The Coleopterists Bulletin, 57(3):297–309. 2003.

MORPHOLOGY OF ADULT *MEIBOMEUS CYANIPENNIS* (SHARP) (COLEOPTERA: BRUCHIDAE)[1]

CIBELE S. RIBEIRO-COSTA AND JOSÉ ALDIR PINTO DA SILVA
Departamento de Zoologia
Universidade Federal do Paraná
Caixa Postal 19020
81531-990 Curitiba, Paraná, BRAZIL

Abstract

The adult morphology of *Meibomeus cyanipennis* (Sharp) is described and illustrated. Structures such as the tentorium, mouthparts, endosternites, hind wings and female terminalia were studied for the first time in the genus.

A detailed morphologic study furnishes the basis for a more precise definition of taxa, besides helping to attain a better understanding of characters and their transformations over time. Earlier studies on the morphology of Bruchidae focused mainly on cosmopolitan species of economic interest. Daviault (1928) studied the morphology of the adult, larva and pupa of *Acanthoscelides obtectus* (Say); Mukerji and Bhuya (1937), the male and female reproductive system of *Callosobruchus chinensis* (L.) and *C. maculatus* (F.); and Mathur and Dhadial (1963), the head morphology of the adult of *Caryedon gonagra* (F.) [= *Caryedon serratus* (Olivier)]. Kingsolver (1970) made an important contribution when he illustrated the male genitalia of the species of different genera of Bruchidae belonging to five subfamilies (Amblycerinae, Bruchinae, Eubaptinae, Kytorhininae and Pachymerinae). Kingsolver (*op. cit.*) also defined terms and established homologies with structures previously cited by Sharp and Muir (1912) and Snodgrass (1935). During the 1980s, Singh conducted a series of morphologic studies on cosmopolitan species as well as species distributed mainly in Asia and Europe. Singh (1981*b*) dealt with the head morphology of *C. chinensis*. In Singh (1981*a*, 1982 and 1986) he based his studies on the comparative morphology of the nine genera of Bruchidae, *Bruchus* Linnaeus, *Bruchidius* Schilsky, *Callosobruchus* Pic, *Conicobruchus* Decelle, *Caryedon* Schoenherr, *Specularius* Bridwell, *Spermophagus* Schoenherr, *Sulcobruchus* Chujo and *Zabrotes* Horn. In the first comparative work, he studied the hind wings, in the second the head excluding the appendages, and in the third the head appendages.

Meibomeus Bridwell comprises 28 species distributed in the Americas and belongs to Bruchinae Pic, which is the largest subfamily in number of genera and species of Bruchidae. The most relevant studies on this genus were Kingsolver and Whitehead's (1976) review of the species of North and Central America, Silva and Ribeiro-Costa's (2001) review of the species of South America and Romero and Johnson's (2002) descriptions of five new species. All studies were based on external and internal characters of the male terminalia, however, without treating the other structures such as the mouthparts, hind wings, endosternites and female terminalia.

[1] Contribution n° 1317 from Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná, Brasil.

The morphology of one species of Bruchinae, *Acanthoscelides obtectus* (Daviault 1928), has been studied in great detail. In consequence, the aim of the present study was to extend our knowledge of the morphology of *Meibomeus* and Bruchidae in general.

Materials and Methods

Specimens of *M. cyanipennis* were borrowed from the United States National Museum of Natural History, Washington, D.C., USA and the following Brazilian institutions: Coleção de Entomologia Pe. J. S. Moure, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba; Museu de História Natural do Capão da Imbúia, Curitiba; and Museu de Zoologia, Universidade de São Paulo, São Paulo.

The methodology adopted was basically that of Silva and Ribeiro-Costa (2001). To study the female terminalia, the specimen was placed in boiling water for about five minutes and the abdominal urosternites then cut to remove the terminalia that was subsequently clarified. Staining of the structures was carried out as proposed by Silva and Ribeiro-Costa (*op. cit.*) for the male and female terminalia and mouthparts.

The terminology adopted was that commonly used in descriptions of Bruchidae. The majority of the terms were defined in works by Kingsolver (1970) who studied the male genitalia, Johnson and Kingsolver (1973) who reviewed the species of *Sennius* Bridwell of North and Central America, defining the terminology related to the carinae of the posterior tibia, and Kingsolver (1988) who reviewed *Merobruchus* Bridwell of North America and the West Indies and presented a glossary of morphologic terms.

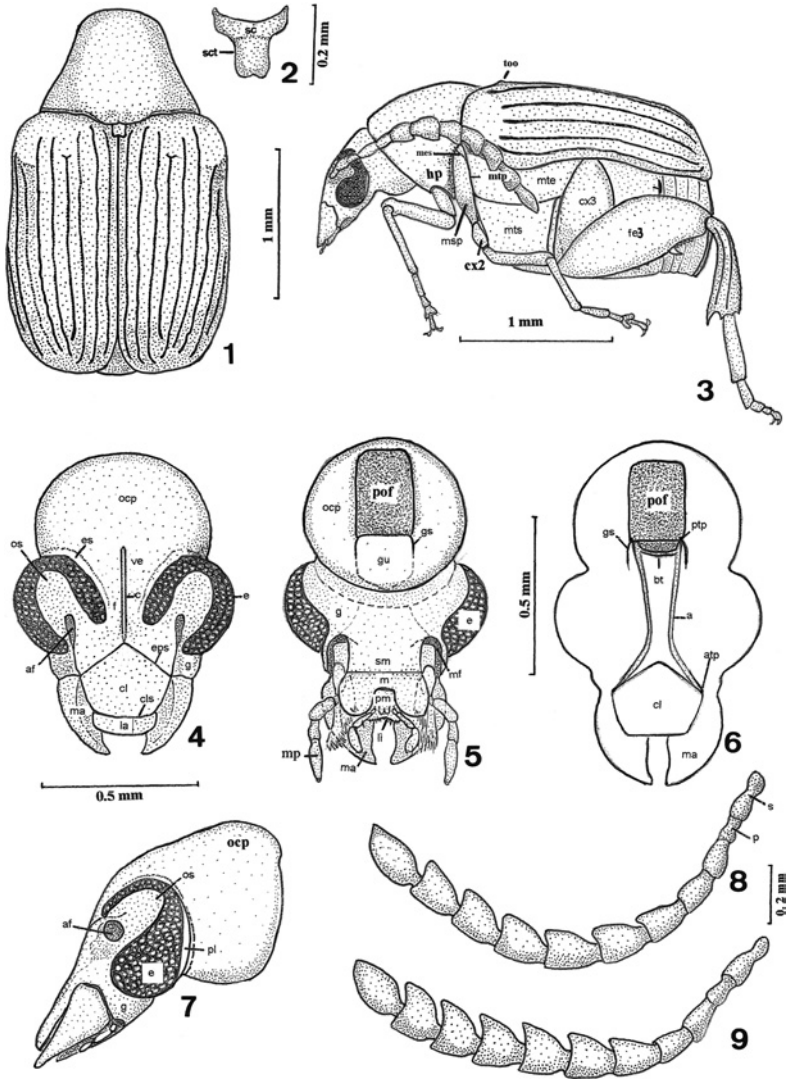
In the case of the hind wings, the terminology of Suzuki (1994) was adopted; for the female terminalia that of Mukerji and Bhuya (1937) and Matsuda (1976), and for the male terminalia that of Kingsolver (1970), but we used the position of the sclerites of the internal sac as did Romero and Johnson (1999).

