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GENERA INSECTORUM

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DIPTERA

FAM. BLEPHAROCERIDÆ

By VERNON L. KELLOGG

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WITH 2 PLAIN PLATES

THE flies belonging to the family Blepharoceridæ, or net-winged midges, have long been of peculiar interest to entomologists because of the small number of known species and their supposed rarity, because of the wide and discontinuous distribution of these known forms, because of the remarkable aquatic life of larvæ and pupæ, and the strange modification of the body in both these stages in conformity with the curious habits, and because of the peculiar pseudo-net-veining of the wings of the imagines produced by a series of folds in the wing membranes. The imagines also present a structural peculiarity of interest in the divided character of the compound eyes. The eyes of these flies (as shown by the writer in 1900) are composed of ommatidia of two types, differing in size, in amount of pigmentation, and to some extent in arrangement of the retinal elements, and in their situation in the eye. These differences result in the possibility of a certain degree of accommodation to different intensities of light.

The Blepharoceridæ were introduced as a family by Rondani (*Prodr. Dipt.*, Vol. 1, 1856) under the name of *Asthenidæ*, without any definition. In 1862 (*Monogr. N. A. Dipt.*, Vol. 1, p. 6, 1862) the generic name *Æsthenia* Westwood having to be given up as preoccupied, Loew gave the family name of Blepharoceridæ. « He had no other choice for the name », says Osten-Sacken, « because the genus *Blepharicera* Macquart (or *Blepharocera*, as Loew amended it) was in 1862 the only published genus in the family. » *Liponeura* Loew (1844) was at that time considered by Loew as a synonym of *Blepharocera* and the genus *Tanyrhina*, from Ceylon, which he mentions at the same time with *Blepharocera* was merely a name without description. Osten-Sacken, in 1895 (« Contr. to the Study of the Liponeuridæ », *Berl. Ent. Zeitschr.*, Vol. 40, p. 148-169, 1895), gave the name Liponeuridæ to the family, but in a supplement to this paper (*Berl. Ent. Zeitschr.*, Vol. 40, p. 351-355, 1895), and even previous to that (*Ent. Monthly Mag.*, Vol. 31, p. 118, 1895), reestablished the name Blepharoceridæ. The first species descrided in the family

was *Blepharocera (Æsthenia) fasciata* Westwood, described in 1842 from a specimen taken in Albania on the Balkan peninsula. Macquart described the same species, in the *Ann. Soc. Ent. Fr.*, 1843, from a female specimen taken by Mr. Arnaud in 1841. The other few European species were discovered slowly, one at a time, as were also the few South and Central American species, and the single species recorded from Ceylon. In 1863 Osten-Sacken found the first North American species, *Blepharocera tenuipes*. Since that time the additional North American species have been found also slowly and one at a time until 1901, when four new species were discovered in one locality in California. There are known to-day twenty species of these curious flies, well distributed over the world. There are certainly other species to be found, but there are probably not many. The flies are too conspicuous and characteristic long to be overlooked in any locality visited by collectors. However, their favorite haunts are rather removed from the more usual collecting grounds of entomologists. Special search will have to be made in mountain regions, where clear, swift streams run over clean rock beds, if the still unknown living species of the family are to be discovered.

Family Characters. — The flies are moderate-sized, elongate and bare, with long legs and broad wings. These wings (pl. 2) contain no discal cell and have a peculiarly large and angular anal lobe. In some species there is apparent a strong iridescence of the wing surfaces, although in others these shifting colors are not so obvious. Alula, tegula and anti-tegula are absent or rudimentary. The unique character is the presence of the « secondary venation », or the net of rather faint, fine crease-like lines on the wings (pl. 1, fig. 7; pl. 2, fig. 19). This net-like lining has nothing in common with the primary or true venation, but is simply the result of the folding of the wings in the pupa. Because of the curious habits of life (spoken of in the latter paragraph on the biology of the insects) the wings must necessarily be fully developed at the moment that the imago issues from the pupa. But that these fully developed wings may be accomodated underneath the pupal cuticle it is necessary that they be strongly and repeatedly folded. The lines of these foldings constitute the so-called « secondary venation » characteristic of the imaginal wings. The eyes are usually dichoptic in both sexes, but are occasionally holyptic in one or both sexes. They are usually bi-sected by an unfaceted cross-band or line separating each eye into two fields, an upper and lower one, the upper composed of larger and less pigmented ommatidia (large and brown facets), the lower composed of smaller and more strongly pigmented ommatidia (small black facets) (pl. 1, figs. 1, 2, 3, 4 and 12). In a few species the eyes are bi-sected only in one sex. Three rather large ocelli are present. The antennæ (pl. 2, figs. 16 and 17) are slender, with from nine to fifteen segments clothed with a short pubescence. The mouth parts (pl. 1, fig. 13) are elongate, the females having in addition to labium and maxillæ, slender flattened elongate saw-like mandibles; the males are without these mandibles. Both sexes have a slender elongate labrum-epipharynx, a similarly slender elongate hypopharynx, a pair of slender blade-like maxillar with five-segmented palpi, and labium with slender elongate basal sclerite and a pair of free, fleshy, terminal lobes without pseudo-tracheæ and with no palpi. The thorax has a distinct, broadly interrupted, transverse suture. The legs are moderately slender and comparatively long, the hind pair much longer than the anterior ones, the front femora of the males curved in some species, the tibiæ with or without spurs, the ungues generally somewhat incrassate at the base, sometimes beset with stiff, minute bristles on the outside; the empodia very small, almost rudimentary, and the pulvilli wanting. The forceps of the male (pl. 2, fig. 15) are somewhat like those in Limnobina, but are flatter, with various modifications; the ovipositor of the females (pl. 2, fig. 14) is composed of two small, rather obtuse, lamellæ.

Biology and Habits. — The eggs and egg-laying of the Blepharoceridæ are yet unknown. However, from the circumstances of the larval life it is nearly certain that the eggs are deposited on sprayed or otherwise wetted stones just above the water in swift, clear mountain streams, or on wetted

stones at the water's edge. The larvæ and pupæ of one European species, one Brazilian species and one North American species, are known. The larvæ of all Blepharoceridæ yet known live submerged in swiftly running clear streams, which practically limits their occurence to mountainous, or at least, to hilly regions. They are found usually in groups of lesser or greater number in favorable spots, sometimes, as in the case of *Blepharocera tenuipes,* in Coy Glen, near Ithaca, N. Y., forming « patches » of hundreds of individuals clinging to the smooth rock bed of the stream, with from an inch to two inches of water running swiftly over them. In Colorado and California the larvæ of Bibiocephala and of Blepharocera have been found more scattered, and usually more deeply submerged; this is usually caused, or at least the other condition made impossible, by the broken condition of the stream beds, which are usually composed of separate stones of various sizes rather than of smooth bed rock. The larvæ (pl. 1, f. 5, 6, 8 and 9) are curious, flattened, slug-like creatures, legless, but enabled to cling firmly to the rock by means of six ventral suckers (whose structure and mode of use are described by Kellogg, *Proc. Calif. Acad. Science*, ser. 3, vol. 3, p. 203, ff., 1903). When disturbed, the larvæ can hold so fast to the rock that the body is more readily torn in two than dislodged as a whole. Locomotion, which, though slow, is freely accomplished, is in a lateral direction; the moving larva loosens the hold of three suckers at a time and swings to one side the hinder half of the body thus released, the suckers again attach this part of the body in its new position, and the other half of the body is loosened and swung over, and thus a slow lateral translation of the larva takes place.

