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TAXONOMIC STUDIES OF HORNET WASPS (HYMENOPTERA : VESPIDAE) *VESPA* LINNAEUS OF INDIA

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INTRODUCTION

The members of the genus *Vespa* Linnaeus are commonly known as Hornet wasps. They are highly evolved social wasps. They built their nest by using wood pulp. They have large colonies consisting of a single female queen, a large number of sterile workers and males. Hornet wasps are mainly distributed in Oriental and Palaearctic Regions of the world. There are 23 valid species known from the world so far of which 16 species from Indian subcontinent and 15 species from India (Carpenter & Kojima, 1997). Economically, hornet wasps can be both beneficial and harmful. They are beneficial as predators of agricultural, forest and hygienic pests. The larvae and pupae of *Vespa* are utilized as food by man in some parts of the world. They are harmful as they sting human beings and domesticated animals. They are the natural enemies of honey bees and they damage fruits by feeding on them, just prior to harvest.

Some important works on the taxonomy and distribution of the hornet wasps are: Archer (1989, 1991a, 1991b, 1999), Bequaert (1936), Bingham (1897), du Buysson (1905), Carpenter (1987), Carpenter & Kojima (1997), Das & Gupta (1989), Harris & Patrick (1997), Jacobson (1986) and van der Vecht (1957, 1959). Some recent works on hornet wasps published from India are: Girish Kumar & Srinivasan (2009), Gupta (1997a, 1997b), Gusenleitner (2006), Jonathan & Kundu (2003), Jonathan *et al.* (1999, 2000a, 2000b), Kundu *et al.* (in press) and Roy & Kundu (1985).

Carpenter & Kojima (1997) published the detailed synonyms of each species. So the same is not provided

here. Since it is a taxonomic paper, we generally used the term 'Female' instead of 'Queen' and 'Worker' and mentioned the terms 'Fertile female' and 'Sterile female' wherever it is necessary.

All specimens studied are properly registered and deposited. Most of the specimens are deposited at 'National Zoological Collections' of the Hymenoptera Section, Zoological Survey of India, Kolkata (NZSI) and the rest of the specimens are deposited at Arunachal Pradesh Field Station, Zoological Survey of India, Itanagar (APFS/ZSI).

Genus *Vespa* Linnaeus

1758. *Vespa* Linnaeus, *Syst. Nat.*, ed. 10, 1 : 343, 572, Genus (17 species).

Type species : "*Vespa crabro*, Fab." [= *Vespa crabro* Linnaeus, 1758], by subsequent designation of Latreille, 1810, *Consid. Gen. Crust. Arachn. Ins.* : 438.

1904. *Macrovespa* Dalla Torre, *Gen. Ins.* 19 : 64, group of genus *Vespa* Linnaeus.

Type species : *Vespa crabro* Linnaeus, 1758, by subsequent designation of Bequaert, 1930, *Bull. Brooklyn Ent. Soc.* 25 : 64.

1959. *Nyctovespa* van der Vecht, *Zool. Meded., Leiden* 36 (13) : 210, subgenus of *Vespa* Linnaeus.

Type species : *Vespa binghami* du Buysson, 1905, by original designation.

Diagnosis : Large sized wasps usually over 20 mm long; clypeus with short hairs on its apical third only; ocelli small (except in *Vespa binghami* du Buysson), posterior ocelli at the level of the centre of eyes; vertex and temple comparatively wider; male antenna with tyloids (except in *V. binghami* du Buysson); occipital carina present laterally and extending to base of

mandible, absent dorsally; pronotal carina strong with a pit or a fovea close to its posterior edge in the lower half; fore wing with prestigma 3x as long as stigma; first cubital cell shorter than the distance between its apex and tip of fore wing; hamuli of hind wing originating before the tip of subcostella.

Van der Vecht (1957, 1959), Matsuura and Yamane (1990) discussed biology and nest building activities of various *Vespa* species in detail.

Distribution : Oriental and Palaearctic Regions including North Africa, Wallacea, Japan and New Zealand.

Key to the Indian species of *Vespa* Linnaeus

(Based on females)

1. Ocelli large (Fig. 1); interocellar distance a little longer than ocellular distance (Fig. 1); nocturnal in habits *binghami* du Buysson.
- Ocelli small (Fig. 4); interocellar distance shorter than ocellular distance (Fig. 4); diurnal in habits 2
2. Apical margin of clypeus with a broad and deep apical emargination forming lateral lobes and with a median triangular tooth projecting only half the length of the lateral lobes (Fig. 2) *analis* Fabricius.
- Apical margin of clypeus emarginate without a median tooth (Figs. 6, 7, 8 & 13) 3
3. Head strongly widened and produced behind eyes; temple in profile view more than 1.8x as wide as eye (Fig. 3); posterior ocelli 3x or more than 3x farther from occiput than from eye (Fig. 4) 4
- Head normal; temple less than 1.8x as wide as eye (Fig. 12); posterior ocelli less than 3x farther from occiput than from eye (Figs. 9 & 10) 5
4. Area around ocelli without black markings; thorax usually black, rarely reddish; abdomen reddish brown with narrow yellow apical bands on first to fifth tergites; last tergite yellowish brown; proportionately wider gena (Fig. 3) *mandarinia* Smith.
- Area around ocelli with black markings; scutellum, postscutellum, two marks on propodeum and often with anterior border of pronotum yellow or orange red; first and second gastral tergites yellow and usually with reddish brown or black stripes in the middle; third to sixth tergites wholly black; proportionately thinner gena (Fig. 5) *soror* du Buysson.
5. Clypeus coarsely punctate; thorax black and head black to red, not marked with yellow; gaster brown or black with second tergite yellow 6
- Clypeus subpolished and with scattered punctures; head, thorax and gaster black to brown, with reddish or yellow areas 9
6. Apical margin of clypeus with a bluntly triangular tooth on each side of the median emargination (Fig. 6); body covered with strong and stiff hairs 7
- Apical margin of clypeus with short broadly rounded lobes on each side of the median emargination (Fig. 7); body hairs fine, shorter and comparatively dense 8
7. First and second gastral tergites orange with a narrow apical black band; fifth and sixth gastral tergites black; clypeus orange red; vertex orange yellow *ducalis* Smith
- First gastral tergum usually entirely black or blackish brown and sometimes with a narrow yellow band on the posterior margin and second gastral tergum orange yellow with a narrow brownish black band basally; clypeus and vertex either black or orange red, if orange red then the apical margin of clypeus black *tropica* (Linnaeus)
8. Punctures on vertex, temple, mesoscutum, scutellum, postscutellum, metapleuron and propodeum small and crowded; second gastral tergum largely or entirely orange yellow *affinis* (Linnaeus)
- Vertex, temple, postscutellum and propodeum sparsely and rather finely punctate; scutellum and metapleuron almost impunctate; second gastral tergum black or dark brown with almost a narrow yellow to reddish brown apical band *mocsaryana* du Buysson
9. Clypeus rather flat and elongate, as wide as long or a little longer (Fig. 8), with scattered moderately sized punctures, its lateral emargination long and convergent; body dorsally less hairy, hairs on head

- and thorax short, sparse, stiff and bristle-like; gaster almost hairless dorsally; body brown with clypeus, frons and third and fourth gastral tergites yellow
orientalis Linnaeus
- Clypeus convex, wider than long, not elongate (Fig. 13), its lateral emargination short, punctures on clypeus finer; head and thorax dorsally covered with dense and long black or yellowish brown hairs; gaster with hairs; body largely black or yellow.....10
10. Second to fifth gastral tergites entirely black.....11
- Second to fifth gastral tergites not entirely black, either largely yellow or black mixed with brown or yellow 12
11. Antennal flagellomeres black; sixth gastral tergum orange yellow; posterior ocelli more than 2x farther from occiput than from eye (Fig. 9); vertex not depressed at medially (Fig. 9); clypeus subpolished with scattered punctures**fumida** van der Vecht
- Antennal flagellomeres usually orange, rarely reddish brown; sixth gastral tergum black; posterior ocelli less than 1x farther from occiput than from eye (Fig. 10); vertex depressed at medially (Fig. 10); clypeus almost impunctate **basalis** Smith
12. Thorax sulphur yellow with mesoscutum, a mark below tegula, a median line on scutellum, margins of postscutellum, Y- shaped mark at junction of postscutellum and propodeum and line between mesopleuron and metapleuron black; gaster largely yellow; legs entirely yellow **bicolor** Fabricius
- Thorax black or black mixed with brown; gaster black mixed with brownish or yellowish bands; legs never entirely yellow 13
13. Head yellow with a ring- like black mark on frons (Fig. 11); gastral tergites black with yellow markings apically, yellow band on third tergum broadly emarginate and covering three by fourth portion .
..... **vivax** Smith
- Head orange red to reddish brown with or without black marks on frons and vertex; if black mark present on frons, it never ring- like; gastral tergites black with reddish brown markings 14
14. Thorax black mixed with reddish brown markings; head reddish brown without black markings
..... **auraria** Smith

— Thorax entirely black without reddish brown markings; upper half of head largely black
..... **velutina** Lepeletier.

1. **Vespa binghami** du Buysson
(Plate I-1)

1905. *Vespa binghami* du Buysson, *Ann. Soc. Ent. France*, **73** : 488 (Key), 523.

Diagnosis : Head yellowish brown; antenna, legs and gaster reddish brown; thorax red to reddish brown; body covered with fine reddish erect pubescence; ocelli large (Fig. 1); interocellar distance a little longer than ocellocular distance in female (Fig. 1); clypeus emarginate in female; apical half of clypeus densely punctate, basal half finer; temple wider than eye in profile.

Size : Sterile female: 24-25 mm.

Material examined : 1 Female, India : Arunachal Pradesh; Kameng; Jhum La, 8.x.1961, Alt. 9000 ft, Coll. F. Schmid, Reg. No. 10892/H3. 1 Female, India: Sikkim, v. 1912, Coll. Unknown, Reg. No. 1036/H3. 1 Female, India: West Bengal; Darjeeling Dt., xi.1941, Coll. H. A. Hafiz, Reg. No. 2270/H3 (NZSI).

Distribution : India : Arunachal Pradesh, Meghalaya, Sikkim (new record) and West Bengal.

Elsewhere : Bhutan, China, Korea, Laos, Myanmar, Russia, Thailand and Vietnam.

F. Schmid collected the specimen from Jhum La; Assam in 1961 and now the locality Jhum La comes under Arunachal Pradesh state.

Remarks : It is a nocturnal hornet wasp. This is a very rare species. In India, it is distributed in Himalayan ranges.

2. **Vespa analis** Fabricius
(Plate I-2)

1775. *Vespa analis* Fabricius, *Syst. Ent.* : 363.

1903. *Vespa nigrans* du Buysson, *Bull. Soc. Ent. France* : 175.

1905. *Vespa analis* var. *tenebrosa* du Buysson, *Ann. Soc. Ent. France* **73** : 516.

Diagnosis : Head reddish brown; vertex without black markings around ocelli; thorax largely reddish brown; pronotum, a triangular spot under each wing base, scutellum and postscutellum reddish brown; mesoscutum anteriorly with reddish brown parallel