Photographs were taken using a scanning electron microscope at the Centro de Microscopia Eletrônica da Universidade Federal do Paraná, Curitiba.

Meibomeus cyanipennis (Sharp, 1885)

(Figs. 1–47)

Head elongate, oblique. Frons (f) medially with a smooth frontal carina (c) which extends from the clypeus to the vertex, differentiating itself from the rest of the integument, which is punctured (Figs. 4, 42, 43). Clypeus (cl) subpentagonal with subparallel lateral margins and integument slightly scale-like in appearance and provided with sparse setae (Fig. 42). Epistomal suture conspicuous (eps) as inverted "V" (Figs. 4, 42). Postoccipital sulcus and postoccipital suture not evident. Occiput (ocp) (Fig. 7) conspicuously rounded. Gula (gu) (Fig. 5) pentagonal and weakly demarcated, except next to the posterior foramen. Gular suture (gs) short, slightly curved. Eye (e) moderately protuberant laterally, interocular ratio about 0.16. Ommatidia, about 17, with short setae between them (Fig. 44). Ocular sinus deep (os) (Figs. 4, 7). Eye supercilium (es) with foveolae larger than those on the frons (Figs. 4, 43), postocular lobe slender (pl) (Fig. 7). Antennal articles from fifth to tenth, serrated; last article subelliptical (Figs. 8, 9). In males, articles serrated from the fifth to the tenth, slightly longer than wide when compared to those of the female, which are quadrangular (Fig. 9). Gena (g) between the base of the mandible and the inferior lobe of the eye, with a length of about 0.7 times the shortest distance between the superior lobes of the eyes (Figs. 4, 5, 7). Labrum (Fig. 4), rectangular, sides rounded, subtruncate apex; integument with a scale-like appearance at the base and smooth at the apex (Fig. 42), internal side of the labrum with sparse, long setae in the lateral third and two rows of very short setae in the median region (Fig. 10). Torma (tr) with elongate arms more dilated at the apex,



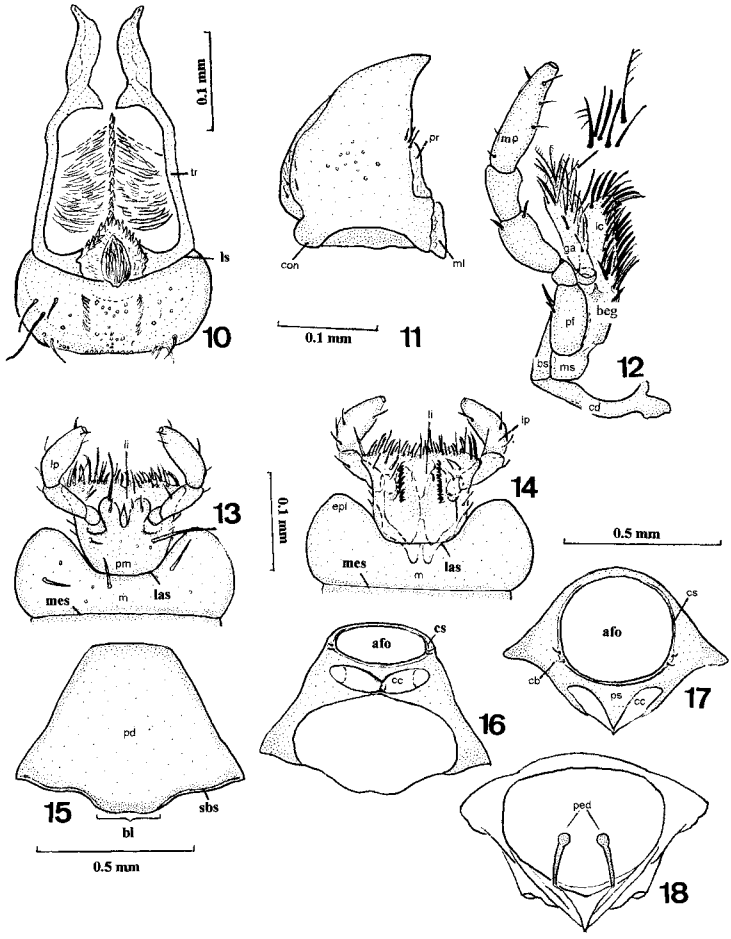
Figs. 1–9. *Meibomeus cyanipennis* (Sharp). **1)** dorsal view; **2)** scutum and scutellum; **3)** lateral view; **4)** head, anterior view; **5)** head, posterior view; **6)** idem; **7)** head, lateral view; **8)** male antenna; **9)** female antenna. a = tentorial arm, af = antennal fossa, atp = anterior tentorial pit, bt = tentorial bridge, c = frontal carina, cl = clypeus, cls = clypeolabral suture, cx2 = middle coxa, cx3 = hind coxa, e = eye, eps = epistomal suture, es = eye supercilium, f = frons, fe3 = hind femur, g = gena, gs = gular suture, gu = gula, hp = hypomeron, la = labrum, li = ligula, m = mentum, ma = mandible, mes = mesopleural suture, mf = maxillary fossa, mp = maxillary palp, msp = mesepisternum, mtp = metapleural suture, mte = metepisternum, mts = metasternum, ocp = occiput, os = ocular sinus, p = pedicel, pl = postocular lobe, pm = prementum, pof = posterior foramen, ptp = posterior tentorial pit, s = scape, sc = scutum, sct = scutellum, sm = submentum, too = tooth, ve = vertex.