The larvæ seem to feed chiefly on diatoms, although other food is doubtless taken. The older larvæ of *Blepharocera tenuipes* (New York) almost always bear a dorsal, felt-like covering, which is composed of a close growth of diatoms. The most abundant diatom in this group was one of the stalked Gomphonema. The basis of the covering is the gelatinous mass at the base of the stalked diatoms. Scattered upon and through this mass were individuals of Nitzschia, and several olher diatomaceous genera. An examination of the alimentary canal of *Blepharocera tenuipes* larvæ always reveals scores or hundreds of the siliceous tests of the diatoms. In the Colorado and California larvæ of the various Bibliocephala species and of *Blepharocera jordani*, the dorsal covering of diatoms is rather uncommon though not infrequently to be seen.

The larvæ cannot live in stagnant or even quiet or slow running water. Indeed if, in the falling of the stream, larvæ get stranded in a suddenly made pool or still, quiet-water part of the stream, they soon die. They must have the highly ærated, swift water of the stream's center. They like the lip of a fall, the rocks of cascades, and the sides of a pot-hole in which the water is ever whirling and boiling. They can live therefore only in clear, swiftly running streams with a rapid fall, and this practically limits these insects to mountain regions.

The pupæ (pl. 1, f. 10 and 11) are found in the same places as the larvæ; that is, the larvæ, when ready to pupate, do little more than arrange themselves, almost always in small or large groups, with heads pointing down-stream, and there make the last larval molt. Each pupa is fastened to the rocks by six pads, three on each lateral margin of the ventral aspect of the abdomen; these pads are not like the suckers of the larva whose hold can be voluntarily loosened, but they permanently attach the pupa to one spot. The pupa is even more extraordinarily shaped than the larva. It is strongly convex above, with a dark brown or black, heavily chitinized body-wall, and is perfectly flat on its ventral aspect, which lies smoothly against the rock. The wings and legs lie folded on the ventral aspect, which is covered only by a thin colorless pupal cuticula. From the prothorax projects dorsally a pair of respiratory organs, each composed of four thin, double-walled plates, the outer plates of each set being strongly chitinized, and acting as protecting covers for the two delicate membranous inner ones (the whole arrangement like a two-leaved book, with board covers).

Of absorbing interest to the observer is the course of emergence of the adult from its submerged,

fixed pupal case. Professor Comstock seems to have been the first to watch the process carefully, and he describes it as follows :

« Each midge on emerging forced its way out through a transverse rent between the thorax and abdomen. It then worked its body out slowly, and in spite of the swift current held it vertical. The water covering the patch of pupæ varied from one-fourth to one-half inch in depth. In the shallower parts the adult had trouble in working its way to the surface, still clinging to the pupa-skin by its very long hind legs. While still anchored by its legs, the midge rests on the surface of the water for one or two seconds and unfolds its wings; then freeing its legs it takes flight. The adults emerging from the deeper water were swept away by the current before they had a chance to take wing. The time required for a midge to work its way out of the pupa-skin varied from three to five minutes. »

As is obvious, the whole process of emergence and escape into free air must be a quick one. Usually with insects it takes some time for the proper expansion of the wings, which are, in the pupa, neither wider nor longer than the pupal wing-cases, but attain their full size only after withdrawal from these cases. But in the Blepharocerid there is no time for that; the slender legs cannot hold long against the beating of the swift water, and so the remarkable condition of a full development and expansion of the wings in the pupa obtains in this family. The fully developed wings lie in the pupal case folded both longitudinally and transversely, and only need to unfold to be ready to carry the fly into the safe air. It is this folding which produces the secondary veining of the wings characteristic of the family, this veining being simply the persisting creases and lines of the folding.

The writer has often watched the emergence of adults, and has been struck by the great loss (apparently) of life in the process. So many flies are swept away by the swift water before the wings can be unfolded or before the legs can be loosened from the pupal sheath, that it seems no wonder that the family is a disappearing one. It is a case of the dangers of an extreme specialization. If the fixed pupæ lie in water too deep (easily occasioned by a sudden rise in the stream at the time for emergence), or on the other hand, become wholly bereft of the life-giving water by a falling of the stream, there is no hope for the fly. The first contingency seems indeed to be somewhat provided for by the apparent power of the insect of postponing for some time, if necessary, its emergence. Thus, in the event of a heavy rain and consequent rise of the stream, the too deeply submerged pupa may lie unchanged until the water has run off (a matter which happens speedily in swift streams) to a safe shallowness.

The fully developed flies have been found numerously in the case of but few species. The flies of *Blepharocera tenuipes* are found abundantly along certain small streams near Ithaca, N. Y., U. S. A. The flies at rest cling by their long legs to the under sides of leaves on the bank from the water's edge to eight or ten feet away. Of the hundreds of flies which were seen here in two or three visits all were females; and they were engaged busily in feeding. This was accomplished by capturing on the wing small Chironomid midges, and then returning to a leaf, where the unfortunate prey was lacerated by the long, strong, saw-like mandibles, and the blood and body-juices drunk. The empty torn skin of the prey was then dropped. As the males do not have mandibles, they must have a wholly different food habit (probably non-predatory) and this may account for the absence of males from this feeding-ground. The flight is rather slow and weak, a sort of timid fluttering. The flies of *Bibiocephala elegantulus* were found by Kellogg to be numerous along the Big Thompson river, in the Rocky Mountains of Colorado, U. S. A. The flies spent most of their time at rest on the vertical sides of the boulders from a few inches to two feet above the water surface, but always where the rock face was frequently wetted by the spray of the dashing water. The flies rested with legs and wings outstretched and body close to the rock. The wings touched the rock face and, indeed, the attitude seemed to be adapted to bring as much of the body as possible into contact with the wet, smooth face of the rock, as if to resist, by increased friction, the tendency of the fly to slide down the vertical surface. None of these flies was seen feeding,

mating or egg-laying, although many hours were spent in watching them. They were most numerous on bright, sunshiny days; on cloudy days the favorite rocks were often entirely deserted. The flight is poor and numerous flies were caught readly in the hands.

Schnuse found the flies of both sexes of *Apistomia elegans* on composite flowers, sucking! But the females were probably hunting small insects, not nectar or pollen. Scherfling and Bezzi have described some of the habits of *Hapalotherix lugubris* found on the southern slopes of the Alps in North Italy. Males were seen flying in and out of the foam of a falls at the tongue of a glacier; no females were with them. As soon as the shadow of the mountains reached the falls the flies dissappeared. When at rest the flies sit on stones and cliff walls near the stream with half opened wings and raised hind body. Females appeared to be in much smaller numbers than males. Various mating pairs resting on the water were washed by the waves on to the banks and often drowned. Several species of Hilara were found associated in flight with Hapalothrix individuals and served as prey for them. Hapalothrix was found flying from the end of May to the end of August, depending somewhat on the altitude.

