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A New Subgenus of *Megachile* from Borneo with *Arolia* (Hymenoptera: Megachilidae)

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ABSTRACT

A new subgenus of the bee genus *Megachile* (Megachilinae: Megachilini) is described from Mt. Matang in Borneo. *Matangapis*, new subgenus, is proposed for *Megachile alticola* Cameron, and is most noteworthy for the possession of arolia on all pretarsi of both sexes. The significance of arolia on *M. alticola* is briefly discussed in the context of the distinctiveness of the tribes Megachilini and Osmiini. Notes on two Oriental subgenera of *Megachile*, *Orientocressoniella* and *Neocressoniella*, are appended. The following taxonomic changes are proposed: *Orientocressoniella* is a new junior synonym of *Callomegachile*, *Neocressoniella* is a new junior synonym of *Xanthosarus*, *Anthophora barbata* Fabricius is a new synonym (senior but suppressed) of *M. carbonaria* Smith, *M. amputatiformis* Cockerell is a new junior synonym of *M. saigonensis* Cockerell, *M. saphira* Cockerell is a new junior synonym of *M. ulrica* Nurse. In addition, the following five species are newly transferred to subgenus *Chelostomoda*: *M. ulrica*, *M. lefroma* Cameron, *M. albolineata* Cameron, *M. funnelli* Cockerell, and *M. bougainvillei* Cockerell. Lectotypes are newly designated for *M. alticola* and *M. anthracina* Smith.

INTRODUCTION

The bee tribe Megachilini is a cosmopolitan and distinctive lineage of long-tongued bees and presently comprises three genera—the cleptoparasitic *Coelioxys* and *Radoszkowskiana* and the free-living species of *Megachile* (table 1). The latter genus, which includes among its members the familiar leaf-cutter bees, is remarkably diverse and has in the past been segregated into multiple genera (e.g., Michener, 1962; Mitchell, 1980). Indeed, once the relationships of the various subgroups within *Megachile* (*sensu* Michener, 2000) are established, a multigeneric system might be warranted. The phylogeny of *Megachile* is presently under critical investigation by Mr. V.H. Gonzalez, and it is hoped that much light will eventually be shed on the natural classification of the lineage. At present one of the least understood faunas for *Megachile*, and many bees in general, are those of Asia. Numerous species are known to exist in this region, some with character combinations that may prove to be crucial in resolving megachiline evolution. Unfortunately, the monographic work that is needed as the foundation for such studies has not been undertaken. The present brief contribution is designed to provide insight into the taxonomic placement of one such critical species as well as to provide some taxonomic notes toward clarifying the confusing Asiatic *Megachile* fauna.

Herein is provided an account of a strange, long-described but apparently little-known, Bornean species, *Megachile alticola* Cameron, 1902, obtained by several collectors on

or near Mt. Matang but not, apparently, obtained elsewhere. The species is remarkable among *Megachile* most notably for the possession of arolia on all pretarsi of both sexes. Indeed, under the more highly split classifications of Megachilini the taxon considered herein would be accorded generic rank. Morphological terminology in the descriptions generally follows that outlined by Engel (2001).

SYSTEMATICS

Genus *Megachile* Latreille
Matangapis, new subgenus

TYPE SPECIES: *Megachile alticola* Cameron, 1902.

DIAGNOSIS: Size small (ca. 8 mm); habitus compact (figs. 1–2); metasoma in both sexes short, in dried material globular, not or little longer than mesosoma; vertex and genae very coarsely, reticulately punctate, several times more coarsely than mesoscutum (as in *Chelostomoda*); female mandible quadridentate, male mandible bidentate; all distitarsi aroliate; distitarsi coarsely setose, apex of each subangularly excised dorsally, accommodating base of pretarsus; pretarsus with orbicula well developed and bearing two strong setae, a distinct unguifer not observed, probably usually invaginated within distitarsus in dried material; arolium well developed (fig. 5) but weakly sclerotized, consequently usually seen crumpled in dried material; a camera distinct; pretarsal ungues (claws) bifid in male, simple in female.

DESCRIPTION: **Male.** Head in frontal aspect

TABLE 1
Current Hierarchical Classification of Tribe Megachilini
 (based on Michener, 2000, and synonymies proposed herein: vide appendix)