membranous area between the arms with setae forming an inverted "Y". Between the bifurcation of the "Y" is the epipharynx, with dense hairs. Mandible (Fig. 11), symmetrical, subtriangular, with slightly curved apex and sparse setae at the base of the external margin. Prostheca (pr) membranous; mola (ml) with small rugosities. Maxilla (Fig. 12) with cardo (cd) slender and elongate; stipe divided into basal stipe (bs) and medial stipe (ms). Fourth segment of the maxillary palp (mp) as long as the the others together. Galea (ga) with simple and pectinate setae having an annulate sclerite at the basal region (beg). Lacinia (lc) shorter than galea, with simple and dense setae. Labium with the submentum (sm) continuous between the genae (Fig. 5). Mentum (m) with two lateral lobes, the epilobes (epl), which are broad and conical. Palpiger inconspicuous, palpifer longer than wide. Ligula (li) with numerous marginal setae. Internally (Fig. 14), in the median region of the pre-mentum, with two rows of short setae. Tentorium with anterior and posterior tentorial arms (Fig. 6), the posterior ones united by the transverse tentorial bridge (bt).

Pronotum (Figs. 1, 15) campanulate, truncate at the apical margin, sinuous at the base and with foveolae, except at the basal half of the medial line (Fig. 45). Pronotal disk raised (pd), basal lobe slightly emarginate (bl) (Figs. 15, 45) and without lateral carinae. Submarginal sulcus (sbs) present at the basal margin of the pronotum, except in the region of basal lobe (Fig. 45); cervical sulcus (cs) evident, largely encircling the anterior foramen (afo) (Fig. 17); cervical boss (cb) with two setae (Figs. 16, 17, 44). Hypomeron (hp) fused to the pronotum (Fig. 3). Anterior coxal cavities (cc) elliptical; trochantin absent; prosternum (ps) with sharp apex not separating completely the coxal cavities (Figs. 16, 17). Proendosternite (ped) (Fig. 18) with two slender arms dilated at the apex. Short scutum (sc), anterior margin arched; scutellum (sct) quadrangular with posterior edge slightly emarginate (Fig. 2).

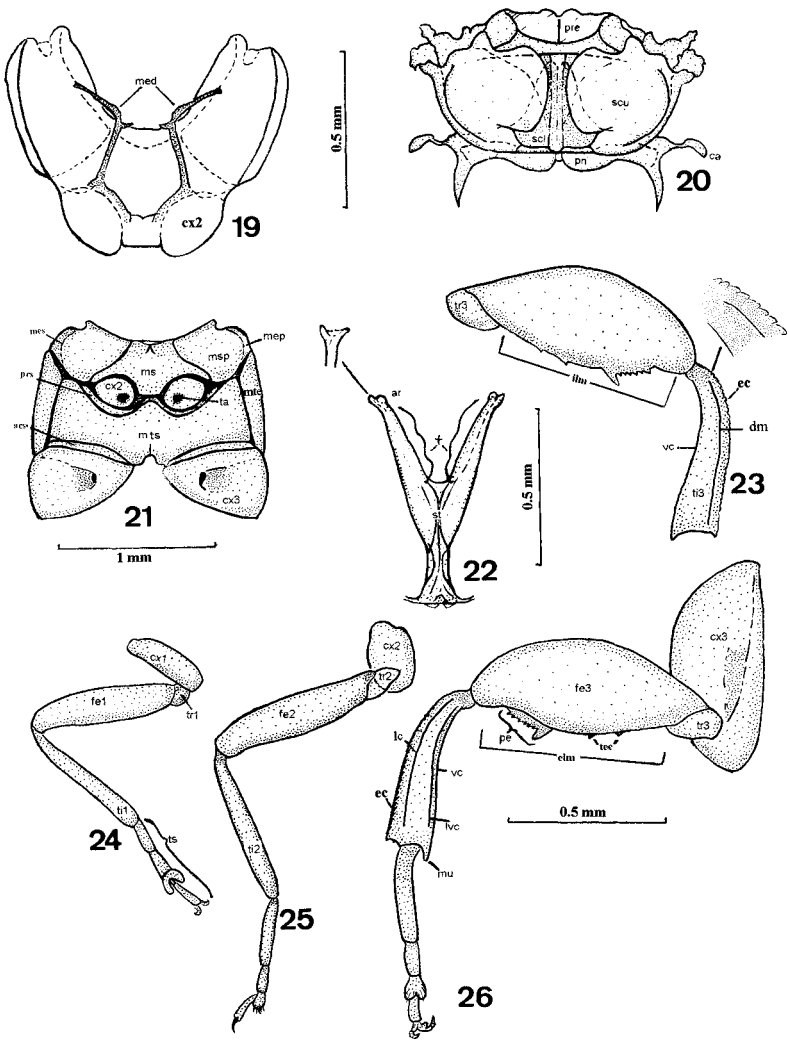
Elytron with a length about two times that of its largest width, all striae with moderately thick punctures followed by slender sulci (Fig. 46). Basal region with the fourth stria shorter than the third and the fifth, starting with a small elevation or tooth (to) (Figs. 1, 3, 46). Mesepimeron (Fig. 3) reduced to a small triangular sclerite above the mesepisternum, separated from this by the mesopleural suture (mes). Mesepisternum (msp) more developed, reaching the coxal cavity (Figs. 3, 21). Truncate mesosternum (ms) between the middle coxae. Mesendosternite (med) (Fig. 19) with slender arms slightly convergent and inclined dorsally toward the sides; with two small processes turned inward near the divergent area (Fig. 19).