For a satisfactory discussion of the feeding habits of these flies a knowledge of the anatomy of the mouth parts is indispensable. The females of Blepharocera, like the females of Simulium, Ceratopogon Dixa, Culex, and some other Nematocera, are bloodsucking, and while the mouth parts of these forms are not strictly of biting type the mandibles are present as cutting or sawing or piercing organs. The males of these forms are nectar-feeding, and have lost the mandibles. In the mouth parts (pl. 1, f. 13) of the female Blepharocera all of the parts of the typical biting mouth are present, namely, the mandibles, maxillæ and labium. The mandibles are long and serrate on their inner edges so as to be effective lacerating instruments. The maxillæ are elongate and blade-like, and have 4-segmented palpi. The labium is, though somewhat elongated, truly lip-like, and has its terminal lobes not coalesced and without pseudo-tracheæ. The hypopharynx is not short and tongue-like, as in the orthopterous mouth, but is long and slender and stylet-like. Altogether the difference between the mouth parts of Blepharocera and the typical biting type is one of modification, and of modification not sufficient to obscure the homologies, although a modification more profound than that shown by the most generalized Lepidoptera or Hymenoptera. On the other hand, there is not much difficulty in tracing the development of the dipterous mouth from the generalized condition of Blepharocera (or Simulium, or Dixa, *et al.*) to that extraordinary specialized condition shown by Musca, where the mandibles and maxillæ are lost, and the labium is so modified that it has no longer any likeness to the lower lip of the orthopterous mouth.

With regard to the curious condition of the eyes of the adult Blepharocerids, the following is taken from the account in the *Entomological News* (Kellogg, 1900) of the eyes of *Blepharocera capitata* :

« A specially interesting point in the imaginal anatomy of Blepharocera is the structural condition of the compound eyes. It has long been observed that several flies (Simulium, Tabanus, *et al.*) and certain other insects (Libellulidæ, Ascalaphus, Ephemeridæ, *et al.*) have two sizes of facets in each compound eye; and that some have the field containing these differently sized facets well delimited, the fields being in some cases actually separated from each other by a non-facetted line or by a constriction. When this constriction is so complete that the eye is truly divided, it may fairly be said that there are two pairs of compound eyes, the two eyes of each lateral pair differing in the size of the facets. This last extreme condition exists in the case of the males of certain Ephemeridæ and in both males and females of Blepharocera capitata. (And in almost all other Blepharocerid species.)

» The eyes of Blepharocera are plainly divided; or it may be said that there are two on each side (pl. 1, f. 12). One of these eyes is dark-colored, has small facets, and faces ventrally, anteriorly and laterally. It is fairly convex. The other is reddish brown, is composed of much larger facets, faces dorsally, and has a nearly flat surface. This red, large-facetted dorsal eye has the appearance of a flattened mushroom head, or thick plate, resting above the other eye. In the males, the dorsal, large-

facetted eye is much smaller and less conspicuous than in the female, but both parts of the eye (or both eyes) are plainly present. This difference in the two parts of the eye is more radical, however, than can be discovered by a mere examination from without. The ommatidia, or eye elements, of each of the regions differ, as shown by sections, in several particulars. Corresponding with the difference in size of the facets (the corneal lenses of the ommatidia), there is a marked difference in the diameter of the ommatidia from the two regions. The ommatidia of the dorsal, large-facetted eye are nearly twice as wide, and they are fully twice as long, as the ommatidia of the small facetted eye. Another striking and important difference is that the larger ommatidia are very much less strongly pigmented than the smaller ommatidia. There are, also, some differences in the character of the inner optic « layers » lying between the hypodermal portion of the eye and the brain ; characters too technical for discussion here. In sum, however, it is evident that there is so marked a difference in structure between the two eye regions that there must be a difference in exercise of the function. The seeing by one of the eye regions differs from the seeing by the other eye region.

» In brief discussion elsewhere of the « divided eyes of Arthropods » (Kellogg, *Zool. Anzeig.* 1898) reference has been made to the observations of Chun (*Bibliotheca Zool.*, 1896). who has described the structure of the divided eyes of certain pelagic crustaceans, and to the observations of Zimmer (*Zeitschr. f. wiss. Zool.*, Bd. 63, p. 236-262, 1898), who has studied the divided eyes of certain male May-flies. In both of these cases the eyes show two sizes of facets, and accompanying this are both those other structural difference which are apparent in Blepharocera viz., the large ommatidia and small amount of pigment of the large-facetted eyes as compared with the small ommatidia and heavy pigmenting of the small-faceted eyes. Here are three groups of Arthropods, viz., certain crustaceans, certain May-flies, and the Blepharoceridæ, widely separated genetically and of widely varying habits, showing a common structural modification of the eyes. We have evidently to do with independent adaptations determined by some common functional need.

» The large size of the ommatidia and the small amount of pigment are characters which adapt the large-facetted eyes for seeing in poor light (in the dark) and for readily perceiving moving objects (delicate perception of shadows). The normal, small-facetted eyes see more accurately the actual shape of visible objects; they have better definition, but require much light. Chun explains that the large-facetted eyes of the pelagic crustacea enable them to perceive their prey (for the crustacea possessing these eyes are all predaceous) in the poorly lighted levels of the water. The large facetted eyes of the male May-flies enable them, according to Zimmer's explanation, to perceive the advancing female during the twilight marriage flight peculiar to these forms. What is the special use of the large-facetted eyes in the case of Blepharocera ?

» The females are predaceous; they capture other smaller live insects, and, lacerating them with the saw-edge mandibles and blade-like maxillæ, lap their blood. The males, on the other hand, presumably, do not capture insects; they have no mandibles, and are probably nectar-feeding. The female might advantageously be possessed of a number of those large, weakly pigmented eye elements which are specially adapted to the quick perception of moving objects. But what makes this explanation less convincing is the fact that the males also possess these large-facetted ommatidia, although, to be sure, in fewer number. Perhaps both males and females are active in twilight. Search as carefully as one might, never but very few of the adult Blepharocera could be found along the stream, from which they were certainly issuing by thousands. Until the habits of our fly are better known, then, it is hardly profitable to speculate on the special use of its large-facetted eyes ».

Distribution. — All the six species of Blepharoceridæ so far found in Europe occur in Italy or adjoining islands; but most of them occur also elsewhere in southern or central Europe. Of the eleven

North American species one is found in the eastern (Allegheny) mountains, two in the middle (Rocky) mountains and six in the western (Sierra Nevada and Coast Range) mountains and two in the West Indies or Mexico. Beside the North American and European species, two species are found in Brazil and one in Ceylon.