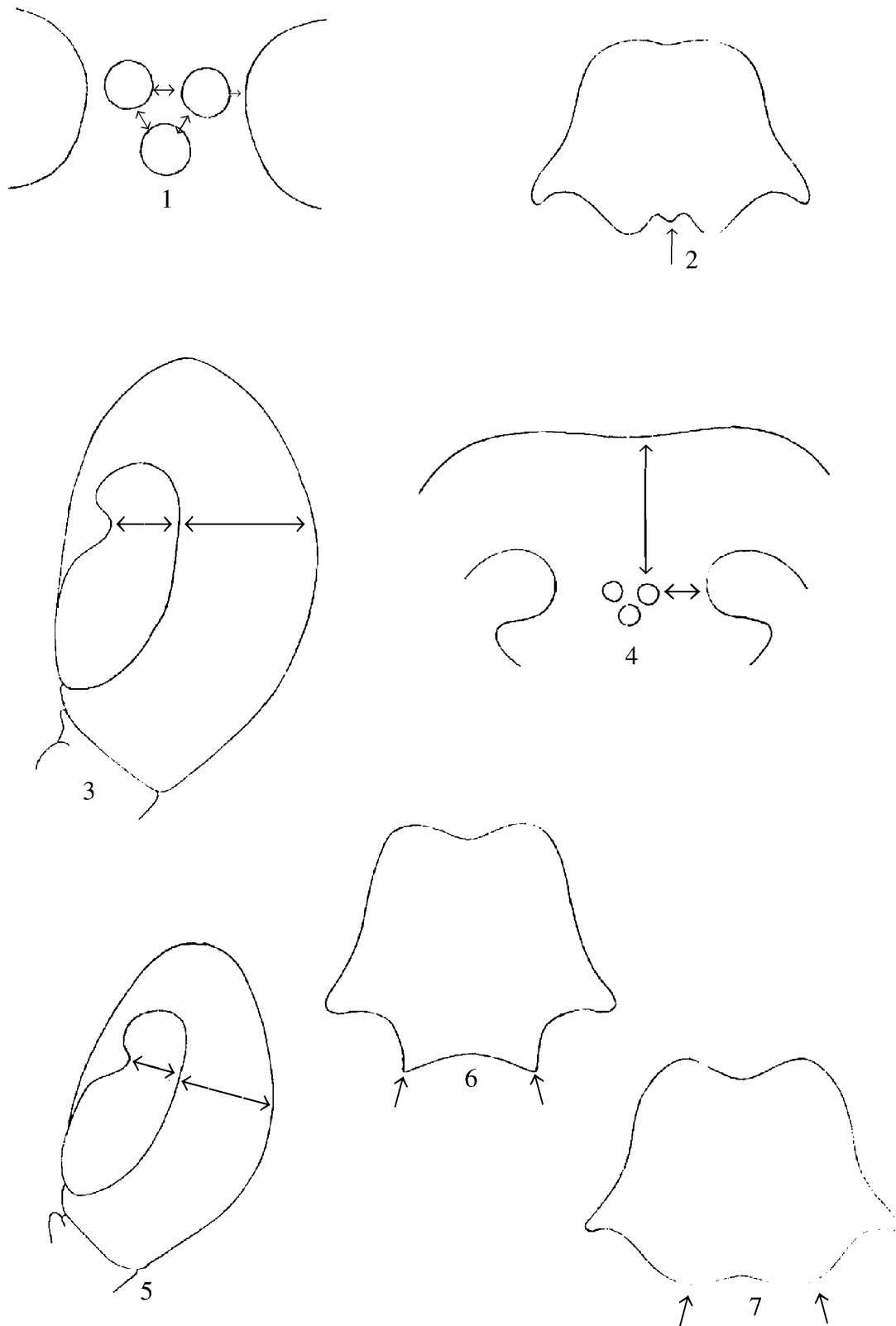


Fig. 1. *Vespa binghami* du Buysson. Female. Part of head dorsal view showing ocelli and inner margin of eye; **Fig. 2.** *V. analis* Fabricius. Female. Clypeus; **Fig. 3.** *V. mandarinia* Smith. Female. Head profile view; **Fig. 4.** *V. mandarinia* Smith. Female. Part of head dorsal view; **Fig. 5.** *V. soror* du Buysson. Female. Head profile view; **Fig. 6.** *V. tropica* (Linnaeus). Female. Clypeus; **Fig. 7.** *V. affinis* (Linnaeus). Female. Clypeus.

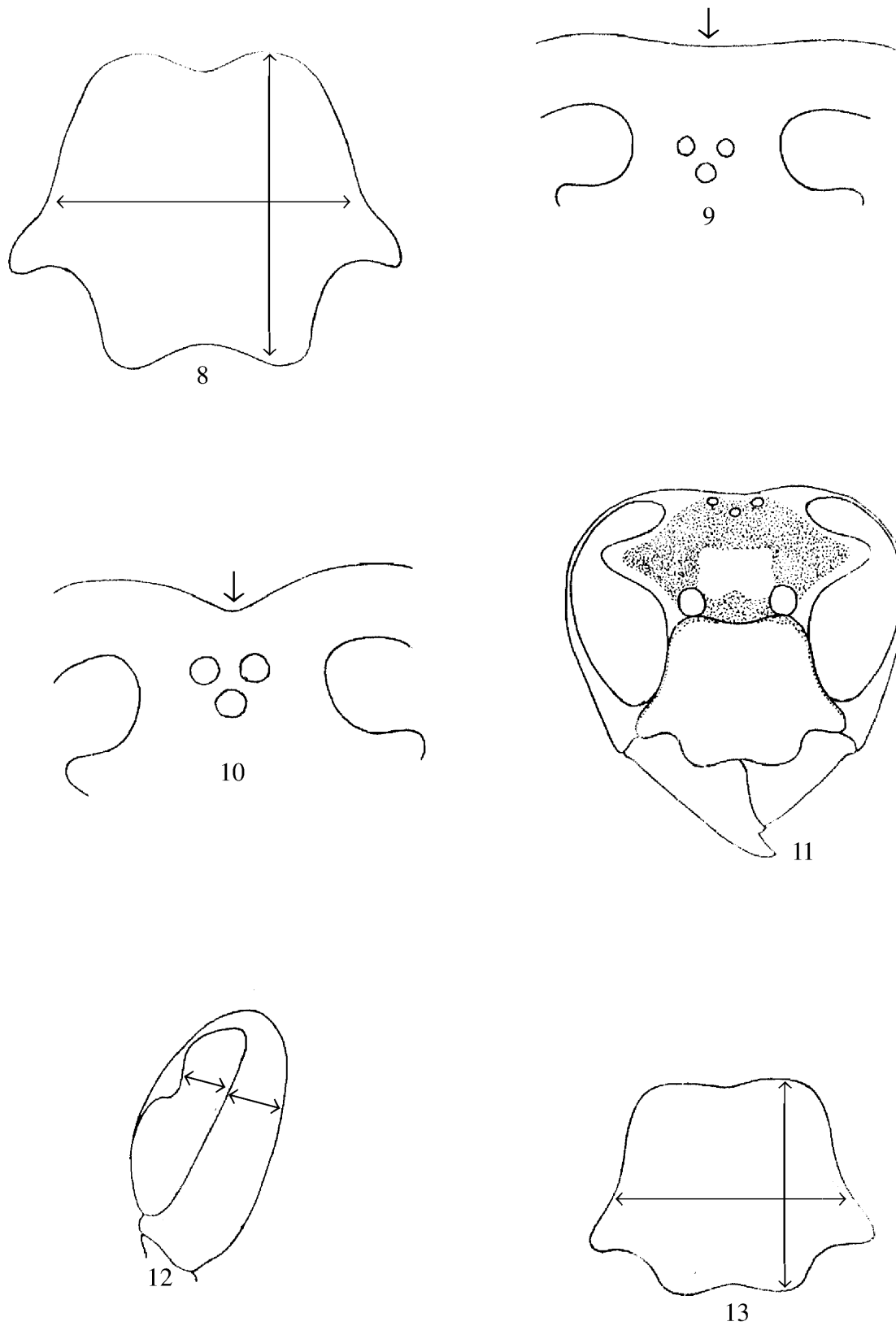


Fig. 8. *V. orientalis* Linnaeus. Female. Clypeus; **Fig. 9.** *V. fumida* van der Vecht. Female. Part of head dorsal view; **Fig. 10.** *V. basalis* Smith. Female. Part of head dorsal view; **Fig. 11.** *V. vivax* Smith. Female. Head front view; **Fig. 12.** *V. auraria* Smith. Female. Head profile view; **Fig. 13.** *V. velutina* Lepeletier. Female. Clypeus.

lines not connected to form a U-shaped mark; gaster largely blackish brown; sixth tergum and sixth sternum yellow; legs brownish black to black; wings infuscate; apical margin of clypeus with broad and deep emargination and forming lateral lobes and with a median triangular tooth projecting half the length of the lateral lobes in females (Fig. 2); in males, the median tooth is rather indistinct or replaced by a short median carina.

Size : Sterile female : 23-27 mm.

Variations : Head sometimes yellow to orange yellow. In one specimen studied from Arunachal Pradesh, thorax more darker, there is no reddish brown parallel marks on mesoscutum anteriorly and scutellum and postscutellum black.

Material examined : 1 Female, India : Uttarakhand; Garhwal, 17.iv.1914, Coll. Tytler, Reg. No. 10893/H3. 1 Female, India : Arunachal Pradesh; East Siang Dt.; Ranaghat, Alt. 219 m, 24.ix.2002, Coll. M. Sil & Party, Reg. No. 10895/H3 (NZSI).

Distribution : India : Arunachal Pradesh (new record), Assam, Jammu & Kashmir, Meghalaya, Sikkim, Tamil Nadu, Uttarakhand and West Bengal.

Elsewhere : China, Indonesia, Japan, Korea, Laos, Malaysia, Myanmar, Nepal, Russia, Singapore, Taiwan and Thailand.

Published records from Tamil Nadu appear to be a misidentification. Published records from Kumaun Hills of Uttar Pradesh is also need to change because Kumaun Hills are now situated in the newly formed Uttarakhand state.

Remarks : This species is not so common. In India, it is distributed in Himalayan ranges.

3. *Vespa mandarinia* Smith (Plate I-3)

1852. *Vespa mandarinia* Smith, *Trans. Ent. Soc. Lond.* 2 (2) : 38, pl. VIII fig. 1.

Diagnosis : Head and scape orange red; flagellum black; thorax black; gaster brown with faint yellow apical bands on first to fifth tergites; sixth tergite yellowish brown; wings fuscous brown; area around ocelli without black markings; head strongly widened and produced behind eyes; temple in profile more than 2x as wide as eye (Fig. 3); posterior ocelli more than 3x farther from occiput than from eye (Fig. 4); clypeus

coarsely punctate; in females clypeus strongly emarginate apically, lateral lobes largely and broadly rounded.

Size : Fertile female : 30-42 mm; Sterile female: 23-35 mm.

Variations : One specimen from Arunachal Pradesh having head and scape yellow. In one specimen from Darjeeling Hills of West Bengal head and scape red. In some specimens studied hind corner of pronotum, two marks on mesoscutum anteriorly, tegula and a spot near wing margin brown.

Material examined : 1 Female, India: Arunachal Pradesh; Kameng; Khelong, 29.ix.1961, Coll. S. Biswas, Reg. No. 3424/H3. 1 Female, India: Arunachal Pradesh; Namdapha National Park, 11.iv.1981, Coll. S. Biswas, Reg. No. 10896/H3. 1 Female, India : Arunachal Pradesh; Namdapha National Park, 13.ix.1981, Coll. S. Biswas & Party, Reg. No. 10897/H3. 2 Females, India : Arunachal Pradesh; West Siang Dt.; Payum village, 3.xii.2002, Coll. N. Tahar & G. Lollen, Reg. Nos. 10898/H3 & 10899/H3. 1 Female, India : Himachal Pradesh; Shimla Dt.; Solan; Kandoli, 3.iv.2006, Coll. R. Babu & Party, Reg. No. 10900/H3. 1 Female, India : Manipur; 16 miles north of Imphal on Dimapur road, Alt. 8500 ft., xi.1945, Coll. M. L. Roonwal, Reg. No. 10901/H3. 1 Female, India: Manipur; 16 miles north of Imphal on Dimapur road, Alt. 8500 ft., 3.xii.1945, Coll. M. L. Roonwal, Reg. No. 10902/H3. 4 Females, India: Mizoram; Aizawl Dt.; Murlen National Park, Alt. 850 m, 16.xii.1993, Coll. S. S. Saha & Party, Reg. Nos. 10903/H3 to 10906/H3. 2 Females, India : Sikkim; East Sikkim Dt.; Tumin, Alt. 1800 m; 28.ix.1988, Coll. V. C. Agrawal & Party, Reg. Nos. 10907/H3 & 10908/H3. 1 Female, India : West Bengal; Darjeeling Dt.; Darjeeling, Alt. 7000 ft., 28.iv-14.v.1915, Coll. F. H. Graveli, Reg. No. 10910/H3. 1 Female, India : West Bengal; Darjeeling Dt.; Rangiroom, Alt. 1700 m, 3.x.1978, Coll. A. N. T. Joseph & Party, Reg. No. 10911/H3 (NZSI). 4 Females, India: Arunachal Pradesh; Tawang Dt.; Tawang, 9.xii.2005, Coll. G. Srinivasan, Reg. Nos. 6/Inv. to 9/Inv. (APFS/ZSI).

Distribution : India : Arunachal Pradesh, Assam, Himachal Pradesh, Manipur (new record), Meghalaya, Mizoram (new record), Sikkim, Uttarakhand and West Bengal. *Elsewhere*: Bhutan, China, Japan, Korea, Laos, Malaysia, Myanmar, Nepal, Russia, Sri Lanka, Taiwan and Thailand.

Records of this species from Sri Lanka appear incorrect (Das & Gupta, 1989).

Remarks : This is the largest hornet wasp in India. The size of the female is up to 42 mm in length. In India it is widely distributed in Himalayan ranges.

4. *Vespa soror* du Buysson (Plate I-4)

1905. *Vespa ducalis* var. *soror* du Buysson, *Ann. Soc. Ent. France* **73** : 490 (key), 519.

1957. *Vespa mandarinia soror* du Buysson: van der Vecht, *Zool. Verh.* **43** : 16.

1991. *Vespa soror* du Buysson: Archer, *Entmol. Mon. Mag.* **127** : 161.

Diagnosis : Head, scutellum, postscutellum, two large marks on propodeum, area around propodeal spiracle and often anterior border of pronotum yellow or brownish yellow; area around ocelli black; first and second gastral tergites yellow with reddish brown stripe in the middle; third and sixth gastral tergites wholly black. Head strongly widened and produced behind the eyes; temple in profile more than 1.8x as wide as eye (Fig. 5); posterior ocelli 3x farther from occiput than from eye; clypeus coarsely punctate. In females clypeus strongly emarginate apically, lateral lobes largely and broadly rounded.

Size : Sterile female : 23-29 mm.

Variations : In some specimens pronotum completely black without any yellow or brownish yellow marks anteriorly. In some specimens propodeum almost completely covered by yellow colour rather than two large marks posteriorly. In some specimens the brown patches are present in lower area of pronotum, mesosternum, dorsal metapleuron and ventral metapleuron.

