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The comb-footed spider genera *Neottiura* and *Coleosoma* in Europe (Araneae, Theridiidae)

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The five European species of the genus *Neottiura* are re-examined, with emphasis on genital morphology and copulatory behaviour. Copulation of *N. bimaculata* is close to the *Theridion*-type, with sperm induction as part of copulation. Copulatory posture differs by lack of leg contact during insertion. Species studied are: *N. bimaculata* (LINNÉ, 1767), which is the type species, *N. curvimana* (SIMON, 1914), *N. herbigrada* (SIMON, 1873), *N. suaveolens* (SIMON, 1879) and *N. uncinata* (LUCAS, 1846). A further representative exists in the Far East (Japan, China): *Neottiura margarita* (YOSHIDA, 1985), nov. comb. For *N. herbigrada* two new synonymies are proposed: *Theridion pusillatum* ROEWER, 1942, nov. syn., *T. pustuliferum* LEVY & AMITAI, 1982, nov. syn. In Europe only one species of *Coleosoma* exists, which is a recent newcomer in greenhouses: *Coleosoma floridanum* BANKS, 1900. For this species two new localities are given from Switzerland and Austria (together with some extra-European records). Two new synonymies are proposed for *C. floridanum*, both recently described from the Philippines: *C. saispotum* BARRION & LITSINGER, 1995, nov. syn., and *Theridion antheae* BARRION & LITSINGER, 1995, nov. syn. Copulatory behaviour of *C. floridanum* was observed for the first time. It clearly belongs to the *Theridion*-type.

Keywords: Theridiidae, *Neottiura*, *Coleosoma*, Europe, Mediterraneis, taxonomy, distribution, mating behaviour

INTRODUCTION

The status of *Neottiura* MENGE, 1868 as a full genus has been doubted for a long time (WIEHLE, 1937; LOCKET *et al.*, 1974; ROBERTS, 1995). Even SIMON, who revised this genus first (1873b), later (1914) preferred to place these species as a subgroup of *Theridion*. The sternal knob and femoral spur, characteristic somatic features of the well-known type species *N. bimaculata* (LINNÉ, 1767), are not present in its close relatives. Therefore the generic separation from *Theridion* was not accepted by LEVI & LEVI (1962). Generic status was again proposed by MILLER (1971) and WUNDERLICH (1975) and is also maintained here.