The Blepharoceridæ are too unfamiliar to allow us to make any generalizations yet regarding their distribution. Although so few species are known, three continents are included in the range of the family. These conditions suggest that we have to do with a family probably formerly including numerous species scattered over the world, but now dying out, a species persisting here and there through the wide range. These persisting species agree remarkably in the habits of the immature stages, and indicate in just what kind of habitat we should look for other members of the family in regions from which as yet no Blepharoceridæ are recorded. The great loss of larvæ and pupæ by the drying up or contamination of streams and the enormous loss of the issuing flies carried away by the current at the time of emergence from the pupa are evidently factors in the peculiar life of these insects tending to prevent them from holding their own. The larvæ and pupæ live shallowly submerged only in swiftly running, clear, fresh water; such conditions are provided by all, or nearly all, mountain or hill brooks and hardly anywhere else. As the known species extend from the Equator to sub Arctic latitudes, temperature or climate offer probably no barriers, nor probably does altitude, the North American species alone ranging from nearly sea-level to 8000 feet above sea-level.

Desiderata. — There must be several living species of this family yet to be found. In a single summer's attention to the streams in the low mountains near Stanford University, California, the writer was able to add as many species to the North American fauna as had been known before from the whole country. Wherever there are mountains or hills with swift, clear streams one can almost assert that Blepharoceridæ will be found. In America the streams of the Ozarks, the Georgia hills, the Tennessee and North Carolina mountains, the Cascades and Olympics of Puget Sound regions, the Rockies of New Mexico and Arizona and the mountains of Southern California should all be examined. Wherever in the world explorers or collectors are penetrating into mountain regions these insects should be looked for along the streams and cascades.

With additional species and a widened distribution of old forms known, classification can be revised and more satisfactorily founded.

The life-history of no Blepharoceridæ is fully known; the first eggs of any species are yet to be found; the food habits of the males are unknown; a host of observations on the habits are to be made.

No one has studied the « secondary venation », the creasing of the wings. Are these lines of folding uniform in the species, genus, family? Are there classificatory characters to be derived from them? What is the significance of the little chitinous thickening or knot in the re-entrant angle of the anal margin of the wing?

Do the well-developed and plainly differing external genitalia, especially those of males, offer characters which can be used in classification? This is practically certain, but as yet no one has even attempted their use.

Classification. — The nine genera are readily separable into two principal groups on the basis of a venational character. The characters drawn from the veins and eyes are chiefly depended on to distinguish the genera.

TABLE OF GENERA

No incomplete vein near the posterior margin of the wings (= an incomplete media$_3$ lacking).

Eyes bi-sected by an unfacetted cross-band or line into a dorsal brownish region of larger facets and a lower black region of smaller facets.

A longitudinal vein between the first and fourth veins (= radial vein at least two-branched) . . . . . 1. Genus APISTOMYIA, Bigot, p. 8.

No longitudinal vein between the first and fourth veins (= radial vein unbranched) . . . . . 2. Genus HAMMATORHINA, Loew, p. 9.

Eyes not bi-sected by an unfacetted cross-band; a longitudinal vein between the first and fourth veins (= radial vein branched).

Eyes separated by a broad front.

Proboscis long, palpi but little developed . . . . . 3. Genus PALTOSTOMA, Schiner, p. 9.

Proboscis not longer than the vertical diameter of the head; well developed four-segmented palpi. . . . . . 4. Genus KELLOGGINA, Williston, p. 10.

Eyes contiguous.

Ungues of the ordinary structure; tibiæ with spurs at the tip . . 5. Genus CURUPIRA, F. Müller, p. 10.

Ungues abnormal, pulvilliform; no spurs at the tip of the tibiæ . 6. Genus HAPALOTHRIX, Loew, p. 10.

An incomplete vein near the posterior margin of the wings (= an incomplete media$_3$ present).

Second longitudinal vein with two branches (= radius$_2$ partly distinct); a cross-vein connecting veins 4 and 5 (= a medio-cubital cross-vein).

Anterior branch of second vein and veins 2 and 3 all separating at a common point or close together (radius$_2$, radius$_3$ and radius$_4$ all separating at a common point or close together). 8. Genus BIBIOCEPHALA, O.-Sacken, p. 13.

Second longitudinal vein simple, without branches (= radius$_2$ wholly fused with radius$_3$).

No cross-vein connecting veins 4 and 5 (= no medio-cubital cross-vein) . . . . . 7. Genus BLEPHAROCERA, Macquart, p. 11.

A cross-vein connecting veins 4 and 5 (= a medio-cubital cross-vein) . . . . . 9. Genus PHILORUS, Kellogg, p. 14.

1. GENUS APISTOMYIA, BIGOT

Apistomyia. Bigot, Ann. Soc. Ent. Fr. (4), Vol. 2, p. 109, pl. 1, f. 1 (1862); Loew, Boll. Soc. Ent. Ital. Vol. 1, p. 97, pl. 2, f. 1-3 (1869); Loew, Schles. Zeitschr. f. Ent. N. F. Vol. 6, p. 71, 91, pl. 1, f. 1 (1877); Osten-Sacken, Berl. Ent. Zeit. Vol. 36, p. 410 (1891) and Vol. 40, p. 162 (1895); Sknuse, Zeitschr. f. Hym. u. Dipt. Vol. 1, p. 145 (1901); Kertész, Cat. Dipt. Vol. 1, p. 283 (1902) (*elegans*).

Characters. — No incomplete vein near the posterior margin of the wings; eyes bisected by an unfacetted cross band or line into a dorsal brownish region of larger facets and a lower black region of smaller facets; a longitudinal vein between the first and fourth veins.

Biology. — Both males and females have been found. Life-history and immature stages unknown. Schnuse found both sexes at composite flowers, sucking. But the females were probably not there for nectar, but hunting small iusects, as they are blood-drinkers.

Geographical distribution of species. — The single species of the genus is recorded, so far, only from the islands of Corsica and Cyprus.

1. *A. elegans*, Bigot, Ann. Soc. Ent. Fr. (4), Vol. 2, p. 110, pl. 2, f. 1 (1862) (Corsica, Cyprus). — **Pl. 1, Fig. 3, 16; Pl. 2, Fig. 20.**

2. Genus HAMMATORHINA, Loew

Hammatorhina. Loew, Boll. Soc. Ent. Ital. Vol. 1, p. 94, pl. 3, f. 3-6 (1869); Loew, Schles. Zeitschr. f. Ent. N. F. Vol. 6, p. 75, pl. 1, f. 2 (1877); Osten-Sacken, Berl. Ent. Zeitschr. Vol. 36, p. 189 and p. 411 (1892); Osten-Sacken, Berl. Ent. Zeitschr. Vol. 40, p. 162 (1895); Kertész, Cat. Dipt. Vol. 1, p. 284 (1902) (*bella*).

Tanyrhina. Loew, Mon. N. Amer. Dipt. Vol. 1, p. 8 (1862).

Characters. — No incomplete vein near the posterior margin of the wings; eyes bisected by an unfacetted cross band or line into a dorsal brownish region of larger facets and a lower black region of smaller facets; no longitudinal vein between the first and fourth veins.

