

A taxonomic review of the genus *Vespula* Thomson (Hymenoptera: Vespidae: Vespinae) from the Indian subcontinent

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Abstract

The genus *Vespula* Thomson, 1869, is reviewed from the Indian subcontinent. New synonymy is *Vespa orbata* var. *aurulenta* du Buysson, 1905, = *Vespula structor* (Smith, 1870). The following species are newly recorded from various states of India as follows: *V. nursei* Archer, 1981, from Delhi, Sikkim and Uttarakhand; *V. orbata* (du Buysson, 1902) from Nagaland; *V. flaviceps* (Smith, 1870) from West Bengal; *V. germanica* (Fabricius, 1793) from Himachal Pradesh; *V. structor* (Smith, 1870) from Arunachal Pradesh; *V. vulgaris* (Linnaeus, 1758) from Himachal Pradesh. Parasitic association of Strepsiptera is observed in one worker specimen of *V. flaviceps*. A modified key to species of the Indian subcontinent is provided.

Keywords: *Vespula*, review, Indian subcontinent, new record, ethology.

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Introduction

Thomson (1869) erected *Vespula* as a subgenus of *Vespa* based on eight species; the type species *Vespa austriaca* Panzer, 1799, was subsequently designated by Ashmead (1902). Members of this social wasp genus are commonly called yellow jackets. They usually make underground nests. They are widely distributed in the Northern Hemisphere. Currently, 25 species are recorded worldwide of which 10 species are present in the Indian subcontinent. In this paper, we review the Indian subcontinent species. A new synonymy is proposed in this paper, i.e., *Vespa orbata* var. *aurulenta* du Buysson, 1905, is synonymized under *Vespula structor* (Smith, 1870). The distributional records of many species are augmented in this paper. Parasitic association of Strepsiptera is observed in one worker specimen of *V. flaviceps*. A key to species of the Indian subcontinent is also provided.

Materials and Methods

This study is based primarily on the specimens present in the Zoological Survey of

India. Most of the specimens were properly preserved and added to the 'National Zoological Collections' of the Hymenoptera Section of the Zoological Survey of India, Kolkata (NZC) and some of the specimens at Western Ghat Regional Centre of the Zoological Survey of India, Kozhikode (ZSIK).

List of repositories: Beijing — Institute of Zoology, Academia Sinica; Budapest — Hungarian Natural History Museum; Dresden — Staatliches Museum für Tierkunde; Genève — Muséum d'Histoire Naturelle; Linnean Society — Linnean Society, London; London — The Natural History Museum; New York — American Museum of Natural History; Paris — Laboratoire d'Entomologie, Muséum National d'Histoire Naturelle; Stockholm — Naturhistoriska Riksmuseet (Entomologiska); Taichung — Taiwan Agricultural Research Institute; Washington — U. S. National Museum of Natural History; Wien — Zoologische Sammlung, Naturhistorisches

Museum; Yunnan — Kunming Natural History Museum of Zoology.

Abbreviations used for the terms: HW = Head width; L = Length; OMS = Oculo-malar space; S = Metasomal sterna; T = Metasomal terga; W = Width.

Results and Discussion

Genus *Vespula* Thomson, 1869

Vespula Thomson, 1869: 79, subgenus of *Vespa* (eight species). Type species: *Vespa austriaca* Panzer, 1799, by subsequent designation of Ashmead, 1902: 164.

Pseudovespa Schmiedeknecht, 1881: 314, subgenus of *Vespa* Linnaeus. Type species: *Vespa austriaca* Panzer, 1799, by monotypy.

Paravespula Blüthgen, 1938: 271, subgenus of *Dolichovespula* Rohwer. Type species: *Vespa vulgaris* Linnaeus, 1758, by original designation.

Allovespula Blüthgen, 1943: 149, subgenus of *Paravespula* Blüthgen. Type species: “*Paravespula rufa* (Linné)” [= *Vespa rufa* Linnaeus, 1758], by monotypy.

Rugovespula Archer, 1982: 261, 264, subgenus of *Vespula* Thomson. Type species: *Vespa koreensis* Radoszkowski, 1887, original designation.

Diagnosis: Oculo-malar space short, as short as or shorter than apical diameter of scape; pronotal carina absent or faintly marked ventrally; female with outer flange on mandible; eye almost touching base of mandible; occipital carina present laterally, reaching or not reaching base of mandible, sometimes weak; male antenna with long scape, equal to or little shorter than third flagellar segment, later without tyloids; branches of aedeagus fused resulting in disc-like or saddle-shaped apical lobe; aedeagus longer than parameres.

Distribution: Eurasia, North Africa, North America, Central America. Adventive in Australia, New Zealand, Tahiti, Hawaii, South Africa, Chile, Argentina.

Key to species of the genus *Vespula* Thomson from the Indian subcontinent

(Modified from Archer, 2012)

1. T1 usually with long black hairs; occipital carina not extending to base of mandible;

lateral mesoscutal depression without a backwardly directed depression; posterolateral margin of S6 of female evenly convex; profile of T7 convex in male; shape of S7 almost triangular in male; male genitalia with digitus small, not extending to level of parameral spine; apex of aedeagus strap-shaped and cuspis cone-shaped, without dorsal lobe.....

rufa species group 2

— T1 usually with long pale hairs; occipital carina usually extending to base of mandible; lateral mesoscutal depression with a backwardly directed depression (sometimes indistinct on workers); posterolateral margin of S6 of female with a backwardly directed projection; profile of T7 concave in male; shape of S7 transversely rectangular in male; male genitalia with digitus large, extending nearly as far as or beyond the level of parameral spine; apex of aedeagus not strap-shaped but either boat-shaped or spoon-shaped and cuspis pyramid-shaped with a dorsal lobe.7

2. Hind tibia with long erect hairs; apex of clypeus sharply produced in females, bluntly produced in males. [Worker caste absent].....*austriaca* (Panzer)

— Hind tibia without long erect hairs; apex of clypeus bluntly produced in females, hardly produced at all in males. [Worker caste present].....3

3. Large punctures on mesoscutum with distance between punctures usually more or less equal or less than the diameter of punctures except at middle where punctures are further apart; large punctures of two sizes with normally a single smaller puncture between larger punctures; micropunctures shallow so that surface between them appears polished.....

.....*rufa* (Linnaeus)

— Large punctures on mesoscutum with distance between punctures usually greater than the diameter of punctures; large punctures of two sizes with normally two smaller punctures between larger punctures; micropunctures deep so that surface between them appears dull.....4

4. Females (queens and workers).....5

— Males.....6

5. Oculo-malar space short, about 1/20 to 1/25 the width of head; occipital carina long, occupying about 70% of the lateral length

