cannot consider such differences more than varietal, and would designate this small pale variety as var. *Coloradensis*. The *Ægiale Cofaqui* of Mr. Strecker (*Proc. Ac. Sci. Phil.* 1876, p. 148), taken in Georgia, should, I think, also be considered but a well-marked variety.

Regarding the boring habit in butterflies, I learn from Prof. P. C. Zeller, of Stettin, Prussia, that there is also a Hesperian (*Erynnis alceæ*, Esp.; *malvarum*, Hoffm.) which Kirby gives as common to Europe, Asia and Africa, whose larva bores in autumn into the stems of its food-plant (*Malva sylvestris*), in which it hibernates, and in which it goes through its transformations the following spring.

Regarding other insects that bore the stems of Yucca, Mr. Bolter found a Cerambycidous larva at this work in Florida. It appears to belong to *Elaphidion*, enters from the side, but not very deeply, and enlarges the bottom of its burrow. The Curculionid *Scyphophorus yuccæ*, Horn, is said to bore the stem of *Yucca gloriosa** in California.

Further Remarks on PRONUBA YUCCASELLA, *and on the Pollination of Yucca.*

By CHARLES V. RILEY.

[Read Nov. 5, 1877.]

In a recent Bulletin of Hayden's *Geological and Geographical Survey of the Territories* (vol. iii., No. 1) is an extended article by Mr. V. T. Chambers on "The Tineina of Colorado," in which, on the very first page (121 of the Bulletin) the following paragraph occurs:

Pronuba yuccasella Riley.—Very abundant in the flowers of "soap-weed" (*Yucca*) as high up on the mountains as 7,000 feet, in the vicinity of Colorado Springs. Mr. Riley says (*Fifth Annual Report Noxious and Beneficial Insects of Missouri*. p. 151), "Front wings uniformly silvery-white." but at least half of the numerous specimens observed by me in Colorado had the wings more or less spotted with black (like *Hyponomeuta*, to which in the form and neuration of the wings it seems somewhat allied, though

* Probably *baccata* or *Whipplei*, since, according to Dr. Engelmann, *gloriosa* does not occur in California.

its affinities seem to be rather with the true *Tineidæ:* it is, however, *sui generis*). These spots vary in number from 0 to 13, and when all are present are arranged as follows: one (the largest) at the end of the disk, with three others before it, making a coffin-shaped figure; one on the dorsal margin before the cilia, and eight others around the apex. The one at the end of the cell is found oftener than any of the others, and those around the apex oftener than the other four. The expanse of wings is given by Mr. Riley at 1.00 inch for the ♀ and 0.90 inch for the ♂. The largest ♀ specimen observed by me scarcely exceeded 10 lines and the smallest ♂ was scarcely 6 lines, so that it seems to attain a greater development of wings in the east than in the west, contrary to the rule said by Prof. Baird, Dr. Packard, and others, to prevail among other insects and birds.

The statements in the above extract are altogether erroneous, being based upon mistaken identity. A careful examination of these supposed spotted Pronubas which I have been permitted to make through the courtesy of Dr. H. A. Hagen of Cambridge, Mass., whither Mr. Chambers had sent all his examples, enables me to state positively that the spotted moths which Mr. C. mistook for *Pronuba yuccasella* are, in reality, *Hyponomeuta;* and, what is the more remarkable, they are one of Mr. C.'s own described species—*H. 5-punctella.* Of the six specimens submitted to me, there was but one *Pronuba*, and that was immaculate, as the species always is. The spots on *Hyponomeuta* are very variable, while some individuals of *5-punctella* are immaculate, when at first sight they might be mistaken for *Pronuba.* Setting aside the less easily observed venation, this *Hyponomeuta* may at once be distinguished from *Pronuba* by its smaller size, narrower and at the same time less pointed wings, and more pearly-white color. The ♂ differs in the anal hooks, and the ♀ in having the ovipositor of different shape and faintly notched superiorly, as well as in lacking the characteristic maxillary tentacles.

