

- [*canosocollaris* Skorikov, 1912*b*, infrasubspecific]
- friseanus* Skorikov, 1933*a* **syn. n.**
- formosellus* (Frison, 1934) (provisional synonym)
- hoenei* Bischoff, 1936 **syn. n.**
- [*flavocorbicularis* Tkalců, 1961, infrasubspecific]
- wutaishanensis* (Tkalců, 1968*a*) **syn. n.**
- rufofasciatus* Smith, 1852*b*
- prshewalskyi* Morawitz, 1880
- rufocinctus* Morawitz, 1880
- chinensis* Dalla Torre, 1890
- championi* Richards, 1928*a* **syn. n.**
- [*rufior* Richards, 1928*b*, infrasubspecific]
- [*intermedius* Richards, 1930, infrasubspecific]
- waterstoni* Richards, 1934

TAXONOMY OF THE KASHMIR BOMBINI

BOMBINI Michener

Bombini Michener, 1944: 290. Type genus: *Bombus* Latreille, 1802*a*: 437.

In this review, formal descriptions of bumble bees are not repeated because the literature already contains many descriptions of particular individuals. Instead I describe just a few characters that may be useful to distinguish species. Tentative interpretations of some of these character-state patterns are included for the continuing discussion of relationships among species.

In the keys, those characters that have been found more reliably diagnostic have generally been placed nearer the beginning of each couplet. Characters of the genitalia are used frequently in the key to males (see Figs 44 & 45), so male specimens should be prepared for examination by extraction of their genital capsules. Colour patterns of the pubescence are used in the final stages of the keys for the determination of species within a species-group, where the range of variation does not overlap among these species within Kashmir. But after a reference collection has been prepared for a particular locality using the keys, it may often be possible to identify the majority of further specimens accurately by direct comparison, using only selected details of their colour patterns. Diagrams of the colour patterns are provided here to illustrate some of the variation (Figs 232–439). These diagrams should be coloured by hand to render them more immediately intelligible (see Fig. 258 for a colour key). Inevitably these diagrams are a compromise between portraying the general appearance of an insect and accurately showing the position of every coloured hair. For

instance, the presence of a minority of black hairs among pale pubescence could not be shown without reducing the general resemblance of the diagram to the insect. Consequently these diagrams provide only a guide that should not be used without the keys.

Records of food-plants are included from notes made in the field during 1980, 1985 and 1986. These plant species were identified by reference to Polunin & Stainton (1984). The lists are by no means exhaustive, but they do include at least some of the preferred species.

Key to species (females: queens and workers)

- 1 Outer surface of hind tibia flat or partially concave, without long hairs on posterior part of lower or distal half of outer surface (corbicula), but with a comb of stout spines (rastellum) along inner distal margin (Figs 225 & 226); gastral sternum VI without ventro-lateral keels; clypeus strongly protuberant, with lateral margins curved back towards occiput (Fig. 15) 2
- Outer surface of hind tibia convex, with moderate to long hairs throughout, but without a comb of stout spines along inner distal margin; gastral sternum VI with a pair of ventro-lateral keels (Figs 206–211); clypeus nearly uniformly flat, only apico-lateral corners curved back strongly towards occiput 5
- 2 Outer (corbicular) surface of hind tibia usually smooth and shining or only weakly sculptured (reticulate coriaceous), without any long stout hairs arising from posterior part of outer surface below upper or proximal quarter (Fig. 226); proximoposterior corner of hind basitarsus strongly and acutely produced, projection longer than its own basal breadth (Figs 41 & 42); labrum with basal transverse depression extending apically as a deep median furrow between pronounced lateral tubercles, displacing ridge between them to form a lamella that overhangs apical margin (Figs 25 & 26) 10
- Outer (corbicular) surface of hind tibia coarsely sculptured (imbricate), appearing very rough, with widely-spaced long stout hairs or bristles arising from near middle of outer surface throughout upper or proximal half (Fig. 225); proximo-posterior corner of hind basitarsus rounded, projection no longer than its own basal breadth (Fig. 43); labrum with a narrow transverse basal depression, leaving a straight transverse ridge joining weak lateral tubercles, so that there is no median furrow and no apical lamella (Figs 23, 220–222) 3
- 3 (Subgenus *Mendacibombus*.) Ridge between labral tubercles is, at its mid point, narrower than basal depression (Figs 23 & 220), with few punctures and shining; wings clouded with brown (moderately infuscated) *avinoviellus*
- Ridge between labral tubercles is, at its mid point, broader than basal depression, with few or many

