or pupæ will touch it. Indeed, the conclusion reached by Mr. Wallace is so manifestly proper that the test of any other theory on the matter must be whether or no it arrives at the same conclusion. I am glad to be able to quote the argument, as probably it is new to many of the readers of this magazine: "Butterflies and moths are broadly characterised by their diurnal and nocturnal habits respectively, and the Papilionidæ, with their close allies, the Pieridæ, are the most pre-eminently diurnal of butterflies, most of them lovers of sunshine, and not presenting a single crepuscular species. The great group of the Nymphalidæ, on the other hand, contains an entire sub-family (Brassolidæ), and a number of genera, such as *Thaumantis*, *Xeuxidia*, *Pavonia*, etc., of crepuscular habits, while a large proportion of the Satyridæ and many of the Danaidæ are shade-loving butterflies." He then speaks of certain special characters in the Papilionidæ, the most noticeable of which is the tentacle for self defence, in second segment, which every one of the Papilionidæ is provided with: "Such a structural addition to the organization of the family, subserving an important function, seems to me alone sufficient to warrant us in considering the Papilionidæ as the most highly developed of the whole order." He speaks of the "tibial epiphysis," common to the Papilionidæ and some Hesperidæ, which was supposed by some authors to show a direct affinity between the two groups.* These examples, I think, demonstrate that we cannot settle the rank of a group by a consideration of the degree in which certain characters resemble or differ from those in what is admitted to be a lower group; and they also show that the highest group of a class may be more closely connected to one of the lowest than some other groups which have developed laterally, and diverged farthest from the parent type, but which yet, owing to want of balance, or too great specialization in their structure, have never reached

* Here is another character which could not have passed into the Papilionidæ from the Hesperidæ. Whether the "common stock" had it no man can tell.

a high grade of organization. The Quadrumana affords a very valuable illustration, because, owing to their undoubted affinity with man, we feel certain that they are really higher than any other order of Mammalia, while at the same time they are more distinctly allied to the lowest groups than many others. The case of the Papilionidæ seems to me so exactly parallel to this, that, while I admit all the proofs of affinity with the undoubtedly lower groups of Hesperidæ and moths. I yet maintain that owing to the complete and even development of every part of their organization, these insects best represent the highest perfection to which the butterfly type has attained, and deserve to be placed at the head in any system of classification."—Nat. Selection, 139 et. seg. It is useless to attempt to disparage the value of the characters cited by Mr. Wallace, as Mr. Scudder does in But. N. E., 74; calling them "utterly insufficient," or to say that they indicate low rank, or have no token of high character about them. To those who also can "see clear and think straight" the argument will be satisfactory.

It accords with reason, that if there is to be, in the future, any advance in the development of the butterflies, it will take place among the sun-loving, many-brooded species of the sub-tropical and tropical regions, where the imagos of the collective broods live fully half a year, rather than among the shade-seeking species, which, according to Mr. Scudder, are mostly one brooded, and numbers of which, as we have seen, live but a few days, with adverse surroundings. It is among the Papilionidæ that variation, and modification and polymorphism run riot, as both Mr. Wallace and Mr. Bates have related. Even in our own limited fauna, we have two species which are dimorphic and polymorphic. But in the eastern Archipelago, every island has a modified form of certain widely distributed species, and several of these species have from two to four different sorts of female. In particular islands the individuals have changed in shape of wing, in neuration and in color. It is out of this family we may expect that species and genera will be evolved.

I, myself, do not consider the Pieridæ as part of the Papilionidæ, having been led to that conclusion by study of eggs, larvæ and pupæ of many species of each family. In these stages the differences are as great as can well be. On page 120, But. N. E., Mr. Scudder says of a paper of mine which appeared in this magazine: "The facts brought forward show that the arrangement of the genera commonly adopted in Europe is

altogether unnatural, as one would expect to find it, founded solely upon a few characters drawn from the neuration of the wings," adding, "an excellent opportunity for inaugurating a new and more substantial classification is now open to the general student." Instead of genera, say genera and families. In my view, the Pieridæ form a natural family, the Parnassidæ another. After these come the Erycinidæ and Lycænidæ, then the Nymphalidæ, with Satyrinæ next the Hesperidæ. With this arrangement, the "curious resemblances" noticed by Mr. Scudder in all the four stages of the Satyrinæ to the Hesperidæ puzzle no longer; the "phyletic meaning" is intelligible, and we can admire the fitness of things in general.