—Tribe **MEGACHILINI** Latreille—

Genus <i>MEGACHILE</i> Latreille subgenus <i>Acentron</i> Mitchell subgenus <i>Amegachile</i> Friese subgenus <i>Argyropile</i> Mitchell subgenus <i>Austrochile</i> Michener subgenus <i>Austromegachile</i> Mitchell subgenus <i>Callomegachile</i> Michener subgenus <i>Cestella</i> Pasteels subgenus <i>Chalicodoma</i> Lepeletier de Saint Fargeau subgenus <i>Chalicodomoides</i> Michener subgenus † <i>Chalicodomopsis</i> Engel subgenus <i>Chelostomoda</i> Michener subgenus <i>Chelostomoides</i> Robertson subgenus <i>Chryosarus</i> Mitchell subgenus <i>Creightonella</i> Cockerell subgenus <i>Cressoniella</i> Mitchell subgenus <i>Cuspidella</i> Pasteels subgenus <i>Dasymegachile</i> Mitchell subgenus <i>Eumegachile</i> Friese subgenus <i>Eutricharaea</i> Thomson subgenus <i>Gronoceras</i> Cockerell subgenus <i>Grosapis</i> Mitchell subgenus <i>Hackeriapis</i> Cockerell subgenus <i>Heriadopsis</i> Cockerell subgenus <i>Largella</i> Pasteels subgenus <i>Leptorachis</i> Mitchell subgenus <i>Litomegachile</i> Mitchell subgenus <i>Matangapis</i> Baker & Engel subgenus <i>Maximegachile</i> Guiglia & Pasteels subgenus <i>Megachile</i> Latreille subgenus <i>Megachiloides</i> Mitchell subgenus <i>Megella</i> Pasteels subgenus <i>Melanosarus</i> Mitchell subgenus <i>Mitchellapis</i> Michener subgenus <i>Moureapis</i> Raw subgenus <i>Neochalicodoma</i> Pasteels subgenus <i>Neochelynia</i> Schrottky	subgenus <i>Paracella</i> Michener subgenus <i>Parachalicodoma</i> Pasteels subgenus <i>Platysta</i> Pasteels subgenus <i>Pseudocentron</i> Mitchell subgenus <i>Pseudomegachile</i> Friese subgenus <i>Ptilosaroides</i> Mitchell subgenus <i>Ptilosarus</i> Mitchell subgenus <i>Rhomomegachile</i> Michener subgenus <i>Rhyssomegachile</i> Mitchell subgenus <i>Sayapis</i> Titus subgenus <i>Schizomegachile</i> Michener subgenus <i>Schrottkyapis</i> Mitchell subgenus <i>Stellenigris</i> Meunier subgenus <i>Stelodides</i> Moure subgenus <i>Stenomegachile</i> Pasteels subgenus <i>Thaumatosoma</i> Smith subgenus <i>Trichurochile</i> Mitchell subgenus <i>Tylomegachile</i> Moure subgenus <i>Xanthosarus</i> Robertson subgenus <i>Zonomegachile</i> Mitchell Genus <i>COELIOXYS</i> Latreille subgenus <i>Acrocoelioxys</i> Mitchell subgenus <i>Allocoelioxys</i> Tkalců subgenus <i>Argcoelioxys</i> Warncke subgenus <i>Boreocoelioxys</i> Mitchell subgenus <i>Coelioxys</i> Latreille subgenus <i>Cyrtoceelioxys</i> Mitchell subgenus <i>Glyptocoelioxys</i> Mitchell subgenus <i>Haplocoelioxys</i> Mitchell subgenus <i>Liothyrapis</i> Cockerell subgenus <i>Neocoelioxys</i> Mitchell subgenus <i>Platycoelioxys</i> Mitchell subgenus <i>Rhinocoelioxys</i> Mitchell subgenus <i>Synocoelioxys</i> Mitchell subgenus <i>Torridapis</i> Pasteels subgenus <i>Xerocoelioxys</i> Mitchell Genus <i>RADOSZKOWSKIANA</i> Popov
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transverse (fig. 4), width: length (to clypeal margin) ratio 1: 0.85. Vertex short, lateral ocelli separated from preoccipital ridge by less than twice their diameter; preoccipital ridge sharply angular dorsally, becoming carinate laterally. Clypeal margin unmodified, straight; surface of clypeus moderately convex, coarsely and densely punctate with long, erect, simple setae arising from punctures, integument glossy between punctures, apically (as adjacent parts of paraocular areas) with appressed plumose pubescence (i.e., the

clypeus as in most *Pseudomegachile*). Lower part of gena not structurally modified but with long, dense pubescence in hypostomal area. Mandible slender, apical margin oblique, bidentate (fig. 7); surface between the coarse, elongate punctures glossy; juxtagenital process absent. Antenna moderately elongate, reaching in repose to slightly beyond mesosoma; A13 compressed and slightly expanded.

Mesosoma short, length (from anterior margin of mesoscutum to posterior margin of



Figs. 1-2. Photomicrographs of *Megachile (Matangapis) alticola* Cameron. 1. Female, lateral habitus. 2. Male, lateral habitus.

scutellum): width (between tegulae) ratio 1: 0.96. Pretarsal ungues cleft and arolium present on all legs; procoxa unmodified, mutic, anterior surface without cluster of rufescent setae, simply, uniformly pubescent; profemur, protibia, and protarsus unmodified; protarsus slender, with short, even, anterior fringe and longer, irregular posterior fringe; probasitarsus parallel-sided, about three times as long as broad; speculi absent. Mid-legs unmodified, mesotibial calcar present; mesotarsal fringes as described for forelegs.

Metafemur and metatibia moderately thickened; metatibia slightly longer than metafemur, at its thickest, at about two-thirds of its length, not thicker than metafemur; two calcaria present; metafemur ventrally with thin fringe of long, simple setae; metatibia ventrally with thin fringe of long, coarsely plumose setae; metatarsus without conspicuous setal fringes.

Metasomal terga without distinct marginal areas, with marginal fasciae, these short and lateral on T1, meeting or nearly meeting on



Figs. 3–4. Photomicrographs of *Megachile (Matangapis) alticola* Cameron. **3.** Female, facial view. **4.** Male, facial view.

