

XV. *Observations on the Structure of some Australian Lepidoptera Homoneura, including the Diagnoses of two new Families.* By A. JEFFERIS TURNER, M.D., F.E.S.

[Read October 5th, 1921.]

TEXT FIGURES 1-8.

THE order *Lepidoptera* is naturally divisible into two sub-orders of very unequal size, but separable by important anatomical characters. In the *Homoneura* or *Jugata* (1) the neururation of both wings is substantially the same: (2) a jugum is developed at the base of the dorsum of the fore-wings as the chief, or at least a most important part of the wing-coupling apparatus: (3) the spiral proboscis or tongue so characteristic of the *Lepidoptera* is never developed. In the *Heteroneura* or *Frenata* (1) the neururation of the hind-wings is reduced by the radial sector being unbranched (Comstock and Needham, p. 81), so that three veins (R3, R4, R5) normally present in the fore-wing are never developed: (2) there is no jugum, but the frenulum of the hind-wings articulates with a special apparatus consisting of a subdorsal retinaculum in both sexes, and in addition a subcostal retinaculum in the ♂ sex, except in groups in which these structures have been lost. By "lost" I mean that these groups can be inferred with considerable certainty to have descended from forms in which these structures were present: (3) A spiral proboscis or tongue is present except in groups in which it has been lost. The absence of a proboscis in the *Homoneura* I imagine to be primitive and correlated with the fact that the group came into existence before the evolution of flowering plants.

I do not doubt that other important anatomical differences might be pointed out, but these appear to me to be sufficient, and this primary division of the *Lepidoptera* is, I think, generally accepted. The names *Jugata* and *Frenata* we owe to Comstock (p. 325). (They are sometimes written *Jugatae* and *Frenatae*, but *Lepidoptera Jugatae* is, of course, an impossible combination.) *Jugata* is a sufficiently suitable term for the group that it represents, but the term *Frenata* is definitely misleading, as a frenulum is present in many *Jugata*, which are in fact, as Tillyard (A., p. 298) has shown, jugo-frenate. I therefore prefer to adopt the more accurate terms of *Homoneura* and

Heteroneura, which have been proposed by the latter author. It is an error to suppose that the jugum is a more primitive structure than the frenulum. Both occur in other orders of insects. A jugal lobe similar to that of the jugate *Lepidoptera* is present in some *Trichoptera* and *Megaloptera*, while a frenulum occurs among the *Mecoptera* and *Planipennia*, and the primitive wing-coupling apparatus, from which all these modifications appear to have developed, seems to have been jugo-frenate (Tillyard, A., p. 312).

Recently Comstock (*l. c.*) has proposed to remove the *Micropterygina* from the *Lepidoptera Jugata*, and to unite them with the *Trichoptera*. While acknowledging their many points of relationship to that order, which suggest a common and not very remote origin, I agree with Tillyard (B., p. 132) that they are true *Lepidoptera*, differing from the *Trichoptera* in (1) the absence of M4 as a separate vein in the fore-wing: (2) the absence of the characteristic trichopterous "wing-spot": (3) the wholly different tracheation of the pupal wings: and (4) in the broad, striated, lepidopterous scales; while in the points on which Comstock relies they are at least as closely allied to the *Hepialidae* as to the *Trichoptera*.

Chapman (p. 310) has proposed to separate the genus *Micropteryx* as a new order, the *Zeugloptera*, leaving the other European genera among the *Lepidoptera*, mainly on account of structural differences in the female genital tube. However important these may be, and I confess that I am not fully competent to weigh their importance, they appear to me quite insufficient to justify the formation of a new order, nor should they close our eyes to the essential similarity between *Micropteryx* and the other genera in so many respects.

Not so long ago only two families were recognised in the *Homoneura*, the *Micropterygidae* and *Hepialidae*. I think we may now recognise six or seven. These comprise the three subfamilies into which Meyrick has subdivided the former group, which are, I consider, fully entitled to be regarded as separate families, and, more closely allied to the *Hepialidae*, the *Prototheoridae* lately described by him, and two new families to be described in this paper. With these introductory remarks I will proceed to my own observations.

