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THE GENUS *AGNISYRPHUS* GHORPADÉ (DIPTERA—SYRPHIDAE), PECULIAR TO THE ORIENTAL REGION, WITH NOTES ON PHYLOGENY, EVOHISTORY AND PANBIOGEOGRAPHY

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[With 3 Text-Figures, 1 Plate, 1 Map]

INTRODUCTION

Agnisyrphus, a new genus endemic to the Oriental Region, was erected by me (Ghorpadé, 1994: 6) for two new species, *A. angara* and *A. gressitti*, from the Himalayan mountains of India and the Siamese highlands in Thailand. That paper had included another new genus and 38 more new species of Syrphini from the Indian sub-continent, which was based on a Ph.D. thesis (Ghorpade, 1981b), and on subsequent post-doctoral research done at the Smithsonian Institution, Washington, D.C. Here, I describe an additional four new species of *Agnisyrphus*, provide some illustrations and give a key to the six known species of this distinctive genus. In the present generic revision, and others to follow, I will use terminology recommended in the "Canadian Manual" (see McAlpine, 1981; Vockeroth and Thompson, 1987; Thompson, 1999).

The following acronyms indicate depositories cited in this paper, and names of the Curators who handled loans are placed in parentheses. The holotypes of new species of Syrphini, from the "GHORPADE COLLECTION" which was hitherto located at Bangalore, have been, or will be eventually deposited, in the U.S. National Museum of Natural History at Washington, DC. Part of the paratypes, where available, especially the "allotype," if also in my collection, will also be deposited in the USNM.

BMNH—The Natural History Museum, London, U.K. (B.H. Cogan, K.G.V. Smith).
BPBM—The Bernice P. Bishop Museum, Honolulu, Hawaii, U.S.A. (W.A. Steffan).
KGC—Personal collection of Kumar Ghorpadé, Dharwar, India.
USNM—The U.S. National Museum of Natural History, Smithsonian Institution, Washington, DC., U.S.A. (F.C. Thompson).
UZM—Universitetets Zoologisk Museum, Copenhagen, Denmark (L. Lyneborg, B. Petersen).
ZFMAK—Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany (H. Ülrich).

TAXONOMY

Genus ***AGNISYRPHUS*** Ghorpadé

Agnisyrphus Ghorpadé, 1994, *Colemania* (insect biosystematics), No. **3**, p. 6. Type-species: *Agnisyrphus angara* Ghorpadé, 1994 (by original designation).

DIAGNOSIS : Large, broad species with flattened abdomen that is distinctly spatulate in some species. Ill-defined, paler mesonotal margin. Long, hyaline wing, vein R_{4+5} straight. Eye bare, holoptic in male. Face yellow, tubercle wide, with two additional lateral "bumps." Anterior mesonotal collar absent; ventral scutellar fringe of several rows, complete; anterior anepisternum (mesopleuron) bare; katepisternal (sternopleural) hair patches narrowly joined posteriorly; meron, metepisternum and metepimeron (hypopleuron) bare; metasternum bare. Hind coxal hair tuft absent. Wing hyaline, or indistinctly smoky at anterior apex, extensively microtrichose; ventral squamal lobe bare above; vein R_{4+5} almost straight, extremely shallowly and widely "dipped," if at all; alula and anal lobe normal, not reduced; wing without sclerotized dots on posterior margin; no costal swelling. Abdomen dorsoventrally flattened, spatulate in some species, moderately margined on tergite 3 and onwards, posteriorly. Male terminalia as illustrated (Text-Fig. 1), without aedeagal guide (lingula); surstylus broad and large, aedeagal base with elongate posterior lobe; distal portion of aedeagus with strongly flared apex; paramere slender, with a thorn-like ventral projection at apex.

DISCUSSION : *Agnisyrphus* was erected for two large, distinctive species, *A. angara* and *A. gressitti* (+ *A. brunettii* sp. nov., described here *vide infra*) (Ghorpadé, 1994). No previously known species of the tribe Syrphini, except *Syrphus issikii* Shiraki (1930: 378, fig. 90), described from the island of Formosa (= Taiwan), are likely congeneric (but *vide infra*). Three other undescribed species from southern China, in the USNM and ZFMAK collections, are also referable to *Agnisyrphus*, and are described as new in this present paper. *Agnisyrphus* bears closest resemblance to the *Didea*—group of genera belonging to the *Sphaerophoria*—Section, as against the *Syrphus*—Section (these divisions of the Syrphini being those recognized by me, unpubl., *vide infra*), which were indicated by the identification numbers 21-27 in the generic revision of the Syrphini by Vockeroth (1969: 3-4). This genus-group includes *Didea* Macquart, *Asiodidea* Stackelberg, *Eriozona* Schiner, and *Megasyrphus* Dušek and Láska, distributed in the north temperate regions. Perhaps *Asarkina* Macquart (including *Achoanus* Munro, synonym), *Dideopsis* Matsumura, and the Neotropical *Dideomima* Vockeroth are the "sibling genera" (*vide infra*) of the *Didea*—group; these being mainly tropical in range. *Agnisyrphus* is separable from all of these genera by its distinctly "tri-tuberculate" yellow face, bare eyes, spatulate and/or flattened, moderately margined abdomen, almost straight R_{4+5} wing vein, characteristic pleural hairing and distinctive male terminalia.

ETYMOLOGY : The name is masculine in gender and alludes to *agni* (= fire, in Sanskrit) + *Syrphus*, in reference to the distal portion of the abdomen of the male of *Agnisyrphus angara*, which looks like red-hot burning coal in the living fly !

GEOGRAPHICAL RANGE (see Map, p. 34) : Politically, in India (Uttaranchal—the Himalayan part of the earlier larger Uttar Pradesh, West Bengal and Arunachal Pradesh); north-western Thailand; China (Szechwan, Fukien). Biogeographically, *Agnisyrphus* is a distinct Sino-Malayan (Indo-Chinese: Sino-Himalayan) element in the Indian sub-continent syrphid fauna. It is confined to the Himalayas, and the Siamese and southern Chinese mountains running north-east, east, and south-east of the towering Himalayan ranges which form the northern edge of the Indian sub-continent, which is the Indian subregion (= areas BA, HK, IP, WH, GP, CH, PC, LM, EH, IB and AN on Map) of the Oriental Region. The Sino-Malayan subregion (= SF, SB, TI, SC, LA, PI, MS, CL on Map) is taken here to mean the Indo-Chinese Peninsula and the Malay Archipelago together, which behave as one homogenous unit, in my opinion, plus the islands from the Ryukyus to the Philippines. The Papuan-Pacific sub-region (= PA on Map) includes the Moluccas, New Guinea and most tropical Pacific Ocean islands. In the Key below (and in forthcoming papers; couplets sequence used *vide* Thompson, 1999) mention will also be made of the biogeographical areas and sub-areas (see Map, p. 34; *cf* also those in Ghorpadé, 2001, 2002a, 2002b) where each species is known to occur, since geographical ranges are considered by me to be also important in recognizing real identities of species, especially of cryptic ones that are externally very similar to their sister-species, but are allopatric.

Key to species of ***Agnisyrphus*** Ghorpadé

1. Tergite 4 reddish; tergite 2 brownish-black, setae on terga all yellow coloured; scutellar setae on disc coloured mostly golden-yellow, tibia 3 with all yellow setae [♂, West Himalayan]……….……………………….. ***angara*** Ghorpadé

-- Tergite 4 yellow or reddish-brown with black subposterior fascia; tergite 2 yellow or reddish-brown with black posterior fascia; setae on tergites mostly black coloured; with black subposterior fascia; tibia 3 with setae mostly coloured black……………………………………….……………………………… 2

2. Setae on tibia 3 yellow and black; subposterior black fascia on tergite 4 narrow, one-sixth length of tergite; fascia on tergite 2 also narrow, only one-fifth length of tergite; antennal segment 3 mostly all yellow coloured [♂, Sino-Burmese and/or Sino-Tibetan]……..……………..…….. ***grahami*** Ghorpadé, **sp. nov.**

-- Setae on tibia 3 all black; subposterior black fascia on tergite 4 broader, at least one-third length of tergite; fascia on tergite 2 also at least one-fourth length of tergite; antennal segment 3 mostly dark, at least dorsal one-third greyish-black ……………………………………………………..……………………….. 3

3. Scutellar setae on disc mixed yellow and black; tergite 4 reddish-brown with subposterior greyish-black fascia one-third length of tergite; antennal segment 3 mostly yellow with dorsal one-third being greyish-black [♀, Sino-Formosan]…..…………………………….. ***mandarinus*** Ghorpadé **sp. nov.**

-- Scutellar setae on disc all black; tergite 4 yellow with subposterior black fascia one-fourth to one-half length of tergite; antennal segment 3 all black, at least on dorsal one-half………………………………..………………………… 4

4. Tergite 4 with subposterior black fascia only one-fourth length of tergite; tergite 2 similar and without black or grey median vitta; antennal segment 3 with dorsal one-half being black and ventral one-half yellow in colour [♂♀, Sino-Formosan].…………………………..… ***klapperichi*** Ghorpadé **sp. nov.**

-- Tergite 4 with subposterior black fascia one-half length of tergite; tergite 2 similar with black median vitta but which may be faint or absent; antennal segment 3 black or only its extreme ventrobasal corner reddish, if at all ………………………………………………………………………..…. 5

5. Tergite 2 with median dark vitta absent or very faint; setae on tergite 3 almost all black; antennal segment 3 black and only ventrobasally reddish [♂, Sino-Burmese]……………………………………………….….. ***gressitti*** Ghorpadé

-- Tergite 2 with fairly broad, distinct, black median vitta; tergite 3 with mixed yellow and black coloured setae; antennal segment 3 all black [♂♀, East Himalayan]…………………..……………….. ***brunettii*** Ghorpadé **sp. nov.**

Agnisyrphus angara Ghorpadé

(Pl. I, Figs 1, 4; Text-Fig. 1)

Agnisyrphus angara Ghorpadé, 1994, *Colemania* (insect biosystematics), No. **3**, p. 6. Holotype ♂, 'Mussoorie' (India) [KGC : examined; deposited in USNM].

DIAGNOSIS : Dark species with terminal terga 4 and 5 bright flame red in life (Pl. I, Fig. 1). Vertical triangle much shorter than sutura of eyes; antennal flagellum elongate, yellow with faint pale brown dorsal coloration, arista orange, dark at tip. Pleura mostly dark, scutellar hairs golden with dark tips. Femur 1 brownish on basal one-fourth or less; tibia 3 with indistinct subapical brownish annulus. Abdomen distinctly spatulate, posterior tergites being wider than anterior ones; sterna brownish black.

MALE.—-*Head* : Vertical triangle black, golden yellow pollinose, specially behind ocelli, with golden yellow pile, and shorter than sutura of eyes. Eye bare, dorsal ommatidia enlarged, golden. Frons, face, gena and occiput a deep, brownish yellow; frontal pile golden with black tips, some frontal pile and that beside antennal bases short and black; rest of pile on face and gena yellow. Occiput white pollinose, white pilose, on dorsal one-fourth with sparser, thinner yellow pile. Antenna deep yellow, except postpedicel (segment 3) faintly pale brown dorsally, being elongate, thinnish, not rounded or oval; arista orange, becoming black at tip, longer than antenna. *Thorax* : Scutum dull black, except rufous lateral margins, including calli; pile short, golden yellow, longer and rufous laterally. Pleuron dull black; dorsal katepisternum (sternopleuron), anepimeron (pteropleuron) and katepimeron (barette) brownish yellow pollinose; pile yellow with a few thin, blackish hairs medially on pteropleuron. Scutellum deep yellow, brownish medially; pile golden-yellow. *Wing* : Hyaline, long, much longer than abdomen, pointed at apex which is feebly smoky; wholly microtrichose except bare as follows: extreme base of cell r1 (marginal cell), anterobasally on cells br and bm (first and second basal cells), posterior and anterior margins of cell cuP (anal cell) to a short distance; anal lobe with two bare strips. Squama yellowish-grey with golden yellow fringe. Plumula pale yellow. Haltere with stem pale yellow, base and knob orange yellow. *Legs* : Coxa 1 deep yellow, coxa 2 and 3 brownish. Femur 1 brownish on basal one-fourth or less, rest deep yellow, brownish black pilose; femur 2 with basal one-third brownish, rest deep yellow, pile brownish black; femur 3 brownish black except yellow apical one-fourth, apical one-half with short yellow hairs, basal one-half with long black hairs; tibiae yellow, yellow pilose; tibia 3 with indistinct, brownish, postmedian (subapical) annulus. Tarsi yellow with slight brownish tinge. *Abdomen* : Brownish black, flat, spatulate in shape, margined. Tergite 3 with submarginal, anterior, reddish yellow band, not reaching lateral margins; posterior two-third of tergite 4 and whole of tergite 5 reddish yellow (burning coal red in living specimen !). Pile on tergites all golden yellow; short black pile on posterior margin of tergite 2, on posterior one-half of tergite 3, extending a little more anteriorly in middle and on lateral margins, on tergite 4 in two anterior patches on each side, reaching three-fourth length of tergite posteriorly; pile on lateral margins of abdomen all golden yellow except two tufts of black pile on posterolateral corner of tergite 2 and medially on tergite 3; sternites brownish black, joints of sternites 1 & 2 and of sternites 2 & 3 reddish yellow. *Male terminalia* : As in Text-Fig. 1.

FEMALE.— Unknown.