A taxonomic review of the genus *Vespula* Thomson

- of head; clypeus largely yellow with either each lateral yellow stripe broader than median black stripe or yellow with three black spots; metanotum with two yellow spots.*nursei* **Archer**
- Oculo-malar space longer, about 1/14 to 1/17 the width of head; occipital carina short, occupying about 50% of the lateral length of head; clypeus largely black, with each lateral yellow stripe narrower than median black stripe; metanotum without yellow spots.....*kingdonwardi* **Archer**
6. Clypeus more than 50% yellow, black median stripe narrow and/or incomplete; metanotum with two yellow spots; coxa with yellow spot.....*nursei* **Archer**
- Clypeus less than 50% yellow, black median stripe broad and complete; metanotum without yellow spots; coxa without yellow spot.....*kingdonwardi* **Archer**
7. T1 raised basally with a depression behind this elevation (sometimes indistinct in workers); In female, outer basal flange of mandible nearly straight; In queen, propodeum coarsely rugose all or over major part of its surface; backwardly directed postero-lateral projection on S6 sharply pointed; In worker, either propodeum rugose or if not clearly rugose in dorsal aspect, then body tricolored (black, yellow, brown); lower side of second submarginal cell on the medial vein before the point of contact with second medio-cubital or recurrent vein shorter than the lower side of second submarginal cell after the point of contact with the recurrent vein; In male, shaft of aedeagus broad and its apex boat-shaped; dorsal terminal process of gonostipes weakly developed; T7 deeply notched.*koreensis* **species group**8
- T1 not raised basally and without a depression; In female, outer basal flange of mandible strongly curved (sometimes indistinct in workers); In queen, propodeum not coarsely rugose, surface smooth with punctures and only weakly rugose around petiole junction; backwardly directed postero-lateral projection on S6 bluntly rounded; In worker, propodeum not rugose and in dorsal aspect body bicoloured (black, yellow) except for *V. structor* and some *V. flaviceps* which are tricoloured (black, yellow, brown); lower side of second submarginal cell on the medial vein before the point of contact with the second medio-cubital or recurrent vein as long as or longer than the lower side of second submarginal cell after the point of contact with the recurrent vein; In male, shaft of aedeagus narrow and its apex spoon-shaped; dorsal process of gonostipes well developed and projects laterally; T7 either slightly or not at all notched.....*vulgaris* **species group** 13
8. Female (queens and workers).....9
- Males..... 12
9. Queens (usually body length greater than 15.5 mm and forewing length greater than 13 mm).....10
- Workers (usually body length less than 15.5 mm and forewing length less than 13 mm).....11
10. Propodeum very coarsely rugose all over its surface and without punctures; ventral metapleura anteriorly and ventro-laterally strongly rugose.....*koreensis* (**Radoszkowski**)
- Propodeum less coarsely rugose and punctures between and interrupting the rugae; ventral metapleura without strong rugae.....*orbata* (**du Buysson**)
11. Mesoscutal punctures dense with distances between punctures equal to diameter of punctures; propodeum rugose and with punctures between and interrupting the rugae; if the rugae indistinct then the body in dorsal aspect clearly bicoloured (black, yellow).....*koreensis* (**Radoszkowski**)
- Mesoscutal punctures usually less dense with distances between punctures greater than diameter of punctures; propodeum not rugose, only punctate; body in dorsal aspect tricoloured (black, yellow, brown); brown particularly visible on vertex, pronotum and mesoscutum although sometimes restricted in amount..... *orbata* (**du Buysson**)
12. Propodeum rugose, without punctures; dorsal terminal process almost absent, indicated by a slight undulation on margin of gonostipes.....*koreensis* (**Radoszkowski**)
- Propodeum punctate, without rugae; dorsal terminal process weakly developed but with a distinct projection on margin of gonostipes.....*orbata* (**du Buysson**)
13. Female (queens and workers)..... 14

- Males.....21
- 14. Queens (usually body length greater than 13 mm and forewing length greater than 11 mm).15
- Workers (usually body length less than 13 mm and forewing length less than 11 mm).18
- 15. Occipital carina not extending to base of mandible, usually extends for less than $\frac{3}{4}$ of lateral length of head; light coloured ocular sinus not deeply penetrated by a medial black projection; black mark on clypeus, if present, usually not reaching apical margin.....*flaviceps* (Smith)
- Occipital carina extending to base of mandible; other characters partly or completely different. 16
- 16. Margin behind third mandibular tooth distinctly concave.....*germanica* (Fabricius)
- Margin behind third mandibular tooth straight or at most slightly concave. 17
- 17. Bi-coloured (yellow and black); scutellum and metanotum black, with yellow spots; clypeus yellow with black median mark; oculo-malar space shorter, HW/OMS greater than 19.....*vulgaris* (Linnaeus)
- Tri-coloured (yellow, black and brown); brown colour particularly visible on pronotum, T2 and S2-S4; scutellum and metanotum black, without yellow spots, at most with brown markings; clypeus yellow to orange without a black median mark; oculo-malar space longer, HW/OMS less than 18.....*structor* (Smith)
- 18. Light colour of gastral terga orange yellow; dorsal surface of T1 without or almost without black marking; metanotum without a yellow mark.....*structor* (Smith)
- Light colour of gastral terga yellow; dorsal surface of T1 with a distinct black marking; metanotum with a yellow mark.....19
- 19. Margin behind third mandibular tooth distinctly concave; lateral surface of mesosoma (mesepisternum, mesepimeron, dorsal and ventral metapleura) with at least some long black hairs; if (rarely) no black hairs present, then long hairs white.*germanica* (Fabricius)
- Margin behind third mandibular tooth straight or at most slightly concave; other characters partly or completely different.20
- 20. Occipital carina incomplete only extending just over half way from vertex to mandible; yellow area of ocular sinus with a slightly convex medial margin and slightly separated from yellow shield of frons.....*flaviceps* (Smith)
- Occipital carina complete, extending from vertex to mandible, but disappearing for a short distance near mandible and then reappearing and reaching to mandible; yellow area of ocular sinus with a concave medial margin and widely separated from yellow shield of frons.....*vulgaris* (Linnaeus)
- 21. Aedeagus without a small backwardly directed pointed barb on each side below the apical spoon-shaped region; aedeagus emarginated apically; aedeagus with a small semicircular projection on each side below apical spoon-shaped region; dorsal terminal process of gonostipes equal to, or less than width of shaft of aedeagus.*germanica* (Fabricius)
- Aedeagus with a small backwardly directed pointed barb on each side below the apical spoon-shaped region; aedeagus rounded apically; other characters partly or completely different. 22
- 22. Volsella visible in ventral view of gonostipes; light coloured area of ocular sinus not deeply penetrated by a medial black projection, medial margin straight or convex or continuous with the light coloured area of frons; mandible without a triangular black spot at its base; genitalia short, L/W less than one.....*flaviceps* (Smith)
- Volsella not visible in ventral view of gonostipes; other characters partly or completely different.23
- 23. Gastral terga not covered by short brown hairs so that the light coloured areas appear clear yellow; metanotum with yellow spots; light coloured areas of frons and ocular sinus parallel, or diverging dorsally, so that they are clearly separated.*vulgaris* (Linnaeus)
- Gastral terga covered by short brown hairs so that the light coloured areas appear orange-brown; metanotum without yellow spots; light coloured areas of frons and ocular sinus either continuous or only narrowly separated.....*structor* (Smith)

The *rufa* species group

Four species of *rufa* species group, namely, *Vespula austriaca* (Panzer, 1799), *V. rufa* (Linnaeus, 1758), *V. nursei* Archer, 1981 and *V. kingdonwardi* Archer, 1981, are present in the Indian subcontinent.

1. *Vespula austriaca* (Panzer, 1799)

Vespula austriaca Panzer, 1799: 2, fig. 2, male, “Viennae Austr.” (destroyed).

Vespula borealis Smith, 1843: 170, fig., female, “Yorkshire... the north of Scotland” (London). Junior primary homonym of *Vespula borealis* Kirby, 1837, and of *Vespula borealis* Zetterstedt, 1840.