The scutum (scu) is the largest part of the metanotum (Fig. 20), with two rounded areas slightly convex; between these areas an elongate medial depression with prominent parallel margins; anteriorly bounded by the acrotergite which is contiguous with the prephragma (pre), this bent inward and with a bilobed anterior margin; scutellum represented externally by the medial depression and internally by strong apodemes that diverge toward the apex; postnotum (pn) contiguous with the postphragma, medially bilobed, with two lateral projections slightly arched and angular. Metepimeron covered by the elytra while the metepisternum is wide and lacks sulci or sutures (Fig. 3). Metasternum (mts) (Fig. 21) bordered anteriorly by the postcoxal sclerite (pcs) which surrounds part of the medial coxal cavities, and posteriorally by the antecoxal sclerite (acs). Metendosternite in the shape of a "Y", arms divergent (ar) with apex in lateral view subtriangular; tendons long (t) (Fig. 22). Axillary region of the hind wing (Fig. 27) constituted by three axillary sclerites (1Ax, 2Ax and 3Ax) and two contiguous middle plates (proximal, Mp and distal, Mp′). Besides the axillary area, hind wings show the remigial regions (Rr), vannal (Vr) and jugal (Jr) regions and two fold-lines, the anterior (Af) and the posterior (Pf). Costa (C) is a short and moderately sclerotized vein, situated at the anterior basal part of the costal margin (MC) and its base is associated with the humeral plate (Hp). Subcosta (Sc) associated at the base with the 1°

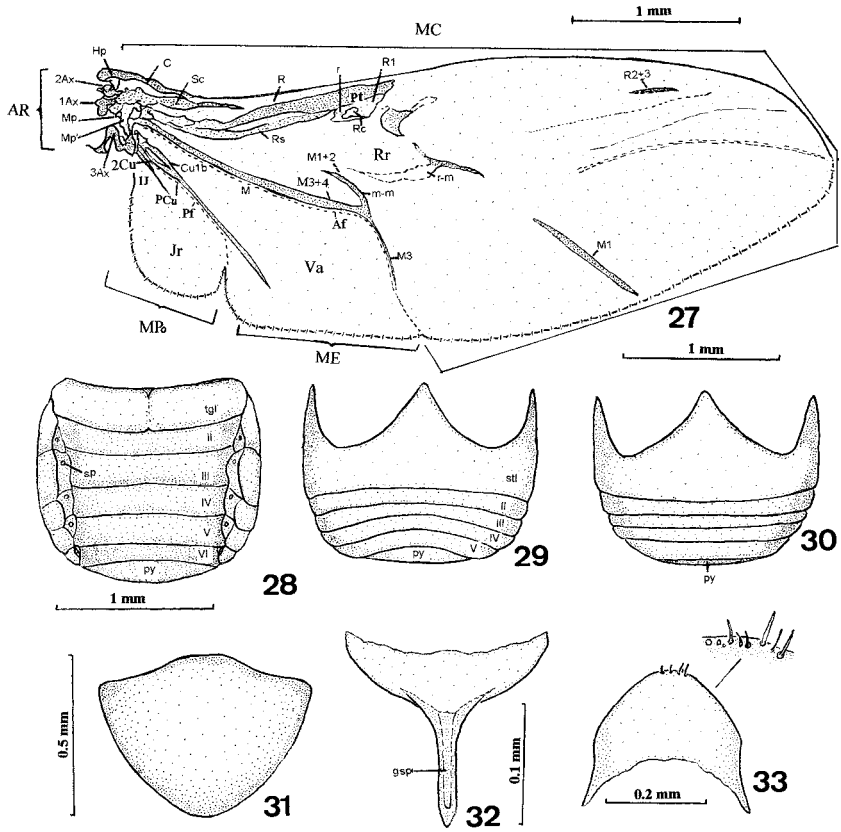


Figs. 10–18. *Meibomeus cyannipenis* (Sharp). **10)** ventral view of the labrum; **11)** inner face of the left mandible; **12)** left maxilla; **13)** labium, outer view; **14)** labium, inner view; **15)** pronotum, dorsal view; **16)** pronotum, ventral view; **17)** pronotum, anterior view; **18)** pronotum, posterior view. afo = anterior foramen, beg = basal sclerite of the galea, bl = basal lobe, bs = basal stipe, cb = cervical boss, cc = anterior coxal cavity, cd = cardo, con = condyle, cs = cervical sulcus, epl = epilobe, ga = galea, las = labial suture, lc = lacinia, li = ligula, lp = labial palp, ls = labral suture, m = mentum, mes = suture of the mentum, ml = mola, mp = maxillary palp, ms = mesostipe, pd = pronotal disk, ped = proendosternite, pf = palpifer, pm = prementum, pr = prostheca, ps = prosternum, sbs = submarginal sulcus, tr = torma.

axillary sclerite (1Ax), longer than the costa (C), contacting this in a small area. Radial vein (R) associated with the 2° axillary sclerite (2Ax), about one-third the length of the wing, forming distally the pterostigma (Pt). This consists of a small radial cell (Rc) formed by veins R1 and r. In the third apical of the wing there is an isolated branch formed by the fusion of R_{2+3} veins. Radial sector (R_S) submembranous, extending subparallel to R. Media vein (M) associated in the axillary region with the R vein and