- punctures (Figs 221 & 222); wings nearly clear (subhyaline).....4
- 4 Ridge between labral tubercles subsiding towards middle, where there are often many punctures (Fig. 221); pubescence of thoracic dorsum grey-white or lemon-yellow, but with a broad black band between wings (Figs 242–245, 247, 248, 250, 251) *himalayanus*
- Ridge between labral tubercles convex for its entire length, with few punctures (Fig. 222); pubescence of thoracic dorsum lemon-yellow, with only a very few black hairs (Figs 254, 255, 257)..... *marussinus*
- 5 (Subgenus *Psithyrus*.) Lateral keels of sternum VI projecting well beyond tergum VI from dorsal aspect, crests of keels sharply acute and blade-like in section, distinctly angled about midway along their length (Figs 207 & 208); pubescence of tergum V usually mostly orange-red, without yellow or white hairs, only occasionally entirely black.....6
- Lateral keels of sternum VI not clearly projecting beyond tergum VI from dorsal aspect, crests of keels broadly rounded, both in section and along their entire length (Figs 206, 209–211); pubescence of tergum V black, yellow or white, but without orange-red hairs.....7
- 6 Crests of lateral keels of sternum VI, beyond projecting angle of mid-point, with a strongly concave margin (Fig. 208); sternum II with transverse ridge sharply-defined and nearly straight; labral furrow narrow, about a fifth of total basal breadth of labrum; clypeus with many large punctures spaced more closely than their own widths, except in a well-defined narrowly-unpunctured mid-apical area; pubescence of thoracic dorsum without black hairs, except for a few hairs adjacent to tegulae, tergum II predominantly black (Figs 263, 265, 266)..... *branickii*
- Crests of lateral keels of sternum VI, beyond projecting angle of mid-point, almost straight (Fig. 207); sternum II with transverse ridge rounded and curved unevenly towards anterior margin in middle; labral furrow wide, about a third of total basal breadth of labrum (Fig. 24); most of clypeus with scattered large punctures spaced more widely than their own widths; pubescence of thoracic dorsum usually with a poorly-defined patch of black hairs between wings, tergum II yellow (Figs 259 & 261)..... *novus*
- 7 Lateral keels of sternum VI strongly swollen almost to their apices, where they are separated by a groove that is narrower than their own breadths (Figs 209 & 210); basal depression of labrum deep and clearly delimited by an absence of punctures, apex of lamella pointed.....8
- Lateral keels of sternum VI declining from near their mid-points so that strongly swollen parts are separated by more than their own breadths (Figs 206 & 211); basal depression of labrum shallow and with punctures, apex of lamella broadly rounded.....9
- 8 Tergum VI with many large punctures, but shining; basal keel of mandible weak or absent; thoracic dorsum without black pubescence (Fig. 267) *ferganicus*
- Tergum VI with only fine punctures, strongly shining; basal keel of mandible well developed but interrupted before margin of mandible; pubescence of thoracic dorsum black with an admixture of yellow hairs as an anterior band (Fig. 269) *morawitzianus*
- 9 Lateral keels of sternum VI small and converging to a point well before apex, which is down-curved as a narrow spinose hook that projects strongly beyond apex of tergum VI (Fig. 211); basal keel of mandible present but interrupted before reaching margin; labral tubercles and lamella weakly developed and rounded in section; oculo-malar distance nearly equal to basal breadth of mandible; pubescence of thoracic dorsum and tergum I predominantly yellow, at most with a narrow band of black hairs between wings (Figs 271 & 273)..... *skorikovi*
- [From material from Britain.] Lateral keels of sternum VI strongly swollen and converging to a point only just before apex of sternum, which is broadly triangular and not down-curved or particularly narrowed and does not project beyond apex of tergum VI (Fig. 206); basal keel of mandible weak or absent; labral tubercles pointed and lamella strongly swollen; oculo-malar distance less than two-thirds of basal breadth of mandible; pubescence of thoracic dorsum and tergum I black, with only a broad yellow band anteriorly on thorax..... *bohemicus*
- 10 Apex of mandible broadly rounded, with a basal tooth, one pre-basal tooth and often an apical tooth (e.g. Fig. 34); longest of erect hairs near anterior margin of outer surface of hind basitarsus shorter than greatest breadth of basitarsus.....11
- Apex of mandible with six teeth, though these are subject to wear (Fig. 33); longest of erect hairs near anterior margin of outer surface of hind basitarsus just longer than greatest breadth of basitarsus. (Subgenus *Alpigenobombus*, oculo-malar distance about half of basal breadth of mandible; pubescence long, with a broad black band between wings, terga III–V always with some reddish hair, remainder grey-white, yellow or black, Figs 295, 296, 298, 299, 301–303, 305, 306, 308, 309)..... *kashmirensis*
- 11 Hind basitarsus with dense pubescence of proximal margin (auricle) continuing onto outer surface of proximo-posterior projection as just a few sparse hairs (Fig. 229); oculo-malar distance shorter or longer than one and a fifth times basal breadth of mandible, but anterior part of malar area smooth, at most the larger individuals have only a narrow diagonal band with a few very small punctures....12
- Hind basitarsus with dense pubescence of proximal margin (auricle) continuing onto outer surface of proximo-posterior projection as a dense long brush (Figs 227 & 228); oculo-malar distance more than one and a fifth times longer than basal breadth of mandible, and for larger individuals at least, anterior