Material examined : 2 Females, India : Arunachal Pradesh; West Kameng Dt.; Rigam, 2.x.2001, Coll. B. Mitra & Party, Reg. Nos. 10947/ H3 & 10948/H3. 1 Female, India: Meghalaya; East Garo Hills Dt.; Songsak Reserve forest, 18.xi.1973, Coll. S. Biswas, Reg. No. 10912/H3 (NZSI). 1 Female, India: Arunachal Pradesh; Papumpare Dt.; Itanagar, 26.xi.2004, Coll. G. Srinivasan, Reg. No. 1/ Inv. 1 Female, same collection data as above except the date of collection, 6.x.2005, Reg. No. 2/ Inv. 1 Female, India: Arunachal Pradesh; Tawang Dt.; Kitpi village, 25.x.2007, Coll. G. Srinivasan, Reg. No.

3/ Inv. 1 Female, India: Arunachal Pradesh; Papumpare Dt.; Itanagar Wildlife Sanctuary; Ganga lakeside, 23.xi.2007, Coll. G. Srinivasan, Reg. No. 4/ Inv. 1 Female, same collection data as above except the date of collection, 24.ii.2008, Reg. No. 5/ Inv. (APFS/ZSI).

Distribution : India : Arunachal Pradesh and Meghalaya (new record).

Elsewhere : China, Laos, Myanmar, Thailand and Vietnam.

Remarks : This is a moderately large sized hornet wasp. In India, it is distributed in high altitudes of North eastern regions.

5. *Vespa ducalis* Smith

1852. *Vespa ducalis* Smith, *Trans. Ent. Soc. Lond.* **2** (2) : 39.

Diagnosis : Head orange yellow; clypeus orange; first and second gastral tergites orange with a narrow apical black band (Nguyen & Carpenter, 2002).

Material examined : No specimen studied.

Distribution : India : Meghalaya and Sikkim. *Elsewhere*: China, Japan, Korea, Myanmar, Nepal, Russia, Taiwan, Thailand and Vietnam.

Remarks : This species comes close to *Vespa tropica* (Linnaeus) but differs in having : (1). First and second gastral tergites orange with a narrow apical black band (in *V. tropica* first gastral tergum usually entirely black or blackish brown and sometimes with a narrow yellow band on the posterior margin and second gastral tergum orange yellow with a narrow brownish black band basally); (2). Clypeus orange red and vertex orange yellow (in *V. tropica* clypeus and vertex either black or orange red, if orange red then the apical margin of clypeus black).

This species is reported in literature as occurring in India. According to Das & Gupta (1989) the record of this species from India may be incorrect.

6. *Vespa tropica* (Linnaeus) (Plate II-5)

1758. *Sphex tropica* Linnaeus, *Syst. Nat.*, ed. 10, 1-517.

1775. *Vespa cincta* Fabricius, *Syst. Ent.* : 362.

1905. *Vespa eulemoides* du Buysson, *Ann. Soc. Ent. France* **73** : 491 (key), 530.

1936. *Vespa tropica tropica* (Linnaeus): Bequaert, *Treubia* **15** (4) : 328, key, des., fig.

1936. *Vespa tropica* var. *haematodes* Bequaert, *Treubia* **15** (4) : 336 (key), 338.

1957. *Vespa tropica leefmansii* van der Vecht, *Zool. Verh., Leiden* **34** : 19.

Diagnosis : Body rather large and thick, covered with strong and stiff hairs; clypeus coarsely punctate, apical margin hairy; in females clypeus apically with a broad emargination, its apicolateral angle triangular (Fig. 6); lower vertical area of pronotum with strong transverse ridges near pronotal pit; second gastral tergite yellow with a slight brown area basally.

Size : Fertile female : 36-40 mm; Sterile female : 19-30 mm.

Comments : Three distinct colour forms of this species are found in India (Archer et. al., 1988). They are : (1). The Indian colour form; (2). The Malayan colour form and (3). The Andaman colour form. The Indian colour form is characterized by reddish brown markings on head and thorax and only the second gastral tergum is orange. It is distributed in India and south China. In India, it is widely distributed in all over India. In the Malayan colour form head and thorax completely black. It is distributed in Indo-China, Malaya, Sumatra and Borneo. In India, it is distributed in North eastern regions, Sikkim and Darjeeling district of West Bengal. In the Andaman colour forms from Andaman & Nicobar Islands, all the gastral tergites are orange except the first. In the Andaman colour forms, head and thorax with reddish brown markings.

Bequaert (1936), van der Vecht (1957), Kojima (1982) and Kojima & Reyes (1984 & 1986) erected various subspecies based on the different colour forms. But Archer (1991) limited all these subspecies into three distinct species namely *Vespa tropica* (Linnaeus), *V. ducalis* Smith and *V. philippinensis* de Saussure.

Variations : In one specimen from Tripura, two small black spots present on second tergum submedially. Another specimen from Tripura, those with predominantly reddish brown head, having a large black area on frons and scutellum completely black.

Material examined :

(1) The Indian color form.

1 Female, India: Karnataka; Chitradurga Dt.; Chitradurga, 22.xi.1980, Coll. S. K. Gupta & Party, Reg.

No. 10998/H3. 1 Female, India: Karnataka; Shimoga Dt.; Shimoga, 23.ix.2008, Coll. S. K. Mandal & Party, Reg. No. 10999/H3. 1 Female, India: Kerala; Idukki Dt.; Painavu, 26.x.1983, Coll. P. T. Cherian, Reg. No. 11000/H3. 1 Female, India: Orissa; Ganjam Dt.; Chilka lake; Barkuda Island, 25.vii- 4.viii.1917, Coll. Annandale, Reg. No. 3164/H2. 1 Female: India: Orissa; Ganjam Dt.; Chilka lake; Barkuda Island, 18.viii.1920, Coll. Unknown, Reg. No. 11001/H3. 1 Female, India: Tamil Nadu; Thirunelveli Dt.; Kalakad Mundanthurai Tiger Reserve, 28.viii.1992, Coll. S. S. Saha & Party, Reg. No. 11002/H3. 1 Female, India: Tripura; West Tripura Dt.; Barjala, 7.viii.1979, Coll. K. P. Singh & Party, Reg. No. 11003/H3. 2 Females, India: Tripura; North Tripura Dt.; Kanchenchera, 11.vi.1988, Coll. V. T. Darlong & Party, Reg. Nos. 11004/H3 & 11005/H3. 1 Female, India: Tripura; Dhalai Dt.; Kamalpur, 10.v.1992, Coll. M. Sil, Reg. No. 11006/H3. 1 Female, India: Uttarakhand; Naini Tal Dt.; Gola forest; 1.x.1974, Coll. P. K. Maity & Party, Reg. No. 11007/H3. 1 Female, India: Uttarakhand; Pauri Garhwal Dt.; Srinagar, 14.ix.2000, Coll. G. C. Sen & Party, Reg. No. 11008/H3. 1 Female, India: Uttarakhand; Almora Dt.; Chopra, 11.x.2001, Coll. B. C. Das & Party, Reg. No. 11009/H3. 1 Female, India: West Bengal; Birbhum Dt.; Palispur, 3.x.1987, Coll. M. Prasad, Reg. No. 11019/H3 (NZSI).

(2) The Malayan colour form

1 Female, India : Arunachal Pradesh; Changlang Dt.; Namdapha National Park, 23.ix.1981, Coll. S. Biswas & Party, Reg. No. 11020/H3. 1 Female, India : Arunachal Pradesh; Lower Subansiri Dt.; Yazuli, 30.x.1981, Coll. S. K. Gupta & Party, Reg. No. 11021/H3. 1 Female, India : Arunachal Pradesh; Tawang Dt.; Kitpi, 5.ix.1998, Coll. A. R. Lahiri & Party, Reg. No. 11022/H3. 1 Female, India : Arunachal Pradesh; West Kameng Dt.; Bhalukpong, 6.ix.1998, Coll. A. R. Lahiri & Party, Reg. No. 11023/H3. 1 Female, India : Arunachal Pradesh; Tirap Dt.; Khonsa, 12.ix.2000, Coll. A. R. Lahiri & Party, Reg. No. 11024/H3. 1 Female, India : Arunachal Pradesh; Dibang Valley Dt.; Roing, 18.ix.2000, Coll. A. R. Lahiri & Party, Reg. No. 11025/H3. 1 Female, India : Arunachal Pradesh; Upper Subansiri Dt.; Daporijo, 18.iv.2001, Coll. S. Sheela & Party, Reg. No. 11026/H3. 1 Female, India : Arunachal Pradesh; Papumpare Dt.; Itanagar, Senkei Valley, 16.vii.2002, Coll. P. T. Bhutia, Reg. No. 11027/H3. 1

Female, India : Arunachal Pradesh; East Siang Dt.; Ranaghat, 24.ix.2002, Coll. M. Sil, Reg. No. 11028/H3. 1 Female, India : Meghalaya; West Garo Hills; Dari, 20.xi.1973, Coll. S. Biswas, Reg. No. 11030/H3. 1 Female, India : Meghalaya; East Khasi Hills Dt.; Shillong; Malki forest, 18.x.1975, Coll. R. S. Giri, Reg. No. 11031/H3. 1 Female, India : Meghalaya; East Khasi Hills Dt.; Shillong; Risa Colony, 2.ix.1976, Coll. D. Lama, Reg. No. 11032/H3. 1 Female, India : Meghalaya; West Khasi Hills Dt.; Nongstoin, 29.ix.1988, Coll. A. R. Lahiri & Party, Reg. No. 11033/H3. 1 Female, India: Meghalaya; West Garo Hills Dt.; Chaipani, 14.x.1988, Coll. K. K. Ray & Party, Reg. No. 11034/H3. 1 Female, India : Mizoram; Aizawl Dt.; Champhai, 15.x.1995, Coll. A. K. Sanyal & Party, Reg. No. 11035/H3. 1 Female, India : Nagaland; Wokha Dt.; Lungsang, 14.x.1998, Coll. T. K. Pal & Party, Reg. No. 11036/H3. 1 Female, India : Nagaland; Mokokchung Dt.; Sungkomen, Alt. 1260 m, 18.x.1998, Coll. T. K. Pal & Party, Reg. No. 11037/H3. 1 Female, India : Sikkim; East Sikkim Dt.; Tumin, Alt. 1475 m, 1.x.1988, Coll. V. C. Agrawal & Party, Reg. No. 11038/H3. 3 Females, India: West Bengal; Darjeeling Dt.; Singla, Alt. 1500 ft.; ii.1913, Coll. Lord Carmichael, Reg. No. 1067/H3, 1068/H3 & 1069/H3 (NZSI). 1 Female, India : Arunachal Pradesh; Papumpare Dt.; Itanagar Wildlife Sanctuary; 2.xi.2004, Coll. G. Srinivasan, Reg. No. 14/Inv. 3 Females, India : Arunachal Pradesh; Papumpare Dt.; Itanagar; ZSI Complex, 6.x.2005, Coll. G. Srinivasan, Reg. Nos. 15/Inv. to 17/Inv. 1 Female, India : Arunachal Pradesh; West Kameng Dt.; Tippi forest, 15.xi.2005, Coll. G. Srinivasan, Reg. No. 18/Inv. 3 Females, India : Arunachal Pradesh; Papumpare Dt.; Itanagar Wildlife Sanctuary, 6-10.x.2008, Coll. G. Srinivasan, Reg. Nos. 19/Inv. to 21/Inv. (APFS/ZSI).

(3) The Andaman colour form.

1 Female, India : Andaman & Nicobar Islands; South Andaman; Carbynscore, 19.v.1981, Coll. R. M. Sharma, Reg. No. 10949/H3. 1 Female, India : Andaman & Nicobar Islands; Port Blair, 1.ix.1983, Coll. David, Reg. No. 10950/H3. 1 Female, India : Andaman & Nicobar Islands; Port Blair, 13.vii.1984, Coll. V. Arumugam, Reg. No. 10995/H3. 1 Female, India : Andaman & Nicobar Islands; Port Blair, 18.ix.1985, Coll. N. K. Bhowmik, Reg. No. 10996/H3. 1 Female, India : Andaman & Nicobar Islands; North Andaman; Mayabunder, 4.ii.1998, Coll. Raja Ram & Party, Reg. No. 10997/H3 (NZSI).

Distribution : India : Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Manipur (new record), Meghalaya, Mizoram (new record), Nagaland (new record), Orissa (new record), Pondicherry, Sikkim, Tamil Nadu, Uttarakhand and West Bengal.

Elsewhere : Afghanistan, Bhutan, Cambodia, China, Indonesia, Japan, Laos, Malaysia, Myanmar, Nepal, Pakistan, Papua New Guinea, Philippines, Sri Lanka, Thailand and Vietnam.

Remarks : This is one of the most common and abundant hornet wasp distributed throughout India, including Andaman & Nicobar Islands. This species is seen in both plains and high altitudes.

7. *Vespa affinis* (Linnaeus)

(Plate II-6)

1764. *Apis affinis* Linnaeus, *Mus. Ludov. Ulricae* : 417.
 1905. *Vespa cincta* var. *picea* du Buysson, *Ann. Soc. Ent. France* **73** : 488 (key), 537.
 1910. *Vespa indosinensis* Perez, *Act. Soc. Linn. Bordeaux* **64** : 8.
 1936. *Vespa affinis continentalis* Bequaert, *Treubia* **15** (4) : 346 (key), 350.
 1936. *Vespa affinis affinis* (Linnaeus): Bequaert, *Treubia* **15** (4) : 347.
 1936. *Vespa affinis indosinensis* Perez: Bequaert, *Treubia* **15** (4) : 349.