SPECIMENS EXAMINED : **2 ♂. Holotype** ♂, labelled "INDIA: U.P., Mussoorie, 2005m, 22.v.1974, Ghorpade No. A123," "GHORPADE COLLECTION, Bangalore," "HOLOTYPE, *Agnisyrphus angara* Ghorpade 1994" (red label); with terminalia in microvial on pin [KGC; deposited in USNM].

Paratype ♂, labelled "Naini Hills, 7-8000 ft, 31.5.27," "N.E. INDIA, T. Jermyn, B.M. 1949-53.," "PARATYPE, *Agnisyrphus angara* Ghorpade 1994" (yellow label) [BMNH].

FLIGHT PERIOD : Only males collected, in the month of May.

GEOGRAPHICAL RANGE : India, in Uttaranchal State (earlier this was the Himalayan portion of Uttar Pradesh). Biogeographically, it is perhaps restricted and peculiar to the West Himalayan sub-area, or biogeographical "track."

ETYMOLOGY : The species name *angara* (from Sanskrit, for "fire") refers to the red terminal abdominal tergites, which appeared like red hot burning coal in the live specimen collected by the author, that were strikingly in contrast to the dull brownish-black anterior tergites. The species name is to be considered "a noun in apposition" to the genus name *Agnisyrphus*, which is masculine in gender.

REMARKS : *Agnisyrphus angara* is a strikingly distinct species with abdominal tergites 4 to tip being visibly flame red in life, contrasting with the darker anterior tergites, especially tergite 2 which is all black, unlike the coloration of other species of this genus described in this paper and known so far. Besides, the hairs on tibia 3 are all yellow in *angara* unlike in other *Agnisyrphus* species. See also the key and diagnosis given above, as well as the diagnostic characters (in Table I, pp. 12-13) documented below, for ease in distinguishing this and other species treated here from each other.

There is need to make some comment on the incorrect labelling of some specimens received from or observed in the BMNH collection. One of the printed labels for the paratype reads "N.E. INDIA, T. Jermyn, B.M. 1949-53." The "N.E. INDIA" is obviously a mistake, as there are no "Naini Hills" in that part of India, as printed on the uppermost label. I have also seen other BMNH specimens of Syrphidae which were also collected on these "Naini Hills." Some specimens had labels (printed and handwritten) reading "India: United Provinces, Naini Hills, 7-8,000', 12.v.1927, R.C. Jermyn, B.M.1949-53.," and the other (printed), reading "N.E INDIA, T. Jermyn, B.M. 1949-53." The latter accession label has obviously been mistakenly printed with "N.E. INDIA"— note "United Provinces" printed on first label ! I have similarly seen specimens of other species of Syrphidae, *Ischiodon scutellaris* (Macquart) from Delhi (India) collected by T. Jermyn with "N.E. INDIA" erroneously printed on the BMNH accession label (see also Lyneborg and Barkemeyer, 2005: 131), and also for *Callicera robusta* Coe (see Ghorpadé, 1982: 166, and Coe, 1964: 287, but *cf* also p. 277 !). The "Naini Hills" can only be those on which the hill station town of Naini Tal is situated (identified and created by the British during their "Empire" years here), on the Western Himalaya, in the present Indian State of Uttaranchal, which was earlier part of Uttar Pradesh (= United Provinces of British India). Thus, note that the Naini Hills cited either by R.C. Jermyn or T. Jermyn are evidently those around Naini Tal in Uttaranchal and not in "N.E. India" as indicated on the incorrectly printed BMNH accession labels.

This hover-fly is apparently a mimic of a species of aculeate Hymenoptera with similar dark colouring and a red abdominal tip, most likely a Pompilidae species. The holotype specimen was caught by me as it alighted on a rootlet jutting out of the earthen bank (see Pl. I, fig. 3) on the side of the foot-track, when on a walk together with my brother Shailendra (who spotted it first) on the hill slopes of Landour (above Mussoorie, another West Himalayan hill station developed during the British Raj).

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Agnisyrphus brunettii Ghorpadé, **sp. nov.**

(Pl. I, Fig. 4; Text-Fig. 2)

DIAGNOSIS : Yellowish species with black banded tergites (Pl. I, Fig. 4). Vertical triangle almost equal to length of sutura of eyes. Antennal postpedicel brownish black. orange-yellow only slightly basoventrally; arista black, only slightly longer than antenna. Pleura black, with more than half the sclerites yellow pollinose. Scutellar hairs dominantly black. Coxa and trochanter dark coloured; femur 1 yellow with some black pile on extreme apex; tibia 3 brownish black except extreme base; all tarsi dark coloured. Abdomen of normal shape, not spatulate; sternites yellow, with feeble black fasciae on sternites 3 and 4.

MALE.—-As in *A. gressitti* except with following differences—*Head* (Text-Fig. 2): Vertical triangle longer, almost equal to sutura of eyes, supra-antennal prominence (lunule) all yellow not black; gena of same yellow colour as is the face; antenna black, scape orange-yellow, pedicel also brownish-orange ventrally, postpedicel all brownish black; arista black and only slightly longer than antennae. *Thorax* : Pleuron black, except yellow pollinose posterior anepisternum (except black anteriorly), extreme ventral margin of anepisternum, katepisternum (except the large yellow dorsal "spot"), anepimeron and meron. *Wing* : Uniformly hyaline, but seems a little darker, being wholly microtrichose. *Legs* : Tarsi 1 and 2 all brownish black. *Abdomen* : Golden yellow; tergite 1 with black pile also posteromedially; tergite 2 with posterior black fascia extending almost to anterolateral corners, with a broad black distinct vitta medially (tergite 2 therefore appearing black with two large yellow spots anteriorly on each side); pile long and yellow all over except some black hairs on posterior black fascia on tergites; tergite 3 with anterior black fascia wider, posterior fascia with black in centre extending little anteriorly for more than one-half length of lateral margin, with all black pile and lateral hairs all black except on anterior corners; tergite 5 with black sub-posterior fascia not reaching lateral margins, pile all black. Lateral abdominal margin with hairs all black except yellow on tergite 1, posterior corner of tergite 2 and anterior corner of tergite 3. *Male terminalia* : Will be figured in a forthcoming supplementary paper.

FEMALE.—As in male except as follows, with the following portions being diagnostic—*Head* : Antennal colour, vitta on tergite 2, colour of coxa and trochanter, pleural colour and hairing, wing microtrichia, colour of lunule, and having black hairs also on tergite 1; eye facets almost uniform in size all over and not enlarged dorsally as in male. Frons more than one-third as wide at vertex as at antennal bases, yellow pollinose, except around ocellar triangle where black; a relatively bare narrow broken blackish brown vitta from antennal prominence (lunule) to ocellar triangle. Frons all black pilose, also beside antennal prominence. *Thorax* : Anterior half of posterior mesopleuron also black, bare; coxae and trochanters may be black or brownish black partially, especially coxae 2 and 3. Metatarsi 1 and 2 almost wholly brownish black. *Abdomen* : Tergite 2 with black median vitta broader and complete; tergite 6 yellow with anteromedian black spot, black fascia not reaching lateral margins.

SPECIMENS EXAMINED : **2 ♂ 2 ♀**. **Holotype** ♂, labelled "ASSAM: Mishmi Hills, Delai Valley, Cha Che, 22.xi.1936.", "Alt. ft., M. Steele., B.M. 1937-324.", "HOLOTYPE, *Agnisyrphus brunettii* Ghorpade 2005" (red label); with terminalia in microvial on pin [BMNH].

Paratypes 1 ♂ 2 ♀, labelled "ASSAM: Mishmi Hills, Delai Valley, Cha Che, 22.xi.1936.", "Alt. ft., M. Steele., B.M. 1937-324." , "PARATYPE, *Agnisyrphus brunettii* Ghorpade 2005" (yellow label), 1 ♂ [BMNH]; "INDIA: West Bengal, Tiger Hill, 2285-2660m, 24.x.1981, K.D. Ghorpade A931" , "GHORPADE COLLECTION, Bangalore" , "PARATYPE, *Agnisyrphus brunettii* Ghorpade 2005" (yellow label), 1 ♀ [KGC]; "INDIA: N.E., Darjeeling-Tiger Hill, 2250m, VIII-3-1958", "J.L. Gressitt Collector", "PARATYPE, *Agnisyrphus brunettii* Ghorpade 2005" (yellow label), 1 ♀ [BPBM].

FLIGHT PERIOD : Only collected in the months of August, October and November.

GEOGRAPHICAL RANGE : India, in West Bengal and Arunachal Pradesh States. The Mishmi Hills are located in the north-eastern area of Arunachal Pradesh (formerly N.E.F.A., in the earlier larger "Assam" area) and east of the Brahmaputra River, which otherwise is a major geographical barrier. Biogeographically, this species is apparently restricted and peculiar to the East Himalayan sub-area, and what is now recognized as a biogeographical track.

ETYMOLOGY : The species name *brunettii* is in honour of Mr Enrico Brunetti, who was perhaps the most industrious describer of Indian Diptera, including Syrphidae.

In a paper dealing with Oriental *Paragus* and *Pandasyopthalmus* species, Thompson and Ghorpadé (1992: 10) had mentioned about Brunetti and listed his obituaries, which give more information on his life's work, mainly on the Oriental, but also on Afrotropical and other Diptera.

REMARKS : *Agnisyrphus brunettii* sp. nov. is a predominantly yellow species with black tergal fasciae, like *gressitti*, from which it is differentiated by the diagnostic characters mentioned above and in the Table below (pp. 12-13).

In the key to *Agnisyrphus* in Ghorpadé (1994: 6) all data for *gressitti* pertaining to areas other than in Thailand are in error and must be deleted. At that time the identity of *A. brunettii* sp. nov. was not recognized as distinct and these specimens of this new species from India wrongly assigned then to *A. gressitti* Ghorpadé.

Agnisyrphus grahami Ghorpadé, **sp. nov.**

DIAGNOSIS : This is the palest *Agnisyrphus* species described, being all yellow with narrow black fasciae on terga 2 to 4. Vertical triangle little shorter than sutura of eyes. Antennal postpedicel yellow, elongate oval with a small dorsal area being pale brown; arista yellow with a dark tip, little longer than antenna. Pleura more yellow pollinose than in *A. gressitti* Ghorpadé. Scutellar hairs almost all brownish black. Coxa and trochanter yellow; femur 1 yellow with few scattered black pile on apical half; tibia 3 yellow with black pile on basal two-thirds; tarsi all yellow, yellow pilose. Abdomen longest of all *Agnisyrphus* species except *mandarinus* Ghorpadé sp. nov., being widest in middle and narrowing on anterior and posterior ends; sternites yellow, sternites 3 and 4 each with triangular black spots in centre.

MALE.—As in *Agnisyrphus brunettii* except with following differential diagnostic characters—*Head* : Eye red with dorsal ommatidia not visibly enlarged much; frontal pile pale brownish yellow to beside antennal bases; supra-antennal prominence (lunule) all yellow; vertical triangle with almost all brownish pile and little shorter than sutura of eyes; occiput all golden pilose; antenna all yellow except postpedicel which has a pale brown extreme anterodorsal area and is elongate-oval and as long as scape and pedicel together; arista yellow with dark tip, a little longer than antenna; face, frons and gena all rich yellow, face medially bare of yellow pollen, frontal pile pale brownish yellow. *Thorax* : Similar to previous species, except perhaps being more yellow pollinose on dorsum, looking less black; pleuron as in *gressitti* Ghorpadé, but a little more yellow; scutellum as in *gressitti*. *Wing* : Hyaline, even at apex which is clear, wholly microtrichose. *Legs* : Generally all yellow, femur 1 with few scattered black pile on apical half, femur 2 ventrolaterally with black hairs on apical half, femur 3 yellow with all black hairs except on basal one-third; tibia 3 with outer two-thirds from base with black hairs; tarsi 1 and 2 yellow and yellow pilose. *Abdomen* : As in *gressitti* except tergite 2 yellow with posterior black fascia one-fifth to one-sixth width of segment, the black extending laterally to one-third; tergite 2 pile concolorous except black of posterior fascia extending a little in centre; tergite 3 yellow with anterior dark fascia blurred brownish but visible, posterior black fascia one-fourth to one-fifth length of tergite, extending laterally as a lighter vitta almost to anterior corners, pile concolorous but black on yellow areas posteriorly and medially to anterior margin; tergite 4 yellow without anterior black fascia, sub-posterior fascia pale brownish, not reaching lateral margins but extending anteriorly as paler vitta almost to anterior margin, pile all black; tergite 5 all yellow without any posterior dark fascia, all black pilose except anteromedially. Sternites all yellow, sternites 2 to 4 with triangular black spots in centre of each, and long yellow pile on sternites 1 to 3, black hairs on a little more than posterior half of sternite 3; abdominal hairs laterally all black except being long yellow on tergite 1, and on a little more than half of tergite 2 outside of black posterior fascia. *Male terminalia* : Will be figured in a forthcoming paper.

FEMALE.— Unknown.

SPECIMEN EXAMINED : **1 ♂. Holotype** ♂, labelled "nr Mupin, China, vii.29, 12-14000ft", "Szechuen, CHINA, DC Graham", "HOLOTYPE, *Agnisyrphus grahami*

Ghorpade 2005" (red label); with terminalia in microvial on pin [USNM].

FLIGHT PERIOD : The only male fly known was collected in the month of July.