T4; T1 short, its dorsal surface medially not greatly longer than ocellar diameter, thinly clothed with long, erect, pale setae; T2 and T3 weakly punctate; T4 and T5 with weak, postgradular sulci, sulci not fasciate; T6 in median third with weak transverse ridge not forming a distinct carina, in profile tergum concave before ridge, weakly convex beyond it, margin without lateral teeth; T7 short, in profile its dorsal surface concave, ending in a distinct lip that in dorsal aspect occupies median third of its width, ventral surface narrow, apical margin simply arcuate, without

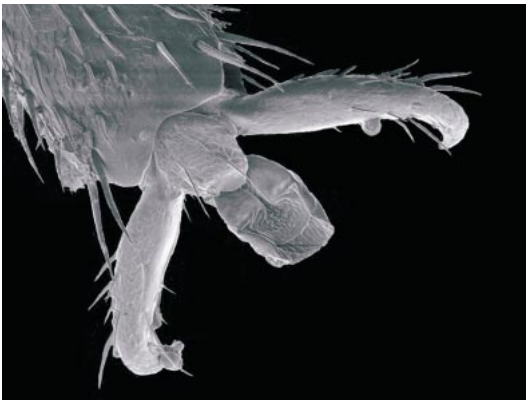


Fig. 5. Scanning electron micrograph of the metapretarsus and metadistitarsal apex of *Megachile (Matangapis) alticola* Cameron depicting large arolium. Arolia are present on all legs of both sexes; the claws of the female (seen here) are simple, whereas those of males are bifid. The small, spheroid objects on the claws are grains of pollen.

teeth. Venter with three normally exposed sterna; S1 deeply, angularly emarginate, the two sides of the emargination forming an angle of about 100° , the base of the emargination enclosed by a V-shaped depression whose apex extends nearly to the base of the sternum, this depression clothed with fine, decumbent, golden pubescence, laterally sternum rather narrowly exposed, broadly overlapped by ventrolateral extension of T1, forming a nearly parallel-sided plate; apically angles of emargination rather broadly rounded; S2 without special structural characters, apically truncate, with dense, broad marginal fascia of white plumose setae; S3 with weak median longitudinal sulcus, apical margin broadly convex, disc thinly clothed with appressed, white, plumose setae, this clothing becoming denser apically on either side of median sulcus; S4 weakly sclerotized, short, rectangular (fig. 8), its apical margin weakly incised medially, the area raised laterally, enclosed by graduli, which are strongly convergent apically and approach apical margin at about one-third inward from its lateral angles, minutely setose; S5 much narrowed mesad, its apicolateral lobes with erect, pale setae arising from a dense, conspicuous cluster of black alveoli, inwardly of each apicolateral lobe with a broad marginal tract, decrescent mesally and not quite reaching midline, of stronger setae arising from pale, well-separated alveoli, these setae either inclined or, toward the margin, strongly bent, mesally (fig. 9); S6 lacking special structural or setal

characters, its apical margin biemarginate, forming a convex median lobe and lateral lobes (fig. 10); S8 of simple outline, shaped as in *M. (Hackeriapis) trichognatha* Cockerell, 1910 (cf. Michener, 1965: 190, his fig. 654), apically, laterally, with a few very weak marginal setae. Genital capsule short and broad (figs. 12, 13); gonocoxa with short, subacute, lateral process; gonocoxae apically divergent, decurved, decurved portion in lateral aspect triangularly expanded (fig. 12); penis valves basally widely separated, convergent apically, their apices roundly expanded.

Female. Head in frontal aspect transverse (fig. 3), width: length (to clypeal margin) ratio 1:0.83. Vertex short, lateral ocelli separated from preoccipital ridge by little more than their own diameter; preoccipital ridge sharply angular dorsally, becoming subcarinate laterally. Clypeal margin weakly concave medially; general surface of clypeus nearly plane, coarsely, reticulately punctate, together with supraclypeal and interantennal areas clothed with stiff, pale, suberect, apically proclinate setae, the proclinate portions more or less spiriform. Mandible quadridentate (fig. 6), without intercalary cutting edges; third tooth weak (as counting from bottom to top), its sides forming an angle of about 165°.

Mesosoma short, length (from anterior margin of mesoscutum to posterior margin of scutellum): width (between tegulae) ratio 1:0.94. Pretarsal ungues (claws) simple, not cleft; arolium present (fig. 5). Anterior and intermediate legs without special characters. Metafemur of normal proportions, more slender than mesofemur; metatibia slightly longer than metafemur, expanded apically, apically slightly wider than greatest width of femur, its posterior surface entirely clothed with pale keirotrichia; metabasitarsus broad, subbasally as wide as greatest width of metatibia, posteriorly entirely and anteriorly in ventral half clothed with a dense brush of black setae.

Metasomal terga without postgradular sulci and without distinct marginal areas; T1–2 with weak, inconspicuous, lateral, marginal patches of pale stramineous pubescence, T3 with denser, conspicuous, lateral fasciae of white pubescence that do not, however, attain

in length one sixth of tergal width; T6 entirely covered dorsally with appressed pale plumose setae. Sterna without marginal fasciae; scopa thin, of rather stiff, simple setae, pale except at extreme sides and distally on S6, where it is black; S6 without glabrous marginal areas.