Biology. — Only the male sex of this genus is known. Life-history unknown. At the Oct. 1, 1890 meeting of the London Ent. Society « Mr. C. J. Gahan exibited a curious little larva-like creature found by Mr. A. P. Green in a rapid mountain stream in Ceylon, and observed that there was some doubt as to its true position in the animal kingdom. » Thereupon the savants of the Society proceeded to make guesses as to the general identity of this little Ceylonese visitor. Mr. Hampson pointed out its likeness to chaetopod worms (especially because of the *parapodia*-like lateral appendages) but added that all the known polychaetous worms were marine. Lord Walsingham and Mr. McLachlan expressed the opinion that the animal was of myriapodous affinities, and was not the larva of an insect. After this meeting Mr. Gahan had his specimen examined by Baron Osten-Sacken and Professor Packard, who recognized it as a Blepharocerid larva. As *Hammatorhina bella* is the only Blepharocerid species so far found in Ceylon Mr. Gahan's specimen may provisionally be looked on as the larva of this species.

Geographical distribution of species. — The single species of this genus is recorded, so far, only from Ceylon.

1. *H. bella*, Loew, Boll. Soc. Ent. Ital. Vol. 1, p. 96 (1869) (Ceylon). — **Pl. 2, Fig. 17, 27.**

3. Genus PALTOSTOMA, Schiner

Paltostoma. Schiner, Verh. Zool.-Bot. Ges. Wien, Vol. 16, p. 931 (1866); Loew, Boll. Soc. Ent. Ital. Vol. 1, p. 95, pl. 2, f. 7 and 8 (1869); Loew, Schles. Zeitschr. f. Ent. Neue Folge, Vol. 6, p. 76 u. 94, pl. 1, f. 7 (1877); Osten-Sacken, Berl. Ent. Zeit., Vol. 36, p. 419 (1892); Osten-Sacken, Berl. Ent. Zeit. Vol. 40, p. 162 (1895); Kertész, Cat. Dipt. Vol. 1, p. 284 (1902); Aldrich, Cat. N. Amer. Dipt. p. 171 (1905) (*superbiens*).

Characters. — No incomplete vein near the posterior margin of the wings; eyes not bisected by an unfacetted cross band; a longitudinal vein between first and fourth veins; eyes separated by a broad front; proboscis long, palpi but little developed.

Biology. — Only males of this genus known. Life-history and immature stages unknown.

Geographical distribution of species. — Of the two known species one is recorded only from St. Vincent Id., West Indies, the other from Columbia, S. A., and, doubtfully, from Mexico.

1. *P. schineri,* Williston, Trans. Ent. Soc. Lond. p. 296, pl. 8, f. 27, 27*a*, 27*b* (1896) (St. Vincent Id., West Indies). — **Pl. 2, Fig. 26.**
2. *P. superbiens,* Schiner, Novara Reise, Dipt. p. 28, pl. 2, f. 4 (1869) (Columbia, South America, and Mexico [?]). — **Pl. 2, Fig. 21.**

4. Genus KELLOGGINA, Williston

Kelloggina. Williston, Journ. New York Ent. Soc. Vol. 15, (1907) (*rufescens*).

Snowia. Williston, Kansas Univ. Quart. Vol. 1, p. 119 (1893); Osten-Sacken, Berl. Ent. Zeit. Vol. 40, p. 162 (1895) (*rufescens*).

Sackienella. Williston, Trans. Ent. Soc. Lond. p. 270 (1896); Kertész, Cat. Dipt. Vol. 1, p. 284 (1902) (*rufescens*).

Characters. — No incomplete vein near the posterior margin of the wings; eyes not bisected by an unfacetted cross-band; a longitudinal vein between first and fourth veins; eyes separated by a broad front; proboscis not longer than the vertical diameter of the head, well developed 4-segmented palpi.

Biology. — Female only known. Life-history and immature stages unknown.

Geographical distribution of species. — The single known species in this genus (represented by a single female specimen) is recorded from Rio de Janeiro, Brazil.

1. *K. rufescens,* Williston, Kansas Univ. Quart. Vol. 1, p. 290 (*Snowia*) (1893) (Rio de Janeiro).

5. Genus CURUPIRA (F. Müller), Osten-Sacken

Curupira (F. Müller). Osten-Sacken, Berl. Ent. Zeit. Vol. 40, p. 162 (1895); & p. 165 ff. of same reference; Kertész, Cat. Dipt. Vol. 1, p. 284 (1902) (*torrentium*).

Paltostoma. Brauer, Zool. Anz. Vol. 3, p. 134 (1880); F. Müller, Kosmos, Vol. 8, p. 37, figs. (1881); F. Müller, Arch. Mus. Nac. Rio Janeiro, Vol. 4, p. 47, pl. 4-7 (1882) (*torrentium*).

Characters. — No incomplete vein near the posterior margin of the wings; eyes not bisected by an unfacetted cross-band; a longitudinal vein between the first and fourth veins; eyes contiguous; ungues of the ordinary structure; tibiæ with spurs at the tip.

Biology. — Males and females, and larvæ and pupæ known. The anatomy of larvæ and pupæ exhaustively studied by F. Müller (Arch. Mus. Nac. Rio Janeiro, Vol. 4, p. 47 ff., pl. 4-7, 1882). Larvæ and pupæ found abundantly in the Garcia, Jordao and Caeté rivers in the province of Santa Catherina, Brazil.

Geographical distribution of species. — The single species of this genus so far known is recorded only from Brazil.

1. *C. torrentium,* F. Müller; Brauer, Zool. Anz. Vol. 3, p. 134 (1880) Brazil). — **Pl. 2, Fig. 24.**

6. Genus HAPALOTRHIX, Loew

Hapalothrix. Loew, Deutsche Ent. Zeitschr. Vol 20, p. 211 (1876); Loew, Schles. Zeitschr. f. Ent. N. F. Vol. 6, p. 81, pl. 1, f. 8 (1877); Osten-Sacken, Berl. Ent. Zeitschr. Vol. 36, p. 411 (1892);

Osten-Sacken, Berl. Ent. Zeit. Vol. 40, p. 162 (1895); Bezzi, Zeitschr. f. Hym. u. Dipt. Vol. 1, p. 275 (1901); Kertész, Cat. Dipt. Vol. 1. p. 285 (1902) (*lugubria*).

Characters. — No incomplete vein near the posterior margin of the wings. Eyes not bisected by an unfacetted cross band; a longitudinal vein between first and fourth veins; eyes contiguous; ungues about normal, pulvilliform; no spurs at the tip of tibiæ.