- part of malar area uneven with many small to moderately-large but widely-spaced punctures almost throughout 23
- 12 Disto-posterior corner of mid basitarsus usually broadly rounded, never produced as a spine (Fig. 40); oculo-malar distance shorter or longer than one and a fifth times basal breadth of mandible ... 13
- Disto-posterior corner of mid basitarsus spinose (Fig. 39), or for small workers, at least acutely produced; oculo-malar distance at least one and a fifth times longer than basal breadth of mandible 16
- 13 Ocello-ocular area with unpunctured and shining areas large or small, but area anterior to ocelli unpunctured for less than breadth of an ocellus; labral lamella narrow, only about a third of basal breadth of labrum; clypeus with many large punctures scattered on flattened central area; pubescence of thoracic dorsum with or without much pale hair 14
- Ocello-ocular area with unpunctured and shining areas very large and including most of area anterior to ocelli for a distance of more than breadth of an ocellus (Fig. 215); labral lamella broad, more than half of basal breadth of labrum; clypeus with almost no large punctures in flattened central area; pubescence of thoracic dorsum entirely black. (Subgenus *Orientalibombus*, large individuals with very dark wings; pubescence short and very even, terga I-II bright yellow, III-V orange-red, Figs 279 & 280) *haemorrhoidalis*
- 14 Band of punctures along eye margin in oculo-ocellar area opposite lateral ocellus with few small punctures, large punctures separated by more than their own widths, whole band occupying about a third of distance between lateral ocellus and eye (Figs 216-219); tergum VI subapically nearly flat, or at most with a poorly-defined apical swelling or a narrow median ridge, but without a discrete subapical rounded boss; wings clear (hyaline), or at most only weakly clouded with brown (weakly infuscated) 18
- Band of punctures along eye margin in oculo-ocellar area opposite lateral ocellus occupying nearly half of distance between lateral ocellus and eye, with many small and large punctures all separated by less than widths of large punctures, or if punctures are mostly large and more widely spaced, then tergum VI has a discrete subapical rounded boss (e.g. Fig. 231, often weak or absent for small workers); wings clear (hyaline) to nearly black (strongly infuscated) 15
- 15 Oculo-malar distance about equal to or distinctly longer than basal breadth of mandible; tergum VI with a discrete subapical rounded boss (e.g. Fig. 231, often weak or absent for small workers); mandible with only a shallow notch (incisura) and tooth apically (Fig. 34) 24
- Oculo-malar distance less than two-thirds of basal breadth of mandible; tergum VI subapically nearly flat, without a rounded boss; mandible with a deep notch (incisura) and tooth apically 22
- 16 Clypeus without large punctures in central area; antennal segment 4 longer than broad and more than three-quarters of length of segment 5; pubescence of gaster white, cream, yellow, brown or black, but without orange-red 17
- Clypeus with many large punctures throughout; antennal segment 4 just shorter than broad and less than three-quarters of length of segment 5 (Fig. 17); pubescence of gaster with some orange-red. (Subgenus *Diversobombus*, pubescence of thoracic dorsum black, terga I-II bright yellow, III-V predominantly orange-red, Figs 275, 276, 278) *trifasciatus*
- 17 (Subgenus *Subterraneobombus*.) Central area of clypeus almost without punctures, at most with only a few very widely-spaced and fine punctures; pubescence of head, lower sides of thorax, legs, all sterna and terga III-V black (Figs 282-284, 286-289) *melanurus*
- Central area of clypeus with many fine punctures, often separated by a distance of only about twice their own diameter; pubescence of thorax almost entirely cream-yellow, except for a black band between wings, and with many pale hairs on head around bases of antennae, on coxae and hind femora, on gastral sterna and as posterior fringes of terga III-V (Figs 291 & 292) *personatus*
- 18 (Subgenus *Pyrobombus*.) Pubescence of thoracic dorsum grey-white or yellow, but not brown, often with many black hairs, terga IV-V orange-red ... 19
- Pubescence of thoracic dorsum uniformly yellow-brown, only occasionally faded to grey, terga IV-V white (Figs 311, 312, 314, 315) *hypnorum*
- 19 Vertex, postero-laterally to ocello-ocular area, shining, with few fine punctures between large punctures (Figs 216 & 217), punctures becoming more numerous and more closely spaced towards posterior margin of vertex (occiput); apex of tergum VI rounded, subacute (Fig. 214) 20
- Vertex, postero-laterally to ocello-ocular area, with many close, fine punctures between large punctures (Figs 218 & 219), punctures uniformly spaced and numerous towards posterior margin of vertex (occiput); apex of tergum VI broadly truncate (Figs 212 & 213) 21
- 20 Labral lamella narrow, less than one-third of breadth of labrum; hind basitarsus with posterior margin nearly straight in distal half (Fig. 42), stout bristles on outer surface arising from sockets that are scarcely raised from surface; pubescence long, longest hairs of anterior margin of hind tibia much longer than its distal breadth, longest hairs of face at least three-quarters as long as segment 1 (scape) of antenna; pale pubescence of thoracic dorsum either yellow, grey-white or absent, but if it is yellow then