I have reared upward of 500 specimens of *Pronuba*, and have it from South Carolina, Texas, California, Colorado and Missouri, and there is never the faintest tendency to maculation. The tendency to variation is, also, exceptionally small. If anything, the Colorado specimens are above the average size, which is natural, since the capsule of *Yucca angustifolia*, in which the Colorado specimens breed, are larger than in other species cultivated around St. Louis.

Mr. Chambers' premise being at fault, there is, of course, no

force in what he says against the general rule laid down by Baird and Packard.

White moths are naturally attracted to white flowers, and it is rash to assume, without careful examination, that all white moths found in Yucca flowers are *Pronuba*.

An interesting fact connected with Yucca pollination came to my notice in the summer of 1876. I have elsewhere shown that the *Pronuba* larva, as it lies in the cocoon underground, is not susceptible to the forcing influences that hasten the development of most other insects. The moths usually issue in St. Louis too late to pollinize the flowers of *Yucca angustifolia*. This species blooms from two to three weeks earlier than *Y. filamentosa*, which, with its varieties, is most commonly cultivated. As a consequence, the former very rarely produces seed. One of the rare occasions on which it did so was in the year stated, in the garden of Dr. Engelmann. All the early flowers at the base of the raceme fell infertile, but a few of the very latest at the apex were fructified, and, as the subsequent discovery of the *Pronuba* larva in the capsules proved, they had been duly visited by the moth.

Since the publication (pp. 208–210, this vol.) of the article "On the Oviposition of the Yucca-moth," the experience of three summers has confirmed everything there said both as to the mode of oviposition and pollination, and as to the remarkable fact that *Pronuba* is the sole pollinizer of our Yuccas. This reiteration of the facts there recorded will scarcely seem necessary to those who have carefully perused what I have written. But one writer, Prof. P. C. Zeller, in Stettin, Prussia, has seen fit to doubt the accuracy of the observations; while a second, Mr. J. Boll, of Dallas, Texas, has attempted to refute my conclusions, in an article in the *Entomologische Zeitung* (1876, pp. 401–5), published at Stettin. To this article I wish, briefly, to reply; for I do not deem it altogether a waste of time, in a mattter so interesting, to notice even that which is palpably superficial and erroneous.

Prof. Zeller, as already shown in these Transactions (p. 325, note), considers the ♀ maxillary tentacles "not available" for purposes of pollination, notwithstanding I had shown so clearly that they were. "The strong tongue seems to me alone available therefor," he writes, and then vouchsafes the opinion that "other observers will be necessary to entirely clear up the curious cir-

cumstances connected with the propagation of the moth." Incited, as he avers, by this expressed belief of Prof. Zeller, Mr. Boll determimed to be one of the "other observers," by carrying some cut Yucca flowers (species not given) containing moths into the house, and placing them in glass cages, where he could observe the doings of the moths. Here is a literal translation of what he says he saw, with a few parenthetical figures of my own adding, to facilitate reference:

The females bored with the fine, pointed, horny ovipositor into the outer flesh of the pistil, which is certainly not quite soft, but on the contrary tolerably hard, and about a line thick (1), and laid each time an egg therein. Afterward they generally clambered on to the anthers and scratched the pollen grains out of the cleft of the same with the maxillary palpi so well fitted for the purpose (2). As soon as they had a sufficient quantity formed into a little lump between the rolled-up tongue, they pushed it into the hole previously made by the ovipositor (3). This operation they often repeated several times on one and the same pistil, and then wandered to another flower. As Prof. Zeller has just narrated, Riley observed the same thing in exactly the same way. From this operation, Riley concludes, as I understand it, that the insect fructifies the plant, and even believes that a natural fructification cannot take place (4).

On which I would remark: (1) Before fructification the pistil is always soft: if unfructified, it remains soft till it wilts and falls: if fructified, it hardens from day to day. Mr. Boll's specimens were probably already fructified, and the poor moths, unable to obtain the sweets from the nectary, lacked the natural inducement to the act of pollination, which may account, perhaps, for their conduct, as he records it, in working at what little moisture there may have been at the punctures.

