

On the genus *Atypus* (Araneae: Atypidae) in northern Thailand

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Summary

Two new species from northern Thailand, *Atypus suthepicus* n. sp. (♂, ♀) and *A. lanmaianus* n. sp. (♀), are described. *A. dorsualis* Thorell, 1897 is revised, and its male described for the first time. Taxonomic characters are discussed; and information is given on habitat and distribution, annual cycles, breeding and early instars, web architecture, prey and predators.

Introduction

In the course of field studies in northern Thailand, *Atypus* was found on several mountains in Chiang Mai Province. The spiders subsequently proved to belong to three species, two of them new to science. Specimens from one locality in Thailand and one spider from Shan State, Burma, were identified as *A. dorsualis*, recorded from nearby Karen State, Burma, by Thorell (1897). These finds continue a series of records and descriptions of *Atypus* species from the Far East (Thorell, 1890, 1897; Gravely, 1935; Schenkel, 1953; Kim, 1985; Zhang, 1985; Namkung, 1986). Additional taxa from as yet poorly investigated areas of Asia can be expected.

The natural history of European *Atypus* species is fairly well known but apart from a few notes (Bösenberg & Strand, 1906; Gertsch & Platnick, 1980; Aoki, 1983; Kim, 1986) little is known about others so far. Observations on *A. dorsualis* and *A. suthepicus* n. sp. presented in this paper provide some basic information on the biology of these species.

Abbreviations: AMNH = American Museum of Natural History, New York; CTh = Arbeitssammlung Thaler, Innsbruck; MCSNG = Museo Civico di Storia Naturale, Genova; MHNG = Muséum d'Histoire naturelle, Genève; NHMW = Naturhistorisches Museum, Wien; SMF = Forschungsinstitut Senckenberg, Frankfurt. AME, ALE, PME, PLE = anterior (posterior) median (lateral) eyes; MEQ = median eye quadrangle; ALS, PMS, PLS = anterior (posterior) lateral (median) spinnerets. All measurements, if not otherwise indicated, are in mm.

Atypus suthepicus n. sp. (Figs. 1, 3, 4, 8-10, 15-18)

Material examined

Thailand: ♀ holotype, Doi Suthep, 1200 m, 20 Oct. 1986, MHNG; paratypes: Doi Suthep, 1200 m: 1♂, 18 June 1987 (MHNG); 1♀, 20 Dec. 1985; 2♀, 14 Mar. 1986; 1♀, 20 Oct. 1986. Doi Inthanon, 1700 m: 1♀, 17 Sept. 1986; 1♀, 23 Oct. 1986; 1♀, 15 July 1987. Doi Angkhang, 1550 m: 1♀, 22 May 1986; 1♀, 18 Mar.

1987; 1♀, 30 Sept. 1987; exuviae of 1♀, 31 Oct. 1987. AMNH, CTh, MCSNG, MHNG, NHMW, SMF. All specimens P. Schwendinger leg.

Etymology

The specific name refers to the type locality, Doi Suthep (Thai: Doi = mountain, Suthep = beautiful angel), a mountain and national park, overlooking the city of Chiang Mai.

Diagnosis

Atypus suthepicus n. sp. resembles *A. karschi* Dönitz, *A. snetsingeri* Sarno and *A. suiningensis* Zhang in the female. Vulva characterised by large pore plates and median receptacles relatively longer and attached to atrium more basally (Figs. 15-18) than in the three similar species. The male is distinguished by the shape of the conductor (Figs. 9, 10); dorsal spines present on metatarsus IV, granular texture on femur II absent. Posterior sternal sigilla suboval; PLS 4-segmented.

Male

Total length, including chelicerae, 14.0. Carapace smooth, shiny, 4.9 long, 4.8 wide, with dark lateral and posterior borders; pars cephalica elevated, dark brown, cephalic suture ending in broad, shallow pit about half-way between front margin and fovea. Pars thoracica low, reddish brown, posterior margin with small pleurites. Fovea deep and narrow, situated at $\frac{2}{3}$ of carapace length, occupying about $\frac{1}{10}$ of cephalic width at that point. Eyes raised on dark tubercle, 0.70 long, 1.48 wide. Eye sizes and interdistances: AME 0.42, ALE 0.28, PME 0.25, PLE 0.20; AME-AME 0.14, AME-ALE 0.09, PME-PME 0.84, ALE-PLE-PME contiguous; MEQ 0.59 long, front width 0.87, back width 1.16. Sternum with distinct ridges on lateral margins, 3.5 long, 3.0 wide, light reddish brown, moderately roughened, sparsely covered by fine hairs. Sigilla deeply imprinted; first pair oval, larger than round second pair, both connected by arched wrinkles; posterior pair suboval, separated by roughly their length (Fig. 1). Labium 0.6 long, 1.0 wide, broadly rounded apically, with two pale dots basally. Palpal lobes clothed with fine hairs, with narrow band of spicules along prolateral margin. Promargin of chelicerae with 12 teeth. Pro- and retrolateral faces of chelicerae and prolateral side of femur I with granular texture. Legs 4123, almost smooth basally, clothed with fine short hairs distally. Anterior legs dark brown, posterior legs brown. Membranous area retrolaterally on patella I unpigmented. Tarsi light brown, flexible, with rings of false sutures from basal quarter to apex. Metatarsi and tarsi cylindrical, armed with several short spines; three spines dorsally on metatarsus IV. Trichobothria in two distally convergent rows on basal $\frac{2}{3}$ of tibiae I-IV (left/right): 5+6/6+6, 5+5/5+6, 6+7/6+7, 6+6/6+6; and in a single row on distal half of metatarsi I-IV: 4/5, 4/4, 6/5, 10/5. Unpaired claws without denticles, paired claws with 5 on proclaws, 5-6 on retroclaws. Measurements:

	I	II	III	IV	Palp
Femur	5.3	4.6	4.0	5.2	2.3
Patella	2.2	2.1	1.9	1.9	1.0
Tibia	3.1	2.5	2.2	2.9	1.2
Metatarsus	4.2	3.8	3.7	4.5	—
Tarsus	2.9	2.7	2.7	3.4	1.4
Total	17.7	15.7	14.5	17.9	5.9

	I	II	III	IV	Palp
Femur	3.9	3.5	3.1	3.8	2.3
Patella	2.3	2.1	1.7	1.9	1.2
Tibia	1.9	1.5	1.2	1.8	1.0
Metatarsus	2.1	1.9	1.7	2.5	—
Tarsus	1.4	1.3	1.2	1.5	1.2
Total	11.6	10.3	8.9	11.5	5.7

Palp clothed with fine hairs and setae. Femur three times as long as basal width, shallow prolateral depression without furrow; patella length 1.5 of width; tibia dorsally arched, less than twice as long as dorsal width; tarsus more than twice as long as wide, rounded at apex (Fig. 8). Bulb small; conductor narrow, with almost straight upper margin, its edge thickened, rounded at distal corner; embolus thin and straight, projecting only slightly beyond distal margin of conductor (Figs. 9, 10).

Abdomen 5.4 long, 2.9 wide, greyish brown, covered by light brown pits and wrinkles and clothed with fine hairs. Dorsal scutum 4.1 long, 1.9 wide, dark brown, smooth, shiny, enclosing orange tergite. Lung patches, genital region and spinnerets light brown, the latter cream at tips and along ventral side of median to apical joints of PLS. ALS 0.6 long, PMS 0.9 long; PLS 4-segmented, 3.1 long, basal joint 0.6, median 0.8, subapical 0.9, apical 0.8.

Female (holotype)

Total length, including chelicerae, 17.8. Carapace smooth, 5.7 long, 5.3 wide, uniformly yellowish brown, with dark borders and small pleurites on posterior margin. Cephalic suture ending in shallow pit at posterior corners of elevated pars cephalica. Pars thoracica low, with indistinct dark stripes radiating from fovea along borders of coxae, not reaching margins. Fovea deep, narrow, situated at about $\frac{2}{3}$ of carapace length, occupying $\frac{1}{2}$ of carapace width at that point. Eye tubercle with few median bristles, 0.64 long, 1.67 wide. Eye sizes and interdistances: AME 0.33, ALE 0.20, PME 0.19, PLE 0.17; AME-AME 0.23, AME-ALE 0.19, PME-PME 1.00, PME-PLE 0.02, ALE-PLE 0.02; MEQ 0.50 long, front width 0.83, back width 1.29. Sternum 4.0 long, 3.9 wide, sparsely covered by short reddish hairs, longest at dark margins. Sigilla superficially imprinted; first pair anteriorly pointed, close to margin; posterior pair suboval, separated by slightly less than their length (Figs. 3, 4). Labium 0.6 long, 1.4 wide, with stout hairs and short spicules apically. Palpal lobes clothed with reddish hairs, densely covered by short spicules prolaterally. Chelicerae with 12/13 teeth on promargin. Sternum, palpal lobes and chelicerae concolorous, orange-brown. Legs 1423, light brown, clothed with reddish brown hairs, more densely on distal segments. Membranous area retrolaterally on patella I unpigmented. Metatarsi and tarsi compressed, armed with several short spines. Trichobothria on tibiae I-IV (left/right): 5+5/6+6, 6+6/5+6, 5+7/6+7, 6+7/7+7; on metatarsi I-IV: 7/6, 5/4, 5/4, 9/8. Palpal claw with 5 denticles; unpaired claws of legs with 2-4, proclaws 3-4, retroclaws 2-5, decreasing in number posteriorly. Measurements:

Abdomen 6.9 long, 4.5 wide, dusky brown, roughened, pitted, clothed with fine reddish hairs. Orange tergite 0.8 long, 1.8 wide, with fine hairy covering. Lung patches, genital region and spinnerets dusky yellow; tips of spinnerets and ventral side of median to apical joints of PLS cream. ALS 0.7 long, PMS 1.1 long; PLS 4-segmented, 4.0 long, basal joint 0.9, median 1.1, subapical 1.1, apical 0.9.

Vulva and lateral pore plates of atrium large. Receptacles pyriform, long basal stalk weakly sclerotised but never incrassate; median pair largest, attached to ventral side of atrium more basally (Fig. 15). Shape of vulva variable; elongated receptacles (Fig. 16), one surplus receptacle (Fig. 17) and one pointed corner of the atrium (Fig. 18) were found.