Biology. — Males and females known. Life-history and immature stages unknown. Loew writes, « Herr Scherfling entdeckte diese interressante Art am 11. Juli an der Südseite des Monte Rosa in der Nähe von Macuguaga in einer Meereshöhe von etwa 6000 Fuss. Die Männchen derselben trieben sich da, wo der Gletscherbach aus dem unteren Gletscher hervorkommt, auf dem vom schnell abwärts strömenden Wasser erzeugten Schaune in ziemlicher Anzahl spielend herum; sie waren wegen der schweren Zuganglichkeit der Stelle gar nicht leicht zu erlangen; zuweilen von spritzendem Wasser getroffen und mit fortgenommen, kehrten sie doch stets bald auf die alte Stelle und zu dem altem Spiele zurück. Weibchen waren, trotz aller längere Zeit hindurch darauf verwendeten Sorgfalt nicht zu entdecken. Das Spiel der Männchen währte so lange, die Stelle von der Sonne beschienen wurde, ununterbrochen fort; sobald diese aber soweit gesunken war, dass der Schatten der Berge den Tummelplatz traf, hörte das Spiel so fort auf, und sämtliche Männchen waren gar bald wie völlig verschwunden. » Bezzi writes, « Ich habe *Hapalothqix lugubris* am 13. Juli d. J. bei Chiesa in Valmalenco (Sondrio), auf einer Meereshöhe von etwa 1000 Meter, unter ähnlichen Umständen wie *H. Scherfling* gefunden; nur kein Gletscher war hier in der Nähe; und die Lebensdauer der Thiere schien länger zu sein, da ich die Art an derselben Stelle noch am 21. Juli zahlreich beobachten konnte. Die Männchen halten beim Flug die hinteren Beine so gestellt, wie einige Arten der Gattung Bibio. In der Ruhe sitzen sie an Steinen und Felsstücken ganz nahe dem Strome mit halbgeöffneten Flügeln und erhobenen Hinterleibe. Die Weibchen sind in viel geringerer Zahl vorhanden, als die Männchen. Die begattung findet auf dem Wasser statt; und die copulirten Pärchen werden von den Wellen hier und da ans Ufer gebracht und oft auch verschlungen. Die fünf Weibchen, welche ich gefangen habe, waren alle in Copula und wurden von den Wellen getragen. Wo die Weibchen sitzen oder fliegen habe ich mit Sicherheit nicht in Erfahrung bringen können. In Gesellschaft mit Hapalothrix fliegen einige Hilara Arten; und die ersteren werden oft von letzteren erbeutet... Das Verbreitungsgebiet von Hapalothrix wird hewiss auf der ganzen Südseite der Alpen zu suchen sein. sie lebt wahrscheinlich an allen grösseren Gewässern, welche von den Gletschen herabfliessen. Ihre Verwandlung wird gewiss im Wasser stattfinden und durfte nicht sehr verschieden sein von derjenigen der brasilianischen Arten, welche Dr. Fritz Müller beschreibt. Die Flugzeit wird je nach der Höhe von Ende Mai bis Ende August reichen; die Art wird gewiss auch nicht ohne praktischen Nutzen sein, indem sie der alpinen Forelle als Nahrung dienen durfte. »

Geographical distribution of species. — The single known species of this genus has been taken near Macuguaga (Italy) (alt. 2000 m.) on the south side of Monte Rosa, and at an altitude of 1000 m. near Sondrio (Italy).

1. *H. lugubris,* Loew, Deutsche Ent. Zeitschr. Vol. 20, p. 212 (1876) (Northern Italy). — **Pl. 2, Fig. 18; Pl. 2, Fig. 28.**

7. Genus BLEPHAROCERA, Macquart

Blepharocera. Macquart, Ann. Soc. Ent. Fr. (2) Vol. 1, p. 61 (1844); (amended in 1862 by Loew to *Blepharocera*) *(fasciata).*

Asthenia. Westwood, in Guérin Mag. Zool. (2) Vol. 4. pl. 94 (1842) *(fasciata).*

Asyndulum. Walker, List Dipt. Brit. Mus. Vol. 1, p. 86 (1848) (*fasciata*)

Liponeura (in part). Loew, Stett. Ent. Zeit. Vol. 5, p. 118 (1844) (*cinerascens*).

Blepharocera (Macquart). Loew, Boll. Soc. Ent. Ital. Vol. 1, p. 85 (1869); Loew, Schles. Zeitschr. f. Ent. N. F. Vol. 6, p. 54, pl. 1 (1877); Osten-Sacken, Berl. Ent. Zeit. Vol. 40, p. 149 (1895); Kellogg, Ent. News. Vol. 10, pp. 305-318, f. 5 (1900); Kertész, Cat. Dipt. Vol. 1, p. 282 (1902); Kellogg, Proc. Calif. Acad. Sc. (3), Zool. Vol. 3, pp. 187-223, pl. 18-22 (revision of the genus) (1903); Aldrich, Cat. N. Amer. Dipt. p. 171 (1905) (*fasciata*).

Characters. — Incomplete vein near the posterior margin of the wings; second longitudinal vein simple without branches; no cross vein connecting veins four and five.

Biology. — Males and females, and larvæ and pupæ known. Anatomy of larvæ, pupæ and imago studied by Dewitz (Berl. Ent. Zeitschr. Vol. 35, pp. 61-66, pl. 3-4, 1880), and Weirseijski (Krakow, 1881), for *B. brevirostris* Loew, and by Kellogg (Ent. News. Vol. 10, pp. 305-318, f. 5, 1900; and Proc. Calif. Acad. Sc., (3), Zool. Vol. 3, pp. 187-233, pl. 18-22, 1903) for *B. tenuipes*. Dewitz found larvæ and pupæ in the Ockerthal near Goslar (Harz Mts.) fastened to loose stones in the swift water, and imagines flying about over the stream and often settling on projecting rocks. Riley found (1881) larvæ and pupæ of *B. tenuipes* near Watertown, New-York (U. S. A.), and Constock has long known them at Ithaca, New-York (U. S. A.) Kellogg has found the immature stages of *B. tenuipes* at Ithaca and in the Riviere des Chiens near Quebec, and of *B. jordani* in many streams near Stanford University, in the Coast Range (60 miles away), while Grinnell has found them in a mountain stream near Pasadena in Southern California. Kellogg records the immature stages of *B. Osten-Sackeni* from several streams in Northern, California. He noted young larvæ of *B. tenuipes* 2.5 mm. long in Coy Glen stream near Ithaca, New-York on May 9; on May 14 the first pupæ were noted; on May 20 the pupæ outnumbered the larvæ, and on June 1 the first flies issued, most of the pupæ being transformed by June 9. On June 27 many female flies were found feeding along another near-by stream. Both of these streams were carefully watched through the rest of the summer and all the autumn, but no other generation appeared. Do the frail imagines live through the winter? The larvæ of *B. jordani Kell.* have been found by Kellogg in Los Gatos Creek near Stanford University, California, as early as Feb. 23 and as late as June 1 (Stevens Creek, an adjoining stream), and at various times in the intervening three months. Pupæ were first found in these streams on April 1 and as late as June 4.

The females of *B. tenuipes* catch small Chironomid mites on the wing, lacerate their bodies and drink the body juices. The feeding of the males has not been observed.

Geographical distribution of species. — Of the six species assigned to this genus three are European and three North American.