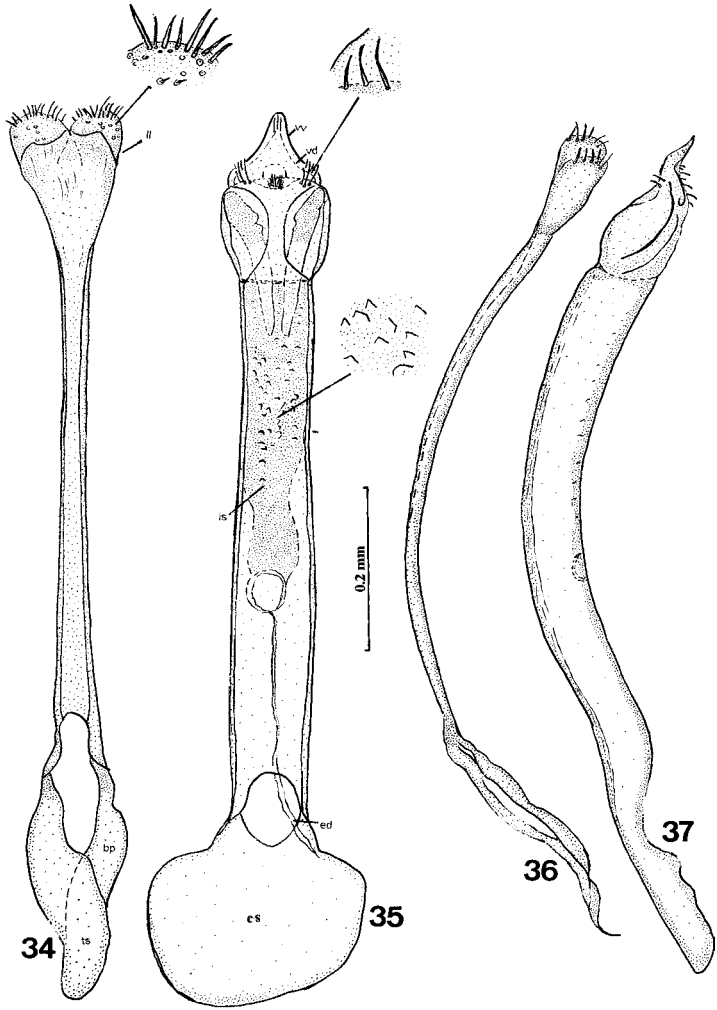


Figs. 19–26. *Meibomeus cyanipennis* (Sharp). **19)** inner view of the mesosternum; **20)** metanotum; **21)** ventral view of the thorax; **22)** metendosternite; **23)** inner view of the hind leg except for the coxa and tarsals; **24)** fore leg; **25)** middle leg; **26)** hind leg. acs = antecoxal sclerite, ar = arms, ca = wing condyle, cx1 = anterior coxa, cx2 = middle coxa, cx3 = hind coxa, dm = dorsomesal carina, ec = external carina, elm = external lateral margin, fe1 = anterior femur, fe2 = middle femur, fe3 = hind femur, ilm = inner lateral margin, lc = lateral carina, lvc = lateroventral carina, med = mesendosternite, mep = mesepimeron, mes = mesopleural suture, ms = mesosternum, msp = mesepisternum, mte = metepisternum, mts = metasternum, mu = mucro, pe = pecten, pn = postnotum, pre = prephragma, scl = scutellum, scu = scutum, pcs = postcoxal sclerite, st = stalk, t = tendons, ta = acetabulum of the trochanter, ti1 = anterior tibia, ti2 = middle tibia, ti3 = hind tibia, tee = teeth, tr1 = anterior trochanter, tr2 = middle trochanter, tr3 = hind trochanter, ts = tarsals, vc = ventral carina.



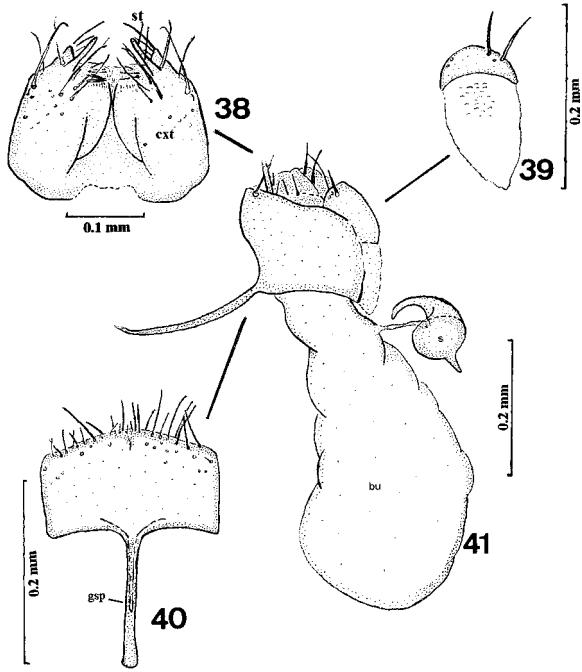
Figs. 27–33. *Meibomeus cyannipenis* (Sharp). **27)** Right hind wing; **28)** dorsal view of the abdomen; **29)** male abdomen; **30)** female abdomen; **31)** pygidium; **32)** eighth sternum; **33)** eighth tergum. Af = anterior fold, AR = axillary region, 1Ax = first axillary sclerite, 2Ax = second axillary sclerite, 3Ax = third axillary sclerite, C = costa, Cu1b = cubitus, 2Cu = cubitus cell, gsp = spiculum gastrale, Jr = jugal region, 1J = jugal vein, Hp = humeral plate, M = middle vein, M1 = middle branch1, M1 + 2 = middle 1 + 2, M3 + 4 = middle 3 + 4, M3 = middle 3, m-m = transverse middle, ME = externalmargin, MC = costal margin, MP_o = posterior margin, Mp = proximal middle plate, Mp′ = distal middle plate, PCu = Post-cubitus, Pf = posterior fold, Pt = pterostigma, py = pygidium, R = radial, r = radial transverse vein, Rr = remigial region, R1 = radial 1, R2 + 3 = radial 2 + 3, Rc = radial cell, r-m = radial-middle transverse vein, Rs = radial sector, Sc = subcosta, sp = spiracle, stI = first urosternite, tgI = first urotergite, Va = vannal region.

distal median plate (Mp′); it is extended obliquely up to about the middle of the length of the wing. Branches M, M_{3+4}, m-m, M_{1+2} form an open cell. From this, the subbranch M3, is directed to the external margin of the wing while M1 is an oblique branch, isolated, in the distal part of the wing. The r-m and M_{1+2} are placed in the medial part of the wing. The vannal region is composed of M3 and by the fusion of the cubitus and post-cubitus veins. The cubitus (Cu_{1b}) and post-cubitus (Pcu) form the cubitus cell, (2Cu,) near the base of the wing. Basal part of the Cu_{1b} associated with the 3° axillary sclerite (3Ax). Jugal region with distinct short vein, the jugal vein (1J).