GEOGRAPHICAL RANGE : China, on the eastern edge of the much geologically "compressed" high mountains just north of the famous "Golden Triangle" at the junction of the political boundaries of present day Burma (Myanmar, Myanma), the provinces of Tibet (Xizang), Szechuan (Sichuan) and Yunnan in China (Zhongguo), as well as Thailand. "Mupin" (= Mapien, Mabian ?) is located on the north-south oriented mountain range of Daliang Shan, west of the town of Yipin (Ipin, Yibin, Suifu) near the borders of Szechuan, Yunnan and Kweichow (Guizhou) and just a little north of the Yangtze River, which latter is usually taken as the northern limit of the Oriental Region in China. Biogeographically, this new species is perhaps restricted and peculiar to the Sino-Burmese (and/or Sino-Tibetan ?) sub-area.

ETYMOLOGY : The species name *grahami* is in honour of the collector, Father D.C. Graham, an American missionary stationed in China, who collected insects from this country extensively during the early middle 20th Century.

REMARKS : *Agnisyrphus grahami* Ghorpadé, sp. nov. is presently the palest of all known species in this genus, and it has the second longest abdomen. It can be differentiated by some other diagnostic characters mentioned above and in the table given below (pp. 12-13).

Agnisyrphus gressitti Ghorpadé

(Pl. I, Fig. 2; Text-Fig. 3)

Agnisyrphus gressitti Ghorpadé, 1994, *Colemania:* (insect biosystematics), No. **3**, p. 6. Holotype ♂, 'Doi Pui Mt., summit' (Thailand) [UZM : examined].

DIAGNOSIS : Yellowish species with black banded tergites (Pl. I, Fig. 2). Vertical triangle shorter than sutura of eyes. Antennal postpedicel brownish black, only basoventrally orange-yellow; arista brownish orange, longer than antenna. Pleura mostly black, more yellow pollinose than in *brunettii* sp. nov. Scutellar hairs almost all black. Coxa and trochanter yellow; femur 1 yellow with some black pile on extreme apex; tibia 3 brownish black except extreme base; tarsi 1 and 2 brownish yellow, these metatarsi yellow, tarsus 3 all brownish black. Abdomen very weakly spatulate, if at all; sternites yellow, with distinct black fasciae on sternites 3 and 4.

MALE.—-As in *angara* Ghorpadé except with following differences—*Head* (Text-Fig. 3): Dorsal ommatidia red with a golden sheen; frontal pile black, even besides antennal bases; supra-antennal prominence mostly black; vertical triangle with black pile and almost one and one-half times shorter than sutura of eyes; occiput white pilose but becoming yellow on vertex, especially behind vertical triangle; antennal scape and pedicel orange yellow, postpedicel orange-yellow only basoventrally, almost three-fourth or so black dorsally, elongate-oval, as long as scape and pedicel, arista brownish orange, longer than antenna; gena distinctly more orange than face. *Thorax* : Scutum black, considerably yellow pollinose dorsally, especially more on lateral margin, including calli; pleuron dull black, shining, with all sclerites except bare black katepisternum (except yellow pollinose dorsal "spot") and meron (except dorsal one-fourth yellow pollinose and pilose; dorsal sclerite of anterior anepisternum (mesopleuron) bare; scutellum deep yellow, pile all black except a few yellow hairs on anterior margin and anterolateral corners; subscutellar fringe also yellow. *Wing* : Hyaline, even at apex which is clear, wholly microtrichose except apical half of cell bc (basal costal cell) anterobasally on cell br (first basal cell) above spurious vein, basal half and anterior margin almost to tip of cell bm (second basal cell), anterobasal margin of cell cuP (anal cell); anal lobe with two bare narrow strips from base almost to posterior wing margin; squamae pale yellow with long golden yellow hair fringe; plumula yellow. *Legs* : Generally golden yellow, femur 1 with some short black pile on extreme apex, femur 3 with apical half black pilose dorsally, femur 3 with medial oblique brownish black fascia on outer side with apex also brownish, black pilose; tarsi 1 and 2, except yellow metatarsi, brownish yellow, tarsus 3 brownish black. *Abdomen* : Golden yellow; tergum 1 all golden yellow pilose; tergite 2 with posterior black fascia one-third width of tergite, extending almost to anterolateral corners on lateral margins, also extending medially as a thin vitta to anterior margin (or at least to middle of tergite); pile concolorous, with some yellow pile on black fascia mediolaterally; tergite 3 with variably narrow black anterior margin, emarginate in centre, posterior black fascia two-fifths length of tergite, less than half on middle, one-half length (or a little more) on lateral margin; pile concolorous dorsally on tergites 1 and 2, laterally black except yellow anterolaterally on tergite 3 and long yellow pile on anterior three-fourths of tergite 2, all black on tergites 3 to 5 except yellow on yellow mediolateral areas of tergite 2, tergite 4 with anterior margin variably narrowly black, on posterior margin orange yellow; tergite 5 orange yellow with similar, arcuate, subposterior fascia but reaching lateral margin, pile all black; lateral margin of abdomen with pile black except on anterior four-fifth of tergite 2 and wholly on tergite 1 where yellow; sternites translucent yellow, the black fasciae of tergites 3 and 4 showing clearly; pile all long and yellow, short black pile from posterior half of sternum 4 posteriorly. *Male terminalia* : With paramere having thorn-like ventral projection short and feeble (will be illustrated in a forthcoming paper).

FEMALE.— Unknown.

SPECIMENS EXAMINED : **2 ♂**. **Holotype ♂**, labelled “Thailand, Doi Pui Mt., summit, 1660m, 28.vii.1979, B. Petersen leg.”, “HOLOTYPE, *Agnisyrphus gressitti* Ghorpade 1994” (red label); with terminalia in microvial on pin [UZM].

Paratype ♂, labelled “Thailand, Doi Pui Mt., summit, 1660m, 28.vii.1979, B. Petersen leg.”, “PARATYPE, *Agnisyrphus gressitti* Ghorpade 1994” (yellow label) [UZM; retained in KGC].

FLIGHT PERIOD : Only males were collected in the month of July.

GEOGRAPHICAL RANGE : Thailand, in the mountainous north-west corner, west and north-west of Chiang Mai town. Biogeographically, it is perhaps restricted and peculiar to the Sino-Burmese sub-area and biogeographical track.

ETYMOLOGY : The species name *gressitti* honours late Dr J. Linsley Gressitt (formerly of the Bernice P. Bishop Museum, Honolulu, Hawaii, U.S.A.; see Radovsky, 1983 and Higg, 1983 for his obituary and bibliography) and is named in recognition of his pioneering work on the eastern Oriental Region insect fauna, especially of the Papuan—Pacific sub-region (see Gressitt, 1956, 1961). Gressitt’s biogeographical research, based on his own field surveys, showed that “Wallacea” (Celebes, the Moluccas and the Lesser Sunda Islands), New Guinea and adjacent islands, and those stretching into the tropical Pacific Ocean, have a dominantly Oriental biota (though increasingly depauperate on the Pacific islands going west to east), rather than an Australian one as earlier believed.

REMARKS : *Agnisyrphus gressitti* is a predominantly yellow species with black tergal fasciae, unlike *A. angara*, which is dark with brilliant red terminal abdominal tergites, and can also be differentiated by some other diagnostic characters mentioned above and in the Table (pp. 12-13). The “Paratype” specimens from India (West Bengal and Arunachal Pradesh), but <u>not</u> the male from Thailand, cited in Ghorpadé (1994: 6) for *A. gressitti* were incorrectly assigned to this species and belong instead to the new species *brunettii* sp. nov. described here above (*q.v.*).

Agnisyrphus klapperichi Ghorpadé, **sp. nov.**

DIAGNOSIS : This is the smallest *Agnisyrphus* species described, being yellow with black fasciae on tergites 2 to 4. Vertical triangle shorter than sutura of eyes. Antennal postpedicel elongate oval and brownish black, except yellow ventrobasally; arista yellow with a dark tip, slightly longer than antenna. Pleura extensively yellow pollinose. Scutellar hairs brownish black.

Coxa and trochanter yellow; femur 1 and tibia 3 yellow with yellow pile; tarsi 1 and 2 brown except metatarsi. Abdomen of normal shape, being widest in middle and narrowing on anterior and posterior ends; sternites all yellow.

MALE.—-As in previous *Agnisyrphus* species except with following differential diagnostic characters—*Head* : Eye red with dorsal ommatidia only slightly larger; frons, face and gena all yellow, except on dorsal lunule with a brownish black inverted triangular spot, lunular prominence golden yellow, darker than rest of frons and face; frontal pile brownish black, also beside antennal bases; antenna elongate-oval, yellow with postpedicel brownish black except yellow ventrobasally; arista yellow but being dark at tip and a little longer than antenna. *Thorax* : Mesonotum less yellow pollinose so appearing more black; pleuron all yellow pollinose except ventral katepimeron and all of meron; scutellum as in other species (except *angara* Ghorpadé). *Wing* : Longer than abdomen, hyaline, even at apex which is clear, microtrichose but with bare areas as in *gressitti*. *Legs* : Generally all yellow, femur 1 with few scattered black pile on apical half, femur 2 ventrolaterally with black hairs on apical half, femur 3 yellow with all black hairs except on basal one-third; tibia 3 with outer two-thirds from base with black hairs; tarsi 1 and 2 yellow and yellowpilose. *Abdomen* : Greasy, so description not possible though it is apparently yellow with black fasciae on tergites; lateral abdominal hairs yellow on tergite 1, and on anterior yellow area of tergite 2, and anterior corners of tergite 3; sterna all yellow. *Male terminalia* : Will be figured in a forthcoming paper.

FEMALE.—As in *brunettii* sp. nov. with following differences—*Head* : Lunular prominence brownish black on dorsal area with a narrow brownish black vitta; frons brown pilose, also besides antennal bases. Legs : all yellow, including coxae; pile all yellow except on posterior two-third of femur 3; tarsi 1 and 2 brownish except metatarsi. *Abdomen* : Tergite 1 yellow, all yellow pilose; tergite 2 yellow with posterior black fascia one-fourth length of tergite, pile concolorous with some black hairs posteromedially on yellow base; tergite 3 anterior brown fascia narrow, posterior broad fascia more than one-third length of tergite, pile all black except small areas anterolaterally; tergite 4 with anterior dark fascia absent, sub-posterior black fascia one-fourth length of tergite, narrowly separated from lateral margins, anterior median emargination of yellow, all black haired; tergite 5 yellow with black sub-posterior fascia curved and not reaching lateral margins. Sternites all yellow, with long yellow hairs on sternites 1 and 2, sternites 3 to 6 mostly with black hairs but some yellow ones as well.

SPECIMENS EXAMINED : **1 ♂ 1 ♀**. **Holotype** ♂, labelled “Kwangtseh—Fukien, J. Klapperich O, 23.7.1937” (on reddish paper) , “HOLOTYPE, *Agnisyrphus klapperichi* Ghorpade 2005” (red label); with terminalia in microvial on pin [ZFMAK].

Paratype ♀, labelled “Shaowu—Fukien (500m), J. Klapperich, 13.7.1937,” (on reddish paper)” , “PARATYPE, *Agnisyrphus klapperichi* Ghorpade 2005” (yellow label) [ZFMAK].

FLIGHT PERIOD : The male and female were collected only in the month of July.

GEOGRAPHICAL RANGE : In south-eastern China; Shaowu and Kwangtseh (Guangze) are located on the almost north-south oriented Wu Yi Shan range near the Shan Pass (“Shan Guan”) in the Fukien (Fujian) Province, on the border of Kiangsi (Jiangxi) Province. These localities are all north-west of Nanping town which itself is north-west of Foochow (Fuzhou) city on the mouth of the Min River emptying into the South China Sea. Biogeographically, this new species is perhaps restricted and peculiar to the Sino-Formosan sub-area and biogeographical track.

ETYMOLOGY : The species name *klapperichi* is in honour of Herr J. Klapperich of Bonn (Germany), who led several collecting expeditions to China and deposited the specimens in the Zoologisches Forschungsinstitut und Museum Alexander Koenig, in Bonn. Results of these expeditions have also been published elsewhere, *e.g.*, see Mader (1955) who described new Coccinellidae, Endomychidae, Erotylidae, Helotidae and Languriidae (Coleoptera) in that paper, many named by him for J. Klapperich.

REMARKS : *Agnisyrphus klapperichi* sp. nov., is the smallest of all species so far known of this genus with a normal shaped abdomen, and can be differentiated by some other diagnostic characters mentioned above and in the Table given below (pp. 12-13).

Agnisyrphus mandarinus Ghorpadé, **sp. nov.**

DIAGNOSIS : The holotype is is the largest *Agnisyrphus* specimen so far described, being reddish yellow, approaching *angara* Ghorpadé in coloration, and also with a distinctly spatulate abdomen which is orange yellow with weakly visible fasciae. Length of vertical triangle versus sutura of eyes unknown as no males are available. Antennal postpedicel elongate oval, orange yellow with a small brownish area dorsally; arista orange yellow with a dark tip, slightly longer than antenna. Pleura all yellow, yellow pilose. Scutellum large, hairs black but with some yellow pile anteriorly. Coxa and trochanter yellow; femur 1 yellow, yellow pilose; tibia 3 yellow with distal one-third brown; tarsi 1 and 2 brown except metatarsi which are yellow. Abdomen longest of all *Agnisyrphus* species and sterna orange yellow with black fasciae on sternites 3 and 4.

MALE.— Unknown.