Sabatinca calliplaca Meyr. is found in tropical rain-forest on hills near the coast of Queensland over an extensive

area. I have taken it, sometimes abundantly, at Montville (1500 ft.) behind Nambour, on Mt. Tambourine (1800 ft.), on the McIntyre Range in the National Park (3000 ft.), and have received it from Kuranda (1000 ft.) behind Cairns. By denuding* the wings of a number of specimens I have been able to obtain the sketch of the neuration shown in Fig. 1. In parts the veins are very fine and indistinct, and in some examples not traceable, these I have indicated by single lines, but in all these

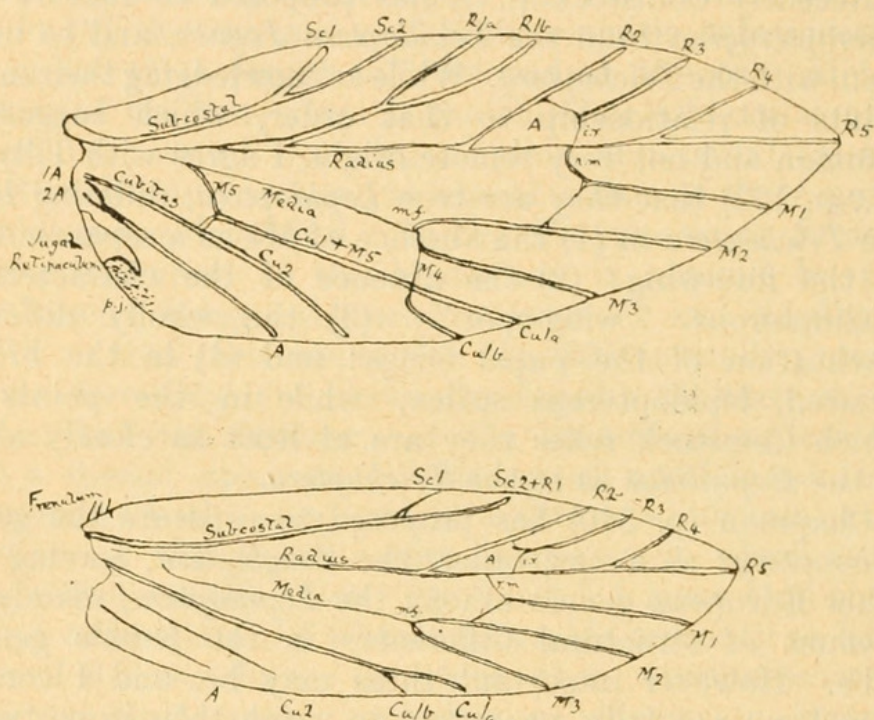


FIG. 1.—*Sabatinca calliplaca* Meyr. Fore- and Hind-wings.

instances the veins are visible in some examples under a low microscope objective. The veins indicated by a double contour are very distinct. The wing-coupling apparatus consists of a sharply deflexed jugal lobe (*v.*) at the base of the dorsum of the fore-wings, articulating with a group of bristles on the base of the costa of the hind-wings, which form a frenulum, as described by Tillyard. The dotted area in front of the jugum marks the position

* I have found chemically denuded preparations much more satisfactory than those prepared by mechanically removing the scales. The wings are dropped into spirit, transferred to Liq. Sodae Chlorinatae and immersed. At the right stage, which must be determined by careful watching with a lens, they are removed with a wooden paint-brush handle, and floated, not immersed, on water acidulated with acetic acid, from this coaxed on to a glass slide and dried.