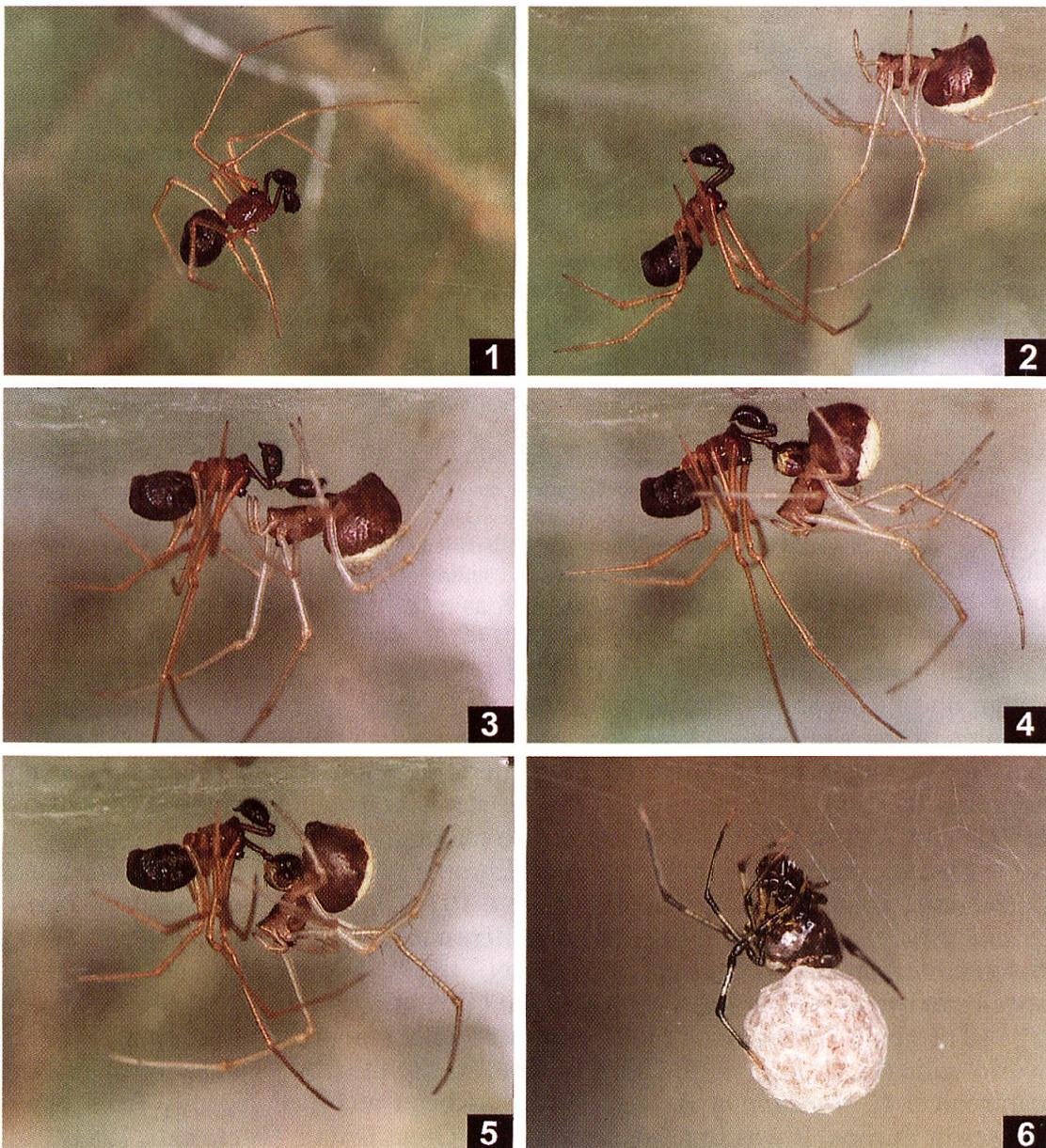
Five species of *Neottiura* occur in Europe: *N. bimaculata*, common, trans-palaearctic, holarctic; *N. curvimana* (SIMON, 1914), west-mediterranean; *N. herbigrada* (SIMON, 1873), probably holomediterranean; *N. uncinata* (LUCAS, 1846), holomediterranean; *N. suaveolens* (SIMON, 1879), sub-mediterranean. Another species exists in the Far East, *N. margarita* (YOSHIDA, 1985).

The genus *Coleosoma* O.P.-CAMBRIDGE, 1882 comprises c. 12 representatives world-wide (PLATNICK, 1993, 1997), all confined to the tropics and subtropics. The pantropical *C. floridanum* BANKS, 1900, has been recorded recently from glass-houses in Europe. It was first mentioned from Great Britain (HILLYARD, 1981), followed by Finland (Turku, KOPONEN, 1990), the Netherlands (HELSDINGEN, 1995) and Berlin (BROEN *et al.*, 1998). Another two records from Basel (Switzerland) and Innsbruck (Austria) are reported here, again from tropical glass-houses.

METHODS

Copulations were observed with a stereomicroscope with horizontal objective body (Nikon SMZ-2B), magnification up to 50x. Two copulations of *N. bimaculata* were videotaped with a SONY DXC-325 P equipped with a macro objective and close-up lenses. For copulatory observations virgin specimens were usually used, males were introduced into the web of the female.