FEMALE.—As in *brunettii* sp. nov., except as follows—*Head* : Frons one-fourth as wide at vertex as at level of antennal bases; frons, face and gena yellow to golden yellow, brownish black around ocellar triangle, lunule bare of pollinosity so appearing deeper golden yellow; frons without any dark vitta from lunule to ocellar triangle, hairs short, brownish yellow down to beside antennal bases. Antennal postpedicel elongate-oval and orange yellow with a brownish dorsal area; arista orange yellow with a dark tip, a little longer than antenna. *Thorax*: Mesonotum black with yellow pollinosity, lateral margins and an area in centre near scutellum more golden yellow; pleuron all yellow and yellow pollinose except ventral corner of katepimeron which looks darker brown, if at all (?). Scutellum distinctly larger in size, almost four-fifths as long as wide, more yellow haired in anterior area. *Wing* : Longer than abdomen, hyaline, even at apex which is clear, microtrichose but with bare areas as in *gressitti*. *Legs* : Generally all yellow, except tarsi 1 and 2 (but not metatarsi), all of tarsus 3 dark, tibia 3 with distal one-third brown; fore and mid legs all yellow pilose, femur 3 black haired on distal one-half or more, tibia 3 black pilose. *Abdomen* : Distinctly spatulate like in *angara* Ghorpadé; tergite 1 yellow, yellow pilose, some black hairs on posteromedian margins; tergite 2 yellow, posterior brown fascia little more than one-third length of tergite, laterally extending anteriorly and almost reaching anterior corners, pile concolorous, but black hairs also in middle on an indistinct, darker golden yellow vitta to anterior margin; tergite 3 yellow, posterior black fascia almost one-half length of tergite, pile black all over, anterior dark fascia absent; tergite 4 yellow with sub-posterior pale brown fascia placed more towards middle and one-third length of tergite, reaching lateral margins; tergite 5 yellow, black pilose, no distinct fascia noticeable; tergite 6 yellow, with long yellow hairs mixed with some short black hairs. Lateral abdominal margins with hairs black, except long yellow ones on tergite 1 and 2 almost to posterior corners, and short yellow hairs on anterior one-fourth of tergite 3. Sternites yellow, 1 and 2 all yellow pilose, sternites 3 and 4 with sub-posterior black fasciae, one-half length of sternite, hairs yellow and black, sternites 5 and 6 yellow and black pilose.

SPECIMEN EXAMINED : **1 ♀. Holotype ♀**, labelled “Kuatun (2300m), 27, 40.n. Br., 117, 40 ö L., J. Klapperich, 9.7.1938 (Fukien)” (on reddish paper) , “HOLOTYPE, *Agnisyrphus mandarinus* Ghorpade 2005” (red label) [ZFMAK].

FLIGHT PERIOD : The only known female was collected in the month of July.

GEOGRAPHICAL RANGE : In south-eastern China; Kuatun is probably also located (?) near Shaowu and Kwangtseh (where *klapperichi* sp. nov. was collected) on the Wu Yi Shan range in Fukien Province. Biogeographically, this new species is also perhaps restricted and peculiar to the Sino-Formosan sub-area and biogeographical track. Only the Sino-Burmese sub-area may also have two *Agnisyrphus* species, *viz*., *gressittii* and *grahami* sp. nov.

Table I. DIAGNOSTIC CHARACTERS OF *AGNISYRPHUS* SPECIES

Species name	Morphological feature	Character state in species
angara	Vertical Triangle Vs Sutura of Eyes	much shorter
	Antennal Postpedicel colour	mostly yellow
	Pleural colour and pile / pollinosity	mostly dark
	Scutellar pile colour on disc	golden yellow
	Tergite 2 colour	all brownish black
	Tergite 4 colour	flaming red in life
	Sternites colour	brownish black
	Femur 1 colour	basal one-third or less brown, rest deep yellow
	Tibia 3 colour	yellow with indistinct brownish subapical ring
	Tibia 3 pile	yellow
brunettii	Vertical Triangle Vs Sutura of Eyes	almost equal
	Antennal Postpedicel colour	all black
	Pleural colour and pile / pollinosity	mostly dark with one-half plus sclerites yellow pollinose
	Scutellar pile colour on disc	all black
	Tergite 2 colour	posterior broad black fascia with distinct central vitta, leaving two large yellow areas on each side anteriorly
	Tergite 4 colour	yellow, posterior one-half black
	Sternites colour	yellow, with feeble black fascia on 3 and 4
	Femur 1 colour and pile	yellow, with black pile on extreme apex
	Tibia 3 colour	brownish black, except extreme base yellow
	Tibia 3 pile	black
grahami	Vertical triangle Vs Sutura of Eyes	slightly shorter
	Antennal Postpedicel colour	mostly yellow
	Pleural colour and pile / pollinosity	dark, even more yellow pollinose than *gressitti*
	Scutellar hairs on disc	black
	Tergite 2 colour	yellow, posterior black fascia one-fifth length
	Tergite 4 colour	yellow, posterior black fascia one-sixth length
	Sternites colour	yellow with triangular black spots in middle of 2 to 4
	Femur 1 colour and pile	yellow, few scattered black hairs on apical one-half
	Tibia 3 colour	yellow
	Tibia 3 pile	yellow and black

gressitti	Vertical triangle Vs Sutura of Eyes	shorter
	Antennal Postpedicel colour	black, base yellow
	Pleural colour and pile / pollinosity	mostly dark, more yellow pollinose than *brunettii*
	Scutellar hairs on disc	black
	Tergite 2 colour	as in *brunettii* but no black median vitta
	Tergite 4 colour	yellow, posterior one-half black fasciate subterminally
	Sternites colour	yellow, with distinct black fascia on 3 and 4
	Femur 1 colour and pile	yellow, with some black pile on apex
	Tibia 3 colour	brownish black, except extreme base yellow
	Tibia 3 pile	black
klapperichi	Vertical triangle Vs Sutura of Eyes	shorter
	Antennal Postpedicel colour	yellow, dorsally black
	Pleural colour and pile / pollinosity	extensively yellow pollinose
	Scutellar hairs on disc	black
	Tergite 2 colour	yellow, posterior black fascia one-fourth length
	Tergite 4 colour	yellow, posterior black fascia one-fourth length
	Sternites colour	all yellow
	Femur 1 colour and pile	yellow, with yellow pile
	Tibia 3 colour	yellow
	Tibia 3 pile	black
mandarinus	Vertical triangle Vs Sutura of Eyes	? [no male available]
	Antennal Postpedicel colour	mostly yellow, dorsal one-third dark
	Pleural colour and pile / pollinosity	yellow, yellow pilose
	Scutellar hairs on disc	yellow and black
	Tergite 2 colour	yellow, posterior black fascia one-third length
	Tergite 4 colour	reddish brown, with subposterior greyish fascia of one-third length
	Sternites colour	orange yellow with black fasciae on 3 and 4
	Femur 1 colour and pile	yellow, with yellow pile
	Tibia 3 colour	yellow, distal one-third brown
	Tibia 3 pile	black

NOTE : The form and shape of the male terminalia are additional distinguishing characters that could help separate these species. Besides, the shape of the facial profile and abdominal colour pattern may turn out to be more easily visible characters under even a low power microscope, once experience is gained in the taxonomy of Syrphidae. On the whole, familiarity with species morphology and a holistic view of processed pinned specimens (colour, shape, proportions of body parts) ultimately become the clues to species identification for experienced specialists. Geographical distribution is also suggestive of species. Illustrations provided here (and in a forthcoming paper) will be useful for species level identities confirmation, as well as the key to the six species given above (p. 3).

ETYMOLOGY : The species name *mandarinus* alludes to the standard language of China, "Mandarin," and thus pertains to that country of occurrence.

REMARKS : *Agnisyrphus mandarinus* sp. nov., could well be the largest of all existing *Agnisyrphus* species, with a distinct spatulate abdomen, like in the type-species *angara*. This new species is much longer in size than *angara* and also *grahami* sp. nov. as well. It can be differentiated by the diagnostic characters mentioned above and listed in Table I (pp. 12-13).

NOTES ON PHYLOGENY, EVOHISTORY AND PANBIOGEOGRAPHY

Until more complete revisions of all the major Oriental genera of the tribe Syrphini (*cf* Brunetti, 1923; Knutson, *et al*., 1975; Ghorpadé, 1994) are available, only preliminary analyses of the phylogeny and biogeography of this group can be provided here. The data on the phylogeny of Palaearctic Syrphidae documented by Rotheray and Gilbert (1989, 1999), and by Ståhls *et al.* (2003), may be used in comparison. These notes provide comments on the phylogeny (pp. 14-20) of *Agnisyrphus* and closely related genera, reflect on the evohistory of this geographical area through time and space (pp. 20-21), and present an analysis of the panbiogeography of this taxon in eastern and southern Asia, where its species fly (pp. 22-24).

Based on the philosophical foundations of phylogeny (and taxonomy) of Mayr (1942, 1969, 1974), Blackwelder and Boyden (1951), W.R. Thompson (1952), Wilson and Brown (1953), Borgmeier (1957), Blackwelder (1964, 1967), Colless (1967), Darlington (1970, 1971, 1980), Kevan (1973), Wiley (1981) and Knutson (1990), all of these summarized by me (Ghorpadé, 1993), I propose the following evolutionary history of the genus *Agnisyrphus* Ghorpadé and its "sibling genera" (*vide infra*). *Agnisyrphus* is here considered to be a member of the *Didea*—group of genera (see p. 16), including the north temperate *Didea* Macquart, *Asiodidea* Stackelberg, *Eriozona* Schiner, and *Megasyrphus* Dušek and Láska, and perhaps also *Asarkina* Macquart (= *Achoanus* Munro) and *Dideopsis* Matsumura, which latter are possibly the "sibling genera" of the above four cold habitat *Didea*—group genera, these latter two being their mainly warm habitat, tropical "cousins." The Neotropical genus *Dideomima* Vockeroth (1969: 107, figs 20, 67, map 17) is doubtfully related to *Didea*, as Vockeroth himself had opined then and based his monotypic new genus on *Didea coquilletti* Williston, 1891 (see F.C. Thompson *et al*., 1976: 10), inhabiting the highlands of Central America in Mexico. *Dideomima* resembles *Didea* in overall habitus and coloration and also has a deeply dipped R_{4+5} vein (as also in *Asiodidea*) and may after all belong correctly to the *Didea*—group, since a *Megasyrphus* species (*laxus* Osten Sacken, 1875), originally described as a *Didea*, also occurs in the North American continent (Nearctic Region; distributed south to the Mexican highlands of the Neotropical; see F.C. Thompson *et al*., *op. cit.*), as well. Hull (1925) had treated and given a key to all species then presumed belonging to "*Didea*," but those included species are currently placed in other genera, like *coquilletti* Williston [= *Dideomima*], *laxa* Osten Sacken and *annulipes* (Zetterstedt) [= *Megasyrphus*], *daphne* Hull [= *Metasyrphus* Matsumura, *vide* Wirth *et al*., 1965: 560, but = *Eriozona* (*Megasyrphus*) *laxa* (Osten Sacken) *vide* Vockeroth, 1992: 92], besides *pacifica* Lovett ["unrecognized" in Wirth *et al*., 1965: 563, but = *Dasysyrphus pauxillus* (Williston) *vide* Vockeroth, 1992: 68]. What the exact cladistics is of this aberrant (?) genus *Dideomima* needs to be worked out properly, based on more collections and a better taxonomic analysis, incorporating and keeping in context the morphology, genetics, biology, ecology, phylogeny, evohistory and panbiogeography of the Tribe Syrphini.

Based on Vockeroth's comprehensive treatment of the world genera of the Tribe Syrphini (Subfamily Syrphinae), I here propose a division of the 37 genera (plus 5 "subgenera") originally included by Vockeroth (1969: 3-4) besides eight other genera either newly described or since included in this tribe — *Agnisyrphus* Ghorpadé, *Allobaccha* Curran, *Asiobaccha* Violovich, *Chrysotoxum* Meigen, *Loveridgeana* van Doesburg and van Doesburg, *Macrosyrphus* Matsumura, *Rhinobaccha* de Meijere, and *Vockerothiella* Ghorpadé — into two large basic segments : the *Syrphus*—Section and the *Sphaerophoria*—Section (see p. 16). The former section is further divided, phylogenetically, into five genus-groups, each named after the oldest included genus, *viz*., *Chrysotoxum, Epistrophe, Melangyna, Scaeva* and *Syrphus*, which comprise most of the genera numbered 1-20 by Vockeroth (1969: 3-4) but with a few omissions, additions or replacements. The *Sphaerophoria*—Section is broken up, similarly, into three genus-groups named after the genera *Didea, Episyrphus* and *Sphaerophoria*, again with a few other inclusions and transferrences, from numbers 1-20 to, or from, numbers 21-37, which mostly make up this latter section. This preliminary reassignment of Syrphini genera (details will be given in a forthcoming paper) to these proposed sections and genus-groups by me is given here (see p. 16, *vide infra*; dealing with 50 genera; 5 other Syrphini genera recognized currently are mentioned in the footnote below on p. 17, which need to be correctly placed in genus-groups in future) and will be tested and upheld or falsified by my own ongoing research, and that of other Syrphidae specialists. A detailed phylogenetic analysis of the Syrphini, now inclusive of two earlier generally recognized Syrphinae Tribes "Bacchini" (only part, excluding the "Melanostomatini") and "Chrysotoxini" as well (but see Rotheray and Gilbert, 1989: 48), will be attempted when I complete my ongoing generic revisions of Indian and other Oriental Syrphini, to supplement the analyses of Palaearctic Syrphidae proposed by Rotheray and Gilbert (1989, 1999), and by Ståhls *et al.* (2003).