Variation

Range in size of females with fully developed internal genitalia: carapace length 3.6-5.6, width 4.0-6.6 ($n=10$). Measurements of smallest reproductive female: total length 14.8, carapace 4.6 long, 4.5 wide.

Affinities

A. suthepicus n. sp. appears most closely related to *A. suiningensis* but differs in having relatively longer median receptacles and a less projecting embolus. Due to orientation of the bulb, illustrations in the description of *A. suiningensis* provide no detailed information on the shape of the conductor. The posterior margin of the carapace is wide and broadly truncate as in *A. karschi*, not strongly narrowed and rounded as in *A. suiningensis* (Zhang, 1985).

Distribution

Known from three mountains in Chiang Mai Province, northern Thailand: Doi Suthep-Pui, 750-1650 m (18°48'N., 98°52'E.), Doi Inthanon, 1700 m (18°33'N., 98°28'E.) and Doi Angkhang, 1450-1550 m (20°01'N., 99°06'E.); Map 1.

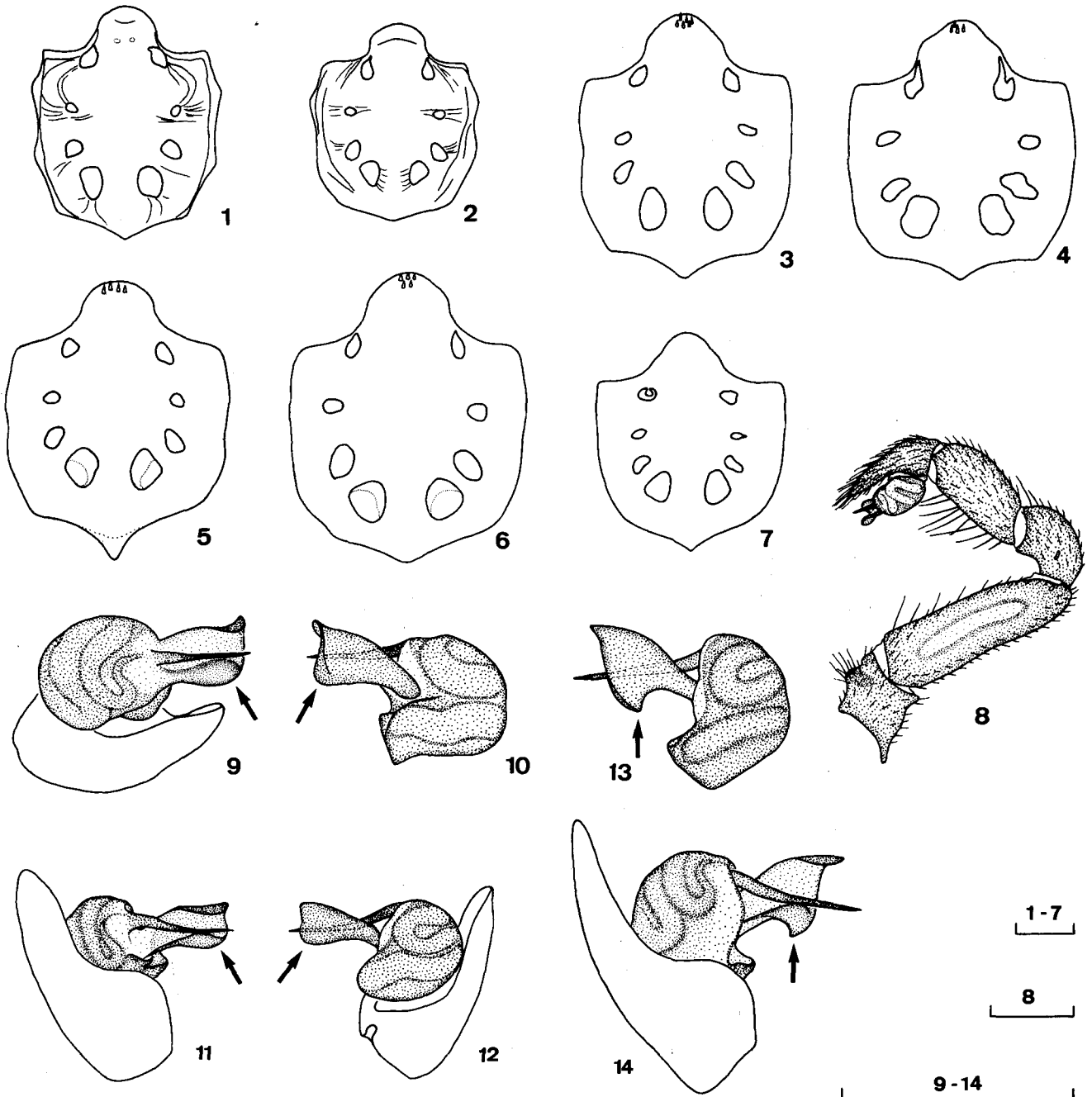
Natural history

Habitat: *A. suthepicus* n. sp. was usually found at altitudes between 1100 and 1700 m. As one empty web was seen in an evergreen forest of Doi Suthep at 750 m, a few spiders may also occur in suitable habitats at lower altitudes. The species occurs in well-shaded evergreen hill forest and on open, exposed roadsides. In the forest, aerial tubes are attached to rocks, tree-trunks and to the base of herbs (often *Phrynium capitatum* Willd., Marantaceae), where the camouflaged silk appears almost indistinguishable from the basal muddy brown cotyledons. One web was even built in a rotten log. Occurrence of the tubes is only scattered; only one

tree was found supporting more than a single web. A similar distribution pattern is known in *Sphodros rufipes* (Latreille) and *S. atlanticus* Gertsch & Platnick (Coyle & Shear, 1981; Coyle, 1983). On roadsides, on the other hand, clusters of tubes with high population density occur. Nineteen apparently occupied tubes were located in a 3m² recess of a path cut at Doi Suthep; all were found abandoned one year later.