Vespula arborea Smith, 1849: 1x. Replacement name for *Vespula borealis* Smith.

Vespula biloba Schilling, 1850: 77, [Poland] “Schlesien” (type depository unknown).

Vespula arborea “Ross” Dalla Torre, 1894: 138, as a synonym of *Vespula austriaca* Panzer. Junior primary homonym of *Vespula arborea* Smith, 1849.

Diagnosis: *Female:* Apex of clypeus sharply produced; occipital carina present only laterally; mesoscutum and scutellum dull with sparse shallow punctures; metanotum dull with fine shallow punctures; metasoma dull; body covered with long black erect hairs; hind tibia with characteristic long erect hairs; clypeus usually with 2-3 black spots; scape yellow ventrally; ocular sinus yellow at ventral side; metasoma without reddish areas.

Male: Apex of clypeus bluntly produced; genitalia with basal part of aedeagus narrower than the apical part, the apex evenly rounded and without lateral projections, but with subapical constriction; volsella short, extending only up to the base of the apical part; aedeagus entirely light brown.

Length: Female, 15-18 mm; male, 13-16 mm.

Ethology: It is an obligatory parasite that does not construct its own nest and breeds in the nests of other *Vespula* species such as *V. nursei*, *V. acadica* and *V. rufa* (Williams, 1988; Archer, 2007). It does not produce a worker caste.

Material examined: No specimens from the Indian subcontinent were available for our studies. We compared the species description from Das and Gupta (1989) with a queen from Suisse - Valais/Grimentz/13 VII - 2 VIII 1941/J. de Beaumont, and a male from Germany and Coll. Konow without further

data (New York).

Distribution: India: Jammu & Kashmir; Pakistan. Elsewhere: Albania; Austria; Belarus; Belgium; Bosnia & Herzegovina; Bulgaria; Canada; China; Croatia; Czech Republic; Denmark; Estonia; Finland; France; Georgia; Germany; Greece; Hungary; Ireland; Italy; Japan; Kazakhstan; Korea; Kyrgyzstan; Latvia; Liechtenstein; Lithuania; Luxembourg; Macedonia; Moldova; Mongolia; Netherlands; Norway; Poland; Romania; Russia; Serbia; Slovakia; Slovenia; Spain; Sweden; Switzerland; Turkey; U. K.; Ukraine.

2. *Vespula rufa* (Linnaeus, 1758)

Vespula rufa Linnaeus, 1758: 572, “in Europa” (lectotype female, Linnean Society). Additional citation: Day, 1979: 71 (designation of lectotype).

Vespula schrenckii Radoszkowski, 1861: 84, figs. 4-5, [Russia] “Amur” (type depository unknown).

Vespula sibirica André, 1884: 599, female, male, [Russia] “Sibérie” (Paris?).

Vespula schrenki; Dalla Torre, 1904: 66. Incorrect spelling of *Vespula schrenckii* Radoszkowski.

Vespula rufa grahami Archer, 1981: 54, 62, female, male – “CHINA, Szechuen, 30 miles north of Tatsienku” (Washington); also from elsewhere in Sichuan.

Vespula obscura Lee, 1986: 201, 205, 206, fig. 5, female – [China] “Zogang County, Xizang (Tibet) Aut. Reg., 3800 m” (Beijing); also from another locality in Xizang.

?*Vespula yichunensis* Lee, 1986: 202, 203, 206, fig. 3, female – [China] “Yichun City, Heilongjiang Province” (Beijing).

Vespula yulongensis Dong and Wang, 2002, in Dong *et al.*: 396, figs. 1- 5, female - “Yunnan China” (Yunnan).

Vespula shinanoensis: Takamizawa, 2005, The Japanese Social Wasps and Bees: 147, 148 (in subgenus *Vespula*). Nomen nudum, described without mentioning repository of the holotype (Articles 13 and 16.4 of the International Code of Zoological Nomenclature).

Diagnosis: *Female:* Large punctures on mesoscutum with distance between punctures

usually more or less equal or less than the diameter of punctures except at middle where punctures further apart; large punctures of two sizes with normally a single smaller puncture between larger punctures; micropunctures shallow so that the surface between them appears polished; metanotum and metasoma more shiny with finer micro sculpture and more superficial punctation; tibiae with sparse hairs; a dagger-shaped mark on clypeus; T1 and T2 partly red.

Male: Aedeagus not constricted basally, its basal part with thick walls; T1 and T2 with red spots.

Material examined: No specimens from the Indian subcontinent were available for our studies. We compared the species description from Das and Gupta (1989) with a queen from Europe without further data, two workers from Bressoux/Belgium/22/7/52 and Tolumierz/22/X/1990/E. Yildirim, and two males from Tolumierz/22/X/1990/E. Yildirim and Maele W/Brugge/Belgium (New York).

Distribution: Nepal. Elsewhere: Afghanistan; Albania; Austria; Azerbaijan; Belarus; Belgium; Bosnia & Herzegovina; Bulgaria; China; Croatia; Czech Republic; Denmark; Estonia; Finland; France; Georgia; Germany; Greece; Hungary; Iceland; Ireland; Italy; Japan; Kazakhstan; Kyrgyzstan; Korea; Latvia; Liechtenstein; Lithuania; Luxembourg; Macedonia; Moldova; Mongolia; Netherlands; Norway; Poland; Romania; Russia; Serbia; Slovenia; Slovakia; Spain; Sweden; Switzerland; Taiwan; Tajikistan; Turkey; U.K.; Ukraine; Uzbekistan.

3. *Vespula nursei* Archer, 1981

(Figs. 1-12)

Vespula nursei Archer, 1981: 54, 57, fig. 4A-B, female, male. "INDIA, Kashmir, 8-9,000 ft" (holotype female London); also from other localities in Kashmir, Punjab, Himachal Pradesh; China; Philippines.

Diagnosis: *Female:* Oculo-malar space short, about 1/20 to 1/25 the width of head; clypeus with coarse punctures separated by more than their diameters; lateral angles of clypeus triangular and projecting outwards; occipital carina long, occupying about 70% of lateral length of head; pronotal carina absent; pronotum punctate and weakly striate

ventrally; large punctures on mesoscutum with distance between punctures usually greater than the diameter of punctures; large punctures of two sizes with normally two smaller punctures between larger punctures; micropunctures deep so that surface between them appears dull; propodeum punctate, weakly striate ventro-laterally; apical margin of S6 evenly convex.

Colour: Head black with yellow marks as follows: most of clypeus except linear black mark medially; frons with a shield reaching antennal bases; stripe along ocular sinus extending to clypeus; mandible; small spot posteriorly and large linear mark anteriorly on gena. Mesosoma black with yellow marks as follows: stripe on pronotum parallel sided; tegula; spot just below hind wing; two spots on scutellum; metanotum with two spots anteriorly; triangular spot on mesepisternum. Legs with coxae black or dark brown with small yellow spot; femur mainly light brown; tibia and tarsus brown with yellow dorsal marks. Metasoma with black, reddish brown and pale yellow marks as in figure 6. Body hairs long and black; legs with long black hairs on coxa, trochanter and femur.

Male: Clypeal angles absent, apical margin of clypeus almost straight; antennal tyloids absent; apical margin of S6 deeply concave; S7 almost triangular. Colouration similar to that of female except as follows: clypeus almost completely yellow except narrow black median stripe; gena with anterior yellow stripe along its entire length.