Diagnosis : Body slender and moderate in size; apical margin of clypeus less hairy and in females with short broadly rounded lobes on each side of the median emargination (Fig. 7); punctures on vertex, temple, mesoscutum, scutellum, postscutellum, metapleuron and propodeum small and crowded; second gastral tergum largely or entirely orange yellow; body hairs fine, shorter and comparatively dense.

Size : Sterile female : 16-23 mm.

Comments : There are three distinct colour forms of this species are found in India. They are as follows :

(1) Predominantly black head with first tergite extensively orange yellow colour form : This colour forms are distributed in North eastern India. Bequaert (1936) erected it as a separate subspecies namely *Vespa affinis indosinensis* (Perez). Thorax entirely black in this colour form. All specimens studied in this colour form having a reddish brown inner orbit.

(2) Predominantly reddish brown head with first tergite extensively orange yellow colour form : This colour forms are distributed throughout mainland India. Bequaert (1936) erected it as a separate subspecies namely *Vespa affinis affinis* (Linnaeus). In this colour form thorax black except pronotum, tegula and scutellum reddish brown. All specimens studied in this colour form having supraclypeal area black.

(3) Predominantly reddish brown head with a very narrow orange yellow stripe on the apex of first tergite colour form : This colour forms are distributed in southern India. Bequaert (1936) erected it as a separate subspecies namely *Vespa affinis continentalis* Bequaert. In some specimens the very narrow orange yellow stripe on first tergite may be incomplete or absent. Thorax entirely black in this colour form. All specimens studied in this colour form having black markings on supraclypeal area and lateral sides of clypeus; mandibles are also black.

Variations :

(1) Predominantly black head with first tergite extensively orange yellow colour form shows the following colour variations : In some specimens tip of mandible reddish brown. In some other specimens the reddish brown markings extended from inner orbits to front, leading to vertex and upper half of temple near occiput. In one specimen from Meghalaya reddish brown marking extended to clypeus submedially. In one specimen from Arunachal Pradesh a large portion of postscutellum reddish brown apically and in another specimen from Arunachal Pradesh having a reddish brown colour on clypeus at apex.

(2) Predominantly reddish brown head with first tergite extensively orange yellow colour form shows the following colour variations : Two specimens from Darjeeling hills of West Bengal having more extended black colouration. The black markings extends to mandibles, clypeus, antennal sockets, area around ocelli extending to vertex and lower half of temple.

(3) Predominantly reddish brown head with a very narrow orange yellow stripe on the apex of first tergite colour form shows the following colour variations: Two specimens from Tamil Nadu having more blackish marks on head. Two male specimens from Bengaluru having a small reddish brown spot on pronotum.

Material examined :

(1) Predominantly black head with first tergite extensively orange yellow colour form.

2 Females, India: Arunachal Pradesh; Papumpare Dt.; Sonajuli; Chessa, 20.x.1996, Coll. S. K. Mandal & Party, Reg. Nos. 11039/H3 & 11040/H3. 1 Female, India: Arunachal Pradesh; East Siang Dt.; D' Ering Memorial (Lali) Wildlife Sanctuary; Sibiamukh, 19.i.2000, Coll. S. K. Mandal & Party, Reg. No. 11041/H3. 1 Female, India: Arunachal Pradesh; East Siang Dt.; Ranaghat, 24.ix.2002, Coll. M. Sil & Party, Reg. No. 11042/H3. 2 Females, India: Arunachal Pradesh; Papumpare Dt.; Itanagar, 16.vii.2003, Coll. P. T. Bhutia, Reg. Nos. 11043/H3 & 11044/H3. 1 Female, India: Assam; Manas National Park; 29.iii.1986, Coll. S. S. Saha, Reg. No. 11045/H3. 1 Female, India: Meghalaya; Jaintia Hills Dt.; Umkiang, 19.ix.1972, Coll. A. K. Ghosh & Party, Reg. No. 11046/H3. 1 Female, India: Meghalaya; East Garo Hills; Dainadubi, Alt. 340 m, 8-13.v.1979, Coll. J. K. Jonathan & Party, Reg. No. 11047/H3. 1 Female, India: Meghalaya; West Garo Hills; Phulbari, 24.x.1988, Coll. K. K. Roy & Party, Reg. No. 11048/H3. 1 Female, India: Nagaland; Dimapur Dt.; Dimapur, 11.ix.1994, Coll. R. S. Mridha, Reg. No. 11049/H3 (NZSI). 7 Females, India: Arunachal Pradesh; Papumpare Dt.; Itanagar; 6.x.2005, Coll. G. Srinivasan, Reg. Nos. 22/Inv. to 28/Inv. (APFS/ZSI).

(2) Predominantly reddish brown head with first tergite extensively orange yellow colour form.

1 Female, India : Tamil Nadu; Coimbatore Dt.; Coimbatore, 9.iv.2006, Coll. S. K. Mandal & Party, Reg. No. 11050/H3. 1 Female, India : Tripura; North Tripura Dt.; Debsai Chowdhury para, 16.iv.1998, Coll. V. T. Darlong, Reg. No. 11051/H3. 1 Female, India : West Bengal; Birbhum Dt.; Santiniketan, 13.ix.1988, Coll. Sudipta Chatterjee, Reg. No. 11052/H3. 1 Female, India : West Bengal; Darjeeling Dt.; Naxalbari, 7.iv.1984, Coll. M. Prasad & Party, Reg. No. 11053/H3. 1 Female, India : West Bengal; Darjeeling Dt.; Ambari, 9.iv.1984, Coll. M. Prasad & Party, Reg. No.11054/H3 (NZSI).

(3) Predominantly reddish brown head with a very narrow orange yellow stripe on the apex of first tergite colour form.

2 Females & 2 Males, India: Karnataka; Bengaluru; 26.vii.1979, Coll. Unknown, Reg. Nos. 11055/H3 to

11058/H3. 3 Females, India : Karnataka; Mysore Dt.; Rajiv Gandhi National Park, 12.ix.2008, Coll. S. K. Mandal & Party, Reg. Nos. 11059/H3 to 11061/H3. 2 Females, India: Karnataka; Chikmangalore Dt.; Bhadra Wildlife Sanctuary; Muthodi, 21.ix.2008, Coll. S. K. Mandal & Party, Reg. No. 11062/H3 & 11063/H3. 1 Female, India : Kerala; Pathanamthitta Dt.; Mudomoozhi, 9.x.2003, Coll. S. K. Mandal & Party, Reg. No. 11064/H3. 1 Female, India : Kerala; Idukki Dt.; Thekkadi, 16.x.2003, Coll. S. K. Mandal & Party, Reg. No. 11065/H3. 2 Females, India : Tamil Nadu; Thirunelveli Dt.; Kalakad Mundanthurai Tiger Reserve; Sengatheru, 30.viii-3.ix.1992, Coll. S. S. Saha & Party, Reg. Nos. 11066/H3 & 11067/H3 (NZSI).

Distribution : India : Arunachal Pradesh (new record), Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Meghalaya (new record), Nagaland (new record), Sikkim, Tamil Nadu, Tripura (new record), Uttarakhand, Uttar Pradesh and West Bengal. *Elsewhere*: China, Indonesia, Japan (in Ryukyu Island), Laos, Malaysia, Myanmar, Papua New Guinea, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam and New Zealand.

Remarks : This is one of the most common and widely distributed hornet wasp throughout the main land of India.

8. *Vespa mocsaryana* du Buysson

1905. *Vespa mocsaryana* du Buysson, *Ann. Soc. Ent. France* **73** : 490 (key), 537, pl. VII, fig. 3.

Diagnosis : Apical margin of clypeus less hairy and in females with short broadly rounded lobes on each side of the median emargination; punctures on vertex, temple, postscutellum and propodeum sparsely and rather finely punctate; scutellum and metapleuron almost impunctate; second gastral tergum black or dark brown with almost a narrow yellow to reddish brown apical band (Das & Gupta, 1989; Nguyen & carpenter, 2002).

Material examined : No specimen studied.

Distribution : India : Assam, Meghalaya and Sikkim.

Elsewhere : China, Indonesia, Laos, Malaysia, Myanmar, Thailand and Vietnam.

Remarks : This species comes close to *Vespa affinis* (Linnaeus) but differs in having: (1). Vertex,

temple, postscutellum and propodeum sparsely and rather finely punctate and scutellum and metapleuron almost impunctate (in *V. affinis* punctures on vertex, temple, mesoscutum, scutellum, postscutellum, metapleuron and propodeum small and crowded); (2). Second gastral tergum black or dark brown with almost a narrow yellow to reddish brown apical band (in *V. affinis* second gastral tergum largely or entirely orange yellow).

This species is distributed in eastern Himalayas (From published datas).

9. *Vespa orientalis* Linnaeus

(Plate II-7)

1771. *Vespa orientalis* Linnaeus, *Mant. Plant.*, ed. **2** : 540.

Diagnosis : Body brown with clypeus, frons, scape ventrally, apical margin of first gastral tergum narrowly, third and fourth tergites almost entirely, posterolateral corner of second gastral sternum, third sternum almost entirely and fourth sternum partly yellow. Third and fourth tergites with blackish brown spot laterally. The yellow marks on first tergum emarginate medially; third tergum with a median triangular blackish mark basally. Clypeus rather flat and elongate, as wide as long or a little longer (Fig. 8), with scattered moderate sized punctures, in females apical margin emarginate with rounded lateral lobes. Hairs on head and thorax short, sparse, stiff and bristle-like; gaster almost hairless dorsally.

Size : Fertile female : 22-28 mm; Sterile female : 17-22 mm.

Material examined : 1 Female, India : Jammu & Kashmir; Jammu; Tilak tiloo, 1.x.1977, Coll. R. C. Basu & Party, Reg. No. 11068/H3. 3 Females, India : Bihar; Bhagalpur Dt.; Mandar, 8.xii.1967, Coll. Raj Tilak & Party, Reg. Nos. 11069/H3 to 11071/H3. 2 Females, India : Jharkhand; Bokaro Dt.; Bandhudih, 5.viii.2009, Coll. Arun Kumar Roy Mahato, Reg. Nos. 11853/H3 & 11854/H3. 1 Female, India : Orissa; Keonjhar Dt.; Barahal, 27.ix.1972, Coll. K. Rai & Party, Reg. No. 11072/H3. 2 Females, India : Uttar Pradesh; Mirzapur Dt.; Dhaudraul, 24.iii.1979, Coll. R. L. Chowdhury, Reg. Nos. 11074/H3 & 11075/H3. 1 Female, India : Uttar Pradesh; Ghaziabad Dt.; Muradnagar, 4.vi.1989, Coll. M. S. Shishodia & Party, Reg. No. 11076/H3. 1 Female, India : Uttar Pradesh; Pratapgarh Dt.; Ranigunge, 15.vi.1989, Coll. A. K. Sanyal & Party, Reg.

No. 11077/H3. 1 Female, India: Uttar Pradesh; Azamgarh Dt.; Azamgarh, 29.iv.1990, Coll. T. R. Mitra & Party, Reg. No. 11078/H3. 4 Females, India : Uttar Pradesh; Aligarh Dt.; Aligarh, 1.x.2001, Coll. M. Prasad & Party, Reg. Nos. 11079/H3 to 11082/H3. 1 Female, India: Uttar Pradesh; Bulandshahr Dt.; Narora, 2.x.2001, Coll. M. Prasad & Party, Reg. No. 11083/H3. 1 Female, India : Uttar Pradesh; Agra Dt.; Fatehpur Sikri, 9.iii.2006, Coll. S. Biswas & Party, Reg. No. 11084/H3. 2 Females, India : Uttar Pradesh; Ballia Dt.; Ballia, 19.iii.2006, Coll. B. C. Das & Party, Reg. Nos. 11085/H3 & 11086/H3. 2 Females, India : Uttar Pradesh; Varanasi Dt.; Banaras, 22.iii.2006, Coll. B. C. Das & Party, Reg. Nos. 11087/H3 & 11088/H3. 4 Females, India : Uttar Pradesh; Rae Bareilly Dt.; Jagadishpur, 15.ix.2006, Coll. M. Sil & Party, Reg. Nos. 11090/H3 to 11093/H3. 2 Females, India : Uttar Pradesh; Sultanpur Dt.; Bahadurpur, 17.ix.2006, Coll. M. Sil & Party, Reg. Nos. 11094/H3 & 11095/H3. 3 Females, India : Uttar Pradesh; Sultanpur Dt.; Prayagpur, 18.ix.2006, Coll. M. Sil & Party, Reg. Nos. 11096/H3 to 11098/H3. 1 Female, India : Uttar Pradesh; Sultanpur; Pachupiran, 19.ix.2006, Coll. M. Sil & Party, Reg. No. 11099/H3. 1 Female, India : Uttar Pradesh; Sitapur Dt.; Gangagange, 23.ix.2006, Coll. M. Sil & Party, Reg. No. 11100/H3. 1 Female, India : Uttar Pradesh; Bareilly Dt.; Shahi, 27.ix.2006, M. Sil & Party, Reg. No. 11101/H3. 1 Female, India : Uttar Pradesh; Bareilly Dt.; Gyani, 28.ix.2006, Coll. R. S. Mridha, Reg. No. 11102/H3. 5 Females, India : Uttar Pradesh; Moradabad Dt.; Bojpur, 11.x.2006, Coll. Animesh Bal & Party, Reg. Nos. 11103/H3 to 11107/H3. 2 Females, India : Uttar Pradesh; Shahjahanpur Dt.; Banda, 14.x.2006, Coll. Animesh Bal & Party, Reg. Nos. 11108/H3 & 11109/H3. 2 Females, India : Uttar Pradesh; Shahjahanpur; Jalalabad, 15.x.2006, Coll. Animesh Bal & Party, Reg. Nos. 11110/H3 & 11111/H3. 1 Female, India : Uttar Pradesh; Sultanpur Dt.; Pachupiran, 19.ix.2006, Coll. M. Sil & Party, Reg. No. 11112/H3. 2 Females, India : Uttar Pradesh; Etawa Dt.; Etawa, 14.iii.2008, Coll. P. Mukhopadhyay & Party, Reg. Nos. 11117/H3 & 11118/H3. 2 Females, India : West Bengal; Medinipur Dt.; Midnapur; Kheoriaghat, 15.iii.1984, Coll. K. K. Ray & Party, Reg. Nos. 11119/H3 & 11120/H3. 1 Female, India : West Bengal; Medinipur Dt.; Midnapur; Garbata, 16.iii.1984, Coll. K. K. Ray & Party, Reg. No. 11121/H3. 1 Female, India : West Bengal; Bankura Dt.; Ramsagar, 7.x.1985, Coll. K. K. Ray & Party, Reg. No. 11122/H3. 1