Annual cycle: One male matured at the end of May and remained in its tube for three weeks until it was extracted. No males were caught by pitfalls, in spite of extensive trapping for two years in an area where *A. suthepicus* n. sp. occurs in fair numbers. Eggs were laid in August, larvae hatched at the beginning of October

and moulted to first instar spiderlings (= nymphs, *sensu* Vachon, 1958) inside the egg sac. A few days later they moulted to second instar spiderlings, remained in the maternal tube and dispersed at the end of December. Second instar spiderlings showed a strong tendency to climb on to elevated objects — aerial dispersal as in *Sphodros* sp. and *Atypus piceus* (Sulzer) (Coyle, 1983; Broen, 1965) is presumed. No egg sac remnants were found in tubes containing spiderlings. Two females without egg sacs were seen newly moulted at the end of October — they either did not reproduce or the offspring had dispersed early. It is presumed that *Atypus* takes about three years to reach maturity; adult females continue to moult and may live for about eight years or



Figs. 1-14: 1, 3, 4, 8-10 *Atypus suthepicus* n. sp.; 2, 5, 6, 11, 12 *A. dorsualis* Thorell; 7 *A. lanaiianus* n. sp.; 13, 14 *A. piceus* (Sulzer). 3, 5, 7 Holo(lecto)types. 1, 2 Male sternum; 3-7 Female sternum; 8 Male palp; 9-14 Male palpal bulb; upper distal corner of conductor indicated by arrow. Scale lines = 1.0 mm.

more (Kraus & Baur, 1974).

Web: Unlike European* and American *Atypus*, *A. suthepicus* n. sp. builds vertical pursewebs as do *Atypus karschi* and *Sphodros* spp. (Bösenberg & Strand, 1906; Gertsch & Platnick, 1980). The aerial portion of the web is attached to the substrate by numerous white lateral silk strands and by a broad apical band. If built on a vertical earth bank, the web often rests in a furrow excavated in the course of web enlargement in order to camouflage the silk with soil and debris particles. In wet places old tubes become partly covered with moss. Occasionally fragments of old, collapsed webs can be seen hanging from the aerial tube or lying on the ground. The total length of tubes of mature females averages 28.5 cm (range 18.0-50.5, $n=16$), 56% (range 34-76%, $n=16$) of which constitutes the aerial portion. Like *Sphodros abboti* Walckenaer (Coyle & Shear, 1981) but unlike European *Atypus* spp. (Kraus & Baur, 1974), the aerial part of the tube of the Thai species is usually longer than the subterranean portion. Owing to higher temperatures and lack of frost, temperature compensation by descending into deeper soil layers in winter (Hiebsch & Krause, 1976) is not necessary. The tube is widest a few cm above the ground (width 2.0 cm, range 1.7-2.3 cm, $n=9$), becomes narrow about 5 cm above the bottom of the subterranean part (width 1.1 cm, range 1.0-1.4 cm, $n=9$) and then again widens to a basal chamber (width 2.0 cm, range 1.5-2.3 cm, $n=9$), which bends slightly towards the side of above-ground attachment. The only available mature male was extracted from a tube 21 cm long, 1.6 cm wide and narrowing to 1.2 cm in the lower portion.

Waste disposal, prey and predators: Moults and prey remnants are usually pushed through the upper end of the tube, where they either fall down or become loosely attached to the web. In a few tubes fragments of moults were found stored in a double floor below the bottom. Newly moulted specimens had their exuviae loosely attached to the wall inside the basal chamber, where ecdysis probably takes place. As otherwise no debris was found in the tubes, it is difficult to identify the natural diet of *A. suthepicus* n. sp. One spider was extracted while devouring a pill millipede (Glomeridae). In captivity termites, grasshoppers, beetles and flies were freely accepted. A geophilomorph centipede (*Mecistocephalus* sp.) was observed attacking a spider in its tube from below. Pupae of flies were found among remains of dead spiders.

Egg sac and early instars: Spindle-shaped, multi-layered white egg sacs, 1.2-1.8 cm long and 0.7-1.1 cm in diameter, are suspended vertically by 0.5-0.8 cm long attachment bands inside the basal chamber of the tube, 0.8-1.6 cm above the bottom ($n=5$). In contrast, egg sacs of *A. affinis* Eichwald are attached to the upper part of the subterranean tube (Broen & Moritz, 1964; Hiebsch & Krause, 1976). In each reproductive period each female constructed only one egg sac, containing

130, 142, 162, 167 and a maximum of 441 eggs. Measurements of six broods: average egg diameter 1.12 ($n=10$); larvae pale, immobile and incompletely developed, total length 2.25, carapace 0.70 long, 0.72 wide ($n=2$); first instar spiderlings fairly motile, pale and spineless, total length 2.41, carapace 0.74 long, 0.73 wide ($n=6$); second instar well developed and pigmented, total length 2.49, carapace 0.84 long, 0.77 wide ($n=14$).