Length (H+M+T1+T2): Queen, 12.5-13.5 mm; Worker, 9.5-10.5 mm; Male, 9.5-11.5 mm.

Material examined: INDIA: Delhi, Delhi University Ridge, 1 worker, date of collection and name of collector unknown, NZC Regd. No. 17587/H3; Delhi University Campus, 1 male, 27.x.1978, Coll. Meenakshi, NZC Regd. No. 17588/H3. Himachal Pradesh, Shimla district, Chini Bungalow, 1 worker, 11.x.1962, Coll. V.K. Gupta, NZC Regd. No. 17589/H3; Shimla district, Narkanda, 2 worker & 1 male, 5.x.1966-13.x.1971, Coll. V.K. Gupta & Party, NZC Regd. Nos. 17591/H3-17593/H3; Shimla, 1 male, 3.x.1966, Coll. Ram, NZC Regd. No. 17590/H3; Chamba district, Khajjiar, 1 worker, 27.vi.1965, Coll. Tikar, NZC Regd. No. 17600/H3; Chamba district, Dainkund, 1 worker, 11.vi.1971, Coll. Unknown, NZC Regd. No. 17594/H3. Jammu

& Kashmir, Baramulla district, Gulmarg, 1 worker, 17.vi.1966, Coll. Joseph, NZC Regd. No. 17595/H3; Baramulla district, Chandanwari, 1 male, 1.x.1978, Coll. Rina, NZC Regd. No. 17597/H3; Srinagar, 1 male, 6.ix.1978, Coll. A. Kaur, NZC Regd. No. 17596/H3; Anantanag district, Pahalgam, 1 male, 2.x.1978, Coll. Bindu, NZC Regd. No. 17598/H3. Sikkim, East Sikkim district, Gangtok, 1 worker, 13.v.1966, Coll. Tikar, NZC Regd. No. 17599/H3. Uttarakhand, Uttarkashi district, Harsil, 5 worker, 9–13.vi.1977, Coll. V.K. Gupta & Party, NZC Regd. Nos. 17601/H3–17605/H3.

Distribution: India: Delhi (new record), Himachal Pradesh, Jammu & Kashmir, Punjab, Sikkim (new record), Uttarakhand (new record); Pakistan. Elsewhere: China; Philippines.

4. *Vespula kingdonwardi* Archer, 1981

Vespula kingdonwardi Archer, 1981: 54, 57 (key), 60, fig. 4C-D, female, male – [China] “TIBET, Kashmir, 28.25 N 97.55 E” (holotype female London); also from other localities in Xizang; Myanmar.

Vespula hirsuta Lee, 1986: 201, 204, 206, fig. 4, female – [China] “Markham County, Xizang (Tibet) Aut. Reg., 3300 m” (Beijing).

Diagnosis: Female: Oculo-malar space longer, about 1/14 to 1/17 the width of head; occipital carina shorter, occupying about 50% of the lateral length of head; large punctures on mesoscutum with distance between punctures usually greater than the diameter of punctures; large punctures of two sizes with normally two smaller punctures between larger punctures; micropunctures deep so that surface between them appears dull.

Colour: Head black with yellow marks as follows: clypeus largely black with lateral narrow yellow stripes; frons with a shield reaching antennal bases; a stripe along ocular sinus not extending to clypeus; Mesosoma black with yellow marks as follows: a stripe on pronotum parallel sided; tegula brown with spots. Metasoma black with reddish brown and yellow markings; vertical face of T1 reddish brown with dorsal and ventral black marks. Body hairs long and black; legs with long black hairs on coxa, trochanter and femur.

Male: Clypeal angles absent, apical margin of clypeus truncate; antennal tyloids absent;

apical margin of T7 not notched, convex in profile; apical margin of S6 concave; S7 almost triangular; genitalia like that of *V. rufa* and *V. nursei*. Colouration similar to that of female except gena with anterior yellow stripe along its entire length.

Length: Queen, 17 mm; Worker, 12–13.2 mm; Male, 13–14.7 mm.

Distribution: Myanmar; Nepal. Elsewhere: China.

Remarks: Specimens of this species was not available for our studies; hence the species diagnosis, colour description and length are taken from Das & Gupta (1989).

The *koreensis* species group

This species group consists of only three species, namely, *Vespula koreensis* (Radoszkowski, 1887), *V. orbata* (du Buysson, 1902) and *V. arisana* (Sonan, 1929) of which the first two species are present in the Indian subcontinent.

5. *Vespula koreensis* (Radoszkowski, 1887)

Vespa koreensis Radoszkowski, 1887: 432, male, female. “Korée” (lectotype female London). Additional citation: Archer, 1982: 263, 267 (designation of lectotype).

Vespa germanica var. *stizoides* du Buysson, 1905: 494 (key), 615, female. “Nord de l’Inde” (holotype London).

Pseudovespa birulai Gussakovskii, 1932: 52, female. [Russia] “Ussuri-Geb.: Tigrovaja...; Sutshan... Sedanka... Kreis Chabarowsk... Wladiwostok” (Stockholm).

Vespula koreensis salebrosa Archer, 1982: 261, 267, female. “CHINA: Szechuen, Suifu” (London); also from other localities in China.

Vespula hainanensis Lee, 1986: 201, 202, 206, fig. 1, female. [China] “Hainan Island, Guangdong Province” (Beijing).

Diagnosis: T1 raised basally with a depression behind this elevation (sometimes indistinct in workers). *Female* (queens and workers): outer basal flange of mandible nearly straight. In queen, propodeum very coarsely rugose all over its surface and without punctures; ventral metapleuron anteriorly and ventro-laterally strongly rugose; backwardly directed postero-

Plate 1



1



2



3



4



5



6

Figs 1-6: *Vespula nursei* Archer, worker. 1: Body, in profile. 2: Head, in frontal view. 3: Head, in lateral view. 4: Head and mesosoma, in dorsal view. 5: Wings. 6: Metasoma, dorsal view.

Plate 2



7



8



9



10



11



12

Figs: 7-12: *Vespula nursei* Archer, male. 7: Body, in profile. 8: Head, in frontal view. 9: Antenna. 10: Head and mesosoma in dorsal view. 11: Metasomal tergum. 12: Metasomal sternum.

lateral projection on S6 sharply pointed. In worker, mesoscutal punctures dense with distances between punctures equal to diameter of punctures, less dense on centre and denser on lateral margins; margin behind inner mandibular tooth distinctly concave; occipital carina reaches base of mandible; lower side of second submarginal cell on the medial vein before the point of contact with the second medio-cubital or recurrent vein shorter than the lower side of second submarginal cell after the point of contact with the recurrent vein.

Male: Propodeum rugose, without punctures; genitalia with dorsal terminal process almost absent, indicated by a slight undulation on margin of gonostipes; dorsal terminal process of gonostipes weakly developed; parameral spine gradually narrowing to an apical point; the shaft of aedeagus broad and its apex boat-shaped; T7 deeply notched.

Length: Queen, usually greater than 15.5 mm; Workers, usually less than 15.5 mm.

Material examined: No specimens from the Indian subcontinent were available for our studies. We compared the species description from Archer (2012) with two queens from Foochow China/Kellogg coll. and Yen-ping, China/IV.16.1917/Ac. 5148, and two workers from Yen-ping, China/X.11.1917/Ac. 5148 and VII.10.1917 (New York).

