

A REVISION OF THE LEPIDOPTEROUS FAMILY SATURNIIDÆ.

By JOHN B. SMITH.

(With three plates.)

The family *Saturniidæ* as limited by me is sharply separated from all the other Lepidoptera by the structure of the antennæ. These organs are always pectinated in the males, and usually also in the females. The branches or pectinations are arranged on each side of the middle of the joints, and there are, in the males always and the females usually, two on each side, or four branches to each antennal joint—a character found in only one other family, the *Ceratocampidæ*. The latter family is sharply separated from the present by having the pectinations extending only half the length of the antennæ, while here they extend to the tip. In life habits they are also very distinct, for while the *Saturniid* larvæ are all spinners and make more or less perfect cocoons, the *Ceratocampid* larvæ all go under ground to pupate. The habitus is also an entirely different one, and thus, though closely allied, the family is abundantly separated from the one here considered. In addition to the distinctive antennal character, the species placed here agree in the retracted head, obsolete tongue (sometimes barely a discernible rudiment), small, often aborted palpi, want of ocelli, no frenulum, no spines to the tarsi, legs sub-equal, the hind pair with small terminal spurs to the tibia only—median tibia usually without spurs. The venation varies somewhat, as do also the male genitalia, and these afford good bases for subdivisions.

As defined above, the family is a very natural one, and includes the species classed in Mr. Grote's most recent list as *Attaci*, and part of those placed as *Hemileucini*.

Most if not all the characters above enumerated apply as well to the *Ceratocampidæ*, and including them, the Lepidoptera with doubly pectinated antennæ are separable as follows:

Pectinations of antennæ extending to the tip.....	SATURNIIDÆ.
Discal cell of both wings open.....	sub-family ATTACINÆ.
Discal cell of both wings closed.....	sub-family SATURNIINÆ.
Pectinations of the antennæ extending to the middle only, simple or serrate beyond,	CERATOCAMPIDÆ.

The *Attacinæ* and *Saturniinæ* are also very sharply separated by the venation of the wings, and it would hardly be doing violence to systematic entomology to rank both as distinct families. Mr. Grote places part of my *Saturniinæ* with his "*Attaci*," while he places another series in his "*Hemileucini*." All of his *Attaci* belong to the *Saturniidæ* as here limited, while of his *Hemileucini*, *Hyperchiria*, and *Coloradia* also belong here. Of the remaining genera *Quadrina* seems to be a *Cossid*, and does not differ very much in structure from *Gloveria*—in fact, this latter

genus has strong Cossid tendencies and in any natural arrangement must stand very close to them. *Hemileuca* is very closely related to *Olisiocampa*, and so also seems *Pseudohazis*: *Euleucophaeus* I have seen, and it has simply pectinated antennæ—what its venation is I do not know.

The material from which this revision was made is principally my own collection, in which most of the species are represented. The museum collection furnished a large amount of material for comparison, while Messrs. Hy. Edwards and B. Neumoegen, of New York, kindly loaned me typical examples of some species from their collections, and Prof. Hy. Snow, of Lawrence, Kans., brought with him on a recent visit to Washington some rarities for examination, including *Quadrina*, *Gloveria* and *Coloradia*, the precise position of which could not have been otherwise determined. As some of the insects included in this revision are of the most interesting and largest of our species of night-flying Lepidoptera, they have been figured and described in almost every work on insects and in almost every treatise on economic entomology. The literature of the species has thus become an enormous one and I have not pretended in this paper to do more than cite the most important or most accessible works. The male genitalia have been examined in almost every species, and figures of the parts are given; but, though the drawings and descriptions are accurate so far as they go, there are yet some structures of importance that have been left untouched simply because our knowledge of these structures in the Lepidoptera is so imperfect that I have not been able to give proper value to them and preferred to omit their consideration here altogether.

#### ATTACINÆ.

The *Attacinæ* express perhaps the highest point in Bombycid development. The imago is absolutely incapable of feeding, and the procreation of the species seems the only point looked to; in consequence the body of the ♀ is very stout and heavy, and filled to its utmost capacity with ova. The insects are strictly nocturnal, and despite the fact that they are usually common, are not often found as imagoes. The larvæ are all spinners, and all make strong double cocoons.

In addition to the family and sub-family characters heretofore mentioned, none of the species have more than 11 veins to primaries, and most have only 10; the accessory cell is always wanting. Briefly the venation is as follows: Primaries, one internal vein, median three branched (v. 2, 3, and 4), 5 and 6 from the end of the sub-costal, 7 and 8 on a long stalk from middle or outer 3d of sub-costal; 9 when present out of 8 at variable points, 10 sometimes from the sub-costal and sometimes out of 8; 12 as usual, from the base. Minor agreements and differences will be noted in treating of the species.

The ♂ genitalia agree in this important particular: all the supra-anal plates are strongly furcate at tip, with the possible exception of *cal leto* and *splendidus*, the latter seeming to lack the plate entirely.

Messrs. Packard and Grote have made numerous genera out of the American species, based on differences in wing shape and the course of the veins; but after careful comparisons of large series of all the species I have come to the conclusion that the separation is not maintainable, and two genera only are recognized separated as follows:

Abdomen untufted..... ATTACUS.  
Abdomen tufted..... SAMIA.

To the latter genus I refer *cynthia* only, which differs also in the more extended secondaries from all the others of our species, but in no further important particulars.

The Linnean species *atlas* is taken as typical of the genus, and *splendidus* is its nearest North American ally. A number of the species described from Mexico and South America have been examined and confirm the views expressed as to the generic identity of our species. It is somewhat remarkable that whereas our North American species vary comparatively little and are rather sharply defined, the Mexican and South American species vary exceedingly, and the limits of and validity of many of the species described in the British Museum Catalogue are still very uncertain.

#### SAMIA Hb.

The only real distinguishing characters have been pointed out. The structure of the head and thorax is shown at plate xiv, fig. 12, and need not be more fully discussed, as the structure of the same parts in the other species of the sub-family is alike. The primaries have ten veins only, the 9th apparently not united to any other, but free from the space between 8 and 10, as shown in the figure. In the specimens the veins are contiguous, but in the figure they are enough separated to indicate their course.

The single species is—

**S. cynthia** Dru., ii, pl. vi, f. 2 (*Phalæna Attacus*); Cram. Ex. i, 62, pl. 39, f. A (*Phalæna Attacus*); Oliv. Enc. Méth., v, 30, 26 (*Bombyx*); Westw. Ed. Dru., ii, 12, pl. 6, f. 2 (*Saturuia*); Hb. Verz., p. 156, 1629 (*Samia*); Wlk. Cat. B. M., v., 1220 (*Attacus*); Riley 4th Mo. Rept., 112 (Life Hist); Hulst. Bkln. Bull., i, 91 (food plant); Nostrand Bkln. Bull., ii, 75 (food plants).

Wings dull luteo-fuscous, primaries with basal space brighter yellowish and space beyond the outer transverse line bright yellow, densely powdered with black atoms; margin luteous gray. A strongly angulated white band, shaded with lilac at base, outwardly shaded with black, the outer angle touching the vitreous lunule. At the outer third the wing is crossed by another, narrower white line, also tinged with pale lilac, and with a broad shade of the same color outwardly. Inwardly it is margined with black. As a whole the line is straight, out-

wardly bent over the lunule. This lunule consists of a narrow vitreous crescent obliquely crossing the median cell, its horns touching the transverse lines. The convex upper margin is black, the concave portion is broadly shaded with yellow. At the apex is a large irregular lilac blotch, outwardly limited by a narrow irregular white line, at the lower end of which is a large round black spot, with a narrow whitish lunule near the inner edge and a few yellow and lilac atoms. Through the luteous-gray outer margin runs a fine dark line, black nearest to apex, fuscous below. Secondaries with an inwardly convex whitish lilac band at base, which at the costal margin connects with a rather acute curve, with an outer band of the same color, and which runs from the middle of the costal margin in two gentle curves to the hind angle. The band is shaded similarly to those of primaries. A strongly curved lunule crosses the cell at the end, its outer upper horn touching the outer band. The space beyond the posterior transverse line is not so bright in color as in the primaries, and is outwardly limited by a narrow, somewhat irregular yellow line, followed by a broad irregular dusky band, and then by two narrow dusky lines, the outer one at base of the fringes. Beneath, the maculation of the upper side is reproduced, save that the basal pale bands are lacking and the color is somewhat paler. Head and thorax like primaries. Head with a white tuft between and at sides of antennæ. Thorax with a narrow white line on collar and a broad white band at base. Abdomen yellow, with a basal white band, a crest of white hair on dorsum, a row of white tufts on each side of the middle; a geminate white line, margined with black, inclosing the stigmata, and two ventral white lines; last segment all white. The body and legs are also white marked. The palpi are small, scarcely reaching the front. The ♀ antennæ with the pectinations even to the tip, but not ciliate, the branches well separated at the joints. The supra-anal plate of the ♂ is broad at base, narrowing toward the tip, and then divided into two divaricate prongs.

The larva of this species has been well described by Riley and figured in the 4th Mo. Rept., and the caterpillar is so well known that it is hardly worth while to describe it again. Its natural food plant is *Ailanthus glandulosa*, but it feeds also on *Ricinus* and "will feed and flourish on lettuce, chicory, willow, and teasel" (Riley). Other recorded food plants are tulip tree (Hulst), sheep berry, wild cherry, and bitter-sweet (Van Nostrand).