Female, India : West Bengal; Bankura Dt.; Simlapal, 31.x.1985, Coll. M. Dutta & Party, Reg. No. 11123/H3. 4 Females, India : West Bengal; Bankura Dt.; Susnia, 9.xi.1985, Coll. K. K. Ray & Party, Reg. Nos. 11124/H3 to 11127/H3. 1 Female, India : West Bengal; Bankura Dt.; Bankura, 11.iii.1986, Coll. K. P. Mukherjee & Party, Reg. No. 11128/H3. 2 Females, India : West Bengal; Malda Dt.; Mahidipur, 18.vii.1986, Coll. M. S. Shishodia & Party, Reg. Nos. 11129/H3 & 11130/H3. 2 Females, India : West Bengal; Malda Dt.; Chanchali, 20.vii.1986, Coll. M. S. Shishodia & Party, Reg. Nos. 11131/H3 & 11132/H3. 4 Females, India : West Bengal; Bankura Dt.; Caochar, 4.ix.1986, Coll. P. Mukhopadhyay & Party, Reg. Nos. 11133/H3 to 11136/H3. 4 Females, India : West Bengal; Bardhaman Dt.; Adra, 8.ix.1986, Coll. K. K. Ray & Party, Reg. Nos. 11137/H3 to 11140/H3. 1 Female, India : West Bengal; Puruliya Dt.; Kejurdanga, 2.xii.1986, Coll. T. R. Mitra & Party, Reg. No. 11141/H3 (NZSI).

Distribution : India : Andhra Pradesh, Bihar, Delhi, Haryana, Jammu & Kashmir, Jharkhand (new record), Maharashtra, Orissa (new record), Punjab, Rajasthan, Uttarakhand, Uttar Pradesh and West Bengal. *Elsewhere*: Afghanistan, Albania, Algeria, Bahrein, Bulgaria, China, Cyprus, Egypt, Ethiopia, Greece, Iran, Iraq, Israel, Italy, Jordan, Lebanon, Libya, Madagascar, Malta, Nepal, Oman, Pakistan, Palestine, Romania, Russia, Saudi Arabia, Somalia, Syria, Tajikistan, Turkmenistan, Turkey, U.A.E., Uzbekistan and Yemen.

Jonathan *et al.* (2000) wrongly reported it from Meghalaya.

Remarks : This is one of the widely distributed hornet wasp in India. It is especially abundant in Indo-Gangetic plains. This wasp commonly seen in human inhabited areas and usually seen in bazaars attracted to sweets and gur.

10. *Vespa fumida* van der Vecht (Plate II-8)

1905. *Vespa fumida* van der Vecht, *Ann. Soc. Ent. France* **73** : 490 (key), 522, 627.

Diagnosis : Head orange brown; antenna black with orange brown scape and pedicel; thorax black; first to fifth gastral segments black, sixth orange yellow; posterior ocelli 2.14x farther from occiput than from eye (Fig. 9); vertex not depressed at medially (Fig. 9); clypeus subpolished with scattered punctures.

Size : Sterile female : 24 mm.

Variations : The single specimen studied here having thorax and first gastral segment entirely black. But Das & Gupta (1989) described as follows : Thorax black with two brownish marks on pronotum, a brown mark on outer margin of tegula and first tergum with a brownish yellow narrow and medially interrupted apical band. This colour difference can be considered as variations.

Material examined : 1 Female, India : West Bengal; Darjeeling Dt.; Pankhasari ridge, 24.xi.1982, Coll. R. K. Kacker & Party, Reg. No. 11142/H3 (NZSI).

Distribution : India : Arunachal Pradesh, Assam, Sikkim and West Bengal. *Elsewhere*: Bhutan, China, Myanmar and Nepal.

Remarks : This species is not so common. In India it is distributed in eastern Himalayan ranges.

11. *Vespa basalis* Smith
(Plate III-9)

1852. *Vespa basalis* Smith, *Trans. Ent. Soc. Lond.* **2** (2) : 46.

Diagnosis : Head and antenna orange to reddish brown; mandible concolorous with head except at apex including teeth and baso-lateral corner black; thorax black with following reddish brown patches : a long band on pronotal collar, pronotum almost entirely, a large spot on mesoscutum postero-medially, scutellum, postscutellum, tegula and mesepimeron anteriorly; legs predominantly reddish brown with black areas on coxa, trochanter and femur of all legs; gaster black except a narrow reddish brown stripe at the apex of first gastral tergum; posterior ocelli 0.77x farther from occiput than from eye (Fig. 10); clypeus almost impunctate; vertex depressed medially (Fig. 10), depression more pronounced in fertile females; ovipositor sheath strongly curved; body hairs rather long and dense, yellowish brown in colour.

Size : Fertile female : 24-25 mm; Sterile female: 15-21 mm.

Variations : In one specimen from Rajabhatkhowa of Cooch Behar district of West Bengal having a brownish black colour at the tip of last flagellar segment of the antenna, rest orange. In two sterile females collected from Sitargunge of Naini Tal district of Uttarakhand having second and third tooth almost

fused. In some specimens the reddish brown patches extended to propodeum posteriorly, propodeal valvula and ventral metapleuron posteriorly. Two specimens studied from Simlipal Tiger Reserve, Orissa having widely spread reddish brown patches on thorax. In these specimens pronotal collar and pronotum almost entirely, mesoscutum with a broad band longitudinally in the middle and two narrow bands on lateral sides, scutellum, postscutellum and propodeum completely, propleuron posteriorly, mesopleuron and metapleuron largely reddish brown. Narrow reddish brown stripe at apex of gaster is completely absent in some sterile females; in fertile females reddish brown stripe at apex of gaster more expanded.

Material examined : 1 Female, India : Arunachal Pradesh; West Siang Dt.; Likabali, 14.x.1981, Coll. S. K. Gupta & M. Prasad, Reg. No. 11144/H3. 1 Female, India: Arunachal Pradesh; Changlang Dt.; Namdapha National Park; Deban North, 28.ix.1981, Coll. S. Biswas & Party, Reg. No. 11145/H3. 1 Female, India: Arunachal Pradesh; Changlang Dt.; Namdapha National Park, Jiffons land, 17.xii.1982, Coll. S. Biswas & Party, Reg. No. 11146/H3. 4 Females, India: Arunachal Pradesh; West Kameng Dt.; Munna, 10.x.1996, Coll. S. K. Mandal & Party, Reg. Nos. 11147/H3 to 11150/H3. 1 Female, India : Arunachal Pradesh; Papumpare Dt.; Sonaguli, Sessa, 20.x.1996, Coll. S. K. Mandal & Party, Reg. No. 11151/H3. 5 Females, India : Arunachal Pradesh; West Kameng Dt.; Bhalukpong, 1.x.2001, Coll. B. Mitra & Party, Reg. Nos. 11152/H3 to 11156/H3. 3 Females, India : Arunachal Pradesh; West Kameng Dt.; Tanga, 2.x.2001, Coll. B. Mitra & Party, Reg. Nos. 11157/H3 to 11159/H3. 3 Females, India : Himachal Pradesh; Shimla Dt.; Solan; Chail, Alt. 1200 m, 29.x.1978, Coll. R. K. Varshney & Party, Reg. Nos. 11160/H3 to 11162/H3. 1 Female, India : Himachal Pradesh; Shimla Dt.; Solan, Alt. 1150 m, 29.x.1978, Coll. R. K. Varshney & Party, Reg. No. 11163/H3. 1 Female, India : Himachal Pradesh; Kangra Dt.; Palampur, 15.iv.2006, Coll. R. Babu & Party, Reg. No. 11164/H3. 3 Females, India : Himachal Pradesh; Hamirpur Dt.; Sujanpur, 19.iv.2006, Coll. R. Babu & Party, Reg. Nos. 11165/H3 to 11167/H3. 1 Female, India : Himachal Pradesh; Shimla Dt.; Rampur, 20.x.2006, Coll. R. Babu & Party, Reg. No. 11168/H3. 1 Female, India : Meghalaya; Jaintia Hills Dt.; Garampani forest, 11.xii. 1975, Coll. S. K. Chandra, Reg. No. 11169/H3. 1 Female, India : Meghalaya; East Khasi Hills Dt.; Shillong; Motinagar forest, 6.xi.1980,

Coll. M. S. Jyrwa, Reg. No. 11170/H3. 6 Females, India : Mizoram; Chhimtuipui Dt.; Saiha, 9.xi.1995, Coll. P. H. Roy & Party, Reg. No. 11171/H3 to 11176/H3. 1 Female, India : Mizoram; Aizawl Dt.; Aizawl, 10.xi.1995, Coll. P. H. Roy & Party, Reg. No. 11177/H3. 1 Female, India : Mizoram; Aizawl Dt.; Sairang, 27.xi.1996, Coll. S. C. Mitra & Party, Reg. No. 11178/H3. 1 Female, India : Orissa; Mayurbhang Dt.; Simlipal National Park; Burrupani, Alt. 2500 ft., 6-9.iv.1923, Coll. R. P. Mullins, Reg. No. 1037/H3. 1 Female, India : Orissa; Mayurbhang Dt.; Simlipal National Park; Joranda, 3.ii.1986, Coll. S. M. Ali & Party, Reg. No. 11179/H3. 1 Female, India : Sikkim; East Sikkim Dt.; Rangpo, 8.xi.1981, Coll. S. K. Gupta, Reg. No. 11180/H3. 3 Females, India : Uttarakhand; Dehra Dun Dt.; Mazra, 24.ix.2000, Coll. G. C. Sen & Party, Reg. Nos. 11192/H3 to 11194/H3. 2 Females, India : Uttarakhand; Pauri Garhwal Dt.; Srinagar, 9.xi.2000, Coll. B. C. Das & Party, Reg. Nos. 11195/H3 to 11196/H3. 1 Female, India : Uttarakhand; Naini Tal Dt.; Jeolikote, 11.xi.2000, Coll. S. K. Mandal & Party, Reg. No. 11197/H3. 1 Female, India : Uttarakhand; Naini Tal Dt.; Chunoti, 13.xi.2000, Coll. S. K. Mandal & Party, Reg. No. 11198/H3. 1 Female, India : Uttarakhand; Almora Dt.; Binsar Wildlife Sanctuary, 17.xi. 2000, Coll. S. K. Mandal & Party, Reg. No. 11199/H3. 4 Females, India : Uttarakhand; Almora Dt.; Ranikhet, 29.ix.2001, Coll. Animesh Bal & Party, Reg. Nos. 11200/H3 to 11203/H3. 1 Female, India : Uttarakhand; Almora Dt.; Artola, 29.ix.2001, Coll. P. Mukhopadhyay & Party, Reg. No. 11204/H3. 1 Female, India : Uttarakhand; Uttar Kashi Dt.; Uttar Kashi Forest Rest House, 11.x.2001, Coll. S. K. Mandal & Party, Reg. No. 11205/H3. 2 Females, India: Uttarakhand; Uttar Kashi Dt.; Gangotri, 12.x. 2001, Coll. S. K. Mandal & Party, Reg. Nos. 11206/H3 & 11207/H3. 1 Female, India : Uttarakhand; Tehri Garhwal Dt.; Gulae, 23.ix.2002, Coll. Animesh Bal & Party, Reg. No. 11208/H3. 5 Females, India : Uttarakhand; Naini Tal Dt.; Haldwani, 24.ix.2002, Coll. P. H. Roy & Party, Reg. Nos. 11209/H3 to 11213/H3. 5 Females, India : Uttarakhand; Naini Tal Dt.; Sitargang, 26.ix.2002, Coll. P. H. Roy & Party, Reg. Nos. 11214/H3 to 11218/H3. 1 Female, India : Uttarakhand; Pauri Garhwal Dt.; Srinagar, 29.x.2002, Coll. M. Prasad & Party, Reg. No. 11219/H3. 2 Females, India: Uttarakhand; Chamoli Dt.; Karnaprayag, 29.x.2002, Coll. P. Mukhopadhyay & Party, Reg. Nos. 11220/H3 & 11221/H3. 2 Females, India : Uttarakhand,