Distribution: India: Meghalaya, Sikkim; Myanmar. Elsewhere: China; Korea; Laos; Russia; Thailand; Vietnam.

6. *Vespa orbata* (du Buysson, 1902)

(Figs. 13-18)

Vespa orbata du Buysson, 1902: 140, female – [India] “Dardjiling” (lectotype Paris); also from Sikkim, China. Additional citations: Archer, 1982: 262, 268 (designation of lectotype).

Vespa minuta Dover, 1925: 304, fig. 9, female – [Myanmar] “Tenasserim” (holotype London). Junior primary homonym of *Vespa minuta* Linnaeus, 1767.

Vespa nujiangensis Dong and Wang, 2004, in Dong et al., 146, female, figs. 1-5 - [China] “Nujiang Liuku, Yunnan, Alt. 1 100 m. 25°58' N. 98°65' E.” (Yunnan).

Diagnosis: T1 raised basally with a depression behind this elevation (sometimes indistinct in workers). *Female* (queens and workers): outer basal flange of mandible nearly straight. In

queens, propodeum less coarsely rugose and punctures between and interrupting the rugae; ventral metapleuron without strong rugae; backwardly directed postero-lateral projection on S6 sharply pointed. In workers, mesoscutal punctures usually less dense with distances between punctures greater than diameter of punctures, less dense on centre and denser on lateral margins; propodeum not rugose, only punctate; margin behind inner mandibular tooth distinctly concave; occipital carina reaches base of mandible; lower side of second submarginal cell on the medial vein before the point of contact with the second medio-cubital or recurrent vein shorter than the lower side of second submarginal cell after the point of contact with the recurrent vein.

Male: Propodeum punctate, without rugae; genitalia with dorsal terminal process weakly developed but with a distinct projection on margin of gonostipes; the shaft of aedeagus broad and its apex boat-shaped; T7 deeply notched.

Colour (Worker): Body dorsally tricoloured: black, brown and yellow. Head yellowish brown with vertex darker; mesoscutum brown except black posteriorly; scutellum yellowish brown with a black mark in the middle; metanotum largely black and with a narrow brownish yellow line across its anterior margin; mesepisternum and usually the mesepimeron with a brown spot; propodeum black with two lateral brownish yellow spots; fore leg yellowish brown with coxa, trochanter and femur dorsally blackish brown; middle and hind legs blackish brown with apex of femur dorsally and tarsus yellowish; T1, T2 and S2 black or blackish brown with a yellow apical band; T3–T5 black basally and with wider apical yellowish brown bands; T6 wholly yellowish brown; S3–S6 largely yellowish brown.

Length (H+M+T1+T2): Worker, 10.5-11.5 mm.

Material examined: INDIA: Nagaland, Mokokchung, 1 worker, 26.iii.1989, Coll. B.C. Das & Party, Regd. No. ZSI/WGRC/I.R-INV.8971; Tuensang, 1 worker, 9.viii.2015, Coll. Lobeno, Regd. No. ZSI/WGRC/I.R-INV.8972. NEPAL: Kathmandu, Sundarjal, 1 worker, date of collection and name of collector unknown, Regd. No. ZSI/WGRC/I.R-INV.8973.

Plate 3



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Figs 13-18: *Vespula orbata* (du Buysson), worker. 13: Body, in profile. 14: Head, in frontal view. 15: Clypeus and mandible. 16: Head and mesosoma, in dorsal view. 17: Metasomal tergum. 18: Metasomal sternum.

Distribution: India: Arunachal Pradesh, Nagaland (new record), Sikkim, Uttarakhand, West Bengal; Nepal: Sundarijal; Myanmar. *Elsewhere:* China; Thailand; Laos; Vietnam. This species was previously recorded by other workers from “Uttar Pradesh: Mussoorie” and from “Assam: Mishmi Hills”. The locality Mussoorie presently belongs to Uttarakhand state and the locality Mishmi Hills presently belongs to Arunachal Pradesh.

The *vulgaris* species group

Four species of this species group, namely, *Vespa flaviceps* (Smith, 1870), *V. germanica* (Fabricius, 1793), *V. structor* (Smith, 1870) and *V. vulgaris* (Linnaeus, 1758) are present in the Indian subcontinent.

7. *Vespula flaviceps* (Smith, 1870)

(Figs. 19-36)

Vespa japonica de Saussure, 1858: 261, female - “Japon.” (Genève). Junior primary homonym of *Vespa japonica* Radoszkowski, 1857.

Vespa flaviceps Smith, 1870: 174, 191, pl. XXI figs. 10, 11, female. “Binsur, Kumaon, North-west Provinces of India” (London).

“*Vespa Lewisii*, Sauss. Guêpes Soc. (MS.)” Smith, 1873: 198. Nomen nudum.

Vespa “*Lewisii*, Sauss. MS.” Cameron, 1903: 280, as a synonym of *Vespa japonica* de Saussure, 1858. Available under Art. 11(e) of the International Code of Zoological Nomenclature.

Vespa Saussurei Schulz, 1906: 231. Replacement name for *Vespa japonica* de Saussure.

Vespa karenkona Sonan, 1929: 137 (key), 148, female. [Taiwan] “Karenkô (3000-6500 ft.)” (Taichung).

Vespa 4-maculata Sonan, 1929: 137 (key), 148, female. [Taiwan] “Arisan” (coll. M. Maki).

Vespa vulgaris var. *flavior* Stofa, 1934: 49, female. “India: Bagarkote 8000 piedi. Kumaon W. Himalaya... Dal, sopra Dharmasala, 5500 piedi Punjab... Pindi Point, Murree, 7242 piedi. Punjab... Rive del fiume Deo Gad e Foresta S. O. di Pinath, 7 miglia da Kausani Distr. Almora” (type depository unknown).

Vespula japonica pionganensis Giordani Soika, 1976: 287, 290, female (in

subgenus *Vespula*). [Korea] “Za-mo san, 60 km NE from Pyongyang” (Budapest); also from other localities in Korea.

Vespa vulgaris var. *flavior*; Das & Gupta, 1984: 449. Incorrect spelling of *Vespa vulgaris* var. *flavior* Stofa.

Vespula gracilia Lee, 1986: 201, 203, 206, fig. 2, female. [China] “Zhoushan, Zhejiang Province” (Beijing); also from Fujian.

Diagnosis: Queens: occipital carina not extending to base of mandible, usually extends for less than $\frac{3}{4}$ of lateral length of head; light coloured ocular sinus not deeply penetrated by a medial black projection; black mark on clypeus, if present, usually not reach apical margin. Workers: pale markings ivory-white; light coloured ocular sinus not deeply penetrated by a medial black projection; black mark on clypeus rarely reaches its apical margin. Males: volsella visible in ventral view of gonostipes; light coloured area of ocular sinus not deeply penetrated by a medial black projection, medial margin straight or convex or continuous with the light coloured area of frons; mandible without a triangular black spot at its base; genitalia short, L/W less than one.

Colour: Body markings highly variable in queen and worker. Yellow usually paler, approaching ivory white. Head yellowish except frons and vertex black; clypeus usually yellow, rarely with a basal black line, or this line divided in to three spots; genal band complete; antenna black with scape yellow to yellowish brown ventrally; mesosoma black except following yellow markings: posterior margin of pronotum; spot under wing base; anterior half of scutellum; anterior margin of metanotum; a pair of spots on propodeum; gaster black with yellow bands that are darker than mesosomal markings; legs largely yellowish. Male similar to worker in colouration.