ERRATUM.—The word "turned," on page 66, line 13 from top, should read "tumid."

NEW SPECIES OF CANADIAN TENTHREDINIDÆ.

BY W. HAGUE HARRINGTON, OTTAWA.

1. NEMATUS OCREATUS.—♀. Testaceous or honey-yellow; length, 0.35 inch.

Head polished, sutures behind ocelli well defined; ocelli in a slightly curved line with the lower one on the rim of a large shallow basin; face below antennæ whitish, especially a triangular spot at their base; mandibles reddish; a dark impressed point above each antenna, another between them, and one on edge of occiput; antennæ slender, two-thirds as long as body, black with basal joints paler; joints three and four subequal; five shorter.

Thorax with sides of prothorax paler; the meso-thorax darker with a black line on the lateral lobes, and a dark spot within at the base of this line; metathorax with tip of scutellum and post-scutellum and the sutures narrowly black; wings large, hyaline, irridescent; nervures blackish; stigma and anterior border pale; legs unicolorous with body; the extreme tip of posterior tibiæ and their tarsi in part, brown or blackish.

Abdomen stout, slightly longer than head and thorax, uniformly honey-yellow, paler below laterally; basal plates margined with black, and with a dusky spot at side; ovipositor sheaths polished, transparent, plainly showing the large ovipositor; cerci long, black at tips. One specimen captured near Hull, Q., on 16th May, 1886.

2. HARPIPHORUS VARIPICTUS.— ♀. Length 0.35 inch; expanse wings 0.80.

Head and thorax black with white markings; antennæ with terminal joints white; abdomen and legs rufo-testaceous. Head black, with shallow punctures; distinct sutures from base of antennæ to vertex; clypeus truncate; labrum rounded; clypeus, mandibles, palpi, entire orbits and posterior angle, triangular spot at base of antennæ, the tips of two basal joints, sixth in part and seven to nine entirely white.

Thorax polished, black; borders of prothorax, tegulæ, a large spot on flanks, a smaller one over middle coxæ, the scutellum, two short lines on lobes of meso-thorax, the cenchri, the coxæ in larger part, and the trochanters, ivory white; wings hyaline, with a slight yellowish tinge; nervures brown, stigma and costa testaceous; lanceolate cell with straight crossline; hinder wings with one middle cell. Legs, except coxæ and trochanters, rufous; tips of posterior femora, and a dot on tip of tibia behind, blackish; inner spur of anterior tibia strongly bifid; all the claws bifid, rufous.

Abdomen rufo-testaceous above, paler beneath. Captured by Mr. Fletcher, while collecting with me near Hull, 10th June.

This handsome insect is near *varianus* Nort., and *versicolor* Nort., and has also a strong superficial resemblance in size and coloration to *Strongylogaster pallidicornis* Nort. The venation of the anterior wings is peculiar; the lanceolate cell in each has two short straight cross-lines, which form a small cell near its middle.

3. PHYMATOCERA NIGRA.— ♀. Robust, shining black; length 0.20 inch; breadth of wings 0.45 inch.

Head broad, but not so wide as thorax; a brief groove above each antenna and each posterior ocellus; clypeus truncate, labrum edged with white, tips of mandibles rufous; antennæ as long as head and thorax, slender, gradually tapering to tip; joints 3 and 4 sub-equal, 5 slightly shorter, remainder of nearly equal length.

Thorax polished; beneath with very fine short pubescence; wing-scales white; median lobe of meso-thorax short, sutures faint, scutellum sparsely punctate; flat, polished, with two shallow pits at base; wings hyaline; nervures brownish, first recurrent received in middle of second submarginal cell, second recurrent about one-third from base of third submarginal cell, nervure dividing marginals straight; legs whitish, base of

the anterior and intermediate and most of posterior femora black, tips of tarsi, especially the posterior ones, piceous or blackish.