Rudraprayag Dt.; Nagrasu, 7.xi.2002, Coll. P. Mukhopadhyay & Party, Reg. Nos. 11222/H3 & 11223/H3. 1 Female, India : Uttarakhand; Almora Dt.; Koshi, 18.ix.2003, Coll. B. Mitra & Party, Reg. No. 11224/H3. 1 Female, India : Uttarakhand; Naini Tal Dt.; Bhawali Forest Rest House, Alt. 1920 m, 20.ix.2004, Coll. D. R. Maulik & Party, Reg. No. 11225/H3. 1 Female, India : Uttarakhand; Pithoragarh Dt.; Pacholi, 22.ix.2004, Coll. B. Mitra & Party, Reg. No. 11226/H3. 1 Female, India : Uttarakhand; Pithoragarh Dt.; Dharchula, 26.ix.2004, Coll. B. Mitra & Party, Reg. No. 11227/H3. 1 Female, India : Uttarakhand; Pithoragarh Dt.; Charchum, 27.ix.2004, Coll. B. Mitra & Party, Reg. No. 11228/H3. 1 Female, India : Uttarakhand; Bageshwar Dt.; Kotbhamari, 29.ix.2004, Coll. M. Ghosh & Party, Reg. No. 11229/H3. 3 Females, India : Uttarakhand; Almora Dt.; Brechhina, 5.x.2004, Coll. D. R. Maulik & Party, Reg. Nos. 11230/H3 to 11232/H3. 5 Females, India : Uttar Pradesh; Saharanpur Dt.; Mohand forest, 7.xi.1978, Coll. R. K. Varshney & Party, Reg. Nos. 11233/H3 to 11237/H3. 1 Female, India : West Bengal; Cooch Behar Dt.; Rajabhatkhawa, 22.xi.1983, Coll. A. K. Sanyal & Party, Reg. No. 11238/H3 (NZSI).

3 Females, India : Arunachal Pradesh; Papumpare Dt.; Itanagar, 28.ii.2008, Coll. G. Srinivasan, Reg. Nos. 29/Inv. to 31/Inv. (APFS/ZSI).

Distribution : India : Arunachal Pradesh, Assam, Himachal Pradesh, Meghalaya, Mizoram (new record), Orissa (new record), Sikkim, Uttarakhand, Uttar Pradesh (new record) and West Bengal.

Elsewhere : China, Indonesia, Laos, Myanmar, Nepal, Pakistan, Taiwan, Thailand and Vietnam.

Remarks : This is a moderately sized hornet wasp. It is one of the common species found in northern, eastern and north eastern India.

12. *Vespa bicolor* Fabricius (Plate III-10)

1787. *Vespa bicolor* Fabricius, *Mant. Ins.* 1 : 288.

Diagnosis : Body sulphur yellow; Black colour as follows: apex of mandible including teeth, head dorsally including antennal scrobe and lateral margins of clypeus, mesoscutum entirely, a mark below tegula, a median line on scutellum, margins of postscutellum, a Y-shaped mark at junction of postscutellum and propodeum, mesopleuron ventrally near to fore coxa,

line between mesopleuron and metapleuron and base of first tergite. Antenna black dorsally; brownish bands on first gastral tergum subapically and base of second tergum widely; legs yellow; wings flavohyaline, darker along costal margin of fore wing; clypeus almost impunctate; body dorsally covered with fine, rather stiff erect blackish hairs.

Size : Fertile female : 18-21 mm; Sterile female : 15-19 mm.

Variations : In some specimens the general body colour changes from sulphur yellow to brownish yellow. In some specimens brownish band on base of second gastral tergum becomes black. The extend of brown colour on tergites are varying in different specimens.

Material examined : 2 Females, India : Arunachal Pradesh; West Siang Dt.; Aalo; Basar, 22.x.1981, Coll. S. K. Gupta & Party, Reg. Nos. 11239/H3 & 11240/H3. 1 Female, India : Arunachal Pradesh; Papumpare Dt.; Itanagar, 3.xi.1981, Coll. S. K. Gupta & Party, Reg. No. 11241/H3. 1 Female, India : Arunachal Pradesh; Changlang Dt.; Namdapha National Park; Debon, 9.xii.1982, Coll. S. Biswas & Party, Reg. No. 11242/H3. 3 Females, India : Arunachal Pradesh; Changlang Dt.; Namdapha National Park, Giffons Land, 17.xii.1982, Coll. S. Biswas & Party, Reg. No. 11243/H3 to 11245/H3. 1 Female, India : Arunachal Pradesh; Debang Valley Dt.; Nizam ghat, Alt. 550 m, 11.xi.1985, Coll. G. K. Srivastava & Party, Reg. No. 11246/H3. 1 Female, India : Arunachal Pradesh; West Kameng Dt.; Bhalukpong, 4.ix.1998, Coll. A. R. Lahiri & Party, Reg. No. 11247/H3. 2 Females, India : Arunachal Pradesh; West Kameng Dt.; Bhalukpong, 1.x.2001, Coll. B. Mitra & Party, Reg. Nos. 11248/H3 & 11249/H3. 1 Female, India : Arunachal Pradesh; Upper Siang Dt.; Jenjijing, 14.ix.2002, Coll. M. Sil & Party, Reg. No. 11250/H3. 1 Female, India : Arunachal Pradesh; Upper Siang Dt.; Ramsing, 17.ix.2002, Coll. M. Sil & Party, Reg. No. 11251/H3. 1 Female, India : Arunachal Pradesh; Papumpare Dt.; Konkon Nallah; Naharlagun, 11.ix.2003, Coll. N. Tahar, Reg. No. 11252/H3. 2 Females, India : Manipur; Ukhurul Dt.; Ukhurul, 9.x.1975, Coll. M. S. Shishodia & Party, Reg. Nos. 11253/H3 & 11254/H3. 1 Female, India : Meghalaya; East Garo Hills Dt.; Songsak, 13.iv.1973, Coll. S. Biswas, Reg. No. 11255/H3. 2 Females, India : Meghalaya; Jaintia Hills Dt.; Garam pani, 19.ix.1979,

Coll. C. Radhakrishnan, Reg. Nos. 11256/H3 & 11257/H3. 2 Females, India : Meghalaya; Jaintia Hills Dt.; Garam pani, 10.xii.1995, Coll. B. K. Chanda, Reg. Nos. 11258/H3 & 11259/H3. 1 Female, India : Sikkim; South Sikkim Dt.; Jorethang, 5.xi.1994, Coll. G. C. Sen & Party, Reg. No. 11260/H3. 1 Female, India : West Bengal; Darjeeling Dt.; Rangpo, 14.ix.1978, Coll. A. N. T. Joseph & Party, Reg. No. 11261/H3. 1 Female, India : West Bengal; Jalpaiguri Dt.; Gazaldoba, 9.x.1987, Coll. S. K. Tandon & Party, Reg. No. 11262/H3 (NZSI). 1 Female, India : Arunachal Pradesh; West Kameng Dt.; Sessa, 20.xi.2005, Coll. G. Srinivasan, Reg. No. 32/Inv. (APFS/ZSI).

Distribution : India : Arunachal Pradesh, Assam, Manipur (new record), Meghalaya, Sikkim, Uttarakhand and West Bengal.

Elsewhere : Bhutan, Cambodia, China, Laos, Myanmar, Nepal, Thailand and Vietnam.

Das & Gupta (1989) reported this species from Kumaun hills of Uttar Pradesh. Kumaun hills are now under newly formed Uttarakhand state.

Remarks : This is one of the very common species distributed in Himalayan ranges.

13. *Vespa vivax* Smith

(Plate III-11)

1870. *Vespa vivax* Smith, *Trans. Zool. Soc. Lond.* 7 (3) : 190, pl XXI, fig.9.

Diagnosis : Body black with the following yellow parts: head, apex of femora, tibiae and tarsi, broad apical band on first and third gastral tergites (that on third broadly emarginate), narrow apical bands on second, fourth and fifth tergites, sixth tergite entirely, broad apical bands on second and third sternites, narrow bands on fourth and fifth sternites and sixth sternum entirely. A black mark on frons covering anterior ocelli extending to antennal scrobe and supraclypeal area to form a ring-like structure (Fig. 11). Scape and pedicel ventrally yellow; brownish yellow band on first gastral tergite medially; wings brownish hyaline. Head, thorax and gaster covered with long, erect, somewhat thick black hairs.

Size : Sterile female : 18-21 mm.

Material examined : 1 Female, India : Uttarakhand; Chamoli Dt.; Hanumanhati, 1.ii.2002, Coll. P.

Mukhopadhyay & Party, Reg. No. 11263/H3 (NZSI).

Distribution : India : Jammu & Kashmir, Himachal Pradesh, Sikkim and Uttarakhand.

Elsewhere : China, Myanmar, Nepal, Taiwan and Thailand.

Smith (1870) originally described this species based on the type specimen collected from Binsar, Kumaun hills of Uttar Pradesh state. Now Binsar of Kumaun hills comes under the newly constituted Uttarakhand state.

Remarks : This is not a common hornet wasp. In India it is widely distributed in Himalayan ranges.

14. *Vespa auraria* Smith

(Plate III-12)

1852. *Vespa auraria* Smith, *Trans. Ent. Soc. Lond.* **2** (2) : 46, pl. VIII, fig. 8.

1959. *Vespa velutina pruthii* van der Vecht, *Zool. Meded., Leiden.* **36** (13) : 228.

Diagnosis : Body black. Reddish brown markings as follows : head, pronotal collar posteriorly, pronotum, tegula, scutellum, two lateral spots on postscutellum, propleuron ventrally and usually a triangular mark on mesopleuron. Antenna reddish or blackish brown. Mandible concolorous with clypeus except at apex including teeth black. Mesoscutum dark brown with a U-shaped mark touching scutellum, with golden brown glistening pubescence. Fore leg yellowish brown except inner basal corner of coxa, trochanter and basally in front of femur black. Mid and hind legs black except at apex of femur, apex of tibia and tarsi entirely reddish brown or yellowish brown. Bases of first and second gastral tergites brownish black or black, their margins and the visible part of the following segments usually yellowish brown. Base of second gastral sternum brownish black or black, their margins and visible part of the following sternites usually yellowish brown. Wings brownish hyaline. Head, thorax and gaster covered with fine blackish erect hairs. Gaster with a velvet appearance. Clypeus moderately convex, its apical third depressed and punctate, apical margin emarginate, with distinct lateral lobes in females and quadrate in males.

Size : Fertile female : 22-25 mm.; Sterile female : 15-21 mm; Male : 15-17 mm.

Variations : Yellowish brown markings on tergites greatly varying. Some specimens from Jammu & Kashmir having tergites almost entirely yellowish brown. Van der Vecht (1959) erected it as a separate subspecies namely *Vespa velutina pruthii* van der Vecht. Some specimens from Mizoram, Nagaland and Uttarakhand having more blackish tergites. In some specimens, there is no reddish brown marks on mesopleuron below tegula and gaster more blackish. In some specimens from Uttarakhand the antennal flagellomeres more blackish.

Material examined : 2 Females, India : Himachal Pradesh; Shimla Dt.; Solan, 30.x.1970, Coll. R. K. Varshney & Party, Reg. Nos. 11266/H3 & 11267/H3. 4 Females, India : Himachal Pradesh; Mandi Dt.; Chail, Alt. 1200 m, 29.x.1978, Coll. R. K. Varshney & Party, Reg. Nos. 11268/H3 to 11271/H3. 1 Female, India : Himachal Pradesh; Shimla Dt.; Solan; Kandali, 3.iv.2006, Coll. R. Babu & Party, Reg. No. 11272/H3. 1 Female, India: Himachal Pradesh; Kangra Dt.; Palampur, 16.iv.2006, Coll. R. Babu & Party, Reg. No. 11273/H3. 2 Females, India: Himachal Pradesh; Shimla Dt.; Rampur, 20.x.2006, Coll. R. Babu & Party, Reg. Nos. 11274/H3 & 11275/H3. 4 Females, India: Jammu & Kashmir; Srinagar Dt.; Lalmandi, 10.ix.1977, Coll. R. C. Basu & Party, Reg. Nos. 11276/H3 to 11279/H3. 3 Females, India: Jammu & Kashmir; Srinagar Dt.; Shalimar Garden, 11.ix.1977, Coll. R. C. Basu & Party, Reg. Nos. 11280/H3 to 11282/H3. 4 Females, India: Jammu & Kashmir; Anantnag Dt.; Bijbehara, 22.ix.1977, Coll. R. C. Basu & Party, Reg. Nos. 11283/H3 to 11286/H3. 1 Female, India: Jharkhand; Ranchi Dt.; Netarhat, 23.i.1954, Coll. A. P. Kapur, Reg. No. 11287/H3. 2 Females, India : Madhya Pradesh; Chindwara Dt.; Patakot, 20.x.1992, Coll. R. K. Singh & Party, Reg. Nos. 11288/H3 & 11289/H3. 1 Female, India: Meghalaya; East Khasi Hills Dt.; Shillong, 25.v.1968, Coll. R. K. Varshney, Reg. No. 11290/H3. 1 Female, India: Meghalaya; East Khasi Dt.; Shillong, 30.x.1974, Coll. S. K. Gupta & Party, Reg. No. 11291/H3. 1 Female, India: Meghalaya; East Khasi Hills Dt.; Shillong, 4.x.1977, Coll. A. R. Lahiri, Reg. No. 11292/H3. 1 Female, India: Meghalaya; East Khasi hills Dt.; Shillong; Fruit garden, 22.ii.1978, Coll. M. S. Jyrwa, Reg. No. 11293/H3. 1 Female, India : Meghalaya; East Khasi Hills Dt.; Cherrapunjee, 23-26.iv.1979, Coll. J. K. Jonathan & Party, Reg. No. 11294/