of a group of strong hairs assisting in this articulation; I propose to call these the prejugal bristles (*p. j.*). In the fore-wing the humeral crossbar from the subcostal near its base to the costal margin, present in some species of *Sabatinca*, is not developed; the subcostal branches into Sc1 and Sc2, the first radial into R1a and R1b; the radial sector divides dichotomously; R5 runs to the apex of the wing; an inter-radial crossbar (*i. r.*) is present, completing the areole, which, as I have elsewhere insisted, is a primitive structure in the *Lepidoptera*. That the absence of a median cell is due to the absence of the intermediate crossbar consecutive to a distal position of the bifurcation of M1 and M2, is, I think, proved by Tillyard's figure (B., p. 106) of the pupal tracheation of the fore-wing of *Eriocrania*. It is a specialised form of reduction not, I think, found elsewhere among the *Lepidoptera*. The *Hepialidae* (Fig. 8) and several families of the *Heteroneura* like the *Cossidae* have in this instance preserved a more primitive structure. The media has three developed veins, together with a fourth (M4), which joins the cubitus at its bifurcation into Cula (really a conjoint vein Cula + M4) and Culb. Comstock (p. 314) regards this as a medio-cubital crossbar homologous with that found in the *Trichoptera*; but if the *Micropterygidae* are really lepidopterous, as I believe, it must be homologous with M4 as it occurs in the *Hepialidae* and *Heteroneura*. The basal connection of the media and cubitus by the posterior arculus, which Tillyard (B., p. 637) suggests may be a fifth branch of the media (M5), is very clearly developed. This is a primitive structure of which very little, if any, vestige remains in other groups of *Lepidoptera* in the neuration of the imago. The second branch of the cubitus is seen arising directly from its main stem. Unfortunately by most authors, including Comstock (*l. c.*), this branch together with the main cubital stem have been mistaken for the first anal. The first and second anals are represented by a short loop at the base of a conjoint vein. The third anal I have not been able to distinguish.

The neuration of the hind-wing is very similar to that of the fore-wing with some not unimportant differences due to reduction. The subcostal is branched, but R1 appears to be so completely absent that no trace remains to show what has become of it. The clue to its mode of disappearance is shown in a denuded example of *Sabatinca*

aurella Philpott, of which species I have dissected several examples kindly sent to me by Mr. A. Philpott. In this (Fig. 3) the termination of R1 is seen in some instances running into Sc2, in other examples it is wholly absent as in *calliplaca*. In *S. chrysargyra* Meyr. according to a figure by Tillyard (A., p. 117), which I have copied (Fig. 3), R1 is traceable throughout. It is therefore evident that in this genus R1 of the hind-wings is unbranched, that it runs into Sc2, and that its basal portion



FIG. 2.—*Sabatinca aurella* Philpott.
Part of Hind-wing.

is often obsolescent or obsolete. The remaining radial veins and the areole are exactly as in the fore-wings. The only difference in the median veins is the absence of M4. It is absent also in my examples of *aurella*. As M4 in these species is very feebly represented in the fore-wings, I do not think its absence in the hind-wings is an important character. The basal portion of the media is very feebly developed, and the posterior arcus cannot be traced.

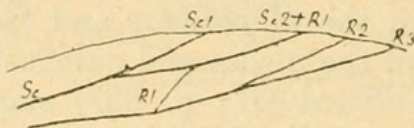


FIG. 3.—*Sabatinca chrysargyra* Meyr.
Part of Hind-wing (after Tillyard).

Cu2 and a solitary anal vein are very feebly developed, and their basal connections not discernible.

If we compare the neurulation of *S. calliplaca* with those of some of the larger New Zealand species as given by Meyrick (A.) and Tillyard (*l. c.*) we find, apart from the variations of R1 of the hind-wing already noted, that the former lacks the humeral bar in the fore-wing, and that there has been a reduction in the anal veins. Whether these differences are of generic value could be decided only by an exhaustive examination of the New Zealand species. For the present, at any rate, we must retain *calliplaca* in the genus.

I have found the study of the mouth-parts difficult.