- there are no black hairs intermixed (Figs 335, 336, 338, 339, 341, 342, 344–346) *biroi*
- Labral lamella broad, more than one-third of breadth of labrum; hind basitarsus with posterior margin usually distinctly concave just proximal to disto-posterior corner (Fig. 41), stout bristles on outer surface arising from sockets that are strongly raised from surface on their proximal sides; pubescence short, longest hairs of anterior margin of hind tibia only as long as its distal breadth, longest hairs of face only two-thirds as long as segment 1 (scape) of antenna; pale pubescence of thoracic dorsum yellow, with black hairs between wing bases (Figs 317, 319, 320, 322, 323) *subtypicus*
- 21 Thoracic scutum mid-dorsally with an area as large as tegula around posterior end of longitudinal median groove smooth with few or no punctures (Fig. 224); oculo-malar distance shorter than basal breadth of mandible; hairs of ventral parts of thorax and gaster predominantly grey-white, top and front of head often with many pale hairs intermixed *lepidus*
- Thoracic scutum mid-dorsally with punctures and sculpturing almost throughout area around posterior end of longitudinal median groove (Fig. 223); oculo-malar distance equal to or just longer than basal breadth of mandible (Fig. 15); hairs of ventral parts of thorax and gaster predominantly black, top and front of head without pale hairs *lemniscatus*
- 22 (Subgenus *Bombus*.) Pubescence of thoracic dorsum grey-white, with a more or less well-developed black band between wings, tergum V red (Figs 347, 348, 350, 351, 353, 354) *tunicatus*
- Pubescence of thoracic dorsum black, with a broad, lemon-yellow or cream anterior band, sometimes with a narrow posterior band, and tergum V nearly white (Figs 356, 357, 359–361, 363, 364, 366, 368, 369) *lucorum*
- 23 (Subgenus *Sibiricobombus*.) Oculo-malar area with many widely-spaced moderate to large punctures; antennal segment 4 less than half of length of segment 3 (Fig. 19); tergum VI coarsely sculptured but without a median groove *asiaticus*
- Oculo-malar area with many widely-spaced small punctures almost throughout, surface uneven; antennal segment 4 more than half of length of segment 3 (Fig. 20); tergum VI coarsely sculptured, with a well-defined long narrow median groove (Fig. 230) *oberti*
- 24 (Subgenus *Melanobombus*.) Ocello-ocular areas laterally shining between few large punctures along eye margin opposite ocelli, these punctures separated by distances greater than their own widths; oculo-malar distance longer than, or about same length as, basal breadth of mandible; long hairs of head interspersed with a dense cover of short branched hairs, which are especially evident between ocelli and occiput; pubescence of tergum V usually with some white hairs, or if these are absent, then wings are nearly black (strongly infuscated) 25
- Ocello-ocular areas laterally matt, with a dense band of large punctures along eye margin opposite ocelli, many of these punctures separated by distances less than their own widths; oculo-malar distance just shorter than basal breadth of mandible; only a few short branched hairs interspersed with long hairs on head; wings nearly clear (subhyaline) and pubescence of tergum V usually uniformly red, or if white hairs are present then there are very few black hairs intermixed with pale pubescence on anterior part of thoracic dorsum 27
- 25 (*rufofasciatus*-group.) Outer (corbicular) surface of hind tibia with only a few short branched hairs, which are confined to margins near disto-posterior corner; pubescence of thoracic dorsum yellow or grey-white, but with a black band between wings; tergum V usually with some white hairs, at least apically; wings nearly clear or lightly clouded with brown (subhyaline to weakly infuscated) 26
- Outer (corbicular) surface of hind tibia with many short to moderately long, branched hairs, at least in proximal half (few or absent for small workers and subject to loss for older females, Fig. 226); pubescence of thorax either entirely black or almost entirely cream-white dorsally and without a black band between wings, tergum V red without any white hairs (Figs 417, 418, 420); wings nearly black (strongly infuscated) *simillimus*
- 26 Boss on tergum VI nearly circular and evenly convex, only narrowly pointed adjacent to apex of tergum; pubescence of head entirely black, thoracic dorsum and tergum I with white pubescence (Figs 431, 432, 434, 435, 437, 438) *rufofasciatus*
- Boss on tergum VI nearly triangular, for some queens with a weak median groove, for workers it may be weakly ridged; short hairs of head yellow, thoracic dorsum and tergum I with yellow pubescence (Figs 422, 423, 425, 426, 428, 429) *pyrosoma*
- 27 (*lapidarius*-group.) Ocello-ocular area with a continuous broad band of fine punctures along eye margin; pubescence of thoracic dorsum uniformly lemon-yellow, without black hairs (Figs 397, 398, 400, 401) *semenovianus*
- Ocello-ocular area with band of fine punctures along eye margin narrowly interrupted opposite ocelli, so that there is a small shining area with only large punctures; pubescence of thoracic dorsum pale yellow, cream, or grey-white, but with a broad black band between wings 28
- 28 Apex of tergum VI usually broadly, but shallowly, notched; pubescence of tergum III predominantly black, often with a posterior fringe of pale hairs, and of tergum V predominantly red (Figs 403–409, 411–415) *keriensis*
- Apex of tergum VI nearly straight; pubescence of tergum III predominantly orange-red and of tergum V white, although these hairs have very dark bases (Figs 394 & 396) *ladakhensis*

Key to species (males)