The color characters above given are not absolute. An average specimen is described, but the species varies from a bright, almost ocher yellow to a pale greenish-clay color. The violet or lilac is also variably intense, and the lines vary somewhat. The insect is, however, so characteristic that there is no mistaking it. The cocoon is spun in a leaf and fastened to the twigs which in *Ailanthus* drop in the fall. The moths emerge in the latitude of New York late in June or early

in July—in Washington two to three weeks earlier. There are two annual broods in these latitudes.

Since the date of its introduction into this country (1861) this insect has undergone a considerable change in color and wing form, quite marked when compared with specimens from China. It is larger, deeper in color, and the wings are much broader and more rounded, much less excavated below the apex.

#### ATTACUS LINN.

This genus, to which I refer all the other American species belonging to this subfamily, is an extensive one, and yet so characteristic in each case that there is no difficulty in recognizing it at a glance. The definition of the family and subfamily contains all the characters of this genus, and it differs from *Samia* only in the untafted abdomen and in not having the hind angle so distinctly produced. The genera based upon wing shape and on the characters of the front appear to me invalid. They are *Callosamia* Paek. and *Platysamia* Grt. All our strictly North American species agree in having the supra anal plate divided into two divaricate hooks at tip. *Splendida* appears to lack the plate altogether, if my specimen was normal—I had only one ♂ that I could dissect—while *calleto* shows an apparently abnormal structure, which I have figured as I saw it, though I believe the figure incorrect. The venation varies in the species and will be separately described and figured. Two rather sharply defined groups can be recognized. The first, containing *splendidus*, *orizaba*, and *cinctus*, have on both wings a large, trigonate, vitreous spot, and they are all subtropical forms. Except *cinctus*, indeed, the question of their occurrence in the United States is yet uncertain. *Splendidus* makes the nearest approach to the type of the genus in wing form and in general habits and maculation; *orizaba* approaches it so closely in the male that they have been considered identical, while *cinctus*, which is undoubtedly distinct from either, has the typical maculation of *orizaba* and the wing form of *cecropia*.

The other group lacks the vitreous spots, though their place is taken by angulated or lunate spots or marks of a light color. *Calleto* (*polyommata* Tepper), *promethea*, and *angulifera* differ from the others of the group by having the sexes more or less dissimilar in color and wing form. The males are very close in wing form to *splendida*, while the females are like *cecropia* or *columbia*. The pale mark in the primaries is here angular, and the abdomen is not banded, but has a stigmal pale band, including black spots. In this feature these species agree with the *splendidus* group, which has the abdomen maculate in the same way.

*Columbia*, *gloveri*, *ceanothi*, and *cecropia* have the sexes similar in maculation and nearly alike in wing form. The abdomen lacks the lateral spots and is furnished with white bands.

There are here three groups or sections, corresponding with *Attacus*, *Callosamia*, and *Platysamia*, and those with a penchant for numerous genera can use those names. They indicate actual divisions, but the lines are so slight and so superficial that I do not care to use them myself.

In synoptic form the scheme above outlined would be as follows:

Both wings with trigonate vitreous spots.

Size large: spots on both wings acutely triangular; the base concave or straight.

SPLENDIDUS.

Size large: spots on both wings rather rounded at angles; base on the primaries straight, on secondaries spot more elliptic, apex indenting the t. p. line. ORIZABA.

Size smaller, spots smaller, not or rarely touching and never indenting the t. p. line, shape much as in orizaba ..... CINCTUS.

Wings without vitreous spots, but with a lunate or angulated pale or white spot.

Male with subfalcate wings, dissimilar in color to ♀; spots angular.

Abdomen of ♀ not banded, a pale lateral stripe including black spots.

Both sexes very dark, with a very distinct broad white t. p. line on both wings.

Angular marks in ♂ distinct. .... CALLETO.

Male blackish, with the transverse lines very faint, the white marks obsolete;

♀ reddish fulvous, the abdomen obsoletely banded ..... PROMETHEA.

Male more like ♀ than usual, fulvo-fuliginous, the t. p. line and strongly angulated mark distinct, primaries less falcate than in *promethea*... ANGULIFERA.

Sexes similar in color and maculation, and but little difference in wing shape; abdomen of both sexes banded pale marks lunate. Size small; spots unusually small; male antennæ moderate; white band not or narrowly edged with pink.

COLUMBIA.

Larger; spots larger and narrower, more lunate, color deep carmine brown; ♂ antennæ very large. .... GLOVERI.

Similar to the preceding but much lighter pinkish or rust red in color, t. a. line angulated instead of rounded ..... CEANOTHI.

Largest, the t. p. line red, or with a broad red outer margin dark smoky brown in color. .... CECROPIA.

*Attacus splendidus* De B., *Ins. Afr. et Am.*, p. 133, pl. 22, f. 1, 2 (*Bombyx*); Clem., *Pr. Ac. N. Sc. Phil.*, 1860, p. 160 (*Attacus*); Morris, *Syn. Lep.*, 228, 1862 (*Attacus*).

Prevailing color dull reddish brown varying in intensity and shade from a rich deep purple brown to a sordid luteous brown. Thorax with a white band on collar and another at base. Abdomen with a stigmatal white band, margined with black and inclosing red brown spots. Primaries with a white basal transverse band, strongly angulated outwardly on the median vein; outwardly bordered with black, inwardly by a brighter orange red shade. At outer third is a similar transverse band, interrupted by the large triangular vitreous spot, above which it is straight and below which it is wavy. The vitreous patch is trigonate, the base extending across the cell near its end and the apex strongly indenting the transverse posterior line. Beyond this band is a pinkish or lilac shade strongly dusted with black scales, irregular in outline and variable in extent and intensity of color. Beyond this the wing is of a deeper luteous or buff color inwardly powdered with black scales,

outwardly limited by a series of ochreous spots beyond which is a margin of luteous gray, and superiorly invaded by a large pale lilac patch which is outwardly bounded by an angulated white line. Between veins 6 and 7 near the margin is a large, somewhat irregular black spot, sometimes divided into three. The line separating the grayish margin from the series of ochreous spots sometimes becomes darker, or more rarely black. Occasionally the vitreous spot does not indent the transverse posterior line, and in fact all the features of maculation are inconstant. Secondaries with the basal band continued along the costal margin so as to connect with the outer band which is similar to and a continuation of the t. p. band on the primaries. The vitreous patch is similar in shape and occupies relatively a similar position. The space beyond the band is similar in color and maculation to the primaries, but the ochreous spots within the gray margin have each an ovate or elongate deep brown center. Beneath, the maculation of the upper side is reproduced except that the basal band is wanting and the color is much lighter—washed out.

Expands 4–6 inches. *Hab.* Mexico, Texas (?).

It is decidedly questionable whether this insect really occurs within our territory; but it is common on the other side of the border, and Mr. Grote has given it a place in his latest catalogue. The sexes differ decidedly in wing form. In the ♂ the apex of primaries is distinctly produced, the outer margin strongly excavated beneath. The secondaries are much prolonged and the outer margin is somewhat incurved, while in the ♀ the margin is rounded and the wing much shorter and proportionately broader. The primaries of the ♀ are hardly excavate beneath the apex. The ♂ of this species makes the nearest approach of any of our North American species to the Chinese *atlas*, in wing form. The variations in color and in maculation are great, and though I have had over a dozen specimens under examination, hardly two have been alike. The characteristic feature is the vitreous spot which is constant so far as I have observed. It is more than likely that some of the species in the catalogue of the B. M. will prove synonymous with this species, but the material in my hands will not permit a decision at present. In venation this species is distinctive—it has but 9 veins to the primaries, and veins 8 and 9 are connected near the apex by a small cross vein. The venation is alike in all specimens examined by me. Otherwise the venation is as in *cinctus*. The ♂ genitalia are figured at pl. xiv, fig. 1, and the figures will explain themselves. The supra-anal plate differs from that of the other North American species (except *calleto*) in that the forks are scarcely divaricate and hardly even separated at the tip. The side pieces are well enough figured to show the method of their fixture to the segments. The larva of this species is not known to me and no description (if such indeed exists) is accessible to me. Señor Aguillero, of the Mexican Geographical Survey, informs

me that the larvæ are sometimes so abundant as to defoliate the trees of some of their cities, and he speaks of them as a very large green, spinous caterpillar.

**A. orizaba** Westw., Ann. Nat. Hist., 2nd ser., xv, 294 (*Saturnia*) Wlk., C. B. M., v, 1201 (*Attacus*).

This species resembles *splendida* very closely in color and maculation—so closely indeed, that it is a matter of some difficulty to find any distinctive features. No male that was available for purposes of dissection was at hand, though I had several beautiful specimens under examination. The venation is exactly like that of *splendida*. The only permanent or apparently constant differences that I can find, are that the primaries of the ♂ are not so distinctly falcate, and the secondaries are not so lengthily extended; and that the vitreous spots are shorter and broader on primaries and do not indent the t. p. line, and on secondaries are more nearly obovate, the base being rounded or convex instead of straight. M. Neumoegen claims (Ent. Am., i, p. 80) that the species is identical with *splendidus*, but I should hesitate to declare it so without a little more positive evidence. Other characters that are more or less inconstant are that the black spot near the apex is always divided into three—the line through the pale terminal space is always distinctly black, and the secondaries have the spots within this line much longer and deep black, often maculate also with deep carmine.

This form has not to my knowledge been found within our borders, and is introduced merely because of its close resemblance to the preceding, and because it has been suggested that it was identical with *cinctus*.