The mandibles are easily seen in microscopical preparations, but I have not obtained any preparations showing satisfactorily the structure of the maxillae and labium. In Fig. 4 I have sketched the mandibles, the five-jointed maxillary palpi, and the very short three-jointed labial palpi, which bear some terminal bristles on the third segment. The antennae consist of short joints bearing

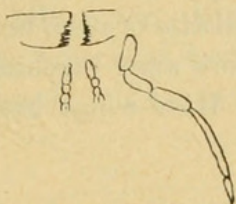


FIG. 4.—*Sabatinca calliplaca*. Mandibles, labial palpi, and one maxillary palpus in situ. (Semi-diagrammatic.)

numerous bristles, and are closely similar to those of *Micropteryx aruncella*. In *S. aurella* the joints are longer, but otherwise their structure is the same. These antennae are primitive, inasmuch as there is no differentiation between dorsal and ventral surfaces, the bristles occurring in complete whorls. There are no fine cilia, and there appears to be no differentiation between the sexes. The posterior tibiae have two pairs of spurs, but the middle tibiae are without spurs; both are finely spinose, and in both some of the spines are apical.

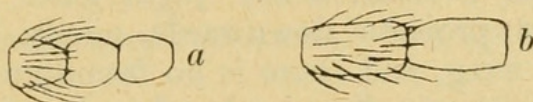


FIG. 5.—a, *Sabatinca calliplaca*. Antennal segments.
b, *Sabatinca aurella*. Antennal segments.

Sabatinca must be referred to the *Micropterygidae* (*sensu stricto*). It is more primitive than *Micropteryx* in the branching of R1 of the fore-wing, and of Sc of the hind-wing, but is specialised in the fusion of R1 of the hind-wing with Sc2 and partial or complete loss of its basal part.

I have a second species of *Sabatinca* from Queensland, which appears to have exactly the same neurulation as *calliplaca*. It is—

***Sabatinca sterops*, n. sp. (*στέγωψ*, flashing, dazzling).**

♂ ♀. 6-9 mm. Head ochreous. Antennae whitish-ochreous, with a dark-fuscous ring at about $\frac{1}{4}$. Thorax shining pale-yellow. Abdomen pale-grey, in ♂ ochreous tinged. Fore-wings narrowly elongate-oval; shining pale-yellow; three dark-fuscous dots on costa, near base, at $\frac{1}{5}$, and on middle; a similar smaller dot in middle of disc between first two costal-dots; a dark-fuscous streak from mid-dorsum obliquely outwards towards third costal dot, but not reaching beyond middle of disc, broad on dorsum; a round, shining, brassy blotch before apex reaching from costa to dorsum; cilia shining pale-yellow. Hind-wings broadly lanceolate; cilia 1; pale-grey; cilia pale-grey.

NORTH QUEENSLAND: Kuranda, near Cairns, in June, Innisfail in November; Mourilyan Harbour, near Innisfail, in July; six specimens.

While camped at an altitude of 3000 ft. in the Queensland National Park in the McIntyre Range, among luxuriant rain-forest, consisting of dense jungle with large numbers of tree-ferns, between Dec. 27th, 1920, and Jan. 3rd, 1921, I took a small moth, which promised to be of great interest. It appears to be of lethargic habit, and I did not see it on the wing. Four specimens in all were secured (one of these has since been dissected) by sweeping the foliage of certain ferns and climbers attached to tree-trunks, or by beating the long sprays of moss hanging from twigs. The neuration of this species, to which I give the generic name *Palaeoses*, is shown in Fig. 6. The fore-wing is provided with a small acute jugal lobe, which is not deflexed, but projects downwards nearly in the same plane as the wing, and there is no frenulum on the hind-wing. The wing-coupling is therefore jugate, and of the same structure as occurs in the *Hepialidae*. In the fore-wing the subcostal gives off a short humeral cross-bar to the costa near the base of the wing, and divides into Sc1 and Sc2, the former vein being very short. R1 is undivided, and the radial sector divides dichotomously, but its lower branches are deflected dorsad, so that R3, R4 and R5 run to the termen, while R2 reaches the costa shortly before the apex. In this it contrasts sharply with *Sabatinca* and with most *Lepidoptera* except the *Hepialidae*, in which the terminal ending of these veins is a usual character. There is no inter-radial, so that the areole is undeveloped. The media arises out of the cubitus, the bases of these

veins being fused for a considerable distance; and there is no trace of the posterior arculus. There is no median cell, but on the analogy of *Anomoses*, as will be shown presently, I assume that its absence is due to the loss of the upper primary branch of the media, not to the loss of the intermedian as in *Sabatinca*. The three median veins are well-developed, but there is no trace of M4, which should unite the media with Cula. As a consequence the lepidopterous cell is left open, but a spurious cell, very much resembling it, is bounded beneath by the media and its lower primary branch. The cubitus divides into Cula