- 1 Volsella always strongly sclerotised, inner corner usually much closer to apex than to base (to form an interio-apical corner), often bearing two inwardly-directed hooks or a single combined inwardly-directed process (Figs 136–165); gonostylus usually with a distinct interio-basal process or shelf, but not associated with long hairs (Figs 176–205); head of penis valve much modified, often curved strongly in towards mid-line of body, as a sickle-shaped hook (Figs 61–71, 76–85), otherwise curved outwards for some individuals (Figs 72–75), but if it is nearly straight from dorsal aspect (Figs 56–60), then volsella has pronounced inner hooks (Figs 136–140) 10
- Volsella weakly or strongly sclerotised, inner corner located near mid-point of its length, without any inwardly-directed hooks, so that volsella is usually nearly triangular in the distal section (Figs 126–135); gonostylus without an interio-basal process (Figs 166–169), or if present (Figs 170–175), then it is associated with many long branched hairs; head of penis valve nearly straight from dorsal aspect (Figs 46–55) 2
- 2 Volsella weakly sclerotised, yellowish in colour; gonostylus with a pronounced interio-basal process (Figs 170–175), associated with many long branched hairs; head of penis valve, as defined by an outer lateral ridge, less than a quarter of total length, not strongly curved but shaped like a slender arrowhead from lateral aspect (Figs 90–95) 5
- Volsella strongly sclerotised, dark brown in colour; gonostylus without an interio-basal process or hairs (Figs 166–169); head of penis valve, as defined by an outer lateral toothed ridge, accounting for nearly half of total length, ventrally curved and sabre-shaped from lateral aspect (Figs 86–89) 3
- 3 (Subgenus *Mendacibombus*.) Penis valve strongly laterally flattened (Figs 46, 47, 86, 87); gonostylus dorso-ventrally flattened (Figs 166 & 167); mandible with basal tooth strongly developed (Fig. 35); wings clouded with brown (moderately infuscated) *avinoviellus*
- Penis valve nearly tubular (Figs 48, 49, 88, 89); gonostylus stout and not strongly flattened (Figs 168 & 169); mandible without a distinct basal tooth; wings nearly clear (weakly infuscated or subhyaline) 4
- 4 Volsella with interio-apical margin weakly concave (Fig. 128); gonostylus from outer dorso-lateral aspect with a distinct, though broadly-rounded, exterio-apical corner (Fig. 168); pubescence of thoracic dorsum anteriorly and of terga I-II grey-white and/or lemon-yellow, with a broad black band between wings (Figs 246, 249, 252, 253) *himalayanus*
- Volsella with interio-apical margin strongly concave, so that apex resembles a curved finger (Fig. 129); gonostylus from outer dorso-lateral aspect with exterio-apical margin evenly rounded, without any trace of an exterio-apical corner (Fig. 169); pubescence of thoracic dorsum lemon-yellow, with few black hairs (Fig. 256) *marussinus*
- 5 (Subgenus *Psithyrus*.) Volsella in its distal section, beyond inner corner, greatly narrowed, almost parallel-sided and finger-shaped (Fig. 135); gonostylus with only a few short hairs *skorikovii*
- Volsella distally broader, in the form of a broad nearly triangular plate (Figs 130, 131, 133, 134), or if distal section is narrowed then inner corner is strongly produced (Fig. 132); gonostylus usually with many long hairs around interio-basal process 6
- 6 Vento-basal angle of penis valve strongly and broadly produced ventrally and outwardly, so as to be clearly visible from dorsal aspect (Figs 51–54, 91–94); inner corner of volsella well defined, strongly produced for some individuals (Figs 131–134); antennal segment 3 distinctly shorter than segment 5 (e.g. Fig. 22); pubescence of scutellum usually almost entirely yellow or grey, terga IV-V with red or yellow, or if terga IV-V are nearly white (Fig. 270) then tergum II has a narrow apical band of pale hair 7
- Vento-basal angle of penis valve much reduced and not visible from dorsal aspect (Figs 50 & 90); inner corner of volsella weak, almost unmarked for some individuals (Fig. 130); antennal segment 3 just longer than segment 5 (Fig. 21); pubescence of scutellum black, with only a narrow band of yellow hairs, apical margin of tergum II without a band of pale hair, terga IV-V nearly entirely white (Fig. 258) . . . *bohemicus*
- 7 Inner margin of distal section of volsella irregular but not predominantly concave (Figs 133 & 134); antennae very long, reaching back nearly to gaster; pubescence of terga V-VII black, with lateral patches of yellow or white 8
- Inner margin of distal section of volsella predominantly concave, with exception of a weak subapical process (Figs 131 & 132); antennae short, reaching back only to tegulae; pubescence of terga V-VII orange-red 9
- 8 Distal section of volsella as long as about one and a half times its maximum breadth from ventral aspect (Fig. 133); gonostylus broadly triangular (Fig. 173); pubescence of thoracic dorsum predominantly brownish-yellow, with only a few black hairs above tegulae (Fig. 268) *ferganicus*
- Distal section of volsella only just longer than its maximum breadth from ventral aspect (Fig. 134); gonostylus reduced to a narrow transverse band at apex of gonocoxite, but retaining a well-developed interio-basal process (Fig. 174); pubescence of thoracic dorsum light yellow with a broad black band between wings (Fig. 270) *morawitzianus*
- 9 Distal section of volsella almost twice as long as its maximum breadth from ventral aspect (Fig. 132); pubescence of thoracic dorsum yellow, with black hairs intermixed between wings (Fig. 264) *branickii*