Atypus lannaianus n. sp. (Figs. 7, 19)

Material examined

Thailand: ♀ holotype, Huay Nam Dang, 1700 m, 4 June 1986, MHNG. P. Schwendinger leg.

Etymology

The specific name is derived from Lan Na Thai (Thai: Lan = million, Na = field), the former name of northern Thailand.

Diagnosis

Atypus lannaianus n. sp. resembles *A. dorsualis* but is distinguished by the shape of the vulva, its receptacles all being basally incrassate (Fig. 19). Posterior sternal sigilla triangular (Fig. 7); PLS 4-segmented.

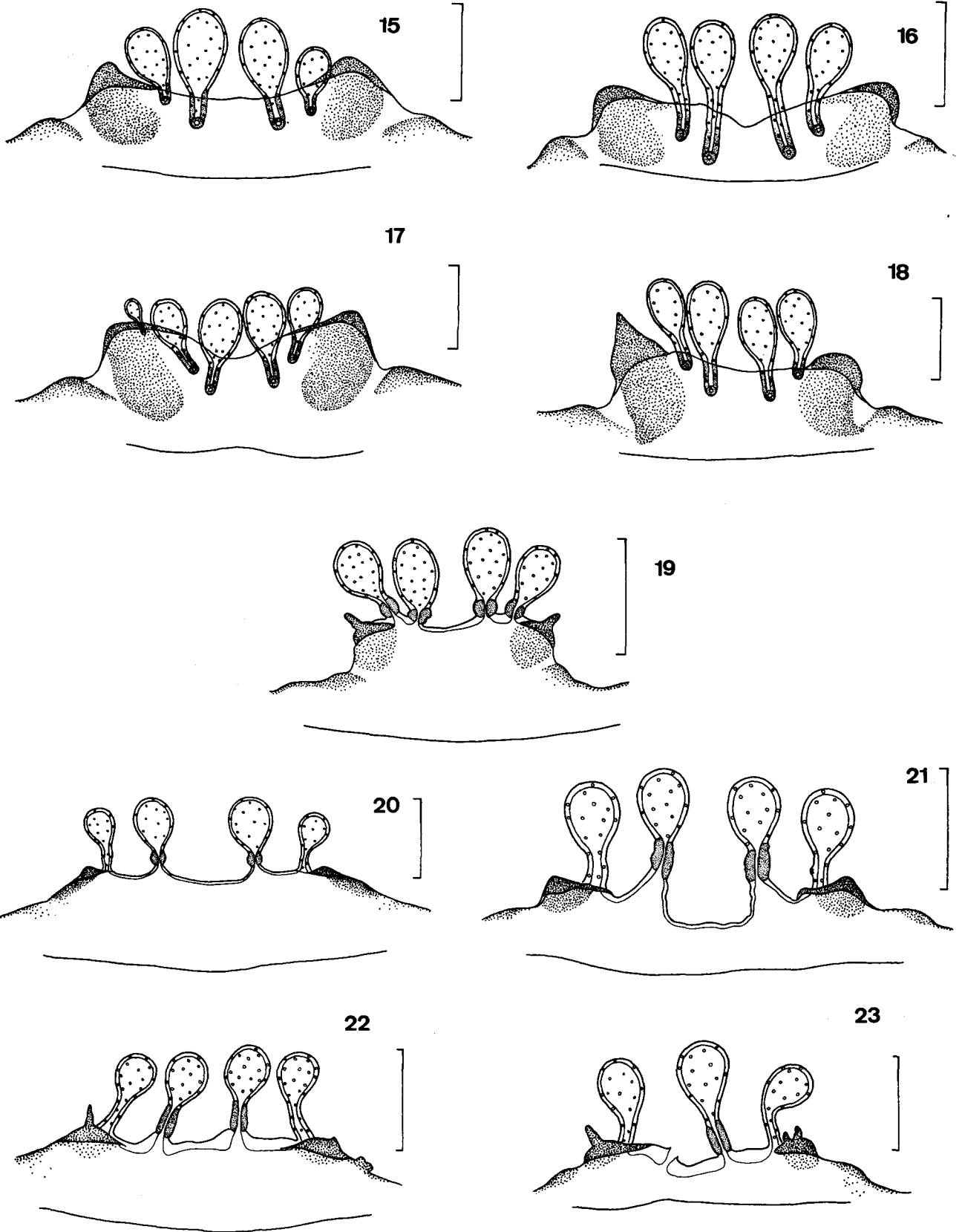
Female (holotype)