**A. cinctus** Tepper, Bull. Bkln. Ent. Soc., v, 65, pl. figs. 1 and 2.

This species has the same colors and essentially the same markings as *orizaba* or *splendidus*, but is decidedly distinct. It is a much smaller species, expanding not more than  $4\frac{1}{2}$  inches, and the wings are not so produced in the ♂. The white band is broader, more conspicuously lunulate, that on the anterior wing somewhat curved outwardly, and the lunations extend to the costa, whereas in *orizaba* they do not extend above the vitreous spot. The vitreous spots themselves are smaller, not reaching the white band on the primaries, and they are there in shape most nearly like an equilateral triangle—they are rather broadly edged with white and beyond that with black. The vitreous spot of secondaries is obovate in shape, very like that of *orizaba* but the white margin is heavier. I have seen all the specimens known of this species, and find these differences constant. However, there is yet one other character that I count as decisive. The primaries have 10 veins instead of 9. Vein 8 forks just before the apex, and there is no connection between 8 and 10 (9 in *orizaba*). This feature is constant, and of specific value. I have had no males that I could examine closely enough

to describe the genital structure, but I should imagine it to resemble *splendidus* rather than *cecropia* in this respect.

The larva of this species is not known, but the cocoon and pupæ are described by Mr. Tepper (*l. c. supra*).

The specimens thus far known are all from Southern Arizona.

*A. calleta* Westw., Ann. Nat. Hist., 2d ser., xv, 297. (*Saturnia*) Wlk. C. B. M., v, 1225 (*Samia*).

*polyommata* Tepper, Bkln. Bull., v, 66 (*Platysamia*).

Male: Black or smoky; a whitish band on collar and at base of thorax. Abdomen with a pale stigmatal band inclosing darker spots. Primaries with a creamy white basal band, outwardly curved and angulated on the median vein. An angular whitish mark at the end of and extending across the discal cell. A broad, even white band, outwardly edged with ferruginous and dotted with black scales. The outer margin is yellowish gray, brightening inwardly to a creamy white where it is limited by a sinuate black line, which extends from vein 6 to the hind angle. Within this line is a light yellow shade interrupted by the black veins, and between each vein by a spur from the lunate black spot which bounds the ferruginous space beyond the white line. Of these spots the 3d, 4th, and 5th from hind angle have centers of bluish scales, the centers increasing in size upwardly. In the apical region beyond the white band is a pearly blue shade in which is between veins 6 and 7 a large round black spot, preceded by a black crescent which is margined with blue scales, and succeeded by an irregular deep red brown blotch which extends to the pale outer space. Between veins 7 and 8 is a 3-shaped white mark, the central part of which touches a pyriform deep brown spot. Secondaries with a pale crescent at the end of cell; a broad white outer band, similar to and joining that of the primaries, followed by a ferruginous shade which is irrorate with light blue and black scales. Beyond, is a mouse-gray marginal space which is crossed by a lunate black line, within which is a series of oval black spots.

Female: "Head and thorax dull black, collar pinkish white; a tuft of red hairs at base of thorax; abdomen dull black with a double row of lateral red stripes inclosing small black spots; legs dull black. Wings dull black, with the costa on primaries slightly inclining to gray; no basal bands, nor light abdominal margin to secondaries; the spots in the median fields are small, and plain white with no edging; on primaries, they form a triangle, and on secondaries simply a bar. A wide band of white near the outer margin runs through both wings and makes a decided curve toward the apex on primaries, where it is tinged with pale fulvous; beyond this band, outwardly, the color on primaries is grayish black, lighter toward the outer margin; the apical spot is black, surrounded by dark gray, then bordered inwardly by a bluish crescent edged with black, and outwardly by a dull reddish shading; between each of the veins below the apical spot, and bordering closely on the white band, is a bluish crescent corresponding to the apical one, filled

in gray, and bordered outwardly by a sharp triangle of black; there are five of these extra spots, which diminish in size and clearness as they approach the inner margin. The dark gray ground is outwardly scalloped with a narrow black line, somewhat as in *cecropia*; the borders to primaries are gray shaded with whitish inwardly, especially toward apical area; at apex a zigzag white line connects with the first blue crescent, and between this line and the outer margin is a dull red spot. Beyond the white band on secondaries the color is blackish, with dark gray borders and a scalloped black line, enclosing inwardly a row of black spots, two between each vein. The underside is a reproduction of the upper side with the colors more subdued—no light costal band to secondaries."

*Hab.*—Southern Arizona, Mexico. Expands 3–4 inches ♂, 5 inches ♀.

In wing shape the ♂ of this species closely resembles *promethea*, while the ♀ has the wing form of *cecropia*. The primaries have but 9 veins, very closely resembling in that respect the typical *Attacus*. The figure will more clearly show the course of the veins. The genitalia are somewhat peculiar and also more nearly resemble *splendidus* than *promethea*, to which group this species undoubtedly belongs. The supra-anal plate has a distinct suture through the center, and the forks at tip are short and not divaricate. My figure is probably not accurate, as I could not dissect out the part from the only ♂ specimen I had at hand. This species does not appear to be common.

**A. promethea** Drn., ii, pl. xi, f. 1, 2 ♂; pl. xii, f. 1, 2 ♀ (*Attacus*) 1773; Cram. Pap. Ex., 1, 118, pl. 75 f. A. B. ♀; pl. 76, f. A. B. ♂ (*Attacus*), Fabr. Syst. Ent., 55–7 (*Bombyx*); Sp. Ins. ii, 168, 8 (*Bombyx*); Mant. Ins., ii, 108, 9 (*Bombyx*); Ent. Syst., iii, 1, 411, 12 (*Bombyx*); Oliv., Enc. Méth., v, 27, 12 (*Bombyx*); Gmel. Ed. Linn. S. N., 2403, No. 464 (*Attacus*); Beauv., Ins. Afr. et Am. Lep., pl. 21 (*Attacus*); A. & S. Ins. Ga. i. t. 46, 1797 (*Phalaena*); Westw. Ed. Dru., ii, 20; pl. 11, f. 1, 2; pl. 12, f. 1, 2, 1837 (*Saturnia*); Hb. Verz., 1816, 156, 1631 (*Samia*); Geyer Saml., pl. ii, f. 3, 4, 1832 (*Samia*); Harris, Cat. Ins., Mass., 1835, p. 72 (*Attacus*); Rept. Ins. Mass., 1841, p. 281; Inj. Ins. (First Ed.), 390 f. 186 ♂, 187 ♀, 1862 (*Attacus*); Duncan, Nat. Lib., 32, p. 134, pl. 12, 1852 (*Hyalophora*); Wlk. C. B. M. v., 1223, 1855 (*Samia*); Fitch 3d Rep., p. 59, 1856 (*Attacus*); Morr. Syn. 224 (1862) (*Attacus*); Pack. Pr. E. S. Ph., iii, 1864, 379 (*Callosamia*); Minton, Can. Ent., ii, 100 (list of food plants); Riley 4th Mo. Rept., 1872, 121, ff. 43–46 (life hist.); Packard, Guide, 1878 (6th ed.), 298 (*Callosamia*).

The above bibliography, voluminous as it is, is far from complete, for in almost every American publication in which Lepidoptera are mentioned at all this species is described. Being so well known no detailed description of any of its stages will be attempted, and reference is made to the works of Harris and Riley for figures and detailed descriptions.

The primaries are 11-veined, vein 8 forking just before the apex. The figures will show the agreements in the sexes. The supra-anal plate of the ♂ is deeply furcate, the points widely divaricate; the side

pieces are, while retaining the chief features of the group, still strongly characteristic, and are best described by a reference to the figures.

Expands 3-4 inches. *Hab.*—United States, east of Rocky Mountains.

**A. angulifera** Wlk., C. B. M. v., 1224, 1855 (*Samia*); Morris, Syn., 1862, 227 (*Samia*); Pack. Pr. E. S. Ph., 1864, iii, 380 (*Callosamia*); Riley, 4th Mo. Rept., 122, note; Suppl. 55=*promethea*.

Allied to *promethea*, of which it has been considered a variety. There are, however, abundant characters separating them, an enumeration of which will suffice for a description. The specimens known to me are uniformly larger, the male and female are similar in wing form, and the wings are more rounded than in *promethea*. The male, though darker in color than the ♀, has essentially the same markings, and is only a little smaller. The angular mark is much larger, more angular, and more distinct in the male of this species than in that of its ally. The maculation is essentially that of the ♀ *promethea*, with the colors less bright, and with a more luteous cast. In venation the two species agree exactly. The supra anal plate is like that of *promethea*; but the side pieces are very distinct, as a comparison of the figures will show. No comparative descriptions of the larva have yet been made to my knowledge, and the food plants seem to be as in *promethea*.

**A. columbia** Smith, Pr. B. S. N. H., ix, p. 343, Mar., 1863 (*Samia*); Pack., Pr. E. S. Ph., iii, 1864, 380 (*Samia*); Wlk., Suppl., v, 1934 (1866); Hagen, Buff. Bull., ii, 201, 1875; Strk., Lep., i, 103, pl. xii, fig. 3♂; Beth. Can. Ent., i, 44 (46); Bowles, Can. Ent., iii, 201, f. 37 (*larva*); Brodie, Pap., ii, 79 (food-plants); Strk., Pr. Dav. Ac. N. Se., ii, 277, 1878 (*larva*).