1. *B. fasciata*, Westwood, Mag. Zool. (2), vol. 4, pl. 94 (*Aesthenia*) (1842) (Europe). Type species. — **Pl. 1, Fig. 4; Pl. 2, Fig. 25.**
   limbipennis, Macquart, Ann. Soc. Ent. Fr. (2), vol. 1, p. 63, pl. 3 (1843).
2. *B. cinerascens*, Loew, Stett. Ent. Zeit. Vol. 5, p. 118, pl. 1, f. 6-10 (*Liponeura*) (1844) (Europe).
   fasciata, Schiner, Fauna Austr. Dipt. Vol. 2, p. 638 (excl. male) (1864) (*Blepharicera*).
   limbinervis, Macquart, Ann. Soc. Ent. Fr. (2), Vol. 2 p. 69, pl. 3 (1844) (*Blepharicera*).
3. *B. brevirostris*, Loew, Schles. Zeitschr. f. Ent. N. F. Vol. 6, p. 67 (*Liponeura*) (1877) (Central Europe: Bohemia, Silesia).
4. *B. tenuipes*, Walker, List Dipt. Brit. Mus. Vol. 1, p. 86 (*Asyndulum*) (1848) (Northeastern United States and Eastern Canada). — **Pl. 1, Fig. 7, 12.**
   capitata, Loew, Berl. Ent. Zeitschr. Vol. 7, p. 298 (1863).
5. *B. jordani*, Kellogg. Proc. Calif. Acad. Sc. (3), Zool. Vol. 3, p. 189, pl. 18, f. 1, pl. 19, f. 3, pl. 20, fig. 1 and 2 (1903) (California). — **Pl. 1, Fig. 8, 9.**
6. *B. osten-sackeni*, Keliogg, Proc. Calif. Acad. Sc. (3), Zool. Vol. 3, p. 191, pl. 18, f. 2, pl. 19, f. 2, pl. 20, f. 3 and 4 (1903) (California).

8. Genus BIBIOCEPHALA, Osten-Sacken

Bibiocephala. Osten-Sacken, Geol. Survey of the Terr. for 1873, p. 564 (1874); Loew, Schles. Zeitschr. f. Ent. N. F. Vol. 6, p. 95 (1877); Osten-Sacken, Berl. Ent. Zeit. Vol. 36, p. 409 (1892) Vol. 40, p. 161 (1895); Kertész, Cat. Dipt. Vol. 1, p. 281 (1902); Kellogg, Proc. Calif. Acad. Sc. (3) Zool. Vol. 3, pp. 187-221, pl. 18-22 (1903) (revision of the genus); Aldrich, Cat. N. Amer. Dipt., p. 171 (1905) (*grandis*).

Agathon. Röder, Wien. Ent. Zeit. Vol. 9, p. 230 (1890) (*elegantula*).

Characters.—An incomplete vein near the posterior margin of the wings; second longitudinal vein with two branches; cross vein connecting veins four and five; anterior branch of second vein, and veins two and three all separating at a common point or close together.

Biology. — Males and females and pupæ known. On June 22 to 25 (1901) Kellogg found imagines of *B. elegantula* numerous among the boulders of Big Thompson stream, Estes Park, Colorado (altitude 7,500 feet), where the stream breaks through the Willow Park terminal moraine. At this time, old pupæ and empty pupal skins were found, but no larvæ except two very young ones. On August 10 to 12, the flies were found still common and numerous larvæ, young and old, but no pupæ. In three other nearby mountain torrents, viz. Wind Creek, Mill Creek and South Fork of Big Thompson, adults and old pupæ were found. A note made at this time is as follows : « It seems to me that I have got here just as the last adults of one generation are issuing, and that the larvæ of August are larvæ from eggs laid by these adults. This would mean a generation of flies appearing about July 1, say, and a second one appearing later, say about September 15. » This is, of course, mere conjecture.

The larvæ of *B. doanei* were taken as early as February 25 (Los Trancos Creek, California), and as late as July 26 (Red Cap Creek, Hoopa Indian Reservation, Humboldt County, California), and in all the intervening months; pupæ are first recorded March 31 (Campbell Creek, California) and from then till July 26 (Red Cap Creek, Humboldt County, California); the only free-flying imago was taken on July 15 (Congress Springs, Campbell Creek, California).

Kellogg's earliest recorded date of taking the laryæ of *B. comstocki* is February 11 (Alembique Creek, California), the latest April 30 (Stevens Creek, California); the earliest pupæ are of the date February 27 (Los Gatos Creek, California). A free-flying imago was taken April 6 (Saratoga Springs, Campell Creek, California).

Geographical distribution of species. — The four species included in this genus are all North American coming from the Rocky, Sierra Nevada and Coast Range mountains of Colorado, New Mexico and California.

1. *B. grandis*, Osten-Sacken, Geol. Survey of the Terr. for 1873, p. 566, fig. (1874) (Colorado, New Mexico, Utah, Idaho).
2. *B. comstocki*, Kellogg, Calif. Acad. Sc. (3), Vol. 3, p. 192, pl. 18, f. 6 and 7, pl. 20, f. 5 and 6, pl. 21, f. 4 (1903) (California). — **Pl. 1, Fig. 1, 2, 5, 6, 11.**
3. *B. doanei*, Kellogg, Psyche, Vol. 9, p. 39 (1900) (*Liponeura*) (California). — **Pl. 1, Fig. 10, 13; Pl. 2, Fig. 23.**
4. *B. elegantula*, Röder, Wien. Ent. Zeit. Vol. 9, p. 230 (1890) (*Agathon*) (Sierra Nevada Mountains, Idaho, Colorado). — **Pl. 2, Fig. 14, 15, 19.**

9. Genus PHILORUS, Kellogg

Philorus(1). Kellogg, Proc. Acad. Sc. Calif. (3), Zool. Vol. 3, p. 199 (1903) (*bilobata*).
Liponeura (in part). Loew, Stett. Ent. Zeit. Vol. 5, p. 118 (1844) (*bilobata*).
Blepharocera (in part). Macquart, Ann. Soc. Ent. Fr. (2), Vol. 1, p. 61 (1843) (*ancilla*).

Characters. — An incomplete vein near the posterior margin of the wings; second longitudinal vein simple, without branches; a cross-vein connecting veins 4 and 5.

Biology. — Males and females and larvæ and pupæ known. Osten Sacken's specimens of *P. yosemite* were three males caught on the wing on the bridle-path to the foot of the upper Yosemite Fall (California), 3 p. m., June 6, 1876. No other specimens of this species are recorded until 1903 when Kellogg records (Psyche, Vol. 10, p. 186) the finding on July 15 of larvæ and pupæ (and male and female flies dissected out from pupæ just ready to transform) in the King's River Canon (another great California canon of the western slope of the Sierra Nevada about 60 miles south of the Yosemite). These larvæ and pupæ were taken from the smooth submerged surfaces of great granite blocks fallen into a swift, little, clear-water stream called Granite Creek which flows into King's River.

Geographical distribution of species. — Of the three species included in this genus one is found in Europe and two in the mountain region of the western United States.

1. *P. bilobata*, Loew, Boll. Soc. Ent. Ital. Vol. 1, p. 97 (1869) (*Liponeura*) (Southern Europe : Greece, Italy). — **Pl. 2, Fig. 22.**
2. *P. ancilla*, Osten-Sacken, Cat. N. Amer. Dipt. (2 ed.), p. 266 (1878) (*Blepharocera*) (California).
3. *P. yosemite*, Osten-Sacken, Bull. U. S. Geol. Survey, Vol. 3, p. 195 (1877) (*Liponeura*) (California, U. S. A., Yosemite Valley).