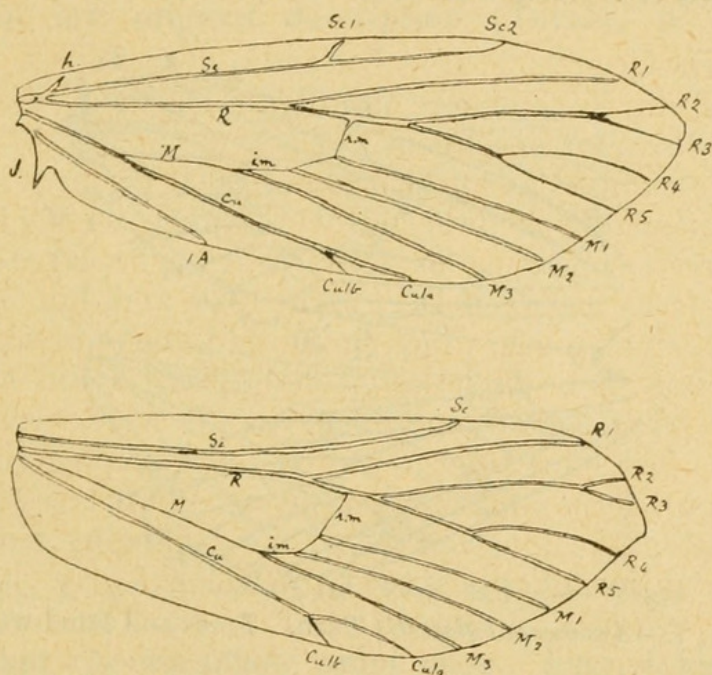


FIG. 6.—*Palaeoses scholastica* Turn. Fore- and Hind-wings.

and Culb very near its termination, the latter vein being short and weak, but there is no trace of Cu2. There is a solitary anal vein with no U-loop at its base. The neurotation of the hind-wing differs only in the absence of the humeral cross-bar, the absence of branching of the subcostal, and the absence of any anal vein, although the anal area of the wing is rather large. The structure of the antennae is of primitive undifferentiated type as in *Sabatinca*. Mandibles and maxillary palpi are absent, but the labial palpi are fairly large and covered with rather long hairs. Tibial spurs are absent as in the *Hepialidae*.

Before discussing the systemic position of this curious

form, it will be well first to consider the structure of *Anomoses* Turn. (p. 391). As this at present consists of a unique type, it cannot be dissected, but by careful denuding of the underside of the wings with a small brush moistened with spirit I have been able to make a trustworthy sketch of its neuration. A small pointed jugal lobe, not deflexed, is present as in *Palaeoses*. There are a large number of fine bristles or hairs from the costa of the hind-wing near its base which may represent a frenulum, and the same thing may be noted of *Palaeoses*, and is recorded by Meyrick (*l.c.*) in *Prototheora*. In neuration *Anomoses* has suffered less reduction, but shows

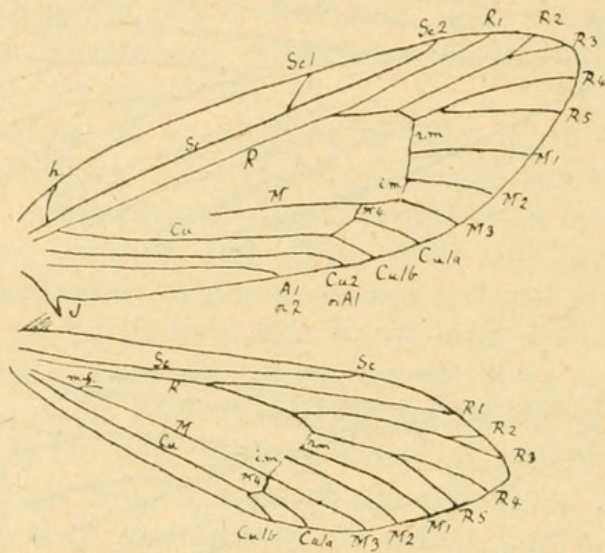


FIG. 7.—*Anomoses hyloecetis* Turn. Fore- and Hind-wings.