This species has been supposed by some to be merely a local variety of *cecropia*, and it has been compared with that species, from which it seems to me very clearly distinct. I am not, however, able to separate it very satisfactorily from *gloveri*. The venation is the same, the genitalia are the same, and but for some slight differences in maculation which are not constant and the fact that the ♂ antennæ are not so disproportionate, the entire insect seems the same. In size it is uniformly somewhat smaller, but I am at a loss to find any other sharp defining feature. I believe it to be another of those cases where a western form has found its way along some isothermal or other natural line, to the northeast, and has become somewhat modified by the changed conditions. The home of this species is Maine and Canada, and Maine especially, offers a number of parallel cases where typically western forms of Noctuidæ there occur in a slightly modified form. The larvæ of both *columbia* and *gloveri* have been described, and Mr. Strecker has pointed out the differences, which consist in the color of the tubercles on the anterior segments; that of *columbia* is known to vary (see Ent. Am., ii, 18), and there seems little reason for doubt that the two forms are identical. I have seen large series of both *columbia* and *gloveri*, and yet hesitate to refer them as synonymous until new regions can be heard from, because I have not been able to fill the gap in the size of specimens, and also

because of the larval differences. All my *columbia* are smaller than any *gloveri* I have ever seen, but all my *columbia* are from Maine, where the species has undergone its greatest changes. The description of *gloveri* will be sufficient for this species also, and the larval differences will be more fully pointed out there.

**A. gloveri** Strk., Lep. Rhop. et Het. 1, p. 1, pl. 1, fig. 1 ♂, 2 ♀, Jan'y, 1872—(*Platysamia*); id., p. 128, pl. 14, fig. 8, aberr.; larva, Strk., Pr. Dav. Ac. Sci., ii, 276, 1878; Graef., Bkln. Bull., 1, 75 (cocoon).

Deep carmine or crimson brown, varying, however, in depth of color. Primaries with a broad outwardly curved white band, shaded on each side with black, near base; a similar broad white band, inwardly black margined, extends straight, or but little sinuate, across the outer third of wing. In the space included between these bands, at the end of the discal cell, is a lunate white spot margined with black, varying very greatly in size and form and sometimes almost obsolete. Beyond the outer band the wing is dull luteous gray to the fine black submarginal line, and beyond that the margin is still paler. For more than half its width this pale space is densely powdered with black scales, and in the interspaces outwardly are a series of large black spots of variable size and distinctness, sometimes obsolete. Crowning this series is a large, round, deep black, apical spot with a blue crescent, from which a zig-zag white line runs to an apical black mark. Within this line is the usual large, irregular, pale lilac patch. The outer narrow black line is very irregular and very variable, occasionally with but a single deep indentation, and again with a deep sinus in each interspace. One difference may be here noted between this species and *columbia* in the course of the outer transverse line—in this species it is straight or merely sinuate; in *columbia* it is outwardly curved and does not so accurately meet the corresponding line on the secondaries. The secondaries have the extreme base white, outwardly margined with black; at the end of the cell is a lunate white patch variable in size and shape, but always larger than that of the primaries. The space between the outer white band and the margin is very similar in color to that of the primaries; but there is an interrupted blackish band and a series of long spots within the fine dark sub-terminal line. Beneath, the maculation is a slightly fainter reproduction of the upper side, with the basal white band wanting. The primaries have 10 veins, the origin of 9 somewhat obscure, and apparently independent of but contiguous to 8, not far from its inception. The form of the genitalia is well given in the figures of plate xiv.

Expands  $4\frac{1}{2}$ , 5 inches. *Hab.*—Utah and Arizona.

Mr. Strecker describes the larva of this species in vol. ii, p. 277, of the Pr. Davenport Ac. N. Sci., and thus states the differences between it and allied forms:

“I would briefly state the difference between the larva of this and the three allied species, *columbia* S. I. Smith, *cecropia* L., and *ceanothi* Behr., which consists principally in the dorsal tubercles.

“*Columbia* has three pair of coral red ones, situated on the third, fourth, and fifth segments; the remaining six pair, as well as the single one of the last segment, are yellow. Lateral tubercles whitish.

“*Cecropia* has two pair of coral-red tubercles; these are on the third and fourth segments; the remaining dorsal ones are yellow as in the preceding. Lateral ones pale blue.

“*Gloveri* has the same tubercles in number and form as the two species above alluded to, but, as I have shown, these are all yellowish; lateral ones bluish white.

“*Ceanothi* has three pair of dorsal yellow tubercles. These are on the third, fourth, and fifth segments; the sixth segment has merely faint white raised spots in place of tubercles, and the remaining segments are without either tubercles or spots dorsally, with the exception of the twelfth, which has the usual single yellow tubercle. This species differs from all the others in the absence of dorsal tubercles on all the segments except the third, fourth, and fifth. It is also devoid of lateral tubercles, these being only represented on the third segment by white spots, and on the fourth to eighth by mere black points; the ninth, tenth, and eleventh segments are devoid of all spots whatever.

“Thus it will be seen that *gloveri* differs from *columbia* and *ceanothi* in having *all* the tubercles yellow, and from *ceanothi* in having dorsal and lateral tubercles on *all* segments (excepting, of course, the first and second), while the latter has these appendages only on the third, fourth, and fifth segments, besides the single one on the twelfth.”

It will be seen thus that the color of three of the pairs of dorsal tubercles makes the distinguishing feature of the larva, and must prevent the union of this species with *columbia* until further breeding has established the validity or invalidity of this character.

**A. ceanothi** Behr., Pr. Cal. Ac. N. Sci., 1, 47, 1855 (*Saturnia*); Strk., Lep., 1, 102, pl. xii, f. 2, 1875 (*Samia*); id., p. 120, 1876; Pr. Dav. Ac. Sci., ii, 277, 1878 (*Samia*); Morris Cat., p. 21, 1860; Wlk., C. B. M., xxxii, p. 525, 1865 (*Samia*); Hulst., Bkln. Bull. iv, 57 (hybrid of); Hy. Edw., Pr. Cal. Ac. Sc. (life hist. and food plants).

*californica* Grt., Pr. E. S. Ph., v, 229, 1865, note.

*euryalus* Bd., Ann. Soc. Ent. Fr., iii, 2d ser., xxxii, 1855; (not desc.) Pack., Pr. E. S. Ph., iii, 380, 1864 (*Samia euryalus*); Guide, 298, 1878 (6th ed.) (*Platysamia*).

Pale, somewhat rusty red brown, with a slight crimson tint, the vestiture of wings very thin, still further diluting the color and making it difficult of definition. The body vestiture is more brick red. **A** white collar and basal band on thorax. Primaries with the usual white bands, similar in shape to those of *gloveri*, except that the basal one is more angulated and is not inwardly black margined. Beyond the outer band the shade is a very light rosy crimson to the outer pale luteous-gray space. The outer fine dark line and the lilac patch and apical black spot are as usual. There are no black spots in the interspaces at

the margin of the pale space. The secondaries are as in *gloveri*, except that the colors are as in the corresponding parts of the primaries.

Expands 4-4 $\frac{3}{4}$  inches. *Hab.*, California.

In venation and genital structure this species corresponds closely with *gloveri*, so that indeed no differences are observable. The antennæ of the male are unusually large and disproportionate, and the wings are very thinly scaled, an effect heightened by the peculiar color of the insect. It seems not uncommon in California, and is further removed from *cecropia* than either of the other species of the same subgroup, though placed nearer to it in the synopsis.

**A. cecropia** Linn., S. N., ed. x, 496, No. 3 (*Bombyx*); ed. xii, ii, p. 809, No. 3, 1767 (*Attacus*); Mus. Lud. Ulr., 368 (*Attacus*); Gmel. ed. Linn., S. N., 2401, No. 3 (*Attacus*); Fabr., Syst. Ent., 575, 3; Sp. Ins., ii, 167, 3; Mant. Ins., ii, 108, 4; Ent. Syst., iii, 1, 408 (*Bombyx*); Oliv. Enc. Méth. Ins., v, 25, 5, pl. 69, f. 3 (*Bombyx*); Clerck., Icon. Ins., pl. 49, f. 1 (*Bombyx*); Cram., Pap. Ex., iv, 66, pl. 42, f. A. B (*Phalœna*); A. & S., Ins. Ga., pl. 45 (*Phalœna*), Dru., i, pl. 18, f. 2; Westw. ed., i, 32, pl. 18, f. 2 (*Saturnia*); Catesby, Carol., ii, 86, pl. 86; Hb. Verz. 156, No. 1630, 1816 (*Samia*); Wlk., C. B. M., v. 1224, 1855 (*Samia*); Fitch, 3d Rep., 363, 1856 (*Attacus*); Morris, Syn. Lep., 1862, p. 223 (*Attacus*); Duncan, Nat. Lib., 32, p. 132, pl. 11, 1852 (*Hyalophora*); Harr., Cat. Ins. Mass., 1835, 72 (*Attacus*); Rept. 1841, 279 (*Attacus*); Inj. Ins., Flint ed., 355, ff. 182 to 185 Sprague, Can. Ent., ii, 82; Minot, Can. Ent., ii, 100; Saund., Can. Ent. iii, 149, f. 31-33 (life hist.) Hulst., Bkln. Bull., iv, 54 (hybrid of); Brodie, Pap., ii, 32 (list of 49 food plants); Riley, 4th Rept., 103, ff. 33-36, 1872 (*Attacus*); Pack. Guide, 6th ed., 298, 1878 (*Platysamia*).

Few moths have been more often figured and described in one or more stages than this species, and I shall not add to the number here, but refer the student to Harris for a very accurate figure. The primaries have 10 veins, as shown in the figure, vein 9 having no distinct point of origin. It seems almost to arise from the membrane, and I cannot trace any distinct connection with 8. Genitalia differ in some slight particulars from those of the species heretofore described, but these differences I shall leave to be explained by the figures, and shall not waste words over them.