As in *A. suthepicus* n. sp. except for the following. Total length, including chelicerae, 12.6. Carapace 4.2 long, 5.0 wide, with pattern of reticulated dark stripes on pars cephalica and on coxal elevations. Pars cephalica strongly elevated, rising abruptly half-way between fovea and front margin (probably partly collapsed). A dark median stripe from eye tubercle to fovea, between two posteriorly convergent stripes. Pars thoracica depressed in its centre (probably collapsed). Eye tubercle 0.83 long, 1.54 wide. Eye sizes and inter-distances: AME 0.28, ALE 0.25, PME 0.23, PLE 0.25; AME-AME 0.19, AME-ALE 0.14, PME-PME 0.83, PME-PLP 0.02, ALE-PLP 0.02; MEQ 0.44 long, front width 0.70, back width 1.17. Sternum 3.4 long, 3.3 wide. First pair of sigilla remote from margin; posterior pair triangular, separated by about their length (Fig. 7). Labium 0.4 long, 1.1 wide, without apical spicules. Promargin of chelicerae with 12 teeth. Sternum, palpal lobes and chelicerae orange-brown. Leg formula 1423. Trichobothria on tibiae I-IV (left/right): 5+6/5+6, 5+6/5+6, 5+6/5+7, 5+6/5+6; on metatarsi I-IV: 4/4, 4/4, 4/4, 7/9. Palpal claw with 4 denticles; unpaired claws with 2, pro-/retroclaws with 2/3 on legs I-III, 3/3 on leg IV. Measurements:

	I	II	III	IV	Palp
Femur	3.4	3.0	2.5	3.0	1.9
Patella	1.8	1.8	1.4	1.6	1.0
Tibia	1.5	1.2	1.0	1.5	0.8
Metatarsus	1.7	1.4	1.5	2.1	—
Tarsus	1.2	1.2	1.0	1.3	0.9
Total	9.6	8.6	7.4	9.5	4.6

Abdomen 5.4 long, 4.2 wide. Tergite 0.8 long, 1.5 wide. ALS 0.5 long, PMS 0.8 long; PLS 4-segmented,

*Vertical tubes have occasionally also been seen in *A. piceus* (Sulzer) (personal observations in Innsbruck and P. J. van Helsdingen, pers. comm.) but they are always fairly short.



Figs. 15-23: Vulva, dorsal view. **15-18** *Atypus suthepicus* n. sp.; **19** *A. lanaiianus* n. sp.; **20-23** *A. dorsualis* Thorell. **15, 19, 20** Holo(lecto)-types. **16** (Doi Suthep); **17** (Doi Angkhang); **18** (Doi Inthanon); **21** (Pindaya); **22** (Doi Inthanon); **23** (Doi Inthanon; one median receptacle destroyed). Scale lines = 0.25 mm.

3.5 long, basal joint 0.9, median 1.0, subapical 0.8, apical 0.8.

Vulva with almost square pore plates and digitiform process at anterior corners. Receptacles subequal, level with each other, attached to anterior edge of atrium; all with very short, strongly sclerotised and incrassate basal stalk (Fig. 19).

Male

Unknown.

Distribution

Known only from Huay Nam Dang, 1700 m (19°18'N., 98°33'E.), Chiang Mai Province, northern Thailand (Map 1).

Natural history

The spider was found on a moderately inclined slope beside a path, among planted *Pinus kesiya* Roy. ex Gard. (Pinaceae) and dense undergrowth of *Eupatorium adenophorum* Spreng. (Compositae). Total length of tube 14 cm, width 1.5-1.8 cm. The aerial portion, only 3.5 cm long, was newly repaired and attached to the ground surface, following a fire. Fragments of exuviae were stored in a double floor at the bottom. No further specimens or data on annual cycle were obtained.

Atypus dorsualis Thorell, 1897 (Figs. 2, 5, 6, 11, 12)

Atypus dorsualis Thorell, 1897: 186; Pocock, 1900: 158.

Material examined

Burma: 1♀ here designated lectotype, Ja-dò, 1885-87, MCSNG, L. Fea leg.; 1♀, Pindaya, 1100 m, 21 Sept. 1987. Thailand: Doi Inthanon, 1000 m, 1♂ (MHNG), 1♀, 23 Oct. 1986; 1♀, 15 Jan. 1988. AMNH, MHNG, SMF, P. Schwendinger leg.

Diagnosis

The male of *A. dorsualis* resembles that of *A. suthepicus* n. sp. but differs in the following: upper edge of the conductor sharp (Fig. 11); granular texture on palpal femur and femur II present; metatarsus IV dorsally without spines. Vulva short, median receptacles basally incrassate (Figs. 20-23). Posterior sigilla triangular (Figs. 5, 6); PLS 4-segmented.

Female

A thorough description of the lectotype is given by Thorell (1897: 186, 187). I obtained slightly different measurements from this specimen: total length 20.6, carapace 5.3 long, 5.4 wide. Characteristic triangular posterior sigilla not mentioned by Thorell (1897), pronounced only on left side (Fig. 5). Trichobothria on tibiae I-IV (left/right): 5+6/5+6, 5+7/-, 5+7/-, 6+8/7+8; on metatarsi: 8/6, 4/-, 5/-, 8/8; distal segments of right legs II and III missing.

Genital atrium of lectotype short, wide, pore plates small, marginal. Receptacles level with each other,

attached to anterior edge of atrium; only median pair basally incrassate (Fig. 20). Shape of vulva variable, receptacles in all new specimens relatively longer than in type (Figs. 21-23), one or two digitiform processes at lateral corners of atrium in spiders from Thailand (Figs. 22, 23).