a structure from which that of the former genus may have been evolved. In the fore-wing the subcostal and radial veins show no difference, except that R3 ends just on the costal side of apex. The media is unbranched, and cannot be traced back far, but M4 is distinct and completes the lepidopterous cell. There are two internal veins, whose basal connections I have not been able to make out, and I am uncertain whether they represent Cu2 and A1, or A1 and A2. In the hind-wing M4 can again be distinctly seen. The media is most interesting, for the primary median fork (*m.f.*) has been preserved and is quite near the base of the wing; the upper branch of the media is obsolete except at its extreme base; if this had been completely lost the result would have been the condition observed in the fore-wing, and in both wings of

Palaeoses, and I believe it is in this way that they have evolved. I can detect no internal veins in the hind-wing, but as this part of the wing is very difficult to observe in my solitary example, I cannot say whether any are present or not.

In *Anomoses* the antennae, which are very short ($\frac{1}{4}$), are primitive with whorls of fine bristles. The labial palpi are rather long, and covered with long hairs. The posterior tibiae have two pairs of long spurs; the middle tibiae, which are densely scaled, have a pair of rather short terminal spurs. I can discover no mandibles, but it is impossible to say that they may not be concealed by hairs. In my original description (Turner, p. 391) I

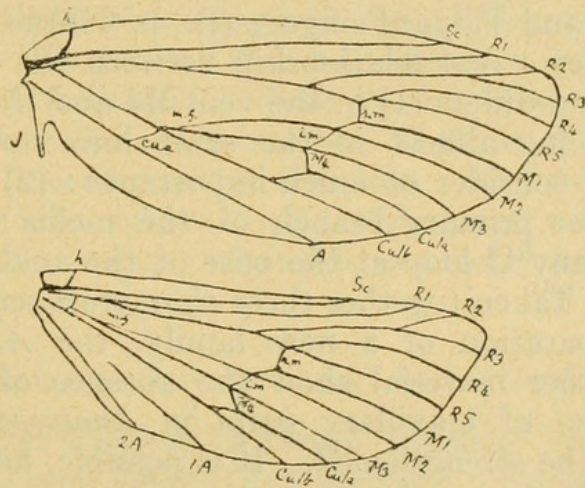


FIG. 8.—*Fraüs crocea* Luc. Fore- and Hind-Wings.

stated that the maxillary palpi were "long, folded." I can detect what may be not long, but rather short maxillary palpi concealed by hairs, but am not sure of their existence.

We are now in a position to discuss the affinities of *Anomoses* and *Palaeoses*. We will commence with the former. In spite of the presence of tibial spurs and the structure of the antennae, both Micropterygid characters, the neurulation shows that it has closer affinities with the *Hepialidae*. This may be understood by a comparison with the neurulation of *Fraüs crocea* Luc. (Fig. 8). No stress can be laid on the forking of the fore-wing subcostal, as this, though rare in the *Hepialidae*, occurs in *Sthenopsis* (Comstock, p. 329); nor on the absence of any forking of R1 in the fore-wing, as this vein is single in *Micropteryx*. The Hepialid characters are (1) the absence of the inter-radial and consequently of the areole: (2) the dorsad