### SATURNIINÆ.

The *Saturniinae* differ at once from the *Attacinae* and are sharply separated from them by the closed discal cell on both wings. There is a peculiarity of habitus common to them all, and a distinct tendency to the other Bombycid families. The male antennæ are always pectinated to the tip as is usual, the joints each with two branches. The ♀♀ may have the antennæ either simple, serrate, singly pectinate, or, as in the *Attacinae*, similar to those of the ♂, but somewhat slighter; in some genera the upper branch of the joint is shorter than the lower, the pectinations still extending to the tip. The venation is very similar in the subfamily, ten being usual, and but one or two species having nine veins

only. This feature will be treated in detail under the different generic heads. The ♂ genitalia also differ somewhat, retaining usually the bilobed supra anal plate, but in some genera having it prolonged into a simple flattened hook. There is much more structural variation here than in the *Attacinae*, and less can be said under the general subfamily definition. There is a difficulty, too, in deciding as to the correct generic term for the species. Genera are here in abundance, but they have been created on superficial characters, and it is not certain but that some of the terms may have to be altered when a study of the exotic members of this subfamily enables the typical species to be properly placed. For the present I retain the names used in Mr. Grote's most recent list, and find myself reluctantly compelled to add a new generic term to the already long list.

The European genus *Saturnia* needs revision in the light of my views, and I think is too heterogeneous to be retained in its present form.

As separated by me the following table will serve to identify the genera:

Antennæ in both sexes pectinated to the tip, each joint with two branches to each side.	
Antennæ of the ♂ with the joints equal; female with the upper joint shorter than the lower.	
Secondaries tailed.....	ACTIAS.
Secondaries rounded.....	TELEA.
Antennæ with the joints equal in both sexes, that of the ♀ slighter....	SATURNIA.
Antennæ of the male equally bipectinate; of the ♀ with a single pectination to each joint.....	CALOSATURNIA.
Antennæ of the ♂ with upper branch shorter than the lower; of ♀ simple or serrate; primaries with acute tip and excavated outer margin; secondaries ocellated.....	HYPERCHIRIA.
Antennæ of ♂ with the upper branch shorter than the lower; of ♀ simple; primaries with outer margin obliquely rounded; secondaries not ocellated.	COLORADIA.

#### ACTIAS LEACH.

This genus is easily recognized by the greenish color of the species, as well as by the tailed secondaries. The primaries have ten veins, distributed as shown in the figure. Veins 7, 8, and 9 are from one stalk, vein 9 out of 8 just before the apex. The secondaries have 8 veins as usual, of which 1 to 4, inclusive, run into the tail, leaving a long marginal space between 4 and 5, while 1 to 4 are closely crowded. The head, body, and genital structure are shown at figs. 11 and 12 of plate xiii.

The supra anal plate here is bifurcate, the forks short and broad with acute tips. The side pieces are better shown in the figure than they can be described, and the structure of the body is also left to the figure for explanation. The antenna of the female is like that of the male except that the upper branch of each joint is shorter than the lower, making an alternate long and short branch.

The only North American species is—

**A. luna** Linn., Syst. Nat., ed. x, 496 No. 5 (*Bombyx*); ed. xii, ii, 810, 1767 (*Attacus*); ed. xiii (Gmel.), 2404, No. 5 (*Attacus*); Mus. L. U., 370 (*Attacus*); Clk., Icon., t. 52, f. 1 (*Phalana*); Fabr., Ent. Syst., iii, 1, p. 414, 1770 (*Bombyx*); Mant., Ins., ii, 109, 17 (*Bombyx*); Sp. Ins., ii, 170, 15 (*Bombyx*); Oliv., Enc. Méth., 5, 29, 20, 1825 (*Bombyx*); Cram., Pap. Ex., 1, t. 2, f. A, et 3, t. 31, f. A, B (*Attacus*); Pal. Beauv. Ins. Afr. et Am. Lep., pl. 22, f. 3 (*Phalana*); A. & S. Ins. Ga., p. 95, pl. 48, 1797 (*Phalana*); Hb., Saml., i, f. 153 (*Echidna caudata*); II, f. 382, 383, 384, 1806 (*Tropea*); Verz., p. 152, 1816 (*Tropea*); Leach., Zool. Misc., 2, 1815 (*Actias*); Dru. Ill., 1, pl. 24, f. 1, 1770; Westw., ed., p. 45, 1837 (*Actias*); Harris, Cat. Ins. Mass., 1835, 72 (*Attacus*); Rept. Ins. Mass., 1841, p. 277 (*Attacus*); Inj. Ins., iii ed., 382, f. 179, 180; Wlk., vi, 1260, 1855 (*Tropea*); Fitch, 3d Rep., 134, 1856 (*Actias*); Morr., Syn., 1862, p. 225 (*Attacus*); Pack. Pr. E. S. Ph., iii, 1864, 379 (*Tropea*); Minot, Can. Ent., ii, 27; Chamb., id. 43; Riley, 4th Rep., 1878, 123, f. 47, 48, 49.

var. **DICTYNNA** Wlk., C. B. M., vi, 1264 (*Tropea*).

**A**n easily distinguished and rather abundant species. The fore wings are of a variable shade of green, costal margin of primaries and a broad band on collar purple, fringes yellow and purple, the two colors variable in extent. Body white, antennæ yellow. A small vitreous spot at the end of the discal cell in each wing, margined with white, purple, green, and black.

Expands 3–5½ inches. *Hab.* Eastern and Central United States.

This species has also been figured innumerable times and is sufficiently well known to make description here unnecessary. The variety *dictynna*, according to Mr. Walker, differs as follows: "This species much resembles *T. luna*, but may be distinguished by the band on the wings, by the not empurpled exterior border, by the fore wings, which have a less oblique and more straight exterior border, and by the hind wings, which have shorter tails."

There are two annual broods of this insect in most sections of the country, and the midsummer brood is usually smaller, more yellowish, and has the wings more densely scaled.

#### TELEA Hb.

This genus is the close ally of *Antherea* and of *Saturnia*, as the term is used in Standinger. I am not at all certain that *Antherea* is not strictly synonymous with *Telea*, and am in doubt whether some of the European species of *Saturnia* are not referable here. The straightening out the perplexing generic synonymy in this group must be the work of the monographer of the whole family, and I simply point out the structures peculiar to our American species.

The primaries have ten veins; vein 7 and 8 from a long stalk out of the subcostal, and vein 9 also from the subcostal, very close to the inception of vein 8. There is thus an essential difference between this genus and *Actias*, in which vein 9 is from the same stalk with 7 and 8. The dorsal vein is furcate, rather an unusual feature in this group. The secondaries are, as usual, 8-veined, vein 7 very strongly curved.

Further details are best shown by a reference to the figure. The ♂ genitalia will be described in the reference to the species.

The only North American representative is—

**T. polyphemus** Cram., Pap. Ex., i, 8, pl. 5, f. A, B (*Phalæna*); Gmel. ed. Linn., S. N., p. 2402 (*Attacus*); Fabr., Sp. Ins., ii, 168, 5 (*Bombyx*); Mant., Ins., ii, 108, 6; Ent. Syst., iii, 1, 410, 8 (*Bombyx*); Oliv., Enc. Méth., v, 25, 7, pl. 69, f. 4 (*Bombyx*); Hb., Saml., ii, pl. 385, 386 (*Telea polypheme*); Verz., 154, 1610, 1816 (*Telea*); Wlk., C. B. M., v, 1226, 1855 (*Telea*); A. & S. Ins. Ga., 93, t. 47, 1794 (*Phalæna*); Harris, Cat. Ins. Mass., 1835, 72 (*Attacus*); Rept. Ins. Mass., 1841, 279 (*Attacus*); Inj. Ins., Flint ed., 383, 384, f. 181 (*Attacus*); Fitch, 3d Rept., 1856, p. 137 (*Hyalophora*); Morris, Syn., 1862, 226 (*Attacus*); Riley, 4th Rept., 1878, 125, f. 50, 51, 52, 53, 54 (*Attacus*); Brodie, Pap., ii, 58 (list of 29 food plants); Pack., Guide, 6th ed., p. 297, pl. 6 and 7, and f. 228, 229 (*Telea*).

var. *OCULEA* Nenm., Pap. iii, 71.

This species also needs no new description. It has appeared in almost all entomological reports and is known to the veriest tyro. Harris and Packard are accessible to all; to these works we refer the student. The antennæ of the ♀ of this species are like those of *Actias*. The genitalia of the ♂ are peculiar, and the supra anal plate shows in its modification a strong resemblance to the typical form of the next family—*CERATOCAMPIDÆ*. It is narrow, widening to the tip, and there modified into two distinct lobes. The side piece bears a three-pronged corneous clasper, which is figured on plate xiv, fig. 8. The structure is unique and very characteristic. Considerable has been written about the economic importance of this species, and as it is the nearest ally of forms that are made useful for sericulture in Japan and other eastern countries, this has more plausibility than what has been published of the other species of this family.

The species is found throughout the United States east of the Rocky Mountains, and in the southern portions of the country is double-brooded.

#### SATURNIA SCHRANK.

The genus *Saturnia* as here limited has but a single American representative, *S. galbina* Clem. In antennal structure it is peculiar by the long branches to the joints, those of the ♀ being only shorter and slighter than those of the ♂, while they are in both rather irregularly crossed and in the ♂ ciliate. Head much retracted, the palpi and tongue completely aborted, vestiture thin, long, and divergent. The body and abdomen are covered with similar long fine hair. The supra anal plate of the male has the typical structure of the group, the points diverging widely and terminating acutely. The figures on plate xiii will show the appearance.

Primaries with 10 veins, 5 and 6 from a stalk out of upper end of discal cell, 8 and 9 on a stalk out of 7, dividing near the apex. The cross-vein, closing discal cell, thin and straight. Secondaries 8-veined, the veins rather straight, but otherwise much as in the other members of the subfamily.