Male

As in *A. suthepicus* n. sp. except for the following. Total length, including chelicerae, 11.7. Carapace 4.4 long, 4.3 wide; posterior pit of cephalic suture shallower than in *A. suthepicus* n. sp. Fovea occupying about 1/8 of carapace width. Eye tubercle 0.64 long, 1.32 wide. Eye sizes and interdistances: AME 0.41, ALE 0.26, PME 0.20, PLE 0.22; AME-AME 0.14, AME-ALE 0.06, PME-PME 0.73, ALE-PLE-PME contiguous; MEQ 0.55 long, front width 0.83, back width 1.02. Sternum 3.1 long, 2.8 wide. Sigilla deeply imprinted; first and second pair not interconnected by arched wrinkles; posterior pair triangular, smaller than in *A. suthepicus* n. sp., separated by more than their length (Fig. 2). Labium 0.3 long, 1.0 wide, without basal dots. Promargin of chelicerae with 10/8 teeth. Pro- and retrolateral faces of chelicerae, retrolateral side of femur I, prolateral side of palpal femur, femora I and II with granular texture. Leg formula 4123. Metatarsus of leg IV without dorsal spines. Trichobothria on tarsi I-IV (left/right): 5+6/5+6, 6+6/6+6, 5+7/5+6, 7+8/7+8; on metatarsi I-IV: 6/8, 4/4, 3/3, 7/7. Unpaired claws without denticles on tarsi I-III, 2 on leg IV; paired claws mostly with 4 on pro- and retro-claw. Measurements:

	I	II	III	IV	Palp
Femur	5.1	4.1	3.4	4.7	1.9
Patella	1.9	1.9	1.5	1.7	1.0
Tibia	3.0	2.3	2.0	3.0	1.0
Metatarsus	3.8	3.3	3.3	4.4	—
Tarsus	2.4	2.4	2.4	2.9	1.0
Total	16.2	14.0	12.6	16.7	4.9

Conductor of bulb with sharp edge, its distal corner rounded (Figs. 11, 12).

Abdomen 4.4 long, 2.6 wide. Dorsal scutum 3.5 long, 1.7 wide. ALS 0.5 long, PMS 0.7 long; PLS 4-segmented, 2.3 long, basal joint 0.5, median 0.5, subapical 0.6, apical 0.7.

Variation

Range of body measurements of females: carapace length 4.8-5.8, carapace width 5.1-6.3 ($n=4$).

Distribution

Known from Ja-dò, Karen State (19°22'N., 96°49'E.), from Pindaya, Shan State (20°52'N., 96°43'E.) (both highlands in eastern Burma) and from Doi Inthanon, a mountain in Chiang Mai Province, northern Thailand (Map 1).

Natural History

Habitat: *A. dorsualis* was collected on open, tem-

porarily shaded verges along unpaved dry-weather roads. Although hot and dry during the inter-monsoon period, the loamy soil stays moderately humid below the surface. At Doi Inthanon the spiders were seen in clusters of up to 35 tubes; at Pindaya only a single specimen was found.

Annual cycle: One male was extracted from the tube of a female in late October, but a lasting association of pairs (overwintering) as reported in *A. affinis* by Hiebsch & Krause (1976) was not observed. Eggs were laid in early January, the first instar spiderlings hatched in late February and moulted to the second instar about two weeks later. One female moulted in mid-July.

Tube: As in *A. suthepicus* n. sp. The total length of tubes of females averages 35 cm (range 22-44 cm, $n=6$), 60% (46-68%, $n=6$) of which consists of the aerial portion; width 2.0 cm (1.6-2.4 cm, $n=6$), narrowing to 1.4 cm (1.2-1.7 cm, $n=6$) above the basal chamber. New moults were first kept at the bottom, loosely wrapped with silk, and later stored on the outside of the subterranean tube.

Offspring: No egg sac was found. Eggs taken from the abdomen of a female were 1.26 ($n=6$) in diameter. Second instar spiderling: total length 2.46, carapace 0.82 long, 0.76 wide ($n=6$).

Discussion

Taxonomic characters

Distinction of *Atypus* species raises problems. Although already illustrated by Chyzer & Kulczynski (1897), female genital characters were neglected in many descriptions thereafter. Attention was instead focused on the male bulb, which hitherto has provided no relevant characters for species separation. A detailed discussion on taxonomic problems in European species has been given by Kraus & Baur (1974). It is now commonly accepted that internal female genitalia are most reliable for distinguishing European *Atypus*. In Asiatic species, however, this

character *per se* may not be sufficient (Schwendinger, in prep.). Nevertheless, in the species reported in this paper three distinct types of vulvae can be recognised:

(1) *A. suthepicus* n. sp.: Genital atrium wide and large, its pore plates long. Receptacles attached to the ventral side of the atrium, median pair attached to atrium more basally and largest; all basally slightly sclerotised but not incrassate, covered with pores throughout (Figs. 15-18).