Length: Queen, 13-15 mm. Worker, 8-9 mm. Male, 13-14 mm.

Material examined: INDIA: Himachal Pradesh, Chamba dist., Dalhousie, Bakrota Hills, 1 queen, v-vi.1927, Coll. S.L. Hora, NZC Regd. No. 2280/H3; Shimla, Matiana, 2 queen, 28-30.iv.1907, Coll. N. Annandale, Regd. Nos. ZSI/WGRC/I.R-INV.8974 & 8975; Ahla, 1 queen, vii.1971, Collector

Plate 4



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Figs 19-24: *Vespula flaviceps* (Smith), Queen. 19: Body, in profile. 20: Head, in frontal view. 21: Antenna. 22: Head and mesosoma, dorsal view. 23: Forewing. 24: Metasoma, in dorsal view.

Plate 5



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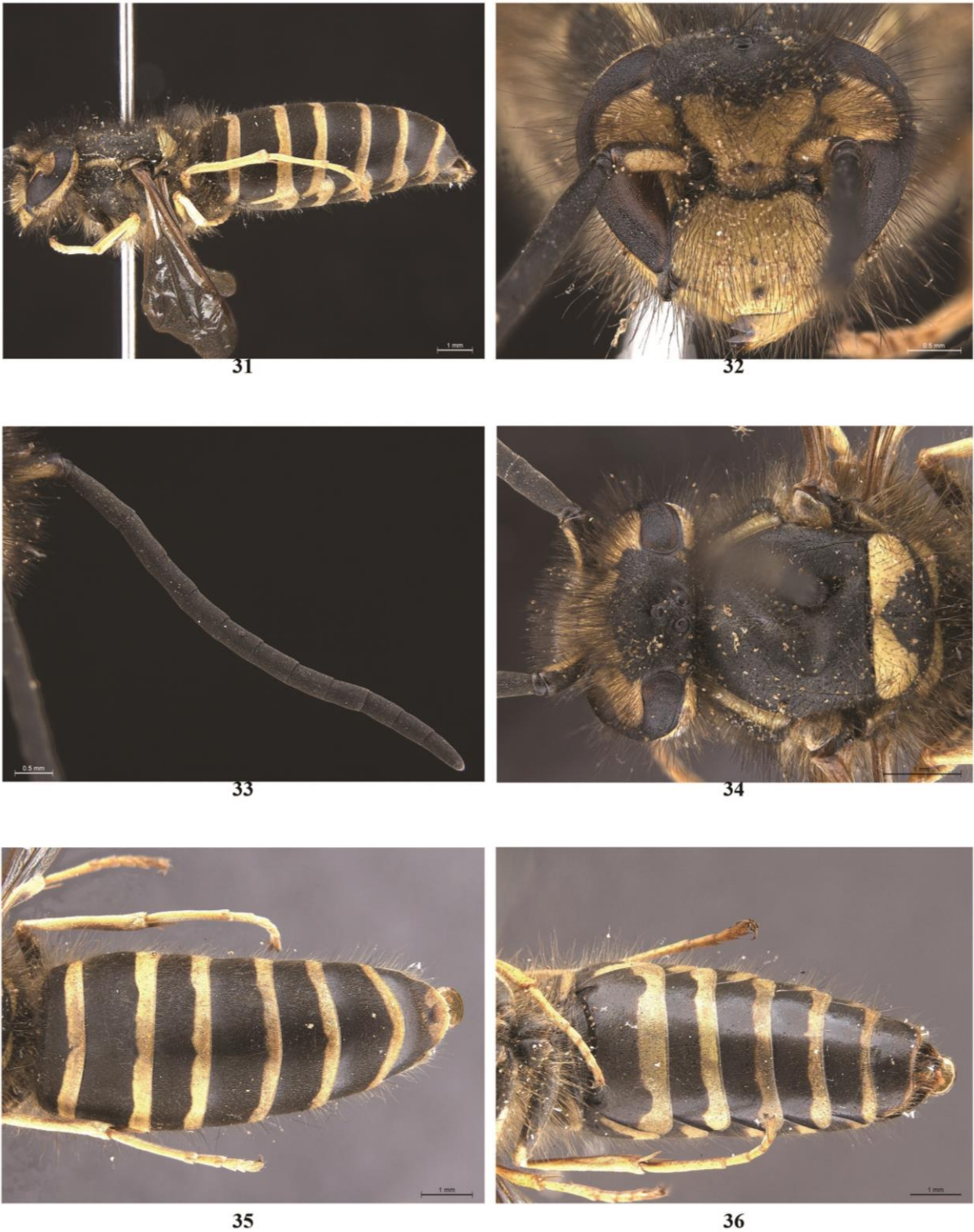
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Figs 25-30: *Vespula flaviceps* (Smith), Worker. 25: Body, in profile. 26: Head, in frontal view. 27: Head and mesosoma, in dorsal view. 28: Metasomal tergum. 29: Metasomal sternum. 30: Parasitisation of Strepsiptera.

Plate 6



Figs 31-36: *Vespula flaviceps* (Smith), male. 31: Body, in profile. 32: Head, in frontal view. 33: Antenna. 34: Head and mesosoma, in dorsal view. 35: Metasomal tergum. 36: Metasomal sternum.

unknown, Regd. No. ZSI/WGRC/I.R-INV.8976; Solan dist., Kandaghat, 1 queen, 6.iv.2011, Coll. D. Banerjee & Party, Regd. No. ZSI/WGRC/I.R-INV.8977; Chamba dist., Khajjiar, 1 queen, 24.iv.2012, Coll. S.K. Ghosh & Party, Regd. No. ZSI/WGRC/I.R-INV.8978; Kullu dist., Manali, 1 queen, 4.vi.2012, Coll. B. Mitra & Party, Regd. No. ZSI/WGRC/I.R-INV.8979; Shimla, 1 worker, 26.ix.1918, Coll. Brunetti, Regd. No. ZSI/WGRC/I.R-INV.8980; Shimla, 1 worker, 11.x.1974, Coll. L.K. Ghosh & Party, Regd. No. ZSI/WGRC/I.R-INV.8981; Solan, 1 worker, 14-17.vi.1979, Coll. V.K. Gupta & Party, Regd. No. ZSI/WGRC/I.R-INV.8982; Chamba dist., Dalhousie, 2 workers, 10.xi.2010, Coll. G.P. Mandal & Party, Regd. Nos. ZSI/WGRC/I.R-INV.8983 & 8984. Jammu & Kashmir, Srinagar, 1 male, 20.x.1976, Coll. S.K. Gupta, Regd. No. ZSI/WGRC/I.R-INV.9084; Shopian district, Heff village, apple orchards, 1 worker, 9.ix.2017, Coll. Altaf Hussain, Regd. No. ZSI/WGRC/I.R-INV.10018. Manipur, Imphal Valley, 3 workers, 24.xii.1945, Coll. M.L. Roonwal, Regd. Nos. ZSI/WGRC/I.R-INV.9085–9087. Uttarakhand, Nainital, 1 male, 1908, Coll. R.E. Lloyd, Regd. No. ZSI/WGRC/I.R-INV.8985; Chamoli dist., Lohba, 1 male, 17.iv.1914, Coll. Tytler, Regd. No. ZSI/WGRC/I.R-INV.8986; Dehradun dist., Mussoorie, 1 worker, 15.vi.1930, Coll. B.N. Chopra, Regd. No. ZSI/WGRC/I.R-INV.8987; Pauri Garhwal dist., Kiwarsh, 1 worker, 17.i.1966, Coll. T.D. Soota, Regd. No. ZSI/WGRC/I.R-INV.8988; Solan dist., Dagshai, 1 worker, 10.xi.1970, Coll. Kailash Chandra & Party, Regd. No. ZSI/WGRC/I.R-INV.8989; Nainital, 4 workers, 2-10.x.1978, Coll. V.K. Gupta, Regd. Nos. ZSI/WGRC/I.R-INV.8990–8993; Uttarkashi Dist., Pilang, 5 workers, 18.xi.1999, Coll. B.C. Das & Party, Regd. Nos. ZSI/WGRC/I.R-INV.8994–8998; Uttarkashi Dist., Bhatwari, 6 workers, 19.xi.1999, Coll. B.C. Das & Party, Regd. Nos. ZSI/WGRC/I.R-INV.8999–9004; Uttarkashi Dist., Bhatwari, 6 workers, 19.xi.1999, Coll. B.C. Das & Party, Regd. Nos. ZSI/WGRC/I.R-INV.8999–9004; Rudraprayag Dist., Chopta, 1 worker, 21.xi.1999, Coll. B.C. Das & Party, Regd. No. ZSI/WGRC/I.R-INV.9005; Almora Dist., Ranikhet, 1 worker, 27.xi.1999, Coll. B.C. Das & Party, Regd. No. ZSI/WGRC/I.R-INV.9006; Pithoragarh Dist., Berinag, 1