Figs. 34–37. *Meibomeus cyannipenis* (Sharp). Male terminalia. **34)** tegmen, ventral view; **35)** medial lobe, ventral view; **36)** tegmen, lateral view; **37)** medial lobe, lateral view. cs = cucullus, bp = basal piece, ed = ejaculatory duct, is = internal sac, ll = lateral lobes, ts = tegminal strut, vd = dorsal valve, vv = ventral valve.

Anterior coxa (cx1) (Fig. 24), elongate, subcylindrical, gradually connate at the apex; trochanter subtriangular (tr1); femur (fe1) a little shorter than the tibia; first tarsal segment with a length similar to the second. Middle coxa (cx2) rounded (Fig. 25), less prominent than anterior one; femur (fe2) and tibia (ti2) almost equal in length; first tarsal segment about twice the length of the second. Hind leg with coxa (cx3) (Figs. 3, 21, 26) conspicuously different than the others, length similar to the largest width of the hind femur and being inserted almost totally in the coxal cavity, being visible only the external face which shows foveolae evenly distributed for the most part, except in the

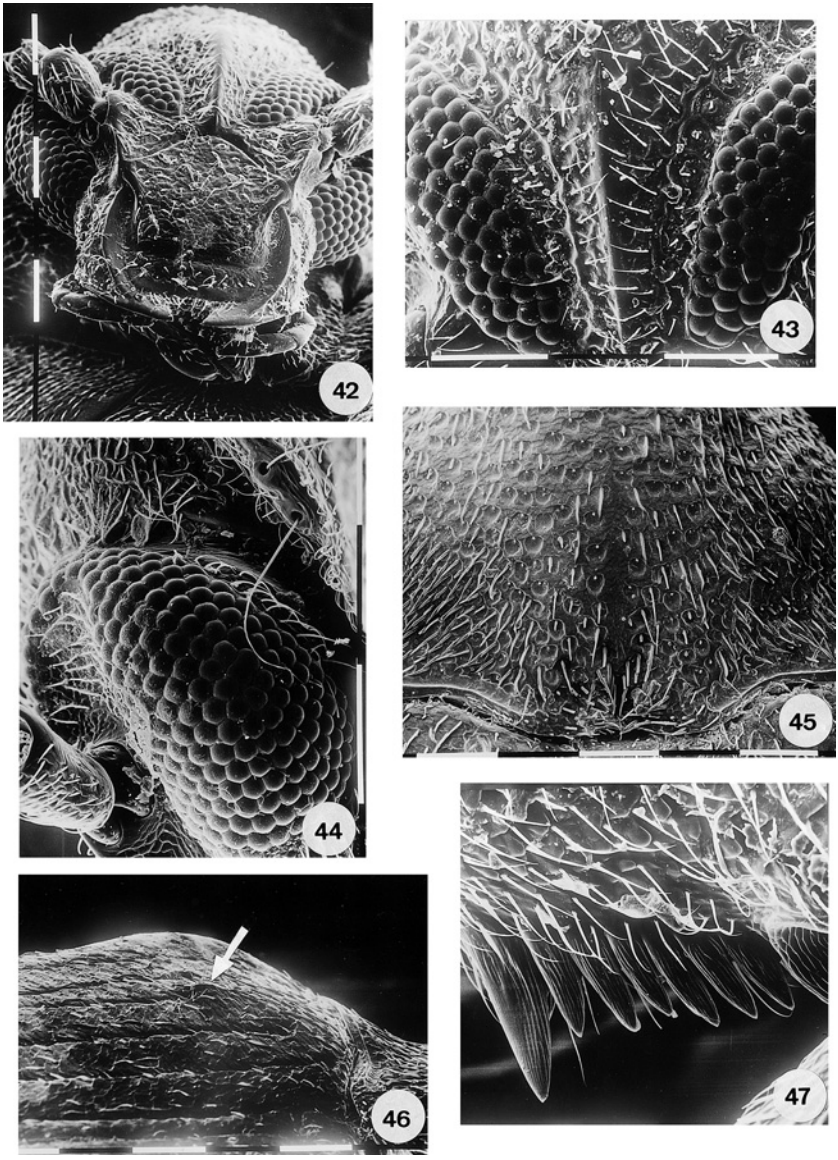


Figs. 38–41. *Meibomeus cyanipennis* (Sharp). Female terminalia. **38)** ovipositor; **39)** eighth tergum; **40)** eighth sternum; **41)** female terminalia, lateral view. cxt = coxite, gsp = spiculum gastrale, bu = bursa, s = spermatheca, st = stylus.

anterior cavity where the femur (fe3) is encased. This slightly narrower at the base than at the apex, with external lateral margin (elm), sinuous and lacking carinae (Fig. 26); internal lateral margin (ilm) (Fig. 23) without teeth or with two denticles (tee) anterior to the pecten (pe), which is constituted by an elongate tooth followed by a row of five to six denticles (Figs. 23, 26, 47). First denticle, if present, at about less than half the femur length, and the second at the middle of its length. Hind tibia (Fig. 26), at the lateral margin, with two carinae, lateroventral (lvc) and lateral (lc), subparallel and of the same length; the lateroventral terminating in the direction of the mucro and the lateral in the direction of one of the coronal denticles. Ventral carina (vc) straight in ¾ apical, slightly curved near the base; external carina (ec) slightly rough (Fig. 23). Internal face (Fig. 23) with long dorsomesal carina (dm), not reaching the apex of the tibia and distant from the external carina (ec) at about 1/4 of the largest width of the tibia. First posterior tarsal article approximately 2.5 times the length of the second.