The only American species is—

*S. galbina* Clem., Pr. Ac. N. Sc., 1860, 156; Morris, Syn., 1862, 222; Wlk., C. B. M., suppl., 32, p. 530 (1865); Pack., Pr. E. Soc. Phil., iii, 383 (1864); Strk., Lep., 1, 104, pl. xii, f. 4 ♂ 5 ♀.

Smoky or blackish, both wings with a broad white margin, which is buff-shaded outwardly. Primaries with a basal, curved, white band and an oblique white band from near apex to inner margin; the subcostal and median veins are white between the white bands, and sometimes all the veins are more or less white marked. A light carmine dash extends from the outer white line on vein 7 to apex; above this, shading the line outwardly, is a black patch, marked with blue scales. At the end of the discal cell is a large black ocellus with a narrow vitreous center and rings of black, yellow, black, blue and black, the blue ring being usually on the inner portion only. Secondaries with an indefinite broad and white basal band and an outer more distinct white band, running parallel to the outer margin. An ocellus at end of cell, similar in all respects to that of primaries. Beneath with the outer margin, apex, and ocelli reproduced as above. Basal band obsolete, outer band a narrow waved white line. The specimens vary much as to amount of white in the wings—sometimes the color is mostly blackish and the markings are limited, while in other specimens the white invades the whole wing—especially the secondaries are occasionally white from outer band to base. The males as a rule are smaller and whiter than the females.

Expands 2.25–2.60 inches. *Hab.* Texas, Arizona.

Rather a rare species. The larva is unknown so far as I am aware, though the cocoon has been superficially described by Mr. Geo. D. Hulst in a communication to the Brooklyn Ent. Soc., published in proceedings of the society in "Entomologica Americana." It is readily known by its white and smoky black colors and the carmine dash at the apex. How it compares with the European species of *Saturnia* I cannot say at present.

#### CALOSATURNIA, n. gen.

Head very much retracted; eyes small, narrow, ovate; tongue and palpi entirely aborted; vestiture thin and divergent. Antennæ of ♂ with two branches to each side of each joint, as usual, the pectinations extending to the tip. In the female the antennæ are stout, shortly pectinated to the tip; a single branch only to each side of each joint. Body vestiture hairy, thin, divergent, the thorax comparatively short. Legs short and weak, the posterior pair shortest and weakest; no visible spurs to any pair of legs. Genitalia of ♂ very like those of *Saturnia*, save that the points of supra-anal plate are not so diverging and not so acute. The side pieces are essentially the same. Primaries with but nine veins, 5 and 6 together from the upper end of the cell; 7 and 8 on a long stalk from the subcostal. The venation of the secondaries is as in *Saturnia*.

As I have previously remarked, it is somewhat a question to what species the term *Saturnia* will eventually be restricted. I am inclined to believe that this genus will be found valid even after the fauna of other countries shall have been studied, and there will probably be other species referable to it.

*C. mendocino* Behrens. Can. Ent., x.

Dark smoky brown, with a somewhat rusty suffusion on primaries; secondaries deep brownish yellow; primaries darker toward base and along costa; along inner margin with long thick reddish hair; at apex a black spot, followed by a few blue scales and a deep red blotch of variable size and indefinite shape. Before the end of the discal cell is an oblong, transverse white mark, followed by a black ocellus ringed with the ground color, and inwardly marked also by blue scales. Secondaries with basal third black, but covered with long tawny hair, obscuring this color—a broad black band near outer margin. At the end of the cell an ocellus similar to that on primaries. Thorax dusky, clothed with deep red brown hair; a broad white band across collar; a deep red tuft at base of antennæ, which are deep orange. Abdomen smoky. Beneath, legs crimson; primaries with maculation reproduced, but the ground color much brighter, almost tawny or reddish luteous. Secondaries almost creamy gray over the ground color, faintly showing the maculation of the upper side.

Expands 1.75–2.75 inches. *Hab.* California.

Also rather an uncommon species with characteristics hard to be mistaken. The insect has a European character or habitus, and its nearest ally will probably be a European form. The male genitalia are very much as in *Saturnia*, and no special description is necessary. So far as I know, the early stages of this species are undescribed.

#### HYPERCHIRIA. Hb.

Head strongly retracted, small; palpi in ♂ distinct but hardly exceeding front; of ♀ almost entirely obsolete. The antennæ in the ♂ have the upper branch of the joints shorter than the lower, but closely applied to it, so that it is somewhat difficult to trace them in all cases. The ♀ antennæ are simple, or serrate, never pectinate in the species known to me. The thorax is short, thick, rounded, and woolly; the abdomen in the ♀ exceeds the secondaries and is obtuse and cylindrical. In the ♂ it is short and conic. The genitalia vary somewhat and are better described with the species. The venation differs essentially from all the preceding. The primaries have 10 veins, v. 5 from the cross-vein closing cell, nearer, however, to 6 than to 4. Vein 6 from the upper angle of cell, 7 and 8 on a stalk from the same point, 8 to the apex. The venation of the secondaries is variable and is described with each

species. The chief peculiarity in the venation of primaries is the inception of vein 5. A comparison of the figures on plate xiii will at once illustrate.

The legs are short, densely clothed with hair; the middle and hind tibia with short terminal spurs. The wings are short, stout, and rather broad, giving the insects rather a heavy appearance. Besides the characters enumerated, the species agree in typical maculation of secondaries. The disc is yellow, outwardly margined by a black line, at base usually more or less pink or reddish. The outer margin is somewhat variable in color, usually very near to that of primaries, and there is always a reddish or brown line or band through its center. In the yellow disc is a large black ocellus with a linear white pupil, and blue irrorations around it.

Four species are described from the United States. *Io*, the most common species, found everywhere in the Eastern United States, is readily distinguished from all its allies by the irregular subterminal line, which is as far from the apex as from the hind angle. The typical form is yellow, with the markings red brown, while the var. *lilith* is suffused with reddish, and in the ♀ the yellow is replaced by a ferruginous red.

The other species have the apex of primaries much more produced, and there is an excavation to the outer margin, making them slightly falcate.

*Zelleri* is the largest of the species, with smoky, luteous brown primaries in the ♀, the transverse anterior line irregular and distinct; the t. p. line is even, nearer to apex than to hind angle—a characteristic shared also by the following species, they having the line still closer to the apex:

*Pamina* and *zephyria* lack the t. a. line entirely, or it is very indistinct. In *pamina* the primaries are bright pale-clay yellow, the t. p. line dusky, with a yellow preceding shade; in *zephyria* the primaries are gray and the line is white, and more than usually oblique. The variety *aurosea* bears to *pamina* the same relation that the var. *lilith* does to *io*. It is the form with a reddish suffusion.

In tabular form, the scheme above set out appears as follows:

T. p. line irregular, wavy, as far from apex as from hind angle.	
Color ♂ primaries yellow, with deep red-brown markings; ♀ red brown, with yellow markings	.....IO.
With a reddish suffusion throughout; in ♀ the yellow of primaries replaced by ferruginous red	.....Var. LILITH.
T. p. line even, much nearer to apex than to hind margin, apex more produced.	
Primaries smoky, luteous brown, t. a. line irregular, distinct.	.....ZELLERI.
T. a. line wanting or very indistinct.	
Primaries bright pale-clay yellow, the transverse line dusky with a yellow preceding shade	.....PAMINA.
With a reddish suffusion throughout	.....Var. AUROSEA.
Primaries smoky gray, the transverse line white and more than usually oblique.	

ZEPHYRIA.

- H. io**, Fabr. Sp. Ins. 2, 173, No. 28; Mant. 2, 110, No. 36 (*Attacus*); Gmel. Ed. Linn. S. N. 2406, No. 477 (*Attacus*); A. & S. Ins. Ga., p. 97 t. 49 (*Phalœna*); Hb. Verz. 157 (*Hyperchiria*); Saml. III, pl. 17, f. 1-4 (*Hyperchiria*); Duncan Nat. Lib. 32, p. 156, pl. 16 (*Aglia*); Harris Cat. 1834, 184 (*Saturnia*); Rept. Ins. Mass. 1841, 284 (*Saturnia*); Inj. Ins. 393, f. 188 to 192 (*Saturnia*); Fitch 3d Rep. 1856, p. 61 (*Saturnia*); Morr. Syn. Lep. 220 (*Saturnia*); Tepper, Bkln. Bull. 1, 36.  
*Varia* Wlk. Cat. Lep. B. M. vi, p. 1278; Paek. Pr. E. S. Ph. III, 384; Beth. Can. Ent. II, 19; Strk., Lep. 138, pl. 15, f. 15 and 16.  
*var.* LILITH Strk. Lep. 139, pl. 15, f. 17.

So well known by figures in all the popular works on Entomology that further descriptions of color are useless. The larva is also well known, and is one of the "stinging" caterpillars, the hairs or spines being sufficiently poisonous to cause intense pain and considerable swelling if rudely placed on tender portions of the skin. The venation of primaries is as described. The secondaries have veins 2, 3, and 4 from the median vein, at about equal distances. A straight veinlet closes the cell, and 5 and 6 are from the same point at the upper angle. V. 7 is from the outer third of the subcostal. The genitalia are somewhat peculiar. The supra-anal plate is broad at base and suddenly narrows, ending in a sort of broad-pointed, spatulate tip. Beneath this is another corneous appendage, which is furcate but does not appear to be part of the plate. The figures will explain the appearance, and reference is made thereto to show the form of side piece as well. The variety does not differ in any respect from the type form except in the reddish suffusion. This does not seem to be a local characteristic, but I have received type and variety together and have taken the ♂ of one and the ♀ of the other in copulation.