The "sibling-genus" denoting the most closely related genus (like "sister-species"), or genera, to *Agnisyrphus* is likely *Asiodidea*, a monotypic genus that includes the single known species *nikkoensis* (Matsumura). Vockeroth (1969: 106-107, figs 24, 64, map 17) compared *Asiodidea* with *Didea* (*ibid*., pp. 108-110, figs 25, 65-66, map 18) and indicated that it was a distinctly marked genus closely resembling *Didea*. The species of *Didea* have similar external appearance but the male terminalia exhibit radical distinctions as two "morphs" (just as the different food intake choices preferred by separate species each of the genera *Cheilosia* Meigen and *Volucella* Geoffroy, *teste* Rotheray and Gilbert, 1999). Coe (1957) demonstrated that the Nearctic *Didea fuscipes* Loew and the Palaearctic *D. fasciata* Macquart were distinct species, and not the same as hitherto considered, and that these two had male terminalia that Vockeroth (1969, *op. cit.*) had also illustrated later and shown to be quite different in their morphology ! Perhaps these two "kinds" of *Didea* species need to be placed in separate genera (?), thus making them "sibling-genera," of phylogenetic lineage, just like *Eriozona* and *Megasyrphus* apparently are (*vide* Vockeroth, 1969 and others; but see Rotheray and Gilbert, 1989: 48) and now *Asiodidea* and *Agnisyrphus* have revealed themselves, or are proposed, to be. The distribution and biogeographic implications and "tracks" of these "sibling-genera" will be discussed in that section of these "Notes" below (p. 23), but some information on the single known, east Palaearctic, species of *Asiodidea* would be in order here.

Matsumura described *nikkoensis* as new in 1916 from the Kuril Islands north of Japan which he had placed in the genus *Brachyopa* Meigen (now recognized as a member of the Subfamily Eristalinae !). The Holarctic genus *Brachyopa* includes species whose larvae (maggots) live in exuding tree sap and is currently placed in the Tribe Brachyopini (= Chrysogastrini), with some genera like *Chrysogaster* Meigen, *Chrysosyrphus* Sedman,

Family **SYRPHIDAE**, Subfamily **SYRPHINAE**, Tribe **SYRPHINI**

Syrphus—Section

(*Syrphus*—group)

Syrphus Fabricius, 1775
Betasyrphus Matsumura, 1917

(*Epistrophe*—group)

Epistrophe Walker, 1852
Leucozona Schiner, 1860
Ischyrosyrphus Bigot, 1882
Afrosyrphus Curran, 1927
Epistrophella Dušek & Láska, 1967
Vockerothiella Ghorpadé, 1994

(*Scaeva*—group)

Scaeva Fabricius, 1805
Eupeodes Osten Sacken, 1877
Simosyrphus Bigot, 1882
Ischiodon Sack, 1913
Macrosyrphus Matsumura, 1917
Metasyrphus Matsumura, 1917
Lapposyrphus Dušek & Láska, 1967

(*Chrysotoxum*—group)

Chrysotoxum Meigen, 1803
Doros Meigen, 1803
Xanthogramma Schiner, 1860
Dideoides Brunetti, 1908
Dasysyrphus Enderlein, 1918
Notosyrphus Vockeroth, 1969

(*Melangyna*—group)

Melangyna Verrall, 1901
Parasyrphus Matsumura, 1917
Meligramma Frey, 1946
Austrosyrphus Vockeroth, 1969
Exallandra Vockeroth, 1969
Melanosyrphus Vockeroth, 1969

Sphaerophoria—Section

(*Didea*—group)

Didea Macquart, 1834
Asarkina Macquart, 1842[1]
Eriozona Schiner, 1860
Dideopsis Matsumura, 1917
Asiodidea Stackelberg, 1930
Megasyrphus Dušek & Láska, 1967
Dideomima Vockeroth, 1969
Agnisyrphus Ghorpadé, 1994

(*Episyrphus*—group)

Episyrphus Matsumura, 1917[2]
Meliscaeva Frey, 1946
Orphnabaccha Hull, 1949
Hermesomyia Vockeroth, 1969
Pseudoscaeva Vockeroth, 1969
Asiobaccha Violovich, 1982

(*Sphaerophoria*—group)[3]

Sphaerophoria Lepeletier & Serville, 1828
Allograpta Osten Sacken, 1875
Rhinobaccha de Meijere, 1908
Allobaccha Curran, 1928
Eosphaerophoria Frey, 1946
Antillus Vockeroth, 1969
Citrogramma Vockeroth, 1969
Giluwea Vockeroth, 1969
Loveridgeana van Doesburg & van Doesburg, 1977

N.B.: See footnotes on facing p. 17.

Cyphipelta Bigot, *Hemilampra* Macquart, *Orthonevra* Macquart, and even *Psilota* Meigen being considered related at one time or the other (but see Rotheray and Gilbert, 1999: 44-45, fig. 6). The placement by Matsumura of his new species *nikkoensis* in *Brachyopa* is thus somewhat puzzling. Stackelberg named a new species *potanini* from China for his new genus *Asiodidea* (monotypic) in 1930 that is now synonymized under *nikkoensis* which latter thus becomes the senior synonym and type species of *Asiodidea.* Tokuichi Shiraki (1930: 338-340), another pre-eminent Japanese syrphidologist (after Shonen Matsumura), transferred *nikkoensis* from *Brachyopa* to *Didea* and identified specimens collected from the Honshu and Hokkaido islands of Japan as of this species. Shiraki included *nikkoensis* as well as *Didea fasciata* and *D. alneti* in a single key to these species. Frey (1946: 153-154, 158-159) keyed out *Asiodidea* in the same couplet as *Didea*, treated *Asarkina* (as "*Asarcina*," misspelling) and *Dideopsis* (as his *Aegrotomyia* gen. nov.) as related genera, but put *Eriozona* somewhat apart with *Leucozona* (see Rotheray and Gilbert, 1999: fig. 6). Hull (1949: 291) placed *Asiodidea* (and *Dideoides* Brunetti also !) as a subgenus of *Didea* in his world generic review. Dušek and Láska (1967: 353-354, 356-357, 377) did not treat *Asiodidea* in their revision but considered *Didea* species to be somewhat aberrant Syrphini, even placing them in a distinct tribe, the "Dideini" (as they did also with their single genus tribes Paragini and Sphaerophorini; note Rotheray and Gilbert, 1989: 48, *q.v.*). They placed *Eriozona* and their *Megasyrphus* gen. nov. near *Episyrphus*, but *Leucozona* and *Ischyrosyrphus* were positioned near *Epistrophe*, these correctly (*cf* Rotheray and Gilbert, 1999: fig. 6; Ghorpadé *op.cit*., p. 16). Hippa (1968), in his "generic revision of the genus *Syrphus* and allied genera . . . in the Palearctic [*sic* !]," did not include *Didea, Eriozona* or *Asiodidea* at all but placed *Megasyrphus* (as his *Syrphoides* gen. nov.) also near *Episyrphus*, like Dušek and Láska (1967) had done. Subsequently, Violovich (1976: 331) recorded *Asiodidea nikkoensis* from "Primorye" and the Kuril Islands in his paper on Siberian Syrphidae. Then, in a larger work on the "Syrphidae of Siberia" Violovich (1983: 25, 48-49, 177) redescribed, illustrated and keyed *nikkoensis* from two regions of Soviet Siberia. In this work, interestingly, *Asiodidea* was keyed out in a couplet with *Asarkina* and placed between this and *Didea*, which agrees with present generic groupings implied above (p. 16). Li and Li (1990: 45, fig. 28; Col. Pl. III, Fig. 21) recorded *nikkoensis* (as "*nikkonensis*," misspelling) from the Gansu Province of China (= Kansu, north of Szechwan) and illustrated the male. They treated this near *Asarkina porcina* (Coquillett) but did not find species of *Didea*, *Megasyrphus* or *Eriozona* there. Species of *Asiodidea* and *Agnisyrphus* are alike in most aspects but can be separated by their distinct facial profile, position of katepisternal hair patches and difference in alignment of vein R_{4+5} in wing. However, the aedeagal apex in both species of these two genera is flared (see Text-Fig. 1) and both have a distinctly margined abdomen.

Dealing with the phylogenetic relations of these six species of *Agnisyrphus*, it is important to explain what "species concept" I am adopting in this analysis. I have written on my preference for what is termed the "Geographical Species Concept"(GSC,

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[1] The "sugenus" *Achoanus* Munro, 1924 (consistently misspelled "*Achaonus*" by Vockeroth, 1969: 4, 42, 49, 51, 112, 113, 147, 161, 173) is a junior synonym of *Asarkina* Macquart, 1842.

[2] Vockeroth (1969) gave "*Episyrphus* Matsumura & Adachi, 1917" but see Ghorpade (1981c: 90) for suggested, possibly correct, change in authorship to *Episyrphus* Matsumura.

[3] The *Sphaerophoria*—group may have to be expanded to include genera like *Toxomerus* Macquart, 1855, and other related ones now placed in a "Tribe Toxomerini" inhabiting the Neotropical Region mainly but also extending north into the Nearctic as well (note also my genus-group placement of *Loveridgeana* van Doesburg & van Doesburg, p. 16, *vide supra*; and refer to Ståhls *et al.*, 2003: Fig. 11).

NOTE : The following five genera of Syrphini not treated by Vockeroth (1969) need also to be analysed as to their proper genus-group affiliations : *Ocyptamus* Macquart, 1834; *Salpingogaster* Schiner, 1852; *Pseudodoros* Becker, 1903; *Eosalpingogaster* Hull, 1949; and *Pelloloma* Vockeroth, 1973.

see Ghorpadé, 2002b; also *loc. cit.*, pp. 22-24), based on the ideas of Mayr (1942: 147-215), and not for either the prevailing Biological Species Concept" (BSC) or the "Evolutionary (= Phylogenetic ?) Species Concept" (ESC, PSC) which have been lucidly explained in Wiley (1981: 21-42). The GSC corresponds to the "Allopatric Speciation Model I-III" as described in Wiley and possibly pertains to the ESC "Corollaries 1-4" as documented in that text-book. The BSC followers do indeed recognise subspecies (or races) but those adhering to the ESC (or PSC ?) do <u>not</u> treat these infraspecific taxa or categories.

Following up on the above Geographical Species Concept (GSC) ideology, the phylogenetics of species level relationships is looked at more in "space" than in "time," though the latter is also obviously involved, besides morphology and genetics, as well as biology. Croizat (1968) had negated the "Centre of Origin" paradigm (see also Croizat *et al.*, 1974; Holloway, 1982: 355, 357), but Holloway (1969, 1974) based his theories on a "Generic Centre" model. *Agnisyrphus* (and *Asiodidea*) probably evolved in the Sino-Formosan and Sino-Japanese sub-areas (see Map, p. 34), hence both *klapperichi* and *mandarinus* are perhaps the most plesiotypic species. *Asiodidea nikkoensis* (sister-species yet undiscovered, or extinct ? Or could it be *Dideomima coquilletti* ? Or, could *potanini* Stackelberg from the Asian mainland be it and actually a species distinct from *nikkoensis* of the offshore islands ?) is the outgroup which now colonizes the Sino-Japanese "generalized track" or biogeographical sub-area, while *Agnisyrphus* is the apotypic branch which has speciated (or is still speciating ?) in the Sino-Formosan, Sino-Burmese, Sino-Tibetan, East Himalayan and West Himalayan tracks/sub-areas, following mountain building in these geographical regions (from the late Eocene Epoch of the Tertiary Period of the Cenozoic Era) and resultant gradual opening up of new ecosystems devoid of adapted specialist habitat taxa of this *Didea*—group lineage, or other so adapted Syrphini. The importance of looking at habitat data <u>also</u> in biogeographic analyses was interestingly emphasized by Holloway (1982: 370-371, *n.b.*).

So, postulating from the current knowledge of these six known *Agnisyrphus* species, I hypothesize here that the *klapperichi—mandarinus* sister-species gave rise to *grahami*, *gressitti*, *brunettii* and *angara*, from east to west, on the "Indo-Chinese track" as geomorphological formations, ecosystems and niches opened up in geological time. The cladistics would be (*klapperichi—mandarinus* (*grahami—gressitti* (*brunettii—angara*))). So, taking up from the geographical base of species distribution now known, it may be useful to consider especial character states of each *Agnisyrphus* species (see Table I) that were primal in the gradual differentiation of new species that adapted to and then occupied new habitats. In this genus *Agnisyrphus*, it is noted that the character state changes related to the pleural colour and pollinosity/pilosity, plus the colour of the hind tibia (tibia 3), are most obvious, while the colour of the antennal postpedicel and the relative lengths of the vertical triangle and sutura of eyes in the male, are not as suggestive in the species evolution "direction" hypothesized, from southern China west through the "Golden Triangle" near northern Burma and then to the Garhwal—Kumaon Himalaya. This, then, is the preliminary phylogeny I notice and propose. As far as the "sibling-genera" phylogeny is concerned, I further hypothesize here that *Didea A—Didea B* are primitive to *Megasyrphus—Eriozona* (however, Rotheray and Gilbert, 1989: 48, 61-62, treat *Didea* and *Megasyrphus* as synonyms !), which are plesiotypic to *Asiodidea—Agnisyrphus* (all these being temperate in climatic/habitat preference) and that *Asarkina—Dideopsis* are the most apotypic, having colonized the tropics and subtropics and still speciating. However, if *Megasyrphus* is considered synonymous with *Eriozona*, as leading specialists (including F. Christian Thompson) prefer, then it is obvious that

(*Didea—Eriozona* (*Asiodidea—Agnisyrphus* (*Asarkina—Dideopsis*))) would be the analyzed cladistics of this *Didea* genus—group. *Dideomima* Vockeroth is still a problem, to be sorted out through more comparative research.