- H3. 1 Female, India : Meghalaya; East Khasi hills Dt.; Shillong, 21.viii.1980, Coll. A. Singh & Party, Reg. No. 11295/H3. 1 Female, India : Meghalaya, East Khasi Hills Dt.; Cherrapunjee, 26.ix.1988, Coll. A. R. Lahiri & Party, Reg. No. 11296/H3. 1 Female, India : Meghalaya; East Khasi Hills Dt.; Umtyngar, Alt. 1800 m, 21.ix.1991, Coll. R. K. Varshney & Party, Reg. No. 11297/H3. 3 Females, India : Mizoram; Lunglei Dt.; Lunglei, 19.ix.1993, Coll. A. R. Lahiri & Party, Reg. Nos. 11298/H3 to 11300/H3. 2 Females, India : Mizoram; Lunglei Dt.; Tlabung, 1.x.1993, Coll. A. R. Lahiri & Party, Reg. Nos. 11301/H3 & 11302/H3. 1 Female, India : Mizoram; Aizawl Dt.; Khawhai, 4.iv.1994, Coll. A. K. Hazra & Party, Reg. No. 11303/H3. 1 Male, India : Mizoram; Aizawl Dt.; Lengpui, 23.xi.1996, Coll. P. H. Roy & Party, Reg. No. 11304/H3. 1 Female, India: Mizoram; Aizawl Dt.; Sairang, 28.xi.1996, Coll. S. C. Mitra & Party, Reg. No. 11305/H3. 1 Female, India : Nagaland; Tuensang Dt.; Tuensang, 29.xi.1983, Coll. S. K. Gupta & B. C. Saha, Reg. No. 11306/H3. 1 Female, India : Nagaland; Kohima Dt.; Kohima, 15.ix.1994, Coll. R. S. Mridha, Reg. No. 11307/H3. 1 Female, India : Nagaland; Kohima Dt.; Kohima, 11.x.1998, Coll. T. K. Pal & Party, Reg. No. 11308/H3. 4 Females, India : Tripura; South Tripura Dt.; Kalibazar, 1.x.1977, Coll. N. Muraleedharan, Reg. No. 11309/H3 to 11312/H3. 2 Females, India : Uttarakhand; Chamoli Dt.; Chinka, 2.ix. 1972, Coll. T. K. Chakraborty, Reg. Nos. 11313/H3 & 11314/H3. 1 Female, India: Uttarakhand; Dehra Dun Dt.; Mussorie; Kempty Fall, Alt. 1220 m, 4.xi.1978, Coll. R. K. Varshney & Party, Reg. No. 11315/H3. 3 Females, India : Uttarakhand; Dehra Dun Dt.; Sahastradhara, Alt. 900 m, 6.xi.1978, Coll. R. K. Varshney & Party, Reg. Nos. 11316/H3 to 11318/H3. 1 Female, India : Uttarakhand; Chamoli Dt.; Joshimath, 14.xi.1986, Coll. G. K. Srivastava & Party, Reg. No. 11319/H3. 1 Female, India : Uttarakhand; Tehri Garhwal Dt.; Dogadda, 6.ii.1989, Coll. S. K. Gupta & Party, Reg. No. 11320/H3. 1 Female, India : Uttarakhand; Chamoli Dt.; Pipalkoti, 24.x.1989, Coll. S. K. Gupta & Party, Reg. No. 11321/H3. 1 Male, India : Uttarakhand; Rudraprayag Dt.; Chopta, 21.xi.1999, Coll. B. C. Das & Party, Reg. No. 11322/H3. 1 Female, India : Uttarakhand; Almora Dt.; Kheroa, 22.xi.1999, Coll. B. C. Das & Party, Reg. No. 11323/H3. 1 Male, India : Uttarakhand; Almora Dt.; Narasingh Rao Bori, 23.xi.1999, Coll. B. C. Das & Party, Reg. No. 11324/H3. 3 Females, India : Uttarakhand; Almora Dt.; Ranikhet, 25.xi.1999, Coll. B.C. Das & Party, Reg. Nos. 11325/H3 to 11327/H3. 1 Female, India : Uttarakhand; Dehra Dun Dt.; Dehra Dun, 18.ix.2000, Coll. G. C. Sen & Party, Reg. No. 11328/H3. 1 Female, India : Uttarakhand; Dehra Dun Dt.; Mussorie; Kempty Fall, 26.x.2000, Coll. P. Mukhopadhyay & Party, Reg. No. 11329/H3. 1 Female, India : Uttarakhand; Dehra Dun Dt.; Sahastradhara, 6.xi.2000, Coll. B. C. Das & Party, Reg. No. 11330/H3. 1 Female, India : Uttarakhand; Naini Tal Dt.; Chunoti, 13.xi.2000, Coll. S. K. Mandal & Party, Reg. No. 11331/H3. 1 Female, India : Uttarakhand; Almora Dt.; Sitalakhet, 25.ix.2001, Coll. Animesh Bal & Party, Reg. No. 11332/H3. 4 Females, India : Uttarakhand; Dehra Dun Dt.; Chakrada road, 4.x.2001, Coll. S. K. Mandal & Party, Reg. Nos. 11333/H3 to 11336/H3. 1 Female, India : Uttarakhand; Almora Dt.; Kosi, 12.x.2001, Coll. B. C. Das & Party, Reg. No. 11337/H3. 1 Female, India; Uttarakhand, Almora Dt.; Chopra, 11.x.2001, Coll. B. C. Das & Party, Reg. No. 11338/H3. 2 Females, India : Uttarakhand; Tehri Garhwal Dt.; Chamba, Alt. 1676 m, 16.x.2001, Coll. G. C. Sen & Party, Reg. Nos. 11339/H3 & 11340/H3. 1 Female, India: Uttarakhand; Almora Dt.; Kausani, 22.x.2001, Coll. B.C. Das & Party, Reg. No. 11341/H3. 1 Female, India : Uttarakhand; Chamoli Dt.; Govindghat, 28.viii.2002, Coll. S. K. Mandal & Party, Reg. No. 11342/H3. 2 Females, India : Uttarakhand; Tehri Garhwal Dt.; Chamba, 14.ix.2002, Coll. Animesh Bal & Party, Reg. Nos. 11343/H3 & 11344/H3. 1 Female, India : Uttarakhand; Tehri Garhwal Dt.; Gular, 23.ix.2002, Coll. Animesh Bal & Party, Reg. No. 11345/H3. 1 Female, India : Uttarakhand; Dehra Dun Dt.; Koulagarh; 27.ix.2002, Coll. Animesh Bal & Party, Reg. No. 11346/H3. 1 Female, India : Uttarakhand; Tehri Garhwal Dt.; Baysi, 24.ix.2002, Coll. Animesh Bal & Party, Reg. No. 11347/H3. 1 Female, India : Uttarakhand; Pauri Garhwal Dt.; Srinagar, 29.x.2002, Coll. M. Prasad & Party, Reg. No. 11348/H3. 6 Females, India: Uttarakhand; Dehra Dun Dt.; Dehra Dun, 3.x.2002, Coll. M. Prasad & Party, Reg. Nos. 11349/H3 to 11354/H3. 2 Females, India : Uttarakhand; Dehra Dun Dt.; Dhanolti, 4.xi.2002, Coll. M. Prasad & Party, Reg. Nos. 11355/H3 & 11356/H3. 1 Female, India : Uttarakhand; Chamoli Dt.; Tangari, Alt. 1550 m, 5.xi.2002, Coll. P. Mukhopadhyay & Party, Reg. No. 11357/H3. 2 Females, India : Uttarakhand; Bageshwar Dt.; Rakhauli, 27.ix.2003, Coll. B. Mitra & Party, Reg. Nos. 11360/H3 & 11361/H3. 1 Female, India :

Uttarakhand; Almora Dt.; Chilianaula, 29.ix.2003, Coll. B. Mitra & Party, Reg. No. 11362/H3. 1 Female, India : Uttarakhand; Almora Dt.; Lamgara, 23.ix.2004, Coll. M. Ghosh & Party, Reg. No. 11363/H3. 2 Females, India : Uttarakhand; Almora Dt.; Khairna, 24.ix.2004, Coll. M. Ghosh & Party, Reg. Nos. 11364/H3 & 11365/H3. 1 Female, India : Uttarakhand; Pithoragarh Dt.; Bhagichora, 25.ix.2004, Coll. B. Mitra & Party, Reg. No. 11366/H3. 1 Female, India : Uttarakhand; Almora Dt.; Khairna, Alt. 1756 m, 25.ix.2004, Coll. D. R. Maulik & Party, Reg. No. 11367/H3. 2 Females, India : Uttar Pradesh; Saharanpur Dt.; Mohand forest, 7.xi.1978, Coll. R. K. Varshney & Party, Reg. Nos. 11377/H3 & 11378/H3. 3 Females, India : West Bengal; Puruliya Dt.; Ajodhya, 3.xi.1985, Coll. M. Dutta & Party, Reg. Nos. 11379/H3 to 11381/H3 (NZSI).

Distribution : India : Arunachal Pradesh, Assam, Jammu & Kashmir, Jharkhand (new record), Himachal Pradesh, Madhya Pradesh (new record), Meghalaya, Mizoram (new record), Nagaland (new record), Punjab, Sikkim, Tripura (new record), Uttarakhand, Uttar Pradesh (new record) and West Bengal. *Elsewhere*: Afghanistan, China, Laos, Malaysia, Myanmar, Nepal, Pakistan, Thailand and Yemen.

Remarks : This is a widely distributed species in the high ranges of Himalayas and extends in to the plains of Northern, Eastern and Central India.

15. *Vespa velutina* Lepeletier
(Plate IV-13)

1836. *Vespa velutina* Lepeletier, *Hist. Nat. Ins. Hym.* 1 : 507.

1905. *Vespa auraria* var. *nigrithorax* du Buysson, *Ann. Soc. Ent. France* 73 : 553.

Diagnosis : Upper half of head including upper half of temple largely black; antenna black dorsally and reddish brown ventrally; clypeus orange or reddish brown coloured; mandible concolorous with clypeus except at apex including teeth brownish black to black; lower half of temple reddish brown; thorax wholly black; legs black with tarsi yellowish brown; first, second and third gastral tergites black with yellow or yellowish brown bands at apical margin; visible part of remaining tergites yellowish brown; second and third sternites black with yellow or yellowish brown band apically, bands strongly emarginate at medially;

visible part of remaining sternites yellowish brown; wings brownish hyaline; head, thorax and gaster covered with fine blackish erect hairs; apical margins of clypeus emarginate with distinct lateral lobes in females and quadrate in males.

Size : Sterile female : 17-19 mm; Male : 16 mm.

Variations : The yellowish brown colour pattern of fourth to the remaining gastral tergites and sternites are variable.

Material examined : 1 Male, India: Arunachal Pradesh; West Kameng Dt.; Sessa, 29.x.1985, Coll. G. K. Srivastava & Party, Reg. No. 11382/H3. 1 Female, India: Sikkim; North Sikkim Dt.; Phensang, 16.ix.1978, Coll. A. N. T. Joseph & Party, Reg. No. 11383/H3. 1 Female, India: Sikkim; East Sikkim Dt.; Rangpo, 6.x.1988, Coll. V. C. Agrawal & party, Reg. No. 11384/H3 (NZSI).

Distribution : India : Arunachal Pradesh (new record), Assam, Sikkim and West Bengal.

Elsewhere : Bhutan, China, Indonesia, Laos, Malaysia, Myanmar, Taiwan. Thailand and Vietnam.

Remarks : This species is not so common. In India it is widely distributed in Eastern Himalayan ranges.

SUMMARY

Hornet wasps of India are taxonomically treated in this work. 15 valid species are present in India so far. 26 new records of different species of hornet wasps are reported here from various states. An illustrated key to species of India is also provided.