worker & 1 male, 30.iii.1999, Coll. B. Mitra & Party, Regd. Nos. ZSI/WGRC/I.R-INV.9007 & 9008; Uttarkashi Dist., Jaspur, 1 worker, 28.viii.2006, Coll. B. Mitra & Party, Regd. No. ZSI/WGRC/I.R-INV.9009. West Bengal, Jalpaiguri Dist., Bangrakote, 1 queen, 2.v.1914, Coll. Tytler, NZC Regd. No. 1099/H3.

Ethology: Parasitic association of Strepsiptera was observed in one worker specimen collected in Himachal Pradesh. The female strepsipteran extruded out from the third tergite of the wasps as seen in the figure 30.

Distribution: India: Assam, Himachal Pradesh, Jammu & Kashmir, Manipur, Meghalaya, Punjab, Sikkim, Uttarakhand, West Bengal (new record); Myanmar; Nepal; Pakistan. Elsewhere: China; Japan (including Amami Is. In Ryukyu Is.); Korea; Laos; Russia; Taiwan; Thailand; Vietnam.

8. *Vespula germanica* (Fabricius, 1793) (Figs. 37-48)

?*Vespa maculata* Scopoli, 1763, 312, [Slovenia] “Carnioliae” (destroyed?). Junior primary homonym of *Vespa maculata* Linnaeus, 1763.

?*Vespa macularis* Olivier, 1792: 695. Unjustified emendation of *Vespa maculata* Scopoli.

Vespa germanica Fabricius, 1793: 256. [Germany] “Kiliae” (type depository unknown).

Diagnosis: Queen and Worker: Margin behind third mandibular tooth distinctly concave; outer basal flange of mandible strongly curved; occipital carina reaching mandibular base; apical margin of clypeus concave and depressed medially; mesosomal punctures indistinct; propodeum not rugose.

Colour: Body black with yellow markings as follows: mandible except teeth brown; clypeus; shield on lower frons; ocular sinus (in queen, yellow mark on frons connected to that of ocular sinus); area between antennal toruli and inner eye margin; temple; broad mark on pronotum; two marks on either sides of scutellum and metanotum; triangular mark on mesopleuron near to forewing; small spots on either sides of propodeum; tegula; mark behind base of hindwing; mark on mid and hind coxa; apical half of all femora; all tibia and tarsus entirely; dorsal side of T1 except

extended black mark at middle (large) and at sides (small); T2-T5 except at base black which triangularly extends towards apex at middle and separate small spots on either sides; S2-S5 except basal black area which extends to apex at middle and both sides; T6 and S6 entirely.

Length: Queen, 14.5 mm; Worker, 8-12 mm.

Material examined: INDIA: Himachal Pradesh, Lahaul Spiti district, Chango, 1 worker, 14.ix.2011, Coll. G. Srinivasan & Party, Regd. No. ZSI/WGRC/I.R-INV.9553; Lahaul Spiti district, Pao, 1 worker, 21.ix.2013, Coll. V.D. Hegde & Party, Regd. No. ZSI/WGRC/I.R-INV.9554. Jammu & Kashmir, Ladakh, Kargil, 1 worker, 15.vi.1973, Coll. V.K. Gupta & Party, NZC Regd. No. 16574/H3; Ladakh, Leh, 98 workers, 19-23.vi.1973, Coll. V.K. Gupta & Party, NZC Regd. Nos. 16575/H3–16672/H3; Ladakh, Chusul, 1 worker, 7.ix.2008, Coll. A.K. Sanyal & Party, Regd. No. ZSI/WGRC/I.R-INV.9555; Ladakh, Nider, 1 worker, 8.ix.2008, Coll. A.K. Sanyal & Party, Regd. No. ZSI/WGRC/I.R-INV.9556; Kargil district, Panikhar, 2 workers, 20.ix.2008, Coll. A.K. Sanyal & Party, Regd. Nos. ZSI/WGRC/I.R-INV.9557 & 9558. PAKISTAN: Chitral, 1 queen & 1 worker, 9.ix.1929, Coll. B.N. Chopra, Regd. No. ZSI/WGRC/I.R-INV.9559 (queen) & NZC Regd. No. 1096/H3 (worker).

Distribution: India: Himachal Pradesh (new record), Jammu & Kashmir; Nepal; Pakistan. Elsewhere: Afghanistan; Albania; Algeria; Armenia; Argentina (Introduced); Ascension Island (Introduced); Australia (Introduced); Austria; Azerbaijan; Belarus; Belgium; Bosnia & Herzegovina; Bulgaria; Canada (Introduced); Chile (Introduced); China; Croatia; Czech Republic; Denmark; Estonia; Finland; France; Georgia; Germany; Greece; Hungary; Iceland (Introduced); Iran; Iraq; Ireland; Israel; Italy; Jordan; Kazakhstan; Korea; Kyrgyzstan; Lebanon; Liechtenstein; Lithuania; Luxembourg; Macedonia; Malta; Mayotte; Moldova; Mongolia; Morocco; Netherlands; New Zealand (Introduced); Norway; Poland; Portugal; Romania; Russia; Sakhalin Island; Scotland; Serbia; Slovakia; Slovenia; South Africa (Introduced); Spain (including Canary Islands); Sweden; Switzerland; Syria; Taiwan; Tajikistan;

Tunisia; Turkey; Turkmenistan; U.K.; Ukraine; U.S.A. (Introduced); Uzbekistan.

9. *Vespula structor* (Smith, 1870)

(Figs. 49-60)

Vespula structor Smith, 1870, in Horne and Smith, 191, pl. XXI fig. 12, female – “Binsur, Kumaon, North-west Provinces of India” (London).