Abdomen short and stout, with very fine yellowish pubescence, more abundant on terminal segments; ovipositor conspicuous, sheathes black, shining.

Described from five specimens, all ♀, collected in this vicinity. In general appearance it much resembles *Monophadnus medius* Nort., and might be readily mistaken for that species, except for the antennæ. It even more closely resembles a Blenocampa, which I take to be *B. paupera* Prov.

4. MACROPHYA PROPINQUA.—♀. Black, length 0.5 inch; expanse of wings 1.0 inch.

Head broader than thorax; clypeus emarginate, labrum truncate, both white, line on mandibles white, palpi whitish; antennæ slightly swollen in middle, joint 3 nearly as long as 4 and 5; two indistinct white dots on edge of occiput.

Thorax with slender white line on edge of collar and of wing-scales; meso-thorax polished, moderately punctured and slightly pubescent, median lobe sulcate; scutellum convex, more coarsely punctured and pubescent; a line on anterior and middle coxæ and most of their trochanters, a large spot on posterior coxæ, with trochanters entirely, white; a white line on anterior tibiæ before, extending nearly half way on femora; tarsi with all the joints white, tipped with black, except first joint of posterior, which is black, with a small white dot at extremity without; edge of basal plates white; apical half of wings pale fuliginous; abdomen stout, polished.

Described from two ♀ collected in July. This species is closely allied to *M. tibiator* Nort., but differs in having the posterior tibiæ entirely black.

Var. a, ♀.—Two specimens, also collected near Ottawa, differ in having only the sutures of trochanters white, and in having more black on the tarsi and anterior legs, with a dusky spot on clypeus and labrum.

5. TAXONUS RUFIPES.—♂. Black, legs rufous; length 0.35 inch; expanse of wings 0.65 inch.

Head finely punctured, with a fine pubescence, more marked upon the face and basal joints of antennæ; ocelli in a triangle the lower one at the summit of a bell-shaped shallow depression, the channels at sides

of ocelli terminating behind in a deep puncture; clypeus short, scarcely emarginate; palpi piceous; antennæ long, stout; joints 3 to 9 sub-equal, terminal joint blunt at apex.

Thorax polished; tegulæ, with a large angulated spot before on prothorax, pale rufous; legs rufous, except base of coxæ and tips of some of the joints of tarsi, which are more or less blackish; wings hyaline, irridescent; nervures and stigma black, a spot in centre of second submarginal cell, lanceolate cell without crossline, two middle cells in posterior wings.

Abdomen long, flattened, sides parallel; segments 2 to 5 of tergum with the apical margin narrowly pale rufous.

Described from two specimens captured in May.

6. TENTHREDO SEMICORNIS.—♂. Black, abdomen and legs partly rufous; length 0.40 inch; expanse of wings 0.85 inch.

Head wider than thorax, excavated in front, with a strong ridge above each antenna; clypeus, labrum and base of mandibles white; antennæ moderately stout and about as long as the abdomen; five basal joints black (the third with a narrow rufous ring at base), four terminal joints white, except the extreme apex of last which is black.

Thorax black, except a white spot on flanks, a larger one above the posterior coxæ, and another on lateral margins of the basal plates; wings hyaline, stigma and nervures blackish; tegulæ and base of costa rufous; legs ferrugineous, anterior pair paler; coxæ and trochanters partly white with base black; a line on femora above, a spot at apex of tibiæ within, and posterior tarsi, except last joint and base of first, black.

Abdomen black at base and apex; segments 3 to 6 rufous, margined with black; ventre rufous except two apical segments.

Described from a single specimen captured in the city on 9th June, 1886, by Mr. J. A. Guignard. This species has the appearance of *rufopediba* Nort., with the antennæ of *grandis* Nort., by which it may be easily recognized.