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REFERENCES

- Archer, M.E. 1989. A key to the world species of the Vespinae (Hymenoptera). *Res. Monogr. College of Ripon & York St. John*, 2. York.
- Archer, M.E. 1991a. The number of species that can be recognized within the genus *Vespa* (Hym., Vespinae). *Ent. Mon. Mag.* **127** : 161-164.
- Archer, M.E. 1991b. Taxonomy and Bionomics of the *Vespa tropica* group (Hym., Vespinae). *Ent. Mon. Mag.* **127** : 225-232.
- Archer, M.E. 1999. Taxonomy, distribution and nesting biology of *Vespa binghami*, *V. basalis*, *V. variabilis*, *V. fervida*, *V. luctuosa*, *V. multimaculata* and *V. bellicose* (Hym., Vespinae). *Ent. Mon. Mag.* **135** : 43-50.
- Archer, M.E., Jacobson, R.E. and Carpenter, J.M. 1988. *Sphecos*, **17** : 9-11.
- Bequaert, J. 1930. On the generic and subgeneric divisions of the Vespinae (Hymenoptera). *Bull. Brooklyn Ent. Soc.* **25** : 59-70.
- Bequaert, J. 1936. The common Oriental hornets, *Vespa tropica* and *Vespa affinis* and their color forms. *Treubia* **15** : 329-351.
- Bingham, C.T. 1897. Fauna of British India, including Ceylon and Burma. Hymenoptera I. Wasps and Bees. *Taylor and Francis, London*.
- Buysson, R. du. 1903. Monographie des guetes ou *Vespa*. *Ann. Soc. Ent. France*, **72** : 260-288.
- Buysson, R. du. 1905. Monographie des guetes ou *Vespa*. *Ann. Soc. Ent. France*, **73** : 485-556., 565-634.
- Carpenter, J.M. 1987. Phylogenetic relationships and classification of the Vespinae (Hymenoptera : Vespidae). *Syst. Ent.* **12** : 413-431.
- Carpenter, J.M. and Kojima, J. 1997. Checklist of the species in the subfamily Vespinae (Insecta : Hymenoptera : Vespidae). *Nat. Hist. Bull. Ibaraki Univ.* **1** : 51-92.
- Dalla Torre, K. von 1904. Vespidae. *Genera Insectorum* **19** : 1-108.
- Das, B.P. and Gupta, V.K. 1989. The social wasps of India and the adjacent countries (Hymenoptera : Vespidae). *Oriental Insects Mon.* **11** : 292 pages.
- Fabricius, J.C. 1775. *Systema Entomologiae*: 832 pages.
- Fabricius, J.C. 1781. *Species Insectorum*. I.C.E. Bohni, Hamburg.
- Fabricius, J.C. 1787. *Mantissa Insectorum*. Hafniae.
- Girish Kumar, P. and Srinivasan G. 2009. New record of *Vespa soror* du Buysson (Hymenoptera : Vespidae) from India. *Rec. Zool. Surv. India*, **109**(Part-4) : 111-112.
- Gupta, S.K. 1997a. Hymenoptera : In Fauna of Nanda Devi Biosphere Reserve : *Fauna of Conservation areas* **9**. *Zool. Surv. India* : 97-104.
- Gupta, S.K. 1997b. Hymenoptera : Aculeata : In Fauna of Delhi: State Fauna Series **6**. *Zool. Surv. India* : 421-440.
- Gusenleitner, J. 2006. Uber Aufsammlungen von Faltenwespen in Indien (Hymenoptera : Vespidae). *Linzer Biol. Beitr.* **38** (1) : 677-695.

- Harris, A.C. and Patrick, B.H. 1997. A large queen Asian hornet (*Vespa affinis*; Hymenoptera : Vespidae) captured live in Arrow town. *New Zealand Entomologist, The Weta*, **20** (1) : 9-13.
- Jacobson, R.E. 1986. A field key to the hornets (*Vespa*) of India. *Ann. Ent.* **4** (1) : 51-52.
- Jonathan, J.K. and Kundu, B.G. 2003. Insecta : Hymenoptera : Vespidae. *Zool. Surv. India, Fauna of Sikkim, State Fauna Series*, **4** (7) : 369-392.
- Jonathan, J.K., Roy, S.B. and Kundu, B.G. 1999. Insecta : Hymenoptera : Vespidae. *Zool. Surv. India, Fauna of West Bengal, State Fauna Series*, **3**(8) : 149-182.
- Jonathan, J.K., Roy, S.B. and Kundu, B.G. 2000a. Insecta : Hymenoptera : Vespidae. *Zool. Surv. India, Fauna of Meghalaya, State Fauna Series*, **4**(7) : 117-160.
- Jonathan, J.K., Roy, S.B. and Kundu, B.G. 2000b. Insecta : Hymenoptera : Vespidae. *Zool. Surv. India, Fauna of Tripura, State Fauna Series*, **3** (7) : 377-390.
- Kojima, J. 1982. The genus *Vespa* in the Philippines (Hymenoptera, Vespidae). *Kontyu*, **50** : 434-444.
- Kojima, J. and Reyes, S.G. 1984. A new subspecies of *Vespa tropica* from Cebu Island, the Philippines (Hymenoptera, Vespidae). *Kontyu*, **52** : 260-261.
- Kojima, J. and Reyes, S.G. 1986. Philippine Vespidae, I. Genus *Vespa*. *Philippine Ent.*, **6** : 445-454.
- Kundu, B.G., Ghosh, S.N. and Roy Chowdhury, S. 2006. Insecta: Hymenoptera : Aculeata (Vespidae and Apidae). *Zool. Surv. India, Fauna of Arunachal Pradesh, State Fauna Series*, **13** (2) : 427-448.
- Kundu, B.G., Girish Kumar, P., Kazmi, S.I. and Roy Chowdhury, S. (in Press). Insecta : Hymenoptera : Aculeata (Vespidae and Apidae). *Zool. Surv. India, Fauna of Uttarakhand, State Fauna Series*.
- Latreille, P.A. 1810. Considerations Generales sur l' Ordre Naturel des Animaux Composant les classes des Crustaces, des Arachnides, et des Insectes. *F. Schoell, Paris*.
- Lepelletier de St. Fargeau ALM. 1836. Histoire Naturelle Des Insectes. *Hymenopteres, I. Roret's Suites a Buffon, Paris*.
- Linnaeus, C. 1758. *Systema Naturae*, (10th Ed.) Vol. **1**. (Holmiae).
- Linnaeus, C. 1764. Museum S : ae Rae Mtis Ludo Ulri. Regi. Suec., Goth., Van. In. quo animalia rariora, exotica imprimis. Insecta & Conchilia describuntur & determinatur. *Pridromi instar* : 1-719 Holmiae.
- Linnaeus, C. 1771. Mantissa Plantarum altera, *Linn. Soc. London* **2** : 540.
- Matsuura, M. and Yamane, Sk. 1990. Biology of the Vespine Wasps. *Springer-Verlag, Berlin* (translation of the 1984 book "Comparative Ethology of the Vespine Wasps", published by *Hokkaido University Press, Sapporo, in Japanese*).
- Nguyen, P.L.T. and Carpenter, J.M. 2002. Vespidae of Vietnam (Insecta : Hymenoptera) I. Vespinae. *J. New York En. Soc.* **110** : 199-211.
- Perez, J. 1910. Notes sur les vespides. *Act. Soc. Linn. Bordeaux* **64** : 1-20.
- Roy, S.B. and Kundu, B.G. 1985. Fauna of Namdhapa, Arunachal Pradesh, India (Insecta : Hymenoptera). *Rec. Zool. Surv. India*. **82** (1-4) : 221-229.
- Smith, F. 1852. Descriptions of some hymenopterous insects captured in India, with notes on their economy, by Ezra T. Downes, Esq. who presented them to the honourable East India Company. *Ann. Mag. Nat. Hist.* **9** (2) : 44-50.
- Smith, F. 1870. A catalogue of the Aculeate Hymenoptera and Ichneumonidae of India and Eastern Archipelago, with introductory remarks by A.R. Wallace. *J. Proc. Linn. Soc. Zool.*, **11** : 285-415.
- Vecht, J. van der, 1957. The Vespinae of the Indo-Malayan and Papuan areas (Hymenoptera: Vespidae). *Zool. Verh.*, **34** : 1-83.
- Vecht, J. van der, 1959. Notes on Oriental Vespinae, including some species from China and Japan (Hymenoptera, Vespidae). *Zool. Meded.* **36** : 205-232.
- Yamane, Sk. 1987. The Vespinea of the Ryukyu Islands, Japan (Hymenoptera, Vespidae). *Kontyu*, **55** : 628-638.

PLATE I



Vespa binghami du Buysson. Female.



V. analis Fabricius. Female.

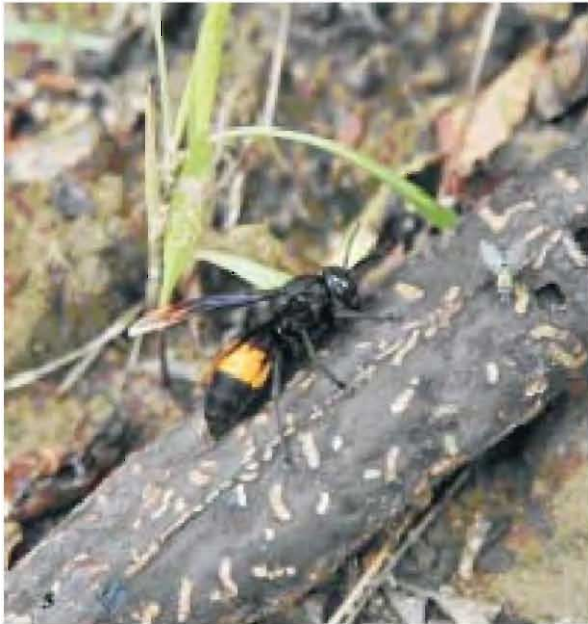


V. mandarinia Smith. Female.

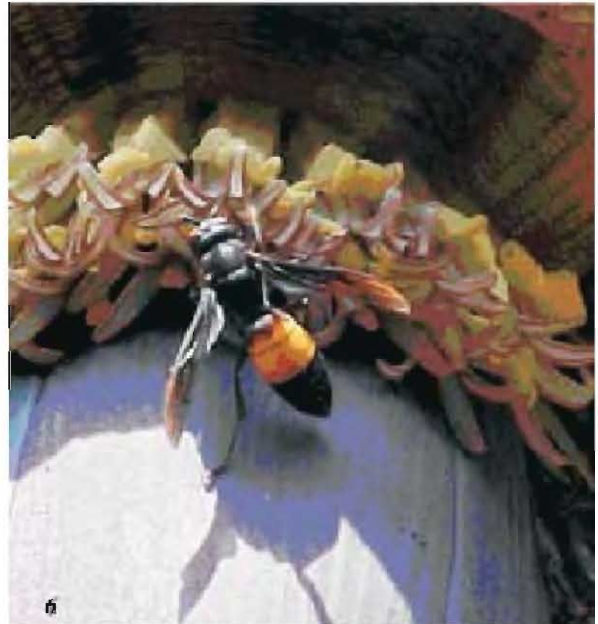


V. soror du Buysson. Female.

PLATE II



V. tropica (Linnaeus). Female.



V. affinis (Linnaeus). Female.



V. orientalis Linnaeus. Female.

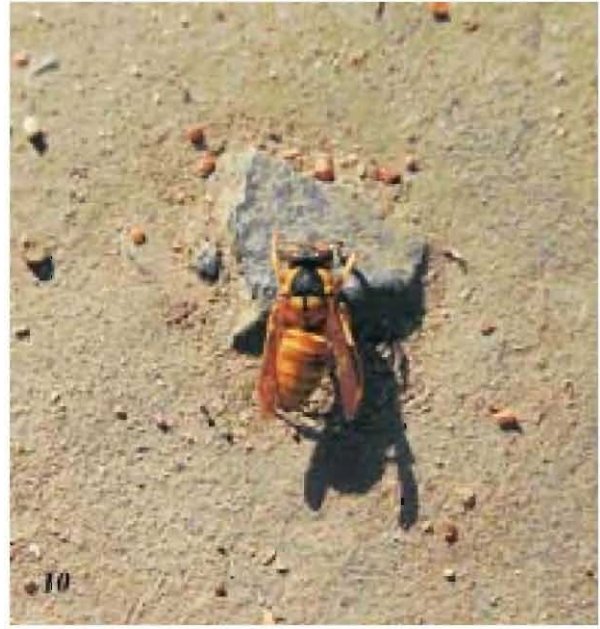


V. fumida van der Vecht. Female.

PLATE III



V. basalis Smith. Female.



V. bicolor Fabricius. Female.



V. vivax Smith. Female.



V. auraria Smith. Female.

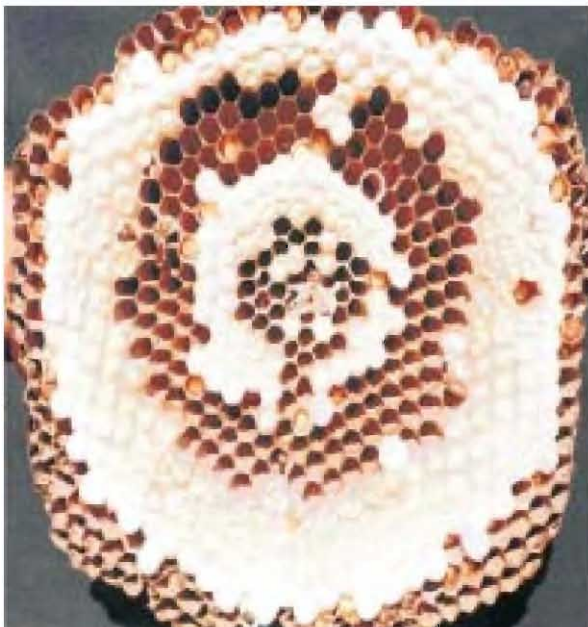
PLATE IV



V. velutina Lepeletier. Female.



Nest of *V. affinis* Linnaeus.



A single comb of *V. affinis* Linnaeus.



V. affinis Linnaeus taking predation on the *Apis* (*Micrapis*) *florea* Fabricius larvae on its comb.