Seven visible urotergites, with five pairs of spiracles in the pleurites of the abdominal segments (Fig. 28). Pygidium (py) with curved lateral margins and rounded apex (Fig. 31). Length of the first urosternite in the medial region, slightly larger than the rest of the sterna. From the second to the fifth urosternite with a similar size, emarginate in males (Fig. 29) whereas in the females with a straight apical margin (Fig. 30).

Male terminalia. Eighth urotergite, almost membranous, rounded apex with a few short setae (Fig. 33); eighth urosternite with the shape of a "T", basal region membranous and apical region sclerotized termed the spiculum gastrale (gsp) (Fig. 32). Median lobe (Fig. 35) as a conspicuously elongate tube, sclerotized for the most part



Figs. 42–47. *Meibomeus cyannipenis* (Sharp). **42)** anterior view of the head (143×); **43)** frons and part of the eyes (274×); **44)** eyes from lateral view (341×); **45)** dorsal view of the pronotum (186×); **46)** dorsal view of part of the elytrum with setae indicating the presence of a tooth at the base of the fourth stria (170×); **47)** pecten (503×).

and with vestige of a fracture near the apical region. Dorsal valve (dv) and ventral valve (vv) triangular, with convex lateral margins and groups of small setae at the base. Middle lobe with a rounded basal region, slightly concave, called the cucullus (cs). Internal sac (is) attached in the base of the valves, near the apical orifice of the middle lobe and has sparse denticles. Tegmen (Fig. 34) extremely elongate, narrow, with parallel lateral margins and rounded lateral lobes, with short setae and separated by a slight emargination.

Female terminalia. Eighth urotergite (Fig. 39), reduced, with the apex more sclerotized than the base and with few long setae. Eighth urosternite (Fig. 40) has a rectangular appearance, anterior margin slightly rounded and with short and long setae; spiculum gastrale (gsp) slightly curved from the side view (Fig. 41). The ovipositor (Fig. 38), the ninth abdominal segment, is enveloped by the eighth tergum and sternum, consisting of two coxites (cxt) with a slight medial depression, some long setae at the apex and two slender styli (st). Bursa (bu) (Fig. 41) membranous and without sclerites. Spermatheca (s) in the form of a broadened capsule with strongly curved projection; duct short and united to the apical region of the bursa.

General Considerations

Meibomeus cyanipennis is externally similar to *M. sulinus* Silva and Ribeiro-Costa. In *M. cyanipennis* the male internal sac has separated denticles whereas in *M. sulinus* these groups together form two rows.

The occipital sulcus of *M. cyanipennis* is not as evident as in Pachymerinae (Nilsson and Johnson 1993). This sulcus corresponds to the occipital suture, which according to Singh (1982), is absent in Bruchidae. The postoccipital suture is absent in *M. cyanipennis* and in *Caryedon gonagra* (Mathur and Dadhial 1963). However, Singh (1982) reported the presence of such a suture in genera that he studied.

The medial process at the tentorial bridge described by Singh (1981*b*) in *Callosobruchus chinensis* was not observed in *M. cyanipennis*.

In the illustrations of the maxilla of *Caryedon gonagra* (F.) (Mathur and Dadhial 1963:269; Singh 1986:56) there is a differentiated annulate area at the base of the galea. In *M. cyanipennis* the presence of a sclerite was observed surrounding the base of the galea, which had simple and unipectinate setae, similar to those of *Specularius bridwelli* Arora (Singh 1986).

The palpigers of *M. cyanipennis* are not differentiated from the prementum as in *Caryedon gonagra* (F.) (Mathur and Dadhial 1963:269) and *Callosobruchus chinensis* (Singh, 1981*b*).

The number of setae on the cervical boss varies in Bruchidae. In *M. cyanipennis* there are two setae. These number is characteristc of specialized bruchids (Kingsolver, pers. comm.).

The costal vein in *M. cyanipennis* does not show a break as in *Caryedon lineatonota* Arora, nor is it very curved as in *Sulcobruchus kingsolveri* Arora (Singh 1981). In *Bruchus*, *Conicobruchus*, *Caryedon*, *Spermophagus*, *Sulcobruchus* and *Zabrotes*, the branch M1 is very elongate, connecting to r-m (Singh 1981*a*). In *M. cyanipennis*, M1 is isolated and localized in the distal part of the wing, with no connection to r-m.

The shape of the metendosternite of *M. cyanipennis* resembles more that of *Rhaebus gebleri* Fischer (Rhaebinae Chapuis) (Crowson 1955). Daviault (1928:112) illustrated the metendosternite of *Acanthoscelides obtectus* (Bruchinae) and Crowson (1944: fig. 85) the metendosternite of *Caryoborus rubidus* (Chev.) [= *Caryobruchus rubidus* (Chev.)] (Pachymerinae). In both species, the metendosternite differs in relation to *M. cyanipennis*. In the case of *A. obtectus*, principally by the shape of the apex of the arms, and in the case of *C. rubidus* by the wide divergence of these.

In *M. cyanipennis* no sclerites were found in the bursa. Nevertheless, in some species of *Amblycerus* Thunberg (Ribeiro-Costa, pers. comm.) and Pachymerinae (Nilsson and Johnson 1993) sclerites are present in different shapes and sizes.

Acknowledgments

We would like to thank Dra. Danuncia Urban, Dr. John M. Kingsolver and Dr. Clarence D. Johnson for reviewing the manuscript.

Literature Cited

Crowson, R. A. 1944. Futher studies on the metendosternite in Coleoptera. Transactions of the Royal Entomological Society of London 94(2):273–310.

Crowson, R. A. 1955. The natural classification of the families of Coleoptera. Nathanial Lloyd, London. vi + 187 pp.

Daviault, L. 1928. Sur le développement post-embryonnaire de la bruche du haricot: *Acanthoscelides obtectus* Say. Suivi de considérations sur la signification phylétique de son dimorphisme larvaire. Annales de la Société Entomologique de France 97:105–132.

Johnson, C. D., and J. M. Kingsolver. 1973. Revision of the genus *Sennius* Bridwell, 1946 (Coleoptera: Bruchidae). United States Department of Agriculture Technical Bulletin 1744. 63 pp.