- Distal section of volsella about as long as its maximum breadth from ventral aspect (Fig. 131); pubescence of thoracic dorsum grey-white, with a poorly-defined black band between wings (Figs 260 & 262) . . . *novus*
- 10 Penis valve from dorsal aspect turned inwards before apex and dorso-ventrally flattened in the form of a sickle (Figs 61-71, 76-85) 11
 - Penis valve from dorsal aspect apically nearly straight, turned outwards, or at least not strongly inwardly directed and flattened as a sickle-shape (Figs 56-60, 72-75) 14
- 11 Vento-basal angle of penis valve much reduced, shown only as a weak curve, or absent (Figs 116-125); spatha, beyond basal fusion with penis valves, more than three times longer than its breadth midway along this length, sides nearly parallel in proximal half 12
 - Vento-basal angle of penis valve produced as a basally-directed hook (Figs 101-111); spatha, beyond basal fusion with penis valves, less than three times longer than its breadth midway along this length, sides weakly diverging in proximal half (*B. kashmirensis*), or distinctly converging towards apex throughout their length 13
- 12 Gonostylus just longer than its greatest breadth, excluding interio-basal process, which is pronounced as a broad shelf, and broadening apically (Figs 196-199); shaft of penis valve more than three-quarters as broad from lateral aspect as greatest breadth of gonostylus, excluding its interio-basal process (Figs 116-119); head of penis valve with a broad outer ridge (Figs 76-79, 116-119) 23
 - Gonostylus shorter than its greatest breadth, excluding interio-basal process, which is reduced to a small rounded projection or a right-angled corner, and narrowing apically (Figs 200-205); shaft of penis valve usually strongly narrowed from lateral aspect, its breadth less than two-thirds as broad as greatest breadth of gonostylus, excluding interio-basal process (Figs 120-125); head of penis valve with only a narrow outer ridge (Figs 80-85, 120-125) 24
- 13 Apex of mandible acutely pointed, with a basal tooth and a pre-basal tooth (Fig. 37); gonostylus with a pronounced interio-basal process (Figs 181-183); volsella, from dorsal aspect, projecting beyond gonostylus apically by about its own apical breadth. (Subgenus *Alpigenobombus*, pubescence with a broad black band between wings, head predominantly black, terga III-VI with some reddish hair, remainder variously banded with grey-white, yellow or black, Figs 297, 300, 304, 307, 310) *kashmirensis*
 - Apex of mandible more or less pointed, otherwise with only a basal tooth; gonostylus without a strongly projecting interio-basal process (Figs 184-191); volsella, from dorsal aspect, projecting beyond gonostylus apically by only about half of its own apical breadth 18
- 14 Penis valves strongly broadened in dorso-ventral plane so as to form two halves of a tube, ends splayed outwards as a broad funnel (Figs 72-75, 112-115); antennae short, reaching back only as far as tegulae 22
 - Penis valves dorso-ventrally narrow, at least in apical third, which is further narrowed and more or less ventrally-directed (Figs 56-60, 96-100); antennae long, reaching back beyond tegulae 15
- 15 Volsella apically not narrowed, with apical corner forming a right angle, not produced, a projection from inner corner terminating in a single small serrated process, which is directed apically, without any trace of a separate recurved basally-directed hook (Figs 138-140); ventro-basal angle of penis valve strongly produced ventro-laterally, forming a flattened paddle-shape, transverse to main axis of penis valve (Figs 98-100); pubescence of thoracic dorsum cream, yellow or brown, some individuals with black bands between wings, terga III-VII without orange-red 17
 - Volsella apically much narrowed, or with apical corner narrowly produced, inner corner terminating in a pair of serrated hooks, one directed apically, the other, which may be very much reduced for some individuals, directed basally (Figs 136 & 137); ventro-basal angle of penis valve produced ventrally, but hardly laterally, as a single tooth (Figs 96 & 97); pubescence of thoracic dorsum black, terga III-VII predominantly orange-red 16
- 16 Gonostylus with interio-basal process strongly produced, with both an apically-directed hook and a more ventrally-directed hook (Fig. 176); volsella with inner hooks very close to apical corner, the large apically-directed hook nearly straight and spinose, the basally-directed hook strongly recurved and broad with many teeth, both hooks projecting beyond gonostylus from dorsal aspect, part of volsella immediately proximal to inner hooks much narrowed (Fig. 136); head of penis valve twice as broad as shaft, from dorsal aspect, with pronounced teeth along outer lateral ridge (Fig. 56) (Subgenus *Diversobombus*) *trifasciatus*
 - Gonostylus without an interio-basal process (Fig. 177); volsella with apical corner narrowly produced distal to inner hooks and curled inwardly, inner hooks close to inner corner and obscured from dorsal aspect by gonostylus, part of volsella immediately proximal to inner hooks broad (Fig. 137); head of penis valve scarcely broader than shaft, from dorsal aspect, without distinct teeth along lateral ridge (Fig. 57) (Subgenus *Orientalibombus*) *haemorrhoidalis*
- 17 (Subgenus *Subterraneobombus*.) Curved head of penis valve, from dorsal aspect, longer than broad (Figs 58 & 59), paddle-like ventro-basal angle of penis valve clearly tridentate, with a spinosely-produced dorso-lateral tooth, which is longer than tooth that some individuals have on extero-basal corner of penis valve head (Figs 98 & 99); tip of