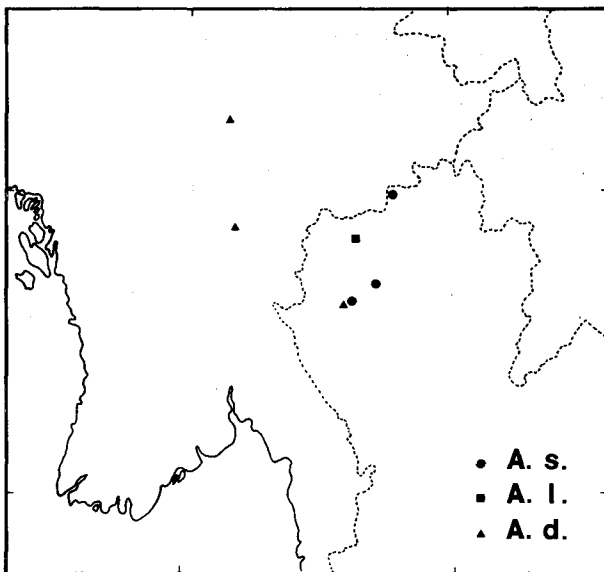
(2) *A. dorsualis*: Genital atrium wide and short, pore plates small, anterior corners with or without digitiform processes. Receptacles subequal, attached to the anterior edge of the atrium; median pair with distinctly incrassate, sclerotised stalk, pores only anterior to it. Lateral pair neither incrassate nor sclerotised, entirely covered with pores, which are generally larger than in type 1 (Figs. 20-23).

(3) *A. lannaianus* n. sp.: Similar to type 2 but atrium and pore plates larger. All four receptacles with short, incrassate basal stalk (Fig. 19).

Although these genital characters are fairly variable, each specimen can be clearly assigned to one type. Biological information supports the distinction of *A. dorsualis* and *A. suthepicus* n. sp.; for *A. lannaianus* n. sp. such data are not available.

The males of *A. dorsualis* and *A. suthepicus* n. sp. are characterised by the shape of the conductor. Its upper lateral edge is almost straight and apically rounded, whereas in all other species the distal corner is turned upwards and appears pointed when viewed laterally (Figs. 13, 14; Kraus & Baur, 1974: figs. 33, 35). Owing to straight, inclined hind margins, the posterior sternal sigilla appear triangular in *A. dorsualis* and *A. lannaianus* (Figs. 2, 5-7); in other species they are oval or square. In the males of *A. suthepicus* n. sp. and *A. dorsualis* the sigilla are imprinted distinctly deeper in the sternal surface than in the others. A granular texture on the male chelicerae and leg I of *A. suthepicus* n. sp. and additionally on palp and leg II of *A. dorsualis* allows distinction of these two species. They may further be distinguished by the presence (*A. suthepicus* n. sp.) or absence (*A. dorsualis*) of spines on the dorsal side of metatarsus IV, as in European species (Kraus & Baur, 1974). As in *A. affinis* there is a longitudinal depression without a ridge on the prolateral face of the palpal femur in both species. A distinction based on the form of the posterior lateral spinnerets is not possible, as they are 4-segmented in all species except *A. affinis* and one undescribed species from Japan (Yaginuma, 1986). Taxonomic characters in these and other species will be discussed in detail elsewhere (Schwendinger, in prep.).

It should be noted that "legs without spines" reported by Pocock (1900) for *A. dorsualis* is incorrect and probably arose from an incomplete translation. In the original description Thorell (1897) refers to *A. javanus*. In that description (Thorell, 1890) we find "*Pedes . . . in metatarsis et tarsis aculeis minutis sparsi; praeterea inermes videntur.*" In fact the legs of *A. dorsualis* are armed with short spines as in all other species.



Map 1: Central Burma and northern Thailand showing sites of collection of *Atypus suthepicus* n. sp. (A.s.), *A. lannaianus* n. sp. (A.l.) and *A. dorsualis* Thorell (A.d.).

Biological aspects

Apart from different morphological and genital characters, *A. suthepicus* n. sp. and *A. dorsualis* differ in their phenologies: the former reproduces from summer to autumn, the latter from autumn to winter. They can be regarded as true biospecies. As there is no corresponding information on *A. lannaianus* n. sp., its distinction is based only on genital characters.

A vague distribution pattern can be recognised from the sites of collection. *A. dorsualis* occurs in the mountains of eastern Burma and northern Thailand, *A. suthepicus* n. sp. is present in northern Thailand and most likely ranges further north into Burma. At Doi Inthanon, the highest mountain of Thailand, both occur at different altitudes. *A. lannaianus* n. sp. was found only at the western boundary of Chiang Mai Province, between the ranges of distribution of the other two species (Map 1).

It has been questioned whether the orientation of the aerial tube is a generic character separating the nearctic genus *Sphodros* from *Atypus* (Gertsch & Platnick, 1980). However, Bösenberg & Strand (1906) had already recorded vertical tubes, attached to trees and bamboos, for the Japanese *A. karschi*. The same type of web was found in *A. suthepicus* n. sp. and *A. dorsualis* and can also be expected in other tropical species. Aerial tubes, horizontally attached to the ground, are probably an adaptation to winter in temperate latitudes, enabling the spider to prey upon arthropods which roam below the snow cover. This is further supported by the fact that not all *Sphodros* in temperate regions construct upright tubes. At least *Sphodros niger* (Hentz), which occurs furthest north (up to 44°N.), constructs horizontal tubes (Beatty, 1986).

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