ETYMOLOGY: The new genus-group name is based on the type locality, Gunong Matang, Sarawak combined with *Apis* (Latin, “bee”). The name is feminine.

Megachile (Matangapis) alticola Cameron
Figures 1–13

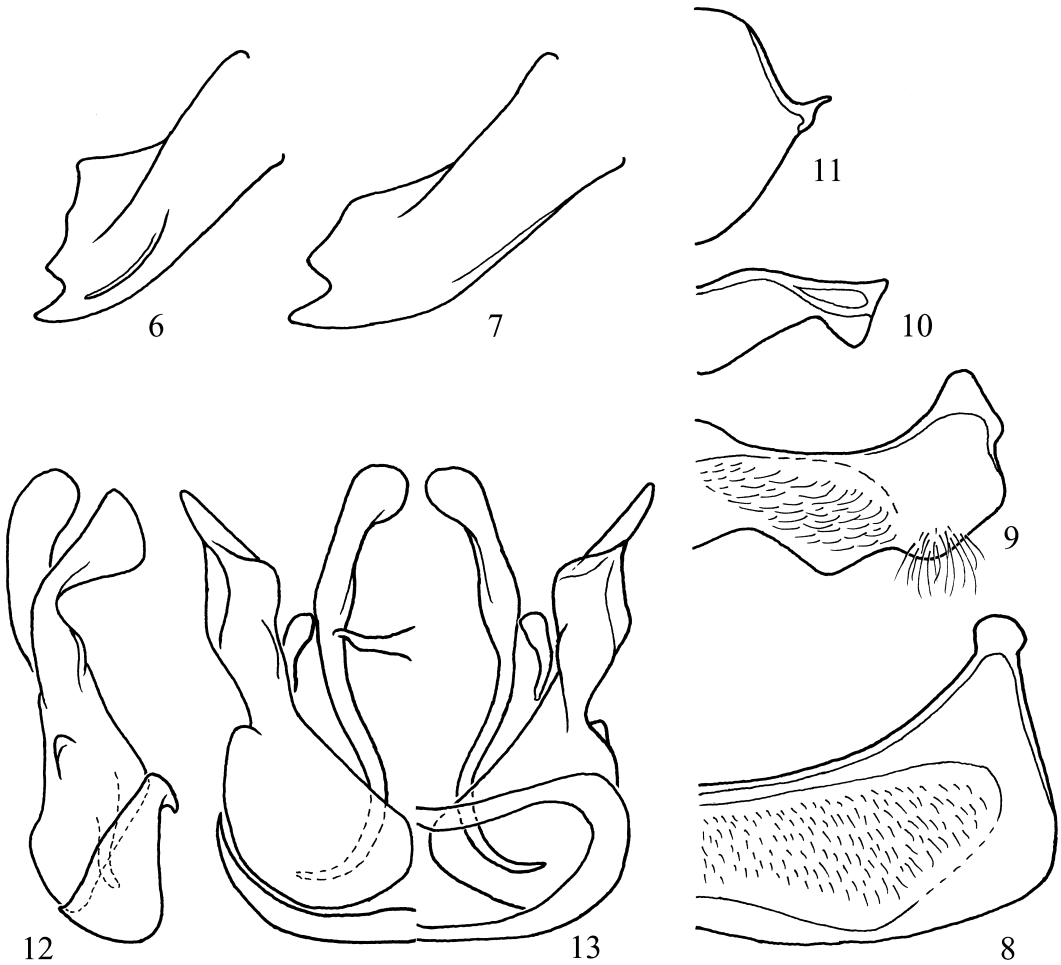
Megachile alticola Cameron, 1902: 118 (♀ ♂).

DIAGNOSIS: As for the subgenus (vide supra).

DESCRIPTION: Cameron’s (1902) description is inaccurate, quite apart from an obvious error in his description of the female where “scape” on p. 119 should be “scopa”, and may be corrected and amplified as follows:

As for the genus with the following additions: **Female.** Length ca. 8.1 mm; forewing length ca. 5.5 mm. Clypeus (except the weakly concave anterior margin narrowly) densely, strongly, subreticulately punctate; supraclypeal area equally strongly, reticulately punctate, especially medially and superiorly the punctures tending to coalesce longitudinally. Mesoscutum semimatt, regularly reticulately, rather shallowly, punctate, except its anterior declivity where the punctation becomes fine and dense; general surface of scutellum similarly punctate; mesepisterna, except anteriorly, strongly, reticulately to subreticulately punctate, glossy. Basal area of propodeum finely coriaceous basally, the sculpture becoming obsolete posteriorly; posterior face of propodeum, outside the basal area, glossy with well-separated punctures. T2–5 glossy, densely, regularly punctate, the punctures finer than those of mesoscutum; T1 dorsally more finely punctate, especially apicad.