- interio-basal process of gonostylus not projecting apically as far as apex of gonostylus (Figs 178 & 179); pubescence of head around antennal bases, of ventral parts of thorax and of terga III-VII, predominantly black (Figs 285 & 290) . . . *melanurus*
- Curved head of penis valve, from dorsal aspect, as broad as long (Fig. 60), paddle-like ventro-basal angle of penis valve almost rounded, with only a weak dorso-lateral tooth, which is shorter than spinose tooth of extero-basal corner of penis valve head (Fig. 100); tip of interio-basal process of gonostylus projecting apically as far as apex of gonostylus (Fig. 180); pubescence of head around antennal bases, of ventral parts of thorax and of posterior fringes of terga III-VII predominantly pale (Figs 293 & 294) *personatus*
- 18 (Subgenus *Pyrobombus*.) Inner margin of gonostylus weakly convex basally, longitudinal submarginal groove arising close to apex of gonocoxite, separated from it by a distance usually only about equal to width of groove (Figs 185-191); pubescence of terga V-VII orange-red 19
- Inner margin of gonostylus with a deep concavity or notch basally, separating longitudinal submarginal groove from apex of gonocoxite by a distance nearly twice width of groove (Fig. 184); pubescence of terga V-VII white (Figs 313 & 316) *hypnorum*
- 19 Antennae short, reaching back only as far as tegulae; head of penis valve with recurved hook not distinctly narrower than adjacent penis valve shaft, from dorsal aspect, and apically broadly rounded (Figs 67-71); pubescence long, longest hairs arising from outer surface of proximal part of mid basitarsus nearly one and a half times breadth of mid basitarsus 20
- Antennae moderately long, reaching back to scutellum; head of penis valve with recurved hook distinctly narrower than adjacent penis valve shaft, from dorsal aspect, and apically acute (Figs 65 & 66); pubescence short, longest hairs arising from outer surface of proximal part of mid basitarsus shorter than breadth of mid basitarsus . . . *subtypicus*
- 20 Penis valve head with recurved hook no greater in breadth than adjacent penis valve shaft, from dorsal aspect (Figs 67-69), and ventro-basal angle of penis valve close to mid-point between penis valve head and its base (Figs 107-109); pale pubescence with grey-white hair, or if this is lacking (i.e. pubescence predominantly yellow), then tergum III is yellow or orange-red with very few black hairs 21
- Penis valve head with recurved hook more than one and a half times breadth of adjacent penis valve shaft, from dorsal aspect (Figs 70 & 71), and ventro-basal angle of penis valve at less than a third of length of penis valve shaft from its base to its head (Figs 110 & 111); pale pubescence without grey-white hair, tergum III predominantly black (Figs 337, 340, 343) *biroi*
- 21 Pubescence of thorax and tergum I predominantly yellow, without grey-white hairs (Figs 329 & 332); volsella with interio-apical process narrow and separated from apex by a distance nearly equal to its own breadth (Figs 148 & 149) *lepidus*
- [From material from Uttar Pradesh, India.] Pubescence of thoracic dorsum and tergum I grey-white, without yellow hairs, but with a broad black band between wing bases; volsella with interio-apical process arising directly from apex (Fig. 147) *lemniscatus*
- 22 (Subgenus *Bombus*.) Pubescence of thoracic dorsum grey-white, often with a more or less well-developed black band between wings, terga V-VI red (Figs 349, 352, 355) *tunicatus*
- Pubescence of thoracic dorsum with lemon-yellow anteriorly, remainder with variable degrees of replacement of black by yellow, terga V-VI nearly white (Figs 358, 362, 365, 367, 370) *lucorum*
- 23 (Subgenus *Sibiricobombus*.) Eyes greatly enlarged, so that separation from lateral ocelli is by less than an ocellar diameter; antennae very long, reaching almost to gaster; volsella narrowed apically, interio-apical process narrow and elongate but extero-apical corner scarcely acute (Figs 156-158); recurved hook of penis valve head broad, tapering to tip (Figs 76-78); pubescence short *asiaticus*
- [From material from the Pamir, U.S.S.R.] Eyes similar in relative size to those of females, not enlarged, and separated from lateral ocelli by more than two ocellar diameters; antennae long, but reaching only just past tegulae; volsella broadened subapically, interio-apical process very short and broad but extero-apical corner strongly produced as a broad tooth (Fig. 159); recurved hook of penis valve head narrowly constricted (Fig. 79); pubescence long *oberti*
- 24 (Subgenus *Melanobombus*.) Gonostylus with apical margin concave, leaving an extero-apical corner and an interio-apical process, latter often with two apical corners or bidentate (Figs 203-205); volsella extending beyond gonostylus apically by at least nearly twice its own breadth at the point where it emerges from beneath gonostylus from dorsal aspect 25
- Gonostylus with apical margin broadly convex (Figs 200-202); volsella extending beyond gonostylus by about its own breadth at the point where it emerges from beneath gonostylus from dorsal aspect 27
- 25 (*rufofasciatus*-group.) Gonostylus about a third as long in middle as broad, excluding interio-basal process, and reduced to a transverse band, with interio-apical corner extended as a spinose or bilobed process (Figs 204 & 205); pubescence of tergum II extensively lemon-yellow 26
- Gonostylus more than half as long in middle as broad, excluding extero-basal process, nearly rectangular, with interio-apical corner not strongly produced (Fig. 203); pubescence of tergum II either