Kingsolver, J. M. 1970. A study of male genitalia in Bruchidae. Proceedings of the Entomological Society of Washington 73:370–386.

Kingsolver, J. M. 1988. Systematics of the genus *Merobruchus* of Continental North America and the West Indies (Coleoptera: Bruchidae). United States Department of Agriculture Technical Bulletin 1744. 63 pp.

Kingsolver, J. M., and D. R. Whitehead. 1976. The North and Central American species of *Meibomeus* (Coleoptera: Bruchidae: Bruchinae). United States Department of Agriculture Technical Bulletin 1523. 54 pp.

Mathur, P. N., and R. K. Dhadial. 1963. Morphology of the head capsule and mouth parts of *Caryedon gonagra* Fabricius (Coleoptera: Bruchidae). Proceedings of the Entomological Society of Washington 65:265–273.

Matsuda, R. 1976. Morphology and evolution of the insect abdomen. Pergamon Press, Oxford, England. 231–255. x + 533 pp.

Mukerji, D., and M. A. H. Bhuya. 1937. Reproductive system of the bruchid beetles *Bruchus quadrimaculatus* Fabr., *Bruchus* (*Callosobruchus*) *chinensis* L. (Bruchidae-Coleoptera). Journal Morphological 61(1):175–221.

Nilsson, J. A., and C. D. Johnson. 1993. A taxonomic revision of the palm bruchids (Pachymerini) and a description of the World Genera of Pachymerinae (Coleoptera: Bruchidae: Pachymerinae). Memoirs of the American Entomological Society 41, 104 pp.

Romero, J., and C. D. Johnson. 1999. *Zabrotes sylvestris*, a new species from the United States and Mexico related to *Z. subfasciatus* (Boheman) (Coleoptera: Bruchidae: Amblycerinae). Coleopterists Bulletin 53:87–98.

Romero, J., and C. D. Johnson. 2002. Five new species of *Meibomeus* Bridwell from the New World with host records for them and six named species (Coleoptera: Bruchidae). Coleopterists Bulletin 56:182–202.

Silva, J. A. P., and C. S. Ribeiro-Costa. 2001. Revisão das espécies sul-americanas de *Meibomeus* Bridwell, 1946 (Coleoptera: Bruchidae). Revista Brasileira de Entomologia. 45(4):305–324.

Sharp, D., and F. Muir. 1912. The comparative anatomy of the male genital tube in Coleoptera. Part III. Transactions of the Royal Entomological Society of London 1912:447–642.

Singh, T. 1981*a*. A taxonomic study of the wing of Bruchidae (Coleoptera). Oriental Insects 15(2):221–225.

Singh, T. 1981*b*. Morphology and musculature of the head capsule and mouthparts of *Callosobruchus chinensis* (L.) (Coleoptera: Bruchidae). Indian Zoologist 5(1 and 2):97–102.

Singh, T. 1982. Comparative morphology of the head capsule of adult Bruchidae (Coleoptera) and

its taxonomic significance. Research Bulletin (Science) of the Panjab University 33. Parts I–II:93–99.

Singh, T. 1986. A taxonomic study on the head appendages of adult Bruchidae (Coleoptera). Uttar Pradesh Journal Zoological 6(1):52–57.

Snodgrass, R. E. 1935. Principles of insect morphology. McGraw-Hill, New York, vi + 667 pp.

Suzuki, K. 1994. Comparative morphology of the hind wing venation of the Chrysomelidae (Coleoptera) [pp. 337–354]. *In:* Novel aspects of the biology of Chrysomelidae (P. H. Jolivet and M. L. Cox, editors). Petitpierre publishers, Netherlands.

(Received 5 November 2001; accepted 10 April 2002. Publication date 12 September 2003.)

BOOK REVIEW

HUCHET, J.-B. 2003. **Insecta Coleoptera Chironidae.** *Faune de Madagascar 90*, 88 pp. ISSN 0428-0709. Price: 37 Euros (about 40 US). Available at the Fauna of Madagascar website: http://www.mnhn.fr/publication/faunemad/index.html.

The Fauna of Madagascar series has been around for almost 50 years. In that time authors have published on a variety of taxa that occur on this remarkable island. Throughout the history of the series there has been a heavy emphasis on beetles. The latest volume by Jean-Bernard Huchet is no exception. Huchet is an expert on Chironidae (or Chironinae depending on which scarab classification scheme you ascribe to). He is in the process of giving a much-needed taxonomic overhaul to the group. Chironidae are odd-looking scarabs that occur in Africa, Asia (mainly India), and Madagascar and are allied taxonomically with Aphodiinae.

Huchet presents an excellent survey of the four species of Chironidae of Madagascar. The text is in French with English translations for the abstract, key to species, and the descriptions of the two new species. The volume begins with an introduction containing an overview of the taxonomic history of the group and a discussion of the biogeography and origin of Chironidae. This is followed by a detailed taxonomic treatment for all taxa (species, subgenera, and genera) occurring in Madagascar. Also provided in this section are the key to all the species, distributional data, habitat information, a larval description for one of the genera, and information on the phoretic mites found on Chironidae in the study region. Finally, there are color habitat images and maps for Madagascar and excellent illustrations and SEMs (65 figures in total) of many adult and larval character states necessary for identification and taxonomic placement.

Overall this is an excellent work. The only drawback is the somewhat steep price relative to the size and scope of the volume. Anyone interested in African and Madagascan scarabs and those generally interested in the fauna and biogeography of Madagascar should consider buying a copy. Longtime fans of the Fauna of Madagascar series will notice the facelift it has experienced in recent years. Gone are the simple paper covers and plain colors. The new layout looks attractive with a slick cover design and crisp color images within. The text is now more appealing to look at and much easier to read. The paper used is thick and a marked improvement over the older volumes.

Andrew B. T. Smith, *Division of Entomology, W436 Nebraska Hall, University of Nebraska State Museum, Lincoln, NE 68588-0514, U.S.A.*

(Received and accepted 22 April 2003. Publication date 12 September 2003.)