(1) Professor Aldrich writes me that the name *Philoros* was used by Walker in 1854 for a Lepidopterous genus, but the difference in spelling, slight as it is, constrains me to hold to the present generic name.

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EXPLANATION OF PLATES

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Fig. 1. Head of *Bibiocephala comstocki*, Kellogg, ♀ (after Kellogg).
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— 4. — *Blepharocera fasciata*, Westwood, ♀ (after Loew).
— 5. Larva of *Bibiocephala comstocki*, Kellogg, dorsal aspect; *ant.*, antenna; *l. p.*, lateral processes.
— 6. — — — — ventral aspect; *t.g.*, tracheal gills; *s.*, sucker (after Kellogg).
— 7. *Blepharocera tenuipes*, Walker, ♂ (after Kellogg).
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— 12. Section through compound eyes and brain of head of *Blepharocera tenuipes*, Walker, showing difference in character of ommatidia in the two parts (dorsal and ventral) of each eye; *o.*, ocelli; *br.*, brain; *l. f.*, large facets; *s. f.*, small facets; *o. l.*, optic lobes (after Kellogg).
— 13. Mouth parts of *Bibliocephala doanei*, Kellogg, ♀; *md.*, mandible; *mx.*, maxilla; *mx. l.*, maxillary lobe; *mx. p.*, maxillary palpus; *li.*, labium; *pg.*, paraglossa; *hyp.*, hypopharynx; *l. ep.*, labrum-epipharynx (after Kellogg).

Plate 2.

Fig. 14. External genitalia of female *Bibiocephala elegantula*, Röder, dorsal aspect (after Kellogg).
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— 17. — — *Hammatorhina bella*, Loew (after Loew).
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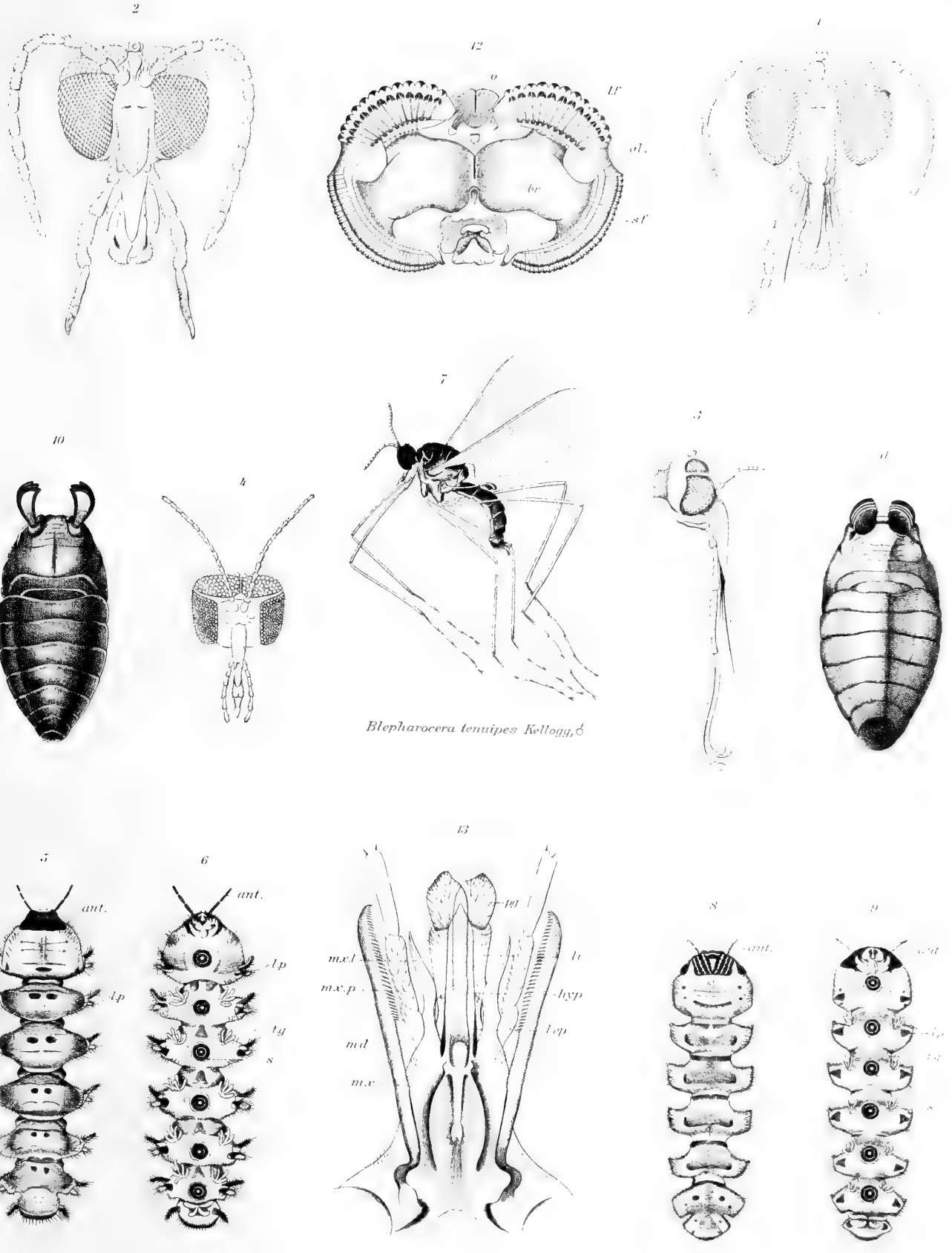
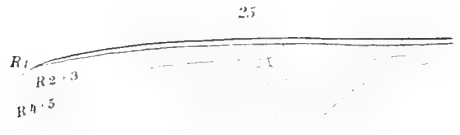
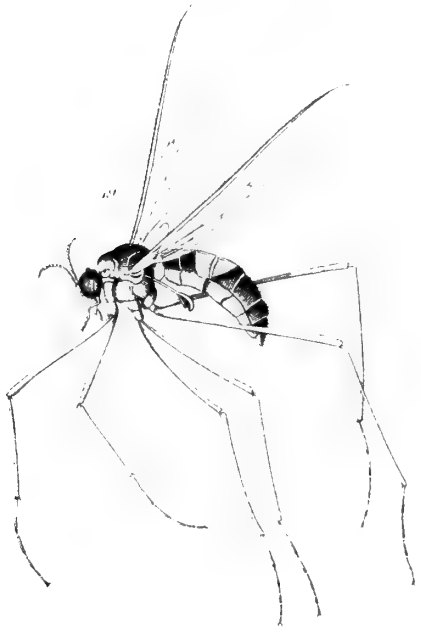
— 26. — *Paltostoma schineri*, Williston (after Williston).
— 27. — *Hammatorhira bella*, Loew (after Loew).
— 28. — *Hapalothrix lugubris*, Loew (after Loew).

Stanford University, Calif., U. S. A., March 15, 1907.



FAM. BLEPHAROCERIDÆ





Bibiocephala elegantula Roder, ♀