- H. zelleri** G. & R., Tr. A. E. S., ii, 193, pl. ii, f. 65 ♀.

This species is unknown to me and is not in any collection I have ever seen. I doubt its being an American species, but rather think it comes over the border occasionally from Mexico. I reproduce the description of Grote & Robinson, but somewhat condensed.

Head and palpi rich dark brown; antennæ testaceous, a little slenderer than in allied species. Thoracic region above, dark brown; laterally at insertion of primaries are short whitish scales forming a spreading tuft. Abdomen above, bright ochreous brown, beneath thorax and legs rich brown, a little paler than upper side. Primaries, apices acute, but not produced. Basal third with rough or woolly dark brown scales, outwardly defined by a darker shade. These dark brown, rough squamæ extend along the costal region to the apex and intrude obliquely downwardly, twice over the middle of the wing; firstly, obliquely and broadly from the costa over the discal cross vein to the first m. nervule; this band is thrice regularly scalloped outwardly between the nervules, and includes a white discal dot on the cross vein situate just below the inception of the disco-cellular nervule; secondly, more narrowly and nearer the apices, the scales forming an even band extending downward to first median nervule at a point where the usual transverse line

crosses the nervule. This transverse line is narrow and distinct, whitish, and is rounded at costa, and joins the costal edge at a point considerably removed from apex. Ground color of median space, a frosted purplish brown, over which the dark costal scales downwardly intrude as above described. The dark scales extend again broadly and more diffusely downwards from the apex, bordering the transverse line externally, and irregularly widening over the median nervules to internal margin, and leaving the irregular terminal space of the wing a pale frosted purplish brown, over which the nervules are marked with ochreous.

Secondaries full and rounded. At base thickly clothed with long and very bright ochreous scales. A large black discal ocellus consisting of a broad blackish annulus surrounding a paler center, which contains a black pupil (the discal spot) containing a few white scales. Outside this ocelloid spot are two broad, subequal, even, blackish bands, the outer the broader, and which traverse the wing from costa to internal margin. The pale dull ground color of the wing separates these bands and obtains beyond the outer band, while the even narrow terminal space is concolorous with that on primaries, being purplish brown, frosted with pale scales, the nervules marked with ochreous.

Beneath of a clear pale purplish brown. On the primaries the discal mark is seen and a blackish shade band indicates the narrow transverse line of the upper surface. Secondaries concolorous with primaries; there is a distinct white discal spot on the cross vein and a faint oblique dark shade band. The ground color of the wings has something of a dead pink tinge beneath; this is especially noticeable on the secondaries below the median nervule. Expanse, 5 inches. No habitat given. This seems evidently a specimen with an erroneous locality, else it would probably have been found by subsequent collectors.

**H. pamina** Neum., Pap. ii, 60.

*var. AUROSEA* Neum., Pap. ii, 61.

Head, thorax, and primaries an olivaceous creamy gray; in the ♀ paler. Primaries subfalcate, somewhat darker at base, but lighter along the exterior margin. An evenly oblique yellow line, with brownish exterior border, from very near apex to the center of the interior margin. An irregular square discal blotch with dark dots at the intersections of the nerves. Secondaries with the discal space bright yellow, the black ocellus centered with white, surrounded by a few blue scales. The margins to this field are rosy, and this rosy margin forms the band through the terminal space. Abdomen above rosy, beneath pale drab. Beneath, primaries and secondaries fawn drab, the transverse line of primaries of a purplish rose tint, the interspace between this line and base being likewise of a lighter purplish rose, fading toward the costa. Discal spot conspicuous, black with white central spot. Secondaries with markings of upper side faintly reproduced. Expands 2.75—3.65 inches. *Hab.* Arizona,

The variety *aurosea*, as has been remarked, differs in the deeper more reddish shade of the ground color. The venation of primaries is as in *io* and the others of the genus. The secondaries have 2, 3, and 4 from the median at about equal distances; the cell is closed by a slender vein, drawn inward at center, and forming thus two waves; 5 and 6 are from the same point at the upper end of the cell, and 7 is from the subcostal near the end of the cell. The genitalia are peculiar, the supra-anal plate forked, the forks pointed and curved outwardly, and covering another pointed corneous plate. The side piece is peculiar in shape and difficult to describe in words. The figure must serve to make it clear.

The insect has been raised by Mr. J. Doll. I have seen the larva in Mr. Neumoegen's collection. So far as I know it has not yet been described.

**H. zephyria** Grt., Tr. Kans. Ac. Sci. viii, 147 (1882).

Primaries are even, soft, deep smoky gray, a distinct somewhat curved white line crossing obliquely from the middle of the inner margin to the apex. At the end of the cell is a rather large black ring with a more or less indistinct white center. At the extreme base of the wing is a narrow white line. Thorax and head concolorous with primaries. Secondaries pink at base, and there densely clothed with long fine hair. The outer margin is pale gray, sharply limited inwardly by a black line. A darker gray shade equidistant from this line and the margin. Disc of wing bright yellow, within which is a large black ocellus with a linear white pupil, marked with pale blue scales each side. Abdomen deep carmine red, the tip and under side mouse gray. Beneath, pale mouse gray, primaries with a large black discal spot with white center, secondaries with ocellus faintly reproduced. Expands 2.25-3 inches. *Hab.*, New Mexico.

The venation of primaries in this species is in all essentials like that of *io*. The secondaries differ from all the other species in that the cross vein closing the cell runs obliquely upward, making the cell pointed with v. 4 from the point.

This species is still very rare, and I have been unable to obtain specimens of which I could examine the genitalia as closely as I desired. The shape of the side piece I could make out, and that I figure at pl. xiv, f. 10; but the supra-anal plate I could not examine. This is perhaps the handsomest and most distinctly marked of all the species, and by its dark color and the oblique white band is not likely to be wrongly identified. Professor Snow has bred this species, but I have seen no description as yet of the larva.

#### COLORADIA BLAKE.

Antennæ of the male doubly pectinated to the tip, the upper branches not more than half the length of the lower; the female antennæ simple. Head small, very much retracted; body robust, densely clothed with

fine diverging hairs; abdomen exceeding the secondaries in both sexes. Male genitalia figured on plate xiv, fig. 11. The side piece is divided, and the supra anal plate is but slightly narrowed to the tip and there emarginate. Primaries with arcuate costa, pointed apices, and obliquely rounded outer margin. Veins 12; 5 from the cross-vein at end of cell nearer to 6 than to 4, 6 and 7 from one point at the upper end of cell, 8 from 7 half way to the apex. Secondaries *with two internal veins*; 5 from the upper end of the cell, 6 and 7 on a short stalk from the same point. The chief peculiarity of the genus is the possession of two internal veins to the secondaries, a characteristic unique in the North American representatives of the family. It shows plainly in habitus and structure a tendency to the other Bombycid families, though fully within the definition of the present family. There is only one species thus far known.

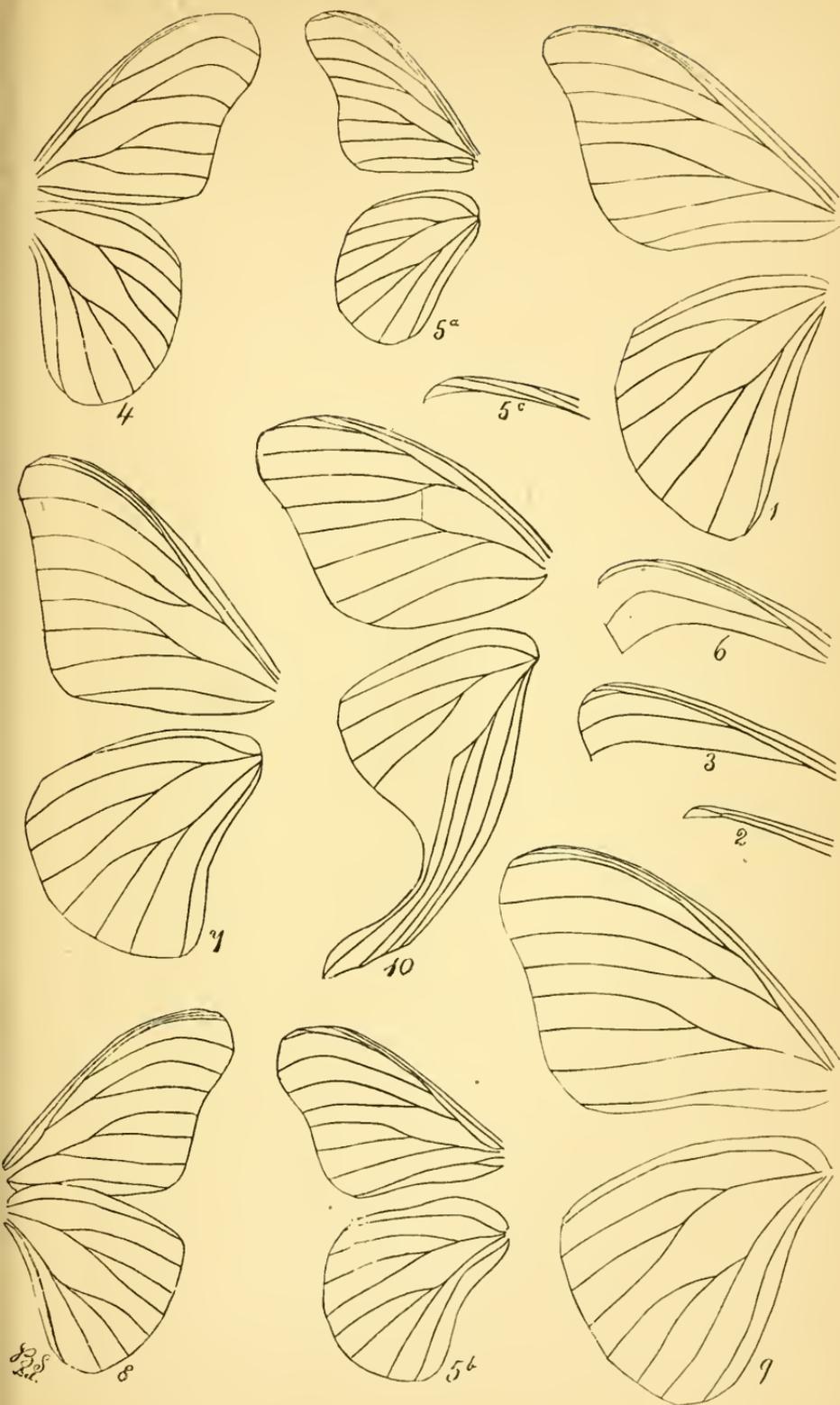
*C. pandora* Blake, Proc. Ent. Soc. Ph., ii, 279, pl. vii, ♀ (1863); Strk., Lep., 137, pl. xv, f. 7, ♂ (1877).