Modified setae of clypeus and supraclypeal area yellowish; erect setae of paraocular areas anteriorly and gena white, a conspicuous but narrow tract of denser white pubescence adapted to lateral epistomal sulci; erect setae of vertex black. Pronotum dorsally



Figs. 6–13. *Megachile (Matangapis) alticola* Cameron; 6, female; 7–13, male. **6.** Female mandible. **7.** Male mandible. **8.** Fourth metasomal sternum. **9.** Fifth metasomal sternum. **10.** Sixth metasomal sternum. **11.** Eighth metasomal sternum (setae omitted). **12.** Genital capsule, lateral aspect. **13.** Genital capsule; left half is dorsal aspect, right half is ventral aspect.

thinly clothed with short, white setae, laterally pronotal lobes with dense white pubescence; mesoscutum with short, inconspicuous, black setae, scutellum with longer, black setae; mesoscuto-scutellar sulcus with inconspicuous, narrow, fasciae of white setae adjoining axillae; mesepisterna thinly clothed with white setae, more or less mixed with black dorsally; propodeum laterally with longer white setae. Setae of legs for greater part black, forming a dense brush on mesobasitarsus, but fine sericeous setae clothing entire posterior surface of metatibia white. Horizontal surface of T1 thinly clothed with long white setae, T1 and T2 laterally with white

setae; marginal areas of T2 and T3 with conspicuous, sublateral patches of pure white setae, punctiform on T2, forming a short fascia on T3 (Cameron's "the segments are probably edged with white pubescence" was ill founded); T6 only (not the apical two segments) dorsally with depressed gray pubescence; setae of dorsal surface of metasoma otherwise inconspicuous, black. Scopal setae long, simple, off-white; no underlying marginal fasciae present.

Male. Length ca. 7.6 mm; forewing length ca. 5.1 mm. Clypeus discally glossy, with well-separated punctures. Punctuation otherwise generally similar to that of the female,

but disparity between sizes of punctures more marked, very coarse on vertex, fine on metasomal terga.

Vestiture generally similar to that of female. Clypeus discally with erect simple setae, laterally and apically, as also paraocular areas anteriorly, with subdecumbent plumose pubescence; supraclypeal and frontal areas also with subdecumbent pubescence but here directed vertically; black setae of vertex and of mesonotum longer and more conspicuous. Setae of all tarsi pale fulvous; protarsus with short (not exceeding probasitarsal width), regular, moderately developed posterior fringe, exceeded by some longer setae of outer surfaces of tarsal segments. Marginal fasciae of terga more strongly developed, short, lateral, on T1, progressively longer, attenuate mesally, T2 and T3, not or only narrowly separated medially on T4; T5 and T6 without special setal characters, weakly pale-pubescent, T5 with scattered, long erect setae. S2 with broad marginal fascia, nearly divided medially, of decumbent white plumose setae; S3 except laterally and narrowly in median line, clothed with fine, decumbent, plumose pubescence that becomes denser, and directed laterally, toward its apex, leaving, however, a small, glabrous median lip (S4 normally concealed); S4–6, S8 depicted in figures 8–11.

TYPE MATERIAL: Of three registered syntypes in the Natural History Museum, London, one ♂ and two ♀, the ♂, B.M. Type Hym.17a 2057b, is now designated as lectotype. The type series was collected by G.E. Bryant at Matang, Sarawak (3,000 ft), one of numerous collectors who have visited the locality.

ADDITIONAL MATERIAL: 2 ♀, 2 ♂, labeled "N.W. Borneo, / 3600 feet / Mt. Matang, near / Kuching, Sarawak. / capt. June 1900 / by Dyak collector. / Presented 1900 by / R. Shelford, M.A." (Donald & Madge Baker Collection, Division of Entomology, University of Kansas Natural History Museum).

DISCUSSION

Where the osmiines, whether including (e.g., Michener, 2000) or not (e.g., Robertson, 1903; Michener, 1941; Peters, 1970; Griswold, 1985) the heriadines, have been

treated as a tribe, Osmiini, equivalent to the Megachilini, one of the principal characters used in distinguishing them has been the presence or absence of arolia, these having until recently been held to be uniformly absent in the latter tribe. Two megachiline groups, however, do possess arolia, *Heriadopsis* Cockerell, 1931, with arolia present on the anterior and intermediate pretarsi in both sexes, and *Matangapis*, with arolia present on all pretarsi in both sexes. The existence of a Bornean megachiline with all tarsi aroliate was noted, without further details and without naming the species, by Michener (2000: 559), who had seen specimens of *M. alticola* when visiting the senior author in 1995. The arolia in *Heriadopsis* and *Matangapis* are likely not indicative of a basal placement for these subgenera within Megachilini as their other characters are suggestive of more derived positions within the *Chalicodoma* series of subgenera. Instead, it is more likely that they have reacquired the arolia otherwise lost within the tribe.