deflection of the last two or three radial veins: (3) the basal forking of the media in the hind-wing: (4) the presence of an inter-median: (5) the fusion of the bases of the media and cubitus in the fore-wing (not indeed discernible in my example of *Anomoses*, but evident in *Palaeoses*), with the absence of the posterior arculus. That it cannot be included in the *Heptialidae* we may infer from (1) the absence of the characteristic angular junction of M4 and Cu 1a: (2) the obsolescence of the upper primary fork of the media: (3) the absence of the cross-bar between the cubital and anal veins (Cua) which appears to be constant in that family: (4) the presence of tibial spurs. It comes nearer to the *Prototheoridae* in which Cua is not developed, and tibial spurs are present. From Meyrick's description (B., p. 17) and Tillyard's figure (B., p. 648) of *Prototheora* we may infer a real relationship between the two genera, but *Anomoses* differs (1) in the vein M4 and the basal part of Cula being almost in the same line, not angled, a character I consider of much importance: (2) in the loss of the upper primary branch of the media: (3) in the absence of any U-loop at the base of the anal vein of the fore-wing. Taken together these characters seem sufficient for the separation of a new family, the *Anomosetidae*. Should further material show the absence of mandibles, possibly also of maxillary palpi in *Anomoses*, this conclusion will be strengthened. It is possible, however, that intermediate forms may be discovered compelling the merging of the two families. We may define the family as follows.

Fam. ANOMOSETIDAE, nov.

Mandibles absent?. Maxillary palpi present?. Labial palpi well-developed. Antennae very short, with whorls of bristles. Posterior tibiae with two pairs of spurs; middle tibiae with terminal spurs. Fore-wings with two internal veins, cell closed, internal vein of cell single, 2, 3, 4, 5, 6, separate, parallel, discocellulars not angled at origin of 3, no areole, 7 and 8 stalked and running to termen, 9 and 10 long-stalked, 11 not branched, 12 giving off a branch to costa, and with a humeral cross-bar near base. Hing-wings similar (? internal veins), but internal vein of cell with a basal fork indicated, 12 not branched and without humeral cross-bar. Wing-coupling by a non-deflexed jugum on base of dorsum of fore-wing.

With regard to *Palaeoses* the case is clearer. The much reduced neurulation and the absence of mandibles, maxillary palpi, and tibial spurs entitle it to family rank. These differences may indeed have been evolved from a form resembling *Anomoses* by a simple process of reduction, and I consequently regard the *Palaeosetidae* as derived from the *Anomosetidae*. It only remains to describe the new family, genus, and species.

Fam. PALAEOSETIDAE, nov.

Mandibles and maxillary palpi absent. Labial palpi well-developed. Antennae with whorls of bristles. Tibiae without spurs. Fore-wings with a single anal vein, 1 absent, 2 and 3 long-stalked, cell open between 3 and 4, internal vein of cell single, 4, 5, 6 separate and parallel, 7 and 8 stalked and running to termen, 9 and 10 long-stalked, 11 unbranched, 12 giving off a branch, and also with a humeral cross-bar near base. Hind-wings similar but without anal vein, subcostal not branched, and without humeral cross-bar. Wing-coupling effected by a non-deflexed jugum from base of dorsum of fore-wing.

Gen. PALAEOSES, nov. (*παλαιός*, ancient, *σής*, a moth).

Palpi moderate (about 1), porrect, expanded with long rough hairs towards apex, terminal joint concealed. Antennae very short (about $\frac{1}{6}$), similar in both sexes. Fore-wings with vein 9 to termen.

Palaeoses scholastica, n. sp. (*σχολαστικός*, sluggish).

♂ ♀. 14–18 mm. Head, palpi and thorax fuscous with some pale-ochreous irroration. Antennae fuscous, basal joints partly pale-ochreous. Abdomen fuscous; tuft large. Legs fuscous, irrorated, and tarsi annulated with pale ochreous. Fore-wings elongate-triangular, costa gently arched, apex round-pointed, termen long, bowed, oblique; fuscous, sparsely irrorated with pale-ochreous scales, more densely on dorsal and terminal margins; cilia fuscous, with indistinct pale-ochreous bars containing dark-fuscous points. Hind-wings subovate, rather narrow towards base, broadly expanded distally, apex round-pointed, termen rounded; cilia $\frac{1}{2}$; fuscous; cilia fuscous.

QUEENSLAND: National Park (3000 ft.) in December and January; three specimens.



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