Vespula orbata var. *aurulenta* du Buysson, 1905: 579, female, “Chine, Mou-pin ... ; Amur” (Paris, Wien?). NEW SYNONYMY.¹

Vespula structrix Schulz, 1906: 231. Unjustified emendation of *Vespula structor* Smith.

Vespula gongshanensis Dong 2005, in Dong *et al.*: 65, female, male – “China, Gongshan, Yunnan Province, alt. 2,950” (holotype female Yunnan).

Diagnosis: Queen: Tri-coloured (yellow, black and brown); brown colour particularly visible on pronotum, T2 and S2-S4; scutellum and metanotum black, without yellow spots, at most with brown markings; clypeus yellow to orange without a black median mark; oculomalar space longer, HW/OMS less than 18; margin behind third mandibular tooth straight or at most slightly concave; occipital carina extend to base of mandible. Workers: Light colour of gastral terga orange yellow; dorsal surface of T1 without or almost without black marking; metanotum without a yellow mark.

Material examined: INDIA: Arunachal Pradesh, West Kameng district, Bomdila, 1 worker, 30.viii.1998, Coll. A.R. Lahiri & Party, Regd. No. ZSI/WGRC/I.R-INV.10234; Jammu & Kashmir, Srinagar, 1 worker, 29.ix.1978, Coll. Bindu, Regd. No. ZSI/WGRC/I.R-INV.10235; Sikkim, exact collection locality and date of collection unknown, 2 workers, Coll. A.V. Knyvett, Regd. Nos. ZSI/WGRC/I.R-INV.10236 & 10237; Uttarakhand, Uttar Kashi district,

¹ One of us (JMC) has seen a specimen from Mou-pin in Paris, with a determination label by du Buysson, a label reading “Type/examined by/Dr. J. v. d. Vecht 1956” and a determination label as *Paravespula structor* Sm. ab. by I. H. Yarrow. 1958. The determination appears to be correct, which represents revised synonymy for this taxon. JMC checked for material in Vienna, but only found an empty labeled space in the collection.

Plate 7



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Figs 37-42: *Vespula germanica* (Fabricius), Queen. 37: Body, in profile. 38: Head, in frontal view. 39: Mandible. 40: Head and mesosoma dorsal view. 41: Metasomal tergum. 42: Metasomal sternum.

Plate 8



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Figs 43-48: *Vespula germanica* (Fabricius), Worker. 43: Body, in profile. 44: Head, in frontal view. 45: Head and mesosoma, in dorsal view. 46: Apical half of forewing. 47: Metasomal tergum. 48: Metasomal sternum.

Plate 9



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Figs 49-54: *Vespula structor* (Smith), Queen. 49: Body, in profile. 50: Head, in frontal view. 51: Ocellar area. 52: Head and mesosoma, in dorsal view. 53: Apical half of forewing. 54: Metasoma, in dorsal view.

Plate 10



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Figs 55-60: *Vespula structor* (Smith), Worker. 55: Body, in profile. 56: Body, in dorsal view. 57: Head, in frontal view. 58: Antenna. 59: Apical half of forewing. 60: Metasomal sternum.

Plate 11



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Figs 61-66: *Vespula vulgaris* (Linnaeus), Worker. 61: Body, in dorsal view. 62: Head, in frontal view. 63: Head and mesosoma, in dorsal view. 64: Wings. 65: Metasomal tergum. 66: Metasomal sternum.

Syana Chatti, 4 queens & 1 worker, 14.xi.2003, Coll. S.K. Chakraborty & Party, Regd. Nos. ZSI/WGRC/IR-INV.10238-10242.

Distribution: India: Arunachal Pradesh (new record), Assam, Jammu & Kashmir, Himachal Pradesh, Sikkim, Uttarakhand, West Bengal; Nepal; Myanmar. Elsewhere: China; Laos;

Thailand.

10. *Vespula vulgaris* (Linnaeus, 1758)

(Figs. 61-66)

Vespula vulgaris Linnaeus, 1758: 572, “in Europa” (Lectotype female, Linnaean Society, London). Additional citation: Day, 1979: 77 (designation of lectotype).

Vespula sexcincta Panzer, 1799: 1, fig. 1, male – “Viennae Austr.” (destroyed).

Vespula vulgaris var. *pseudogermanica* Stolfa, 1932: 26 (key), female – [Italy] “Lago superior di Weissenfels (Tarvisio Senosecchia” (type depository unknown).

Vespula mixta “Schenck” Edwards, 1980: 363. Nomen nudum.

Vespula rufosignata Eck, 1998: 299, female, figs. 1A, C, 2 - “India: Kashmir, Gulmarg, 2900 m” (type depository not stated; London); also from two other localities.

Vespula vulgaris vetus Eck, 1999: 309, 329, female, male - “China, Quinghai Prov., Datong-Tal, 120 km NE Xinging, 2360 m” (holotype female Dresden); also from five other localities.

Vespula yunlongensis Dong and Wang, 2003, in Dong *et al.*: 212, fig. 1, female [?] - “Yunnan, China” (Yunnan).

Diagnosis: Worker. Occipital carina complete, extending from vertex to mandible, but disappear for a short distance near to mandible and then reappear and reaching to mandible; yellow area of ocular sinus with a concave medial margin and widely separated from yellow shield of frons; margin behind third mandibular tooth almost straight.

Colour: Body black with yellow markings as follows: mandible except teeth brown; clypeus except an anchor-shaped black mark; shield on lower frons; ocular sinus; area between antennal toruli and inner eye margin; temple except wide black interruption; narrow mark on pronotum; two marks on either sides of scutellum and metanotum; triangular mark on mesopleuron; spots on either sides of propodeum; tegula; small mark behind base of hindwing; mark on mid and hind coxa; apical half of all femora; all tibia and tarsus entirely; apical half of dorsal side of T1, band medially invaginated; apex of T2-T5, anterior side with

irregular zigzag margin; apex of S2-S5 with almost regular band, narrowed towards sides; outer margin of T6; visible part of S6 almost entirely.

Length: worker, 12.5-13.5 mm.

Material examined: INDIA: Himachal Pradesh, Kinnaur district, Sangla, 1 worker, 17.x.2006, Coll. R. Babu & Party, Regd. No. ZSI/WGRC/I.R-INV.9560; Jammu & Kashmir, Pahalguaon, 2 workers, 1-2.x.1978, Coll. Bindu, Regd. Nos. ZSI/WGRC/I.R-INV.9561 & 9562.

Distribution: India: Himachal Pradesh (new record), Jammu & Kashmir; Pakistan. Elsewhere: Albania; Argentina (Introduced); Australia (Introduced); Austria; Azerbaijan; Belarus; Belgium; Bosnia & Herzegovina; Bulgaria; Chile (Introduced); China; Croatia; Czech Republic; Denmark; Estonia; Finland; France; French Polynesia (Introduced); Georgia; Germany; Greece; Hungary; Iceland (Introduced); Iran; Ireland; Israel; Italy; Japan; Kazakhstan; Korea; Kurile Islands; Kyrgyzstan; Latvia; Liechtenstein; Lithuania; Luxemburg, Macedonia; Mexico; Moldova; Mongolia; Netherlands; New Zealand (Introduced); Norway; Poland; Portugal; Romania; Russia; Serbia; Slovakia; Slovenia; South Africa (Introduced); Spain; Sweden; Switzerland; Syria; Turkey; U.K.; Ukraine.

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