Peters (1970: 199)⁴ recognized that *Heriadopsis*, described in a paper entitled "Heriadine and related bees from Liberia and the Belgian Congo" (Cockerell, 1931), was in fact a megachiline, although he remained uncertain as to its status vis-à-vis *Chalicodoma* and chose to treat it as of generic rank rather than associate it with such other forms as *Chelostomoides* Robertson, 1901, *Hackeriapis* Cockerell, 1922, and *Chelostomoda* Michener, 1962, as a subgenus of *Chalicodoma* or *Megachile* s.l. Michener (2000: 559) treated *Heriadopsis* as a subgenus of *Megachile* in an essentially retrograde classification that subsumed all nonparasitic megachilines in a single genus. *Megachile* so constituted is an enormous and morphologically very diverse assemblage, and attempts to date have, in the absence of a fully comprehensive cladistic analysis, embracing not

⁴ According to Peters (1970: 203), the distribution of *Heriadopsis striatulus* Cockerell, 1931, was possibly limited to S. Katanga; Michener (2000) added Zimbabwe and Malawi. A long series of both sexes from Zambia is in the University Museum of Oxford and are labeled as: "N.E. Rhodesia: Luwingu to mouth of Chambezi River, x [October] 1908, S.A. Neave" and "Lower Kalungwesi Valley, dense forest, 3500 ft, 12–13 ix [September] 1908, S.A. Neave".

only named genus-group entities but also informally recognized groupings and individual highly aberrant species, inevitably failed to yield any universally acceptable scheme of classification. The fact that there exists a number of elements that would appear to defy classification does not, however, justify failure to recognize that included under *Megachile* s.l. there are numerous genus-group taxa that are as distinct as any genera of bees, and that, although their exact status may not yet be clear, most if not all the residuum of groups and species can safely be associated with one or another of those genus-group taxa. As a practical convenience, aberrant taxa could temporarily be classified under the names of most-probable relatives by such a simple expedient as using an informal group or species name in combination with that of the putative relative; e.g., *Chalicodoma* (*Pseudomegachile* [amputatum-group]) *sandacanum* (Cockerell, 1919) or *Megachile* [*Eutricharaea*-aff.] *orientalis* Morawitz, 1895, the square brackets denoting that the enclosed term was not intended to have any nomenclatural standing under the Code. This might prove to be an intermediate solution, permitting the segregation of these distinct groups and placement of aberrant species while cladistic work is ongoing.

Matangapis belongs clearly to Michener's (2000) "chalicodomiform" series, although its habitus is distinctly not chalicodomiform. In his keys to Palearctic and Oriental *Megachile* s.l. (Michener, 2000: 544–545), the male runs best to *Chelostomoda*, the female to *Pseudomegachile*; in his earlier key to Australian *Chalicodoma*, the male again runs best to *Chelostomoda*, the female to the entirely dissimilar *Chalicodomoides*. Superficially, except in its short and thick, not slender-bodied and parallel-sided, habitus, *Matangapis* does resemble *Chelostomoda*,⁵ perhaps most strikingly in the exceptionally

coarse punctuation of the head, but it differs in a number of significant details apart from the possession of arolia, including, in both sexes, the much shorter vertex, which in *Chelostomoda* is three or more times as long as the ocellar diameter. In the male, it differs in the bidentate, not tridentate, mandible; in the proportions of basitarsus and tibia⁶; in the edentate apical margin of T6; and in the entirely different, complex, form of the genitalia (cf. Michener, 2000: 536, fig. 82–10m). In the female, it differs in the unusual setal characters of the face; in the mandible having four, not five, teeth and no intercalary cutting edge; in T2 and T3 lacking postgradular sulci and distinct marginal areas; in T6 being clothed with pale tomentum; and in the sterna lacking apical fasciae.

Although *Heriadopsis* and *Matangapis* are at present the only apparent exceptions to the absence of arolia in all Megachilini, their existence does to some extent vitiate the distinctness of the tribes Megachilini and Osmiini (or Osmiini/Heriadini). Michener (2000: 426), in keying the tribes of the Megachilinae, employed only two other characters for separating the Megachilini and the Osmiini, one, in practice rather challenging, relating to the orientation and vestiture of the preaxilla, the other, neither universal nor clear-cut, relating to the presence or absence of integumental metallic coloration. It will be apparent that any student dealing with unfamiliar and unusual Megachilinae must pay attention to the presence or absence of arolia in addition to more commonly observed characters. Certainly, to revert to the recognition of a single tribe Megachilini for the megachilines, osmiines, and heriadini (e.g., Michener, 1944) is unwarranted and not to be preferred. Future cladistic and taxonomic studies must focus on more rigorously defining higher clades among the Megachilinae.

⁵ *Chelostomoda* includes, in addition to the species indicated by Michener (1965: 204), *Megachile ulrica* Nurse, 1901 [= *M. saphira* Cameron, 1907, **new synonym**]; *M. lefroma* Cameron, 1907; *M. albolineata* Cameron, 1897; *M. funnelli* Cockerell, 1907; and *M. bougainvillei* Cockerell, 1911, all newly placed in subgenus *Chelostomoda* herein. There are also several undescribed species known from Sri Lanka, India, Thailand, the Malay Peninsula, and Indo-China.

⁶ Exceptionally, in *Chelostomoda*, the protarsus may be moderately expanded (e.g., as in *M. ulrica*) or all the tarsi may be highly modified, the pro- and mesotarsi greatly expanded, the metabasitarsus contracted and expanded, the mediotarsal segments very short but prolonged distad on either side in slender digitiform processes, and the distitarsus elongated and arched, conspicuously longer than the other tarsomeres combined.