7. TENTHREDOPSIS EVANSII.—♀. Yellow, with black and green markings; length 0.45 inch; breadth of wings 0.90 inch.

Head yellow, except an oval black spot surrounding the ocelli, within this black patch are two short yellow lines, one on each side of lower ocellus; clypeus squarely emarginate, pubescent, as also labrum which is margined with green; mandible yellow at base, centre green and tip

black, shading to ferrugineous; palpi greenish; antennæ black, greenish below; eyes bronze.

Thorax yellow, paler below; dorsal surface black; scutellum and post-scutellum, with four short lines before, yellow; wings hyaline, lightly obscured in apical half; nervures almost black, stigma and costa green; legs variegated; coxæ, trochanters and femora yellow, the latter with a small black dot at tip within; tibiæ and tarsi green, with the tip of former and of each joint of latter black; claws red.

Abdomen yellow, with a broad black dorsal band, uniform in width to terminal segment, when it is rounded and does not quite attain tip; ventre inclining to ferrugineous, especially the terminal segments.

Described from a specimen collected at Sudbury, Ont., by Mr. John D. Evans.

I have much pleasure in naming this beautiful insect after its captor, who has made large collections at Sudbury, and added much to our knowledge of the fauna of that part of Ontario.

CORRESPONDENCE.

ARZAMA OBLIQUATA.

Dear Sir: Upon my return from London on the 29th March, there was awaiting me, through the kindness of Mr. Brehme, a parcel containing a piece of Typha stalk nine inches long, full of longitudinal burrows, indicative of larval work. In one of these I found a small sized chrysalid and a larval skin. I put the pupa in my hatching box, and the stalk out of the way for the time. On the morning of the 8th of April, sitting in my room looking vacantly at the window, my attention was aroused by observing the outline of a moth at rest on the upright centre sash. Upon close inspection it proved to be a large sized *Arzama obliquata*, in perfect condition. Had Mr. Brehme's chrysalid hatched and the moth escaped from the box? But it seemed quite too large to have come from it. I then looked in the box, and there, resting at the top, was a small sized moth, and the empty pupa case lying on the bottom. I then got the stalk and began a careful investigation, and in the very centre I found a large cavity with a quantity of fine cuttings at the bottom, the empty pupa case of my large moth, and the cast off larval skin. A natural pair at the same time.

Hamilton, April 10th, 1889. J. ALSTON MOFFAT.

BOOK NOTICE.

INSECTS INJURIOUS TO FRUITS, by William Saunders. Second editon. Philadelphia: J. B. Lippincott Company. 1 vol., 8 vo., pp. 436.

It is with great pleasure that we announce the publication of the second edition of this valuable and important work. That a new issue should be called for is a most satisfactory proof of the excellence and permanent usefulness of the book, and establishes the fact that Prof. Saunders has provided the fruit growers of North America with a standard manual upon the insect enemies they have to contend with. Six years have gone by since the issue of the first edition, and, during that time, great and steadily increasing attention has been given to the study of economic entomology, with the result that many new methods have been discovered for successfully combatting the ravages of noxious insects. The most important and useful of these the author has now embodied in his book, and has done so with very little change in the text of the w rk. A superficial reader would hardly notice the alterations, but we find that many have been made, and that they bring down the information given to the knowledge of the present day. As an example, we may mention the insertion among the remedies for the codling worm, of the apple and the plum curculio, the recently discovered method of spraying with a mixture of Paris green and water, which has proved so eminently successful. For the information of those of our readers who are not already familiar with the work, we may mention that the insects treated of are grouped under the name of the particular fruit that they attack, and are arranged in order according as they affect the root, trunk, branches, leaves and fruit. An illustrated life history is given of each, followed by an account of the most useful remedies that may be employed, and of any parasitic insects that assist in keeping the pest in check. Twenty of the most important fruits are dealt with, and two hundred and sixty-six noxious insects and a large number of beneficial ones are more or less fully described. The book is beautifully printed on fine paper, and illustrated with four hundred and forty admirable wood cuts. While this work is simply indispensable to the intelligent horticulturist, it is al- of great value to the practical entomologist, and a most useful book to place in the hands of beginners. The young collector will find in its pages figures and descriptions of most of the insects that he meets with, and the more advanced student cannot fail to learn from it much that would otherwise escape his observation.

Mailed May 7th.