Blackish gray, powdered with white scales. Primaries with a broad, waved, and dentate black transverse line from base, and another broad, black, lunulate line about one-third from tip, running parallel to outer margin; the two lines rather closely approximate on inner margin. An irregularly dentate and somewhat diffuse whitish band from apex to hind angle, inwardly somewhat darker shaded. A small black discal spot. Palpi and tongue aborted; antennæ yellow; thorax black, vestiture with fine white hairs intermixed. Secondaries thinly scaled; deep pinkish hair at base and along inner margin, whitish to the dusky outer margin. Within this margin is a narrow, lunulate black band. A small black discal spot. Beneath dull grayish white, the maculation of upper surface faintly reproduced, the costa and disk with long pinkish hair. Abdomen black, with edges of segments and sides clothed with white hair.

Expands 2.50–3.25 inches. *Hab.* Colorado, Oregon, New Mexico.

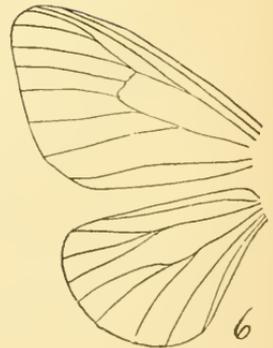
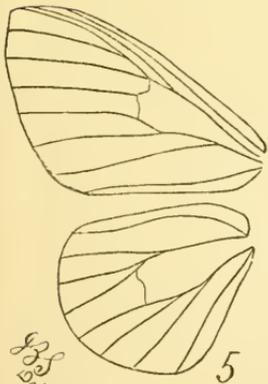
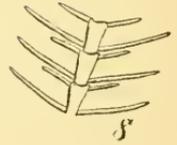
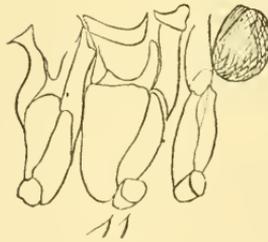
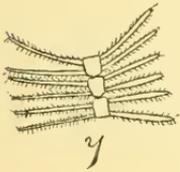
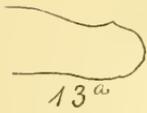
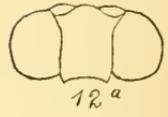
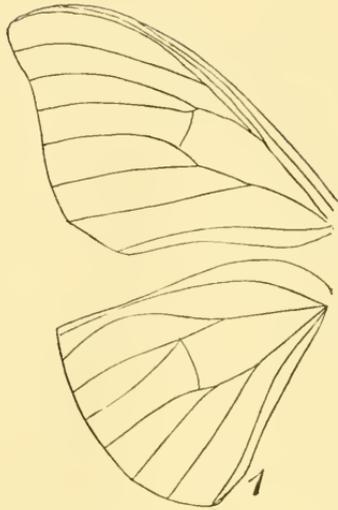
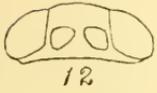
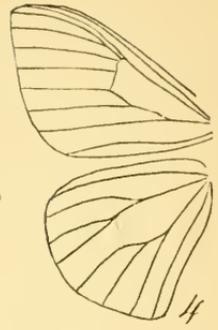
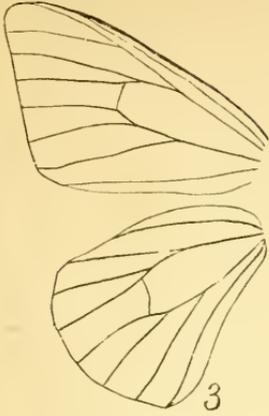
## EXPLANATION OF PLATE XII.

1. Venation of *Samia cynthia* (page 416).
2. Venation of *Attacus splendidus* (apex of primaries) (page 420).
3. Venation of *Attacus cinctus* (apex of primaries) (page 421).
4. Venation of *Attacus calleta* (page 423).
- 5a. Venation of *Attacus promethea* ♂ (page 423).
- 5b. Venation of *Attacus promethea* ♀ (page 423).
- 5c. Venation of *Attacus promethea* ♂ at tip of primaries.
6. Venation of *Attacus columbia* at tip of primaries (page 424).
7. Venation of *Attacus gloveri* (page 425).
8. Venation of *Attacus ceanothi* (page 426).
9. Venation of *Attacus cecropia* (page 427).
10. Venation of *Actias luna* (page 428).



## EXPLANATION OF PLATE XIII.

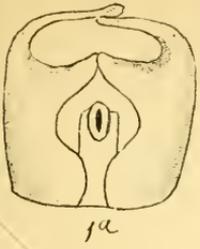
1. Venation of *Telea polyphemus* (page 429).
2. Venation of *Saturnia galbina* (page 431).
3. Venation of *Calosaturnia mendocino* (page 432).
4. Venation of *Hyperchiria io* (page 434).
5. Venation of *Hyperchiria pamina* (page 436).
6. Venation of *Coloradia pandora* (page 437).
7. Antenna of *Saturnia galbina* ♂ (page 431).
8. Antenna of *Telea polyphemus* ♀ (page 429).
9. Side view of thorax of *Samia cynthia* (page 416).
10. Dorsal view of thorax of *Samia cynthia* (page 416).
11. Side view of thorax of *Actias luna* (page 428).
12. Head of *Actias luna* (page 428).
13. Genitalia of ♂ of *Saturnia galbina*: *a*, side piece; *b*, supra-anal plate (page 430).



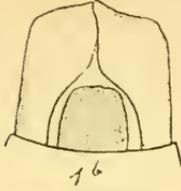
535  
54

## EXPLANATION OF PLATE XIV.

1. Genitalia of *Attacus splendidus* ♂: *a*, from below; *b*, from above; *c*, side piece detached; *d*, supra-anal plate (page 420).
2. Genitalia of *Attacus calleta* ♂: *a*, side piece from side; *b*, same from below; *c*, supra-anal plate (page 423).
3. Genitalia of *Attacus promethea* ♂: *a*, side piece from side; *b*, same from below; *c*, supra-anal plate (page 423).
4. Genitalia of *Attacus angulifera*: *a*, side piece from below; *b*, from side (page 424).
5. Genitalia of *Attacus ceanothi* ♂ (*glöveri* and *columbia* are exactly the same): *a*, side piece from side; *b*, from above; *c*, supra-anal plate (page 426).
6. Genitalia of *Attacus cecropia* ♂: *a*, side piece from above; *b*, same from side; *c*, supra-anal plate (page 427).
7. Genitalia of *Actias luna* ♂: *a*, from below, showing supra-anal plate and side piece; *b*, side piece from side (page 428).
8. Genitalia of *Telea polyphemus* ♂: *a*, half side view from above; *b*, side view (page 430).
9. Genitalia of *Hyperchiria io* ♂: *a*, side piece from side; *b*, supra-anal plate from side; *c*, same from above (page 434).
10. Genitalia of *Hyperchiria zephyria* ♂: *a*, from above; *b*, from below (page 436).
11. Genitalia of *Coloradia pandora* ♂: *a*, from above; *b*, from behind (page 437).
12. Head of *Samia cynthia* (page 416).



1a



1b



2a



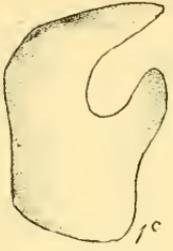
2b



2c



1d



1c



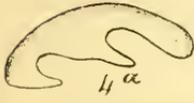
3a



3b



3c



4a



5a



6a



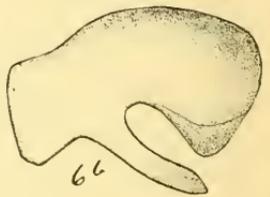
6c



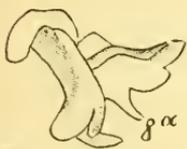
4b



5b



6b



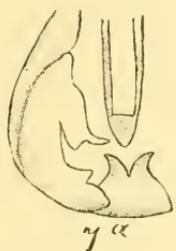
8a



5c



8b



7a



10a



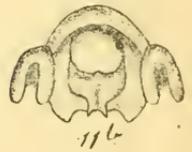
11a



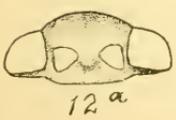
7b



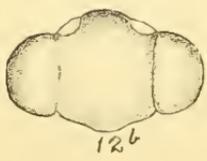
10b



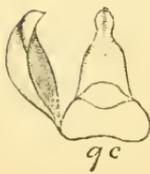
11b



12a



12b



9c



9b



9a