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REFERENCES

- Baker, D.B. 1993. The type material of the nominal species of exotic bees described by Frederick Smith. Ph.D. dissertation, Oxford University, Oxford, UK, vi + 312 pp.
- Bingham, C.T. 1897. The fauna of British India including Ceylon and Burma, Hymenoptera, Volume I: Wasps and bees. London: Taylor and Francis, xxix + 577 pp., 4 pls.
- Cameron, P. 1897. Hymenoptera Orientalia, or contributions to a knowledge of the Hymenoptera of the Oriental zoological region: Part V. *Memoirs and Proceedings of the Manchester Literary and Philosophical Society* 41(4): 1–144.
- Cameron, P. 1902. On the Hymenoptera collected by Mr. Robert Shelford at Sarawak, and on the Hymenoptera of the Sarawak Museum. *Journal of the Straits Branch of the Royal Asiatic Society* 37: 29–131.
- Cameron, P. 1907. Description of a new genus and some new species of Hymenoptera captured by Lieut.-Col. C.G. Nurse at Deesa, Matheran and Ferozepore. *Journal of the Bombay Natural History Society* 17: 1001–1012.
- Cameron, P. 1909. On some undescribed bees and wasps captured by Lieut.-Col. C.G. Nurse in India. *Journal of the Bombay Natural History Society* 19(1): 129–134.
- Cockerell, T.D.A. 1907. On a collection of Australian and Asiatic bees. *Bulletin of the American Museum of Natural History* 23: 221–236.
- Cockerell, T.D.A. 1910. Some Australian bees in the Berlin Museum. *Journal of the New York Entomological Society* 18: 98–114.
- Cockerell, T.D.A. 1911. The bees of the Solomon Islands. *Proceedings of the Linnean Society of New South Wales* 36(1): 160–178.
- Cockerell, T.D.A. 1919. Descriptions and records of bees—LXXXVII. *Annals and Magazine of Natural History*, series 9, 4: 355–360.
- Cockerell, T.D.A. 1920. Descriptions and records of bees—LXXXVIII. *Annals and Magazine of Natural History*, series 9, 5: 113–119.
- Cockerell, T.D.A. 1922. Descriptions and records of bees—XCV. *Annals and Magazine of Natural History*, series 9, 10: 265–269.
- Cockerell, T.D.A. 1927. Some bees, principally from Formosa and China. *American Museum Novitates* 274: 1–16.
- Cockerell, T.D.A. 1931. Heriadine and related bees from Liberia and the Belgian Congo (Hymenoptera, Apoidea). *Revue de Zoologie et de Botanique Africaines* 20(4): 331–341.
- Engel, M.S. 2001. A monograph of the Baltic amber bees and evolution of the Apoidea (Hymenoptera). *Bulletin of the American Museum of Natural History* 259: 1–192.
- Fabricius, J.C. 1804. *Systema Piezatorum, secundum ordines, genera, species, adiectis synonymis, locis, observationibus, descriptionibus*. Brunsvigae [Brunswick]: Reichard, 439 + 30 pp.
- Griswold, T.L. 1985. A generic and subgeneric revision of the *Heriades* genus-group (Hymenoptera: Megachilidae). Ph.D. dissertation, Utah State University, Logan, xiii + 207 pp.
- Gupta, R.K. 1993. Taxonomic studies on the Megachilidae of north-western India (Insecta, Hymenoptera, Apoidea). New Delhi: Indian Council of Agricultural Research, [iii] + 288 pp.
- International Commission on Zoological Nomenclature. 1999. *International Code of Zoological Nomenclature* [4th ed.]. London: International Trust for Zoological Nomenclature, xxix + 306 pp.
- Michener, C.D. 1941. A generic revision of the American Osmiinae with descriptive notes on Old World genera (Hymenoptera, Megachilidae). *American Midland Naturalist* 26(1): 147–167.
- Michener, C.D. 1944. Comparative external morphology, phylogeny, and a classification of the bees (Hymenoptera). *Bulletin of the American Museum of Natural History* 82(6): 151–326.
- Michener, C.D. 1962. Observations on the classification of the bees commonly placed in the genus *Megachile* (Hymenoptera: Apoidea). *Journal of the New York Entomological Society* 70(1): 17–29.
- Michener, C.D. 1965. A classification of the bees of the Australian and South Pacific regions. *Bulletin of the American Museum of Natural History* 130: 1–362.
- Michener, C.D. 2000. *The bees of the world*. Baltimore: Johns Hopkins University Press; xiv + [1] + 913 pp.
- Mitchell, T.B. 1980. A generic revision of the megachiline bees of the Western Hemisphere. Raleigh: North Carolina State University, [ii] + 95 pp.
- Morawitz, F. 1895. *Beitrag zur Bienenfauna Turk-*

- meniens. Horae Societatis Entomologicae Ros-sicae 29: 1–76.
- Nurse, C.G. 1901. New species of Indian Hymenoptera. Journal of the Asiatic Society of Bengal 70(2) 146–154.
- Peters, D.S. 1970. Die Stellung von *Heriadopsis* Cockerell 1931 (Insecta: Hymenoptera: Apoidea: Megachilidae). Senckenbergiana Biologica 51(3–4): 199–203.
- Robertson, C. 1901. Some new or little-known bees. Canadian Entomologist 33: 229–231.
- Robertson, C. 1903. Synopsis of Megachilidae and Bombinae. Transactions of the American Entomological Society 29: 163–178.
- Smith, F. 1853. Catalogue of the hymenopterous insects in the collection of the British Museum. Part 1. Andrenidae and Apidae. London: Taylor and Francis, [i] + 197 pp., 6 pls.
- Smith, F. 1879. Descriptions of new species of Hymenoptera in the collection of the British Museum. London: Taylor and Francis, xxi + 240 pp.