(2) Mr. Boll means, of course, that the pollen was scratched into a lump by the maxillary tentacle, and I hope this testimony as to the availability of those organs for that purpose will satisfy Prof. Zeller more than my own seems to have done. In reality the moth has little need of scratching, as described by Mr. Boll. Dr. Engelmann has well remarked that the anthers open, contract and curl back before the perigon opens, and often expel the large, adhesive pollen grains, which then lie on the inside of the petals, from which the moth may gather them. When not expelled, as is more often the case, they remain in an entire lump on the curled anthers, and the moth, as I have stated (6th Mo. Ent. Rep. 1873) has no difficulty in accumulating her little load.

(3) I have never noticed anything of the sort in my studies. This is owing, doubtless, to the fact that they have been made on the plants as they naturally grew, assisted by a confederate who carried a dark lantern. The conditions surrounding Mr. Boll's observations were unnatural, and to this circumstance or to pure imagination must be ascribed the stated conduct of his moths.

(4) Now, as I did not observe "the same thing in exactly the same way," but observed and described something totally different, viz., the thrusting of the pollen into the stigmatic tube (*ante*, p. 208), it is evident that Mr. Boll did not know what he was writing about. In truth, as is patent from the article itself, and as he has since confessed to me, Mr. Boll knew at the time absolutely nothing of my writings on the subject except what he learned through Prof. Zeller's notice. Further comment is needless. The fact that Yucca is not a self-fertilizer, I have demonstrated (*ante*, p. 209) by excluding the moth: it does not rest on my testimony, however, but is well known to all botanists who have studied the genus.

Following the portion of the article which I have translated is a long dissertation on the nature of the Yucca flower, in which we are vouchsafed the interesting information that the fruit can only be fertilized through the stigma, and not through the walls of the pistil! The argument is also made, that the capsules containing no *Pronuba* larvæ must have formed without the aid of the moth, notwithstanding I have conclusively shown that pollination may, from one cause and another, be performed without oviposition. The statement is reiterated about the self-fertilizing power of the flower, against experience, experiment, and authority. But the most amusing exhibition of Mr. Boll's logic is where he explains the object of stuffing with pollen the punctures made by the ovipositor, to be the closing of the wound, because the "pollen as soon as it comes in contact with the sap, rapidly swells"; and then, almost in the same breath, tells us that when pollen is not forthcoming, the papillose hairs of the stamens are gathered and used for the same purpose!! Do these swell, too? The truth is that the puncture of the ovipositor is so fine that no single pollen grain could be put into it, while the same will hold true of the papillose hairs referred to, which, by the way, the moth has no means of detaching, and for which Mr. Boll doubt-

less mistook, under his microscope, the hairs of the moth. The article closes with the following:

> Fertilization of plants exclusively by insects is, to my knowledge, not yet positively proven; but intentional fertilization, if one should take this for such, would belong to the realm of fable. This moth, in my opinion, is no Pronuba, but a corruptrix.

Mr. Boll should increase his knowledge by perusing what has been written on the fertilization of flowers by insects. He should also learn something more than he has done in this instance of a subject he intends to treat, and especially of observations which he undertakes to criticize. Investigations, however instigated, should be carried on, not under the warping influence of individual motive, but solely for the love of truth and knowledge.

On the Differences between ANISOPTERYX POMETARIA, *Harr. and* ANISOPTERYX ÆSCULARIA, *W.-V., with Remarks on the Genus* PALEACRITA.

By CHARLES V. RILEY.

[Read Nov. 5, 1877.]

Through profound study alone can we arrive at the true relationships of animals, especially in the inferior classes. Among insects, dozens of species in some families are absolutely undistinguishable in the imago state, though differing widely in the adolescent stages and in habit; while others, again, vary to such a degree that the same species has been described under more than a dozen names, and not unfrequently been made the basis of different genera. The Canker-worms furnish good occasion for these remarks. In the previous communication to the Academy on these insects, I stated (p. 278) that *Anisopteryx pometaria* differed from the other species of the genus, so far as was then known, in having an additional pair of prolegs in the larva state, but added: "For the present I deem it best to refer it to *Anisopteryx*, as more careful study will probably show that in the characters of egg, larva, and chrysalis, the European species of the genus agree with it, and that some of the structural features of the adolescent states have been overlooked in Europe, as they so