Both by habitat selection and perhaps their prey preference, it appears that species of the *Didea*—group are apotypic and recent. Rotheray and Gilbert (1989, 1999) have attempted an analysis of the evolution and phylogeny of the north temperate, Palaearctic, Syrphidae genera based on larvae and puparia, possibly following up on a similar "Evolutionary table of larval habits" first presented by Metcalf (1913: 38-42, fig. C; 1916: 207, fig. 28) for Nearctic genera. Gilbert (1990: 118) had hypothesized that the larger sized syrphids of several genera were more evolved than those with smaller life stages, the most primitive generalists occurring in leaf litter, then evolving to grassland ecosystems and on to being aphidophages on herbs, shrubs and smaller trees, and finally becoming specialists on arboreal aphids infesting taller trees. This, however, seems to me to be a contestable generalization. He gave a cladogram of syrphid genera (Gilbert, 1990: 113, fig. 6.5) which was based on one by Rotheray and Gilbert (1989: 47, fig. 27). This latter cladogram was broader and included *Didea, Megasyrphus* and *Eriozona* (of my *Didea*—group, see p. 16, *op.cit.*) as apotypic genera. Noticeably, the genera *Eupeodes* Osten Sacken (= *Metasyrphus* Matsumura, or this preferably kept distinct ?), *Scaeva* Fabricius and *Ischiodon* Sack (of my *Scaeva*—group, *op. cit.*) were placed as the most highly evolved clade (Rotheray and Gilbert, 1999: 15, fig. 6). *Didea* species possibly specialise in seeking out aphid prey like *Schizolachnus pineti*, which are protected with a mealy covering while infesting *Pinus* conifers (Evenhuis, 1978; Kula, 1980; Rotheray and Gilbert, 1989: 62). Metcalf (1911: 337-341, Pl. XVI; 1913: 58, figs 1-8, 17) found larvae of *Didea fuscipes* Loew feeding on the aphid *Longistigma* (= *Lachnus*) *caryae* on sycamore (*Tilea*) and basswood (*Platanus*) in Ohio State (U. S. A.) and later on another aphid, *Plocomaphis* (= *Pterocomma*) *flocculosa*, on willow grove (*Salix*) in Maine (Metcalf, 1916: 246-248, fig. 35). *Didea alneti* (Fallén) was found predating on the aphid *Lachnus tropicalis* on oak (*Quercus*) in Japan (Ninomyia, 1959: 188-189; Okuno, 1967: 126). Speight *et al.* (1975: 13) had observed that "None of the three species of *Didea* occurring in the British Isles is common," and that "*Didea* species are not easy either to detect or to catch. They are not often found at flowers and are very fast flying, spending much of their time around tree foliage at some height above the ground." *Didea* species inhabit patches of Caledonian Pine forest surviving in the highlands of Scotland, and also occur in pine woods in southern England, but *D. fasciata* Macquart "is found in a variety of woodland situations but perhaps particularly in scrub deciduous woodland" (Speight *et al.*, *op. cit.*). *Eriozona syrphoides* (Fallén) larvae were found feeding on *Cinara pineae* aphids infesting Spruce, *Picea* (Kula, 1983; Rotheray and Gilbert, 1989: 61). Goeldlin de Tiefenau (1974: 200-203, figs 40-43), in another "classic" bioecological paper (like that of Speight *et al., op. cit.*), with some strikingly artistic illustrations, discussed *Megasyrphus annulipes* (Zetterstedt) which he had reared (in the laboratory) on *Aphis fabae* aphids, and compared this genus with *Eriozona* and *Didea*, opining that it was possible that *Megasyrphus* should be considered a subgenus of *Didea* (*cf* Rotheray and Gilbert, 1989; but see Vockeroth, 1992: 92). I myself had netted 29 females of *Megasyrphus himalayensis* Kohli, Kapoor and Gupta (1988: 123, figs 44-47) on the hill station of Dalhousie (2133m) in Himachal Pradesh, India, in October 1974. These large sized hover-fly females were collected either while hovering (!) well above ground level near the foliage of Deodar trees, "or flying haphazardly along the chalky, excavated hillsides beside the mountain highways. This behaviour is purposeful, and akin to the similar habit of certain stinging Hymenoptera, specially the Vespidae, and serves, perhaps, to accentuate the external mimetic resemblance to the wasps" (Ghorpade, 1981b: 234-235).

Surprisingly, I found no males (!) at this location on these Chamba Hills and took only females, which were plentiful, always in deodar forest, and had therefore named this new species I had recognized then as "*Megasyrphus deodarae* sp. nov." (*nom. nud.*) in my doctoral thesis (Ghorpade, 1981b: 232-235). This new *Megasyrphus* was however later found, named, described, illustrated and formally published as *M. himalayensis* by Kohli *et al.* (*op. cit.*), based on two other females taken in the Kalatop and Carignano forests, above Dalhousie, in October and November 1981. I may mention here that the Deodar, or Himalayan Cedar, *Cedrus deodara* Loudon (Coniferae; see Troup, 1921: 1096-1132, figs 442-463; Maheshwari and Biswas, 1970), is a magnificent, imposing, very large evergreen coniferous tree with dark green or silvery foliage, the tallest trees exceeding 70m in height and others spanning more than 11m in girth ! The Deodar is found throughout the Western Himalaya, from Afghanistan through Kashmir to Garhwal (this latter area now in Uttaranchal State of India), at elevations of 1250m to 3050m or above, but most commonly between 1800-2600m altitude. The other true Cedars known are *Cedrus libani* Barrelier, the Lebanon Cedar, indigenous to the Lebanese range and Asia Minor, *Cedrus atlantica* Manetti, the Atlas or Atlantic Cedar, endemic to Algeria and Morocco, in northern Africa, and *Cedrus brevifolia* (Hooker f.) Henry, the Cyprus Cedar, which occurs on this Mediterranean island.

The other two temperate genera of the *Didea*—group, *Asiodidea* and *Agnisyrphus*, do not have any prey recorded of their larval stages yet. Unlike species of *Didea* and *Eriozona* (and *Asiodidea* !) which I have never encountered in nature up until now, I have however found and netted *Agnisyrphus angara* and *A. brunettii* sp. nov. flies in conifer forest, mixed with broadleaved trees, at 2005m and 2660m, in the Western and Eastern Himalaya, respectively. These must be arboreal species like those of *Didea*, *Megasyrphus* and *Eriozona*, the other temperate ecosystem genera of this *Didea* genus-group. Coming to the tropically adapted and evolved genera *Asarkina* and *Dideopsis*, larvae of one species of the former have been found feeding on froghopper spittle bug nymphs, named as *Poophilus* sp. nr *costalis* Walker (Hemiptera : Cercopidae, as "Aphrophoridae"), in their frothy spittle masses on some grass species by Musa (1975) at Samaru near Zaria in Nigeria (west Africa). Perhaps therefore *Asarkina* is a predominantly ground layer adapted taxon, especially seeking prey in forest undergrowth, be they comprising of dicots (broadleaved plants) or of monocots (grasses), this based on known data and my own field experiences also. Larvae of *Dideopsis aegrota* (Fabricius), on the other hand, have been recorded feeding on several aphids (Hemiptera : Aphididae), especially the dark coloured ones like *Aphis citricola*, *A. craccivora*, *Pentalonia nigronervosa*, *Toxoptera aurantii*, *T. citricidus*, *T. odinae*, *etc.* (see Tao and Chiu, 1971: 73; Ghorpade, 1981a: 70-71) infesting herbs, shrubs and trees in forest as well as in modified agroecosystems. Maki (1935) had dealt with the mouthparts of *Asarkina porcina* (Coquillett) and *Dideopsis aegrota* (Fabricius), based on specimens taken on the island of Formosa (Taiwan). Compare the biological notes given above with the interesting papers by Rotheray and Gilbert (1989, 1999) on the European predacious Syrphinae.

Now to what I call "Evohistory," or what has been termed earth history or historical geology in past works. There are several opinions and theories about the geology, and hence the climatology and biogeography, of south and south-east Asia (see Whyte, 1984). To mention a few of the most plausible, Croizat (1968) preferred and adopted an Indian Ocean—Tethys Sea panbiogeography, involving vicariance and continental drift. Meher-Homji (1983) on the other hand, postulated both "Indo-Malaysian" and "Indo-African" sources for the entry (migration/colonization) of biota into the Indian sub-continent, the northward drifting "Greater Indian Plate" first contacting the Asian landmass with its north-eastern corner in the late Eocene and resulting in an entry of Indo-Malaysian elements earlier, followed by intrusion of Indo-African elements (East African—Arabian—Persian) after the Miocene, when the north-western edge of the Indian Plate also "ploughed into" Asia, the monsoonal weather system became well established and drying of the sub-continent proceeded rapidly. Gupta (1962: 98-114) had recounted the geological history of S. and S.E. Asia in some detail (*q.v.*). Likewise, Eliot (1973: 457-465; *vide infra*, p. 24) had given a very useful and informative account of the geological history and zoogeography of the Oriental Region, in comparison with other biogeographical regions, using the Family Lycaenidae (Lepidoptera—Rhopalocera) higher classification database.

Holloway (1974: see especially pp. 496-497) gave what is probably the best summarized evohistorical timetable and suggested a "vacuum biogeography" theory (see Holloway, 1982: 355-357) which implied that the Indian sub-continent was depauperate (as oceanic islands generally are, being far from, and having no access to, any continental biota) during its 75-100 million year drift from the once existent southern "supercontinent" Gondwanaland north to the Asian continent. He considered it had only recently been colonized by fauna and flora "invading" mainly from the Sino-Malayan subregion and also, more recently, from the Afrotropical Region (particularly the "Sudano—Deccanian" or "Saharo—Sindhian" elements; see *e.g.*, Meher-Homji, 1965). The tropical and sub-tropical rainforest wet habitat areas (Western Ghats, Naga—Chin—Arakan Hills and the Himalayan Mountains; as also the eastern Central Highlands ?) had also been enriched through migration from the north and/or east, as well as by local speciation, through ecological isolation, in time. Holloway (1974) wrote that the Greater Indian Plate (was this actually much larger than what is normally depicted as an inverted triangular area in maps showing continental drift?) was isolated as an "island" for millions of years while drifting from southern latitudes across the then equator to the north, and possibly carried on it, initially, a temperate flora (and associated fauna) which evolved into a moist or wet tropical one as it crossed the equator, and is now becoming more and more arid due to the rising Himalayan mountain barrier and the seasonal monsoonal weather pattern, unlike earlier island precipitation probably falling on it all year round and ensuring relatively high humidity. Or, like Croizat (1968) submits, was the Greater Indian Plate a relatively larger "island continent," with a rich biota, that had then acted as a major biogeographical "node" but now lies partly submerged, through faulting, where the Bay of Bengal (and the Arabian Sea) now is ? In the beginning of the Miocene the Greater Indian Plate was located some 2000 km south of the Asian landmass, then some 700 km from it in the early Pliocene, and anything from 200-400 km away across a still existing Tethyan Ocean gap in the late Pliocene (*cf* Holloway, 1974: 478-481). Pearson & Ghorpade (1989: 334-336) had also favoured the vacuum biogeography theory and the invasion of "relatively stable and ecologically mature" (see Holloway, 1974: 481) biota from the Asian and African continents into a depauperate, fragmented and diminished Indian Plate (with a relict, unstable, extinction-prone biota ?), which land now exists only as what are termed by me as the "Central Highlands and Peninsular India+Ceylon" biogeographical areas ("Dravidia" = CH+PC on Map, p. 34), south of the recently formed Indo-Gangetic Plain. India and Africa had split, simultaneously, from Gondwanaland more than 100 million years ago and all of the northern Indian sub-continent is relatively young geologically—not only the three newly uplifted Baluch-Afghan, Himalayan and Indo-Burmese mountain arcs, but also the vast, high water-table, Indo-Gangetic

Plain, as well as the lofty Tibetan Plateau, besides the Hindu Kush, Karakoram and associated mountain ranges, with some of the tallest peaks on earth (like "K2," Mt Godwin-Austen). This evohistory (and geology) must be applied to phylogenetic analyses of present day floral and faunal distributional patterns and "tracks," if any sense is to be made out of the few pieces available to us of the very many originally existing of this vast jig-saw puzzle !

On biogeographic matters, in general, I am of the opinion that Croizat's "Panbiogeography" is perhaps the most robust, theoretical alternative. His extremely enlightening paper (Croizat, 1968) on "The Biogeography of India: a note on some of its fundamentals" provides compelling reasons to adopt his line of thought with the implied importance given to the "Bay of Bengal node of form-making" as against the other major node hereabouts, lying in the Pacific Ocean. His conviction about what of life comes from Afghanistan to Ceylon (Indian subregion) being noticeably distinct from what comes from China to the Malay Archipelago (Sino-Malayan subregion), and these two subregions being separated by the major "Bay of Bengal node," is interesting. Croizat's fundamental theory that "earth and life evolve together" and his warning that some existent animals and plants may be much older than recent geological changes, is a strong counter to what is elucidated above in the evohistory section concerning the vacuum biogeography and migration/colonization models (see Holloway, 1982). It is imperative that we search for reality in biogeographical theory, either proving vicariance and passive dispersal of biota through geological changes in time, or falsify this and uphold the active dispersal paradigm (as stated in Island Biogeography models; MacArthur and Wilson, 1967) of plants and animals actually migrating and invading new niches opening up and being created by geological movements or the effects of the Pleistocene Ice Ages and changes in ocean levels, *etc.* Or, could it be that both theories apply specifically, each for a different kind of evohistorical pattern in various plant or animal taxa ? A recent paper by Karanth (2003) on the causes of disjunct distribution, related to currently existing rain forest habitats in the Orient, suggested a) Vicariance, b) Dispersal, or c) Convergence (and Extinction, lately) models, and hinted that correct taxonomy, based on molecular data [only ? – K.G.], may actually help in identifying what he termed as either "true disjunct" or "false disjunct" distributions.