APPENDIX 1

NOTES ON TWO ORIENTAL *MEGACHILE* “SUBGENERA”

ON *ORIENTOCRESSONIELLA*

Megachile relata Smith, 1879, described from China (Shanghai and Hong Kong) is a species of subgenus *Callomegachile* (Holotype ♀ BMNH, B.M. Type Hym.17a 2158; *visum*). *Megachile relata* Smith sensu Gupta (1993) is a misidentified *Megachile* in no way resembling Smith’s species. Gupta’s ♀ may have been *M. conjuncta* Smith, 1853; his supposed ♂ was evidently a species of the same group but certainly not *M. conjuncta*: the male of *M. conjuncta* has genitalia very different from those illustrated by Gupta (his fig. 681), which evidently represents a male of the *fulvifrons* species complex. *Megachile anthracina* Smith, 1853, and *M. simlaensis* Cameron, 1909, although not closely related, may be referred to subgenus *Xanthosarus*. The lectotype of *M. anthracina* is in the Oxford University Museum (♀, ‘Ind.’; *visum*; vide Baker, 1993: 141). (N.B.: B.M. Type Hym.17a 2013, ♀, India, is a **false type**⁷: it is in fact a ♀ of *carbonaria* Smith, cf. Baker, 1993: 141). *Megachile anthracina* Smith sensu Gupta (1993), is, so far as can be judged from his figure of the genitalia (his fig. 695), a *Megachile* of the entirely different

conjuncta group (and one that may eventually warrant separate subgeneric status). Two syntype females of *M. simlaensis* are in BMNH (B.M. Type Hym.17a 2114a, b; *visum*). Gupta’s supposed subgenus of *Cressoniella* is clearly a generic hybrid. Since the actual identity of Gupta’s “*relata* Smith”, in any event a composite species, cannot be determined from his descriptions and figures, the nominal species cited by him, i.e., *Megachile relata* Smith, 1879, is now selected and fixed as the type species of *Cressoniella* (*Orientocressoniella*) Gupta, 1993, in accordance with ICZN (1999: Art. 70.3.1). Gupta’s taxon therefore becomes a junior subjective synonym of *Callomegachile* Michener, 1962 (**new synonymy**).

ON *NEOCRESSONIELLA*

Megachile carbonaria Smith, 1853, described from a ♂ from northern India in W.W. Saunders’ collection, is a species of *Megachile* (*Xanthosarus*) (holotype in the Oxford University Museum; *visum*). (A much earlier name for this species, but one that cannot now be recalled, is *Anthophora barbata* Fabricius, 1804 [**new synonymy**]. *Anthophora barbata* was described from a specimen of unknown locality in Lund’s collection. The holotype, a ♂ with Fabrician label “*A:barbata*”, Zim-sen no. 1171, probably from peninsular India, is in Copenhagen; *visum*.) Provisionally, therefore, *Neocressoniella* Gupta, 1993, is regarded as a subjective synonym of *Xanthosarus* Robertson, 1903 (**new synonymy**). *Megachile elizabethae* Bingham, 1897, described in both sexes from Tenasserim, is also a true *Megachile* (i.e., the *Megachile* group) (syntypes ♂ and ♀ BMNH, B.M. Type Hym. 2010a, b; *visum*). Its subgeneric placement does not affect the immediate issue; as characterized by Gupta, *M. elizabethae* in both sexes is structurally so different from *M. carbonaria* that it is difficult to see how both could be placed in one subgenus. *Megachile amputata* Smith, 1857, described from a ♀ from Borneo (Sarawak)

⁷ The ♀ specimen in the Natural History Museum, London labeled as “B.M. Type Hym.17a 2013” and from India is not the actual type of *M. anthracina*. The specimen does not match his description and the BMNH specimen is a female of Smith’s *carbonaria*. The true type of *anthracina*, and the one that matches the description provided by Smith, is a ♀ labeled, “Ind.” and “Type of *Megachile anthracina* Sm.” in the University Museum of Oxford. This specimen was labeled as lectotype and designated by Baker (1993: 141). Since dissertations such as Baker (1993) do not constitute a permanent, scientific record (ICZN, 1999), the lectotype designation for the Oxford specimen is formally established by the senior author herein (**new lectotype designation**). For more details on the history of this material refer to Baker (1993).

in W.W. Saunders' collection, is a species of the *Chalicodoma* group belonging to an as yet unpublished subgenus in the vicinity of *Pseudomegachile* (group of *Megachile dimidiata* Smith, 1853) (holotype, 'SAR.', Oxford University Museum; *visum*: *vide* Baker, 1993: 194). *Megachile amputata* Smith *sensu* Bingham (1897: a misiden-

tified species, = *amputatiformis* Cockerell, 1927, = *saigonensis* Cockerell, 1920, [**new synonymy**]), is a species of *Megachile* (*Callochile*). The name *saigonensis* has priority. Gupta's "*amputata*" was presumably this species. Once again, Gupta's supposed subgenus of *Cressoniella* is a generic hybrid.

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