- nearly white or chocolate brown, but not yellow (Figs 419 & 421) *simillimus*
- 26 Eyes distinctly enlarged relative to those of females, separated from lateral ocelli by one ocellar diameter; interio-basal process of gonostylus with apex forming nearly a right angle, interio-apical process with sides diverging towards apex, which is broadly bilobed (Fig. 205); pale pubescence of thorax and tergum I grey-white (Figs 433, 436, 439) *rufofasciatus*
- Eyes not enlarged relative to those of females, separated from lateral ocelli by two ocellar diameters; interio-basal process of gonostylus with apex distinctly acute, interio-apical process with sides often converging towards apex (Fig. 204), which may be spinose even from outer lateral aspect; pale pubescence of thorax and tergum I yellow (Figs 424, 427, 430) *pyrosoma*
- 27 (*lapidarius*-group.) Eyes slightly enlarged relative to those of females, separated from lateral ocelli by less than two ocellar diameters; pubescence of thoracic dorsum uniformly lemon-yellow, without black hair (Figs 399 & 402) *semenovianus*
- Eyes not enlarged relative to those of females, separated from lateral ocelli by about two and a half ocellar diameters; pubescence of thoracic dorsum pale yellow with a black band between wings 28
- 28 Free, recurved hook of penis valve head about two-thirds as long as more apical part of penis valve head (Fig. 82), penis valve shaft narrower at its mid-point from lateral aspect (Fig. 122) than spatha is at its mid-point from dorsal aspect; pubescence of tergum III black, at most with only a narrow apical and lateral fringe of pale hairs, terga IV-VII orange-red (Figs 410 & 416) *keriensis*
- Free, recurved hook of penis valve head about one-third as long as more apical part of penis valve head (Fig. 80), penis valve shaft broader at its mid-point from lateral aspect (Fig. 120) than spatha is at its mid-point from dorsal aspect; pubescence of terga III-V predominantly orange-red, terga VI-VII predominantly pale, hairs nearly white with orange bases, black hairs mostly confined to basal margin of tergum III, otherwise intermixed on lateral quarters of remaining terga (Fig. 395) *ladakhensis*

Genus *BOMBUS* Latreille

[*Bremus* [Jurine], 1801: 164. Type species: *Apis terrestris* Linnaeus, 1758: 578 = *Bombus terrestris* (Linnaeus), by subsequent designation of Morice & Durrant (1915: 429). Suppressed by the ICZN in Opinion 135 (ICZN, 1939).]

[*Bremus* Panzer, [1801]: pls. 19-21. Type species: *Apis agrorum* Fabricius, 1787: 301 = *Bombus pasuorum* (Scopoli), by subsequent designation of Sandhouse (1943: 532). Suppressed by the ICZN in Opinion 220 (ICZN, 1954).]

Bombus Latreille, 1802a: 437 [redescribed 1802b: 385]. Type species: *Apis terrestris* Linnaeus, 1758: 578 [cited as *Apis terrestris* F.] = *Bombus terrestris* (Linnaeus), by monotypy.

Specialists often find it useful to be able to refer to groups of closely related species by group-names. The use of the established subgeneric names as labels for assemblages of similar bumble bee species is continued here solely for the sake of nomenclatural continuity, because there is little advantage at present in modifying the usage of previous authors (see the introduction on genera of Bombini). When it is possible to revise all of the bumble bees thoroughly, this system could be replaced or at least simplified. For this review, only a few additions and revisions to a preliminary cladistic study of relationships (Williams, 1985) are included in the discussions of affinities for each species. As little as possible is added to the burden of subgeneric nomenclature, although the application of certain names does require some clarification.

Richards (1968) described the characteristics of both sexes for species of the subgenera referred to here, with the exception of *Psithyrus*, which is described by Popov (1931) and by Løken (1984).

Subgenus *MENDACIBOMBUS* Skorikov

Mendacibombus Skorikov, 1914a: 125. Type species: *Bombus mendax* Gerstaecker, 1869: 323, by subsequent designation of Sandhouse (1943: 572).

Mendacibombus Skorikov; Krüger, 1917: 62 (as a subgenus of *Bombus* Latreille).

Species of the subgenus *Mendacibombus* have been regarded as showing the most plesiomorphic forms of the male genitalia among bumble bees (Williams, 1985). A brief review of most species of this group is now possible thanks to generous loans of material from other institutions (ITZ, MNHU, ZI). These nominal taxa have been described from female type specimens, which are all closely similar in morphology (e.g. mostly described as subspecies of *B. mendax* by Skorikov, 1910a). The application of the names to the more divergent males naturally depends on correct association of the sexes. For these associations I have relied on reference material from A. S. Skorikov's collection (ZI, with a few specimens in the BMNH), because he had access to relatively large samples of material and had described many of the taxa himself.

The results of a cladistic analysis show that the subgenus *Mendacibombus* is likely to be