The only published paper on the "Zoogeography of Indian Syrphidae" was the preliminary, general documentation by Kapoor and Kohli (1985). Vockeroth's (1969: 27-38) section on "Zoogeography of the Syrphini," on a global scale, was however very well written (*q.v.*). The biogeographical areas and sub-areas of the Oriental Region, as shown on my Map here (p. 34), including the Papuan-Pacific subregion (= "Celebes—Melanesian" of Gupta, 1962: 98, *q.v.*) as defined by me (Ghorpadé, 2001, 2002a, 2002b) and also those provided by authors who have published some useful, exhaustive, recent works (*e.g.*, Gressitt, 1956, 1961; Gupta, 1962; Croizat, 1968; Holloway and Jardine, 1968; Vockeroth, 1969; Eliot, 1969, 1973; Holloway, 1969, 1974; Darlington, 1970; Bernardi, 1973; Good, 1974; Papavero, 1977; Pearson and Ghorpade, 1989), could be exactly what are currently recognized as "generalized tracks" in historical biogeography. Though much has been written on general theories of biogeography (see especially Hora, 1950; Udvardy, 1969; Good, 1974; Mani, 1974; Cox and Moore, 1980; Nelson and Platnick, 1981; Wiley, 1981; and in some of the works cited immediately above), there is surprisingly little of note dealing with specific taxon tracks used to prove or falsify theories. Of the 642 biogeography titles cited in Ghorpadé (1997b), only Gupta's

(1962) paper on the Indo-Australian parasitic wasp genus *Theronia* (Hymenoptera—Ichneumonidae), Eliot's (1969, 1973), Holloway's (1969, 1974) and Bean's (1988) papers on Indian butterflies (Lepidoptera—Rhopalocera), that of Pearson and Ghorpade (1989) on Indian tiger-beetles (Coleoptera—Cicindelidae), and the one of Thompson and Ghorpadé (1992) on the syrphid genus *Paragus* Latreille in the Orient, besides papers of Mani and Santokh Singh (1961-1963) and Santokh Singh (1968) on the north-west Himalayan high altitude fauna, do provide any real, fairly detailed analyses pertaining to the Indian sub-continent. There are also two early works of Christophers (1921, 1933) on the biogeography of Indian mosquitoes (Diptera—Culicidae). The paper of Santokh Singh (1974), on the "ecology and geography" of Indian Diptera, was an attempt to summarize the still limited knowledge of our true flies, but may be consulted for ideas of their "climatic and habitat communities" here that he dealt with.

For *Agnisyrphus*, the similarity of biogeographical "tracks" exhibited by the plant genus *Tilia* (Tiliaceae, related to the limes of Rutaceae, and also close to Sterculiaceae and Linaceae), as highlighted and explained in some detail by Croizat (1968: 577-588), is worth taking a comparative look at. *Tilia* (unlike the related drier habitat *Grewia*) does not enter the island of Formosa (= Taiwan) and this suggests that what "*Syrphus issikii* " of Shiraki (1930: 378-381, fig. 90) probably is (*cf* p. 2, *vide supra*), may be a species of *Epistrophella* Dušek and Láska, taking the cue from Shiraki's own comparison of *issikii* with *horishana* (Matsumura) which latter is an *Epistrophella*. It is interesting to note that Thompson (1974: 18-19, Map 1), in his paper on *Pterallastes* Loew (= *Pseudozetterstedtia* Shiraki), had shown a similar pattern of distribution for that genus which occurs in south-west China, Japan and then also in the north-eastern United States ! Genera related to *Pterallastes*, *viz*., *Palumbia* Rondani and *Korinchia* Edwards, temperate and tropical respectively, are as similarly distributed as are the sibling-genera *Didea—Megasyrphus—Eriozona—Asiodidea—Agnisyrphus* (temperate) and *Asarkina—Dideopsis* (tropical), respectively, which may be so noted. Incidentally, Meher-Homji (1974: 2-3), discussing patterns of plant discontinuity, had written about the Eastern Asian—Eastern North American disjunction, as a "baffling pattern of certain plants that are common to East Asia and eastern U.S.A., but curiously wanting on the western side of U.S.A.," like *Tipularia discolor, Cypripedium arietinum, Adlumia fungosa, Penthorum sedoides, Gaultheria hispidula and Phryma leptostachya.* He noted that "these relationships are interesting from an evolutionary point of view, because they imply that the related species of eastern Asia and the eastern U.S. have been evolving in isolation for approximately 50 million years. . . There are genera common to these two regions, but very few species, a good indication of evolutionary rate in the groups involved."

Holloway (1974: 475-476) had cited some other "tracks" that relate to Oriental butterfly genera, which may be congruent with those of *Agnisyrphus* and its "sibling-genus" *Asiodidea.* These involve three Lycaenid genera (*Psolos*, *Badamia*, *Tapena*) centered on W. China: Kashmir—Himalayas—W. China (*ibid.,* Centre 1e; Fig. 88, bottom), besides two other genera (*Araschnia, Carterocephalus*) also centered on W. China: Tibet—China—Japan—Amur (*ibid.,* Centre 5; fig. 94, top left), and finally two more genera (*Apatura, Ochlodes*) centered on W. China but distributed in the Oriental as well as the Palaearctic (*ibid.,* Centre 9; fig. 82, upper centre). Sub-elements of the Indian butterfly fauna given by Holloway (1974: 484) that approximate to the generalized track of *Agnisyrphus* species are 1d (fig. 88, lower centre right) *viz*., East Himalaya—Szechuan—Yunnan, of open montane woodland, and 1e (fig. 88, bottom) *viz*., Kashmir—Sikkim—Assam—Yunnan, of similar vegetation type.

Holloway's (1974: fig. 81, top) "Generic Centre" theory gave the most species rich "track" in the Oriental Region as centering along the "Assam—Burma—Siam—Malaya—Sumatra" track (and inclusive of the Andaman—Nicobar Islands as well ?), this track being the dominant "hot spot" here and holding some 40-43% of the species, with the following areas being progressively poorer : Borneo (36%), Java (28%), Annam in Vietnam (22%), Philippines (20%), central India (18%), Celebes and Szechuan—Yunnan (17% each), south-east China and southern India (16% each), Himalayas (14%), Ceylon and the Lesser Sundas (13% each), New Guinea (11%), north-west Himalaya in Pakistan (9%), Formosa (7%), north-east China (4%), Madagascar (3%), Afghanistan, Tibet and Japan (2% each). Holloway presumed that the relationship of India to Asia could be similar to that of Madagascar to Africa and that it is the region of Somalia—Kenya—Tanzania (African Savannah *vide* Holloway, 1974: 475, Centre 3; fig. 84, top) that has prinicipally sourced the Afrotropical elements now found in some parts of India, as well as the wider area of the Sudan—Ethiopia—Mediterranean—Middle East (*ibid*., Centre 4; fig. 84, centre). Holloway also hinted at the possibility of obvious "undercollecting" in India and parts of south-east Asia, and that we need a lot more sampling of specimens, plus bioecological databases, in order to understand reality (see also Darlington, 1970, 1971, 1980). That the Indian subcontinent is still poorly surveyed, even with a Zoological Survey of India existing since 1916, and an Indian Museum of the "Hon. East India Company" and then of the Asiatic Society of Bengal much before that (collections from the 1820s or earlier; see Subba Rao, 1998: 12-13, 2 pls), is an unfortunate fact (see also Ghorpadé, 1997a, 1998). Perhaps southern (Oriental Region) China is still unsatisfactorily sampled as well ?

It may be helpful here to observe that Eliot (1973: 457-459) had defined the limits of the Oriental Region fauna as follows: "In the case of the Oriental Region, I accept the view of Gressitt (1956) who, using evidence mainly derived from the Coleoptera, considered that it extended from the Yangtse Basin in the north to Ceylon and through the Malay Archipelago to the Cape York Peninsula of Australia and to the whole of Polynesia. Its butterfly fauna is decidedly mixed, so that it is best divided, albeit somewhat arbitrarily, into subregions. In doing so I have disregarded the Polynesian Subregion of Gressitt, since it is unimportant in considering the origin of the Lycaenidae [*cf* also the genus *Theronia* in Gupta, 1962: 98, *vide infra* — K.G.], and have modified his other subregions. The S.E. Asian Subregion (sensu mihi) comprises virtually the whole of the Oriental Region in its traditional, restricted sense and extends from S.E. China to Ceylon and as far east as Weber's Line; its characteristic species are lowland or submontane in habit and appear to be centred in Sundaland. The Papuan Subregion lies east of Weber's line. What I have elsewhere termed the Sino-Himalayan Subregion (Eliot, 1969) is a particularly complex area which widely overlaps the S.E. Asian Subregion but at a higher average elevation. Its original centre probably lay in the area of S.E. Asia termed Cathaysia by du Toit (1937) and others. To-day it essentially comprises the upper basin of the Yangtse, but extends through the highlands of Yunnan, Indo-China and Burma and along the outer slopes of the Himalayas, with a few characteristic elements, such as *Heliophorus* (Lycaeninae) reaching, at a moderate elevation, as far east as Wallace's Line. The Palaearctic Region is clearly defined in its western half by the Sahara and the deserts of Central Asia, only a few African and Oriental species having invaded its southern fringes, but in its eastern half its boundary with the Sino-Himalayan Subregion is extremely blurred and in part altitudinal." Gupta (1962: 138) however had summarized his biogeographical findings thus: "The fauna of

India and Indo-China was derived from stocks in Sundaland, which has further differentiated into Peninsular Indian, Himalayan, and Taiwan faunas. Of these three faunas, that of Peninsular India is closest to the ancestral stock in Sundaland." My own concept of the expanded Oriental Region, with its areas and sub-areas, is elucidated on the accompanying Map (p. 34, see also my notes on p. 2, *op. cit.*) which could be tested though future work and either corroborated and refined, or contested and falsified, using biogeographical taxon-tracks to do so, principally.

In closing, it may be appropriate to quote what Harold Wellman and Philip England had mentioned about geology. They stated that our earth behaves like a "sticky fluid" which becomes weaker the harder it is pushed, and that there are thus no rigid plates in the oceans. Mountain building started some 50 million years ago, in the late Eocene, but mountains are ephemeral, they move and flow, becoming plateaus finally through erosion in time (like in peninsular India, except for the Western Ghats which is a recently faulted range and was uplifted in the post Miocene and Pleistocene, like the Baluch-Afghan, Himalayan and Indo-Burmese mountain arcs, the Tibetan Plateau, and perhaps the Naga—Chin—Arakan hill ranges as well). Earth gets compressed at faults creating rapid subsidence of mountains or land (like those areas now lying submerged in the Bay of Bengal and in the Arabian Sea, *vide* Croizat, 1968). Some 84 million years ago the Malay Archipelago, and perhaps south-east Asia (southern Indo-China), were formed by volcanic action in the ocean which squeezed subterranean rocks to throw up mountainous islands. Gupta (1962: 109) also wrote that "Much of S. China and SE Asia arose above water during the Cretaceous (map 11). It is believed that the rise of land in the Malay Archipelago was accompanied by intense volcanic activity." The evohistory (and geology) of south and south-east Asia, and the Pacific Ocean, could be critical for really understanding the biogeography and evolution of life in the Oriental Region and in "deciphering" phylogenies based on known recent, and often fossil, species.

The importance of "good taxonomy" in helping influence decisions on conservation priorities (see Quammen, 1996; Collar, 1997) in protecting our biodiversity heritage, may also be highlighted here, exemplifying "reality" in nature (see Darlington, 1970, 1971, 1980). Vane-Wright (1993), quoting May (1990), had emphasized that "in some very real sense, taxonomy may affect the destiny of species" in future. It is hoped that this present paper, and forthcoming ones on the Oriental genera of the Family Syrphidae, will be attempts towards this vital goal to identify and then help in the survival of a majority of extraordinarily peculiar and endemic Oriental taxa, like this genus *Agnisyrphus* Ghorpadé and its rare, exquisite species deserving protection through focused conservation of their special ecosystems.

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SUMMARY

The genus *Agnisyrphus* Ghorpadé, known only from the Oriental Region, is reviewed. Four new species, *A. brunettii* Ghorpadé, *A. grahami* Ghorpadé, *A. klapperichi* Ghorpadé and *A. mandarinus* Ghorpadé, all collected in China, except the first from north-east India, are named here. The two known species of this newly proposed genus, *A. angara* Ghorpadé and *A. gressitti* Ghorpadé, from the West Himalaya and from the Siamese mountains, respectively, had been introduced to Science, through diagnostic keys, by me earlier (Ghorpadé, 1994). All six species are fully described and three minimally illustrated here, pending further illustrations, *etc*., of all known species to be given in a forthcoming supplementary paper, and they are separated using a key and a diagnostic characters table. A map is also provided to show the distribution of these species of this endemic Oriental genus, besides also indicating what the limits of the biogeographical areas and sub-areas of the Oriental Region are, in my opinion. Notes on the phylogeny, evohistory and panbiogeography (also biology) of *Agnisyrphus* (and other genera of the *Didea*—group) are also given as a preliminary discussion, hoping to provide a holistic picture, in space and time, of this peculiar Oriental taxon, comprising species that are both large and beautiful, but which were curiously unknown until recognized as distinct by me. Two major "Sections" and eight genus-groups of the Tribe Syrphini have been proposed here to accomodate 50 known genera. The phylogeny of the *Didea*—group, belonging to the newly proposed *Sphaerophoria*—Section here, including *Agnisyrphus* and its closely related "sibling-genera," both temperate and tropical, is analysed. The distribution of species is referred also to biogeographical areas and sub-areas ("tracks") inhabited by each of them. Political ranges, usually given in taxonomic papers (like here, in addition), are considered minimally useful or even relevant in depicting and analyzing the natural habitat preferences of living taxa in undisturbed, or minimally modified, ecosystems.

Vicariance or passive dispersal, versus active dispersal through migration and colonization, is debated. So also the possible sources of biota now existent in the Indian sub-continent, especially the land south of the Indo-Gangetic Plain (termed "Dravidia," a remnant of the "Greater Indian Plate" of Gondwanaland history), is investigated, using biogeographical "tracks" and comparing the possibility of a "Vacuum Biogeography" and invasion of elements from Asia and Africa, or postulating that this ancient land may have been an "Island Continent" actually, during its drift from Gondwanaland to its collision with Asia, and therefore being biologically rich, with numerous still existing endemic taxa.

It is also suggested that a "Geographical Species Concept" (GSC) may be more weighty, and durable, than pursuing either an "Evolutionary Species Concept" (ESC) or a "Biological Species Concept" (BSC), as is currently debated and selectively utilized by modern taxonomists. Using this "Geographical Species Concept" it is hypothesized here that *Agnisyrphus klapperichi* and *A. mandarinus* spp. nov. are the plesiotypic, basal species of this genus, which evolved in the Sino-Formosan track, giving rise to *A. grahami* sp. nov. in the Sino-Burmese and/or Sino-Tibetan track, which gave "birth" to *A. gressitti* in the Sino-Burmese track, then this latter to *A. brunettii* sp. nov. in the East Himalayan track, and finally to *A. angara* which speciated and evolved in the West Himalayan track and is considered here to be the most recent and apotypic species of *Agnisyrphus*. This evolutionary "prediction" is based on what is termed the pattern and process of the "evohistory" of this part of the earth (Oriental Region), emphasizing that Croizat's maxim — " earth and life evolve together " — suggests that older, stable geographical areas source newer and newer taxa, speciating in new land formed through geological movements of the earth, these speciating to occupy newly evolving ecosystems and their microhabitats, as they open up (*cf* also Signor, 1990: 527-530). This is in conjunction with the theory of "Island Biogeography" (MacArthur and Wilson, 1967; see also Quammen, 1996 for a very readable account) which postulates that island biota are sourced from nearby continental areas, their richness being a factor of comparative land area and proximity to continental masses; the more distant, tinier oceanic islands being depauperate (Gressitt, 1956, 1961, 1971). Thus, geographic speciation (mostly allopatric) appears to be a dominant factor, over what can otherwise only be "sympatric speciation" (*cf* Mayr, 1942: 187), in the evolution of life on earth. Investigation of the process of speciation, and reasons for it, seems to me to be more important than just looking at its "products" (real species and maybe sibling-genera) for educated evolutionary "guesswork." Making hypotheses, by using computer software to decipher complicated OTUs and a host of morphological, and now genetic, characters to show natural relationships over evolutionary time and adopting what are currently conceptualized as "Biological" or "Evolutionary" Species Concepts to make difficult taxonomic and phylogenetic judgements, using available, but usually insufficient, "live" data based on randomly sampled specimens, and maybe incorporating their bioecology and genetics also, is here questioned and debated. Arriving at what may be the most real and natural "Pattern and Process" of the evolution of life on earth, I suggest, is easier by using what I call a "Geographical Species Concept," which was probably recognized long ago by the "Master," Carolus Linnaeus, and carried forward by some "new systematists" like Ernst Mayr and Leon Croizat, but generally overlooked or ignored by most modern biosystematists and "computer taxonomists," owing to pressure of prevailing dogmas. The geographical history of the earth and the natural distribution of living taxa may offer better "clues" to relationships, be they plesiotypic or apotypic, through speciation, rather than by comparing morphological and genetic "characters" of selected taxa for study, with dependence on computer programme software to suggest multiple phylogenies through cladograms. Therefore, the importance of understanding the "evohistory" of the earth, for theorization of biogeography and evolution of select taxa, is also highlighted and recommended here, using available specimens and data of this peculiarly endemic Oriental genus of Syrphidae, *Agnisyrphus*, and comparing them with those of its sibling-genera.

Incidentally, this paper celebrates a whole century (100 years) after Enrico Brunetti's first papers on Indian Syrphidae were published in 1907, in the inaugural volume of the *Records of the Indian Museum* (*cf* Brunetti, 1907a, 1907b) and hopefully marks a fresh beginning in serious revisions of the genera of Syrphidae in the Indian sub-continent.

TAXONOMIC SYNOPSIS

AGNISYRPHUS Ghorpadé, 1994: 6 [Oriental Region: N. India to E. China,"Sino-Himalayan"].

Agnisyrphus angara Ghorpadé, 1994: 6. Holotype ♂, India : Mussoorie [♂, West Himalayan; type-species; USNM, Washington, DC.].

Agnisyrphus brunettii Ghorpadé, 2006: 5. Holotype ♂, India : Mishmi Hills [♂♀, East Himalayan; BMNH , London]. **sp. nov.**

Agnisyrphus grahami Ghorpadé, 2006: 7. Holotype ♂, China : nr Mupin [♂, Sino-Burmese and/or Sino-Tibetan; USNM, Washington, D.C.]. **sp. nov.**

Agnisyrphus gressitti Ghorpadé, 1994: 6. Holotype ♂, Thailand : Doi Pui Mt. [♂, Sino-Burmese; UZM, Copenhagen].

Agnisyrphus klapperichi Ghorpadé, 2006: 9. Holotype ♂, China : Kwangtseh--Fukien [♂♀, Sino-Formosan; ZFMAK, Bonn]. **sp. nov.**

Agnisyrphus mandarinus Ghorpadé, 2006: 11. Holotype ♀, China : Kuatun [♀, Sino-Formosan; ZFMAK, Bonn]. **sp. nov.**

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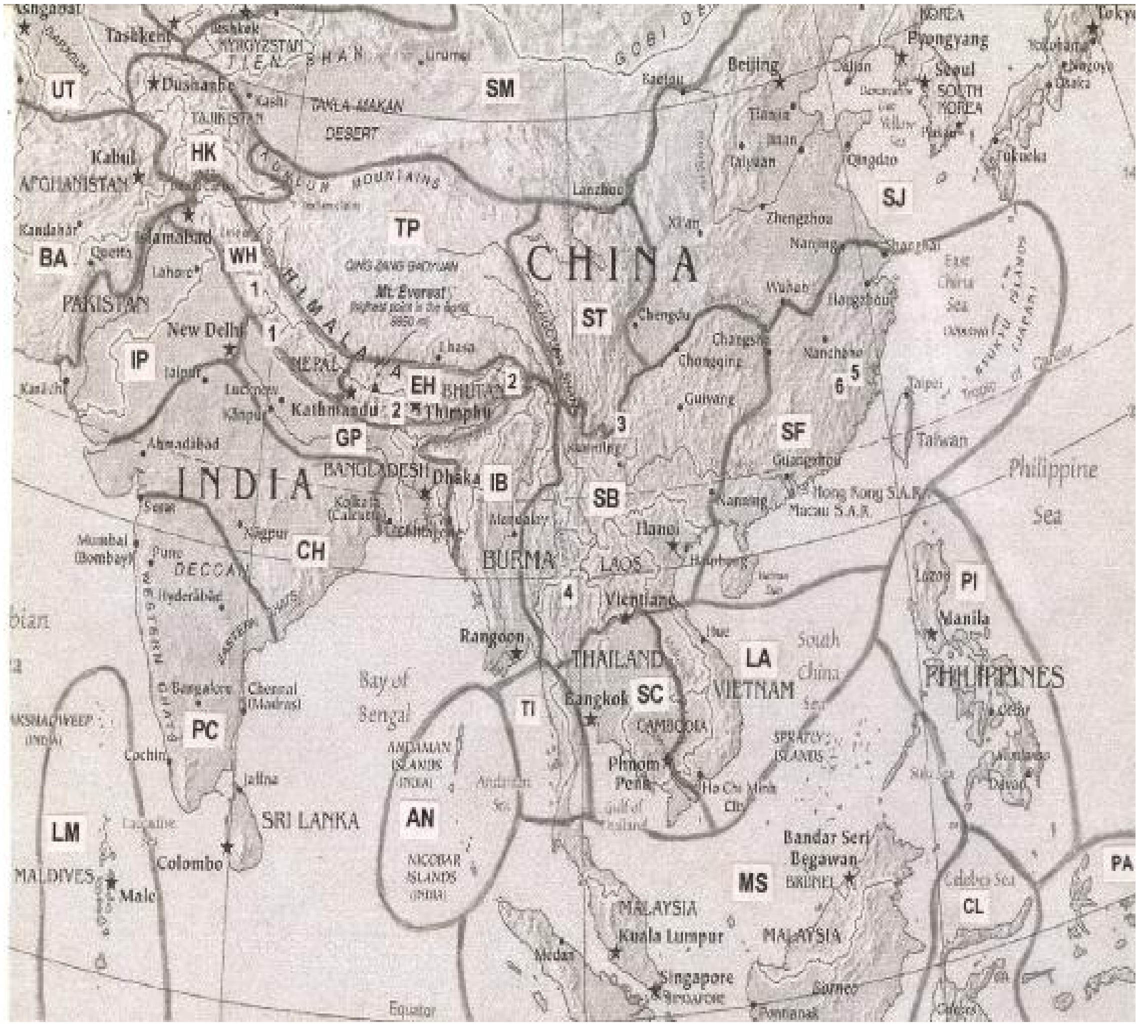
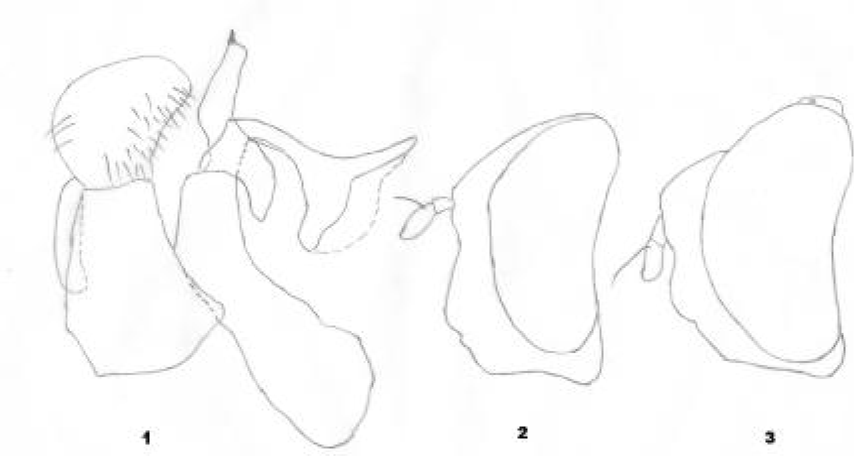


Map. Localities of occurrence of *Agnisyrphus* Ghorpadé species : **1** = *angara*, **2** = *brunettii*, **3** = *grahami*, **4** = *gressitti*, **5** = *klapperichi*, **6** = *mandarinus*.
Biogeographical areas and sub-areas in Asia : **AN** = Andaman—Nicobar, **BA** = Baluch—Afghan, **CH** = Central Highlands**,** **CL** = Celebes—Lesser Sunda, **EH** = East Himalayan, **GP** = Gangetic Plain, **HK** = Hindu Kush—Karakoram, **IB** = Indo—Burmese, **IP** = Indus Plain, **LA** = Laos—Annam, **LM** = Laccadive—Maldive—Chagos, **MS** = Malay—Greater Sunda, **PA** = Papuan Archipelago, **PC** = Peninsular India—Ceylon, **PI** = Philippine Islands, **SB** = Sino—Burmese, **SC** = Siamese—Cambodian, **SF** = Sino—Formosan, **SJ** = Sino—Japanese, **SM** = Sino—Mongolian, **ST** = Sino—Tibetan, **TI** = Tenasserim Isthmus, **TP** = Tibetan Plateau, **UT** = Uzbek—Turkmen, **WH** = West Himalayan.



TEXT-FIGS. 1-3. — (1) Male terminalia of *Agnisyrphus angara*, (2) Facial profile of *Agnisyrphus brunettii*, (3) Facial profile of *Agnisyrphus gressitti*.

PLATE I


1


2


3


4

FIG. 1.— Habitus of *Agnisyrphus angara*, dorsal view.
FIG. 2.— Habitus of *Agnisyrphus gressitti*, dorsal view.
FIG. 3.— Habitat of *Agnisyrphus angara*, author netting the holotype male at Landour.
FIG. 4.— Habitus of *Agnisyrphus brunettii*, dorsal view.