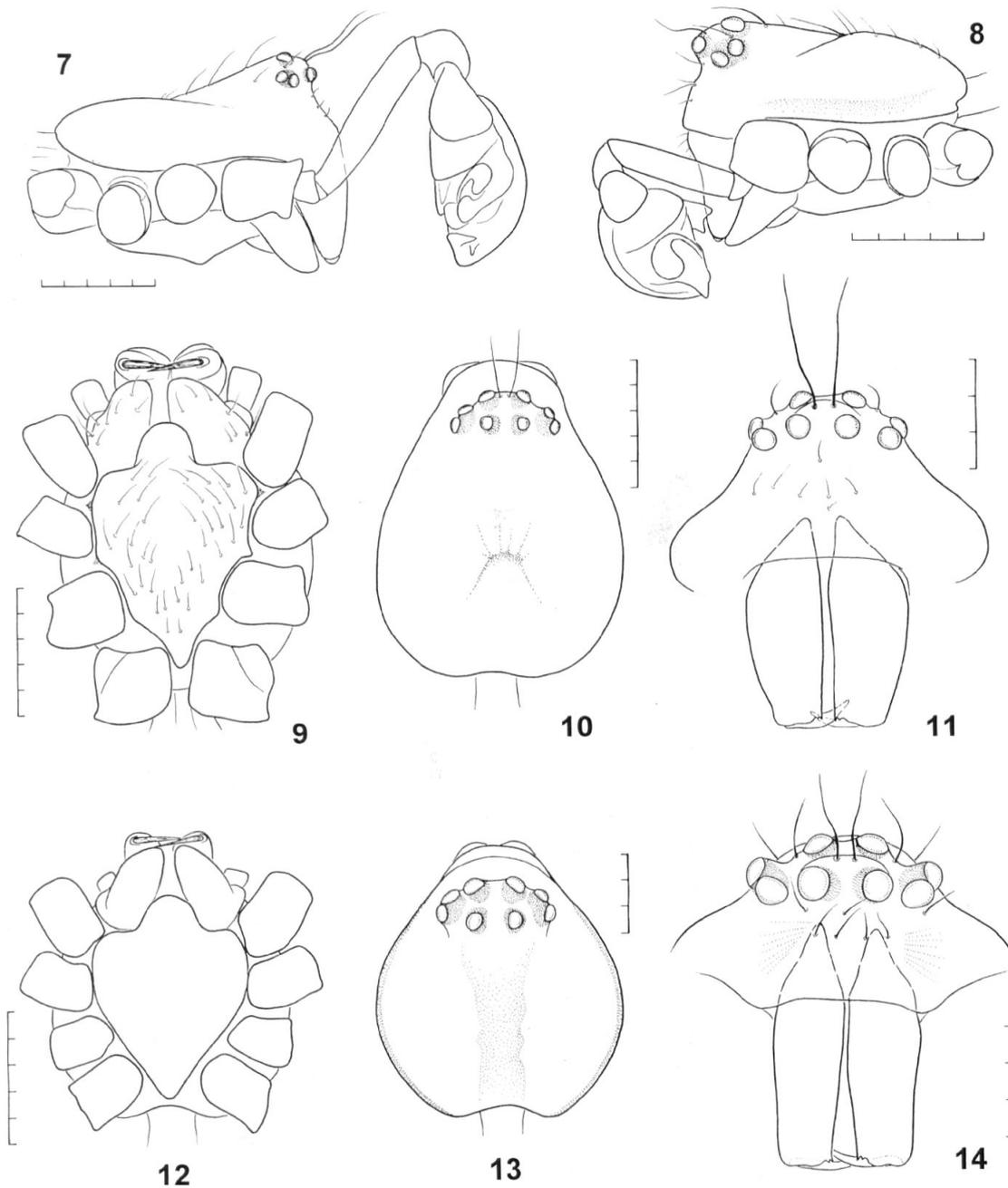
The SEM-micrographs were made with a Leitz AMR 1000 by S. TATZREITER. All measurements in mm. Position of leg spines and trichobothria indicated as a fraction of the length of the respective article (as in Linyphiidae). Figures drawn from right male palp if not indicated otherwise.



Figs 1–6. Mating behaviour of *Neottiura bimaculata* (LINNÉ) (1–5, from S. Tyrol, Brixen). Brood care of *N. herbigrada* (SIMON) (6, Corfu). Male courting (1), approach (2, 3), insertion of left (4) and right palp (5). Female with cocoon attached to spinnerets and held with leg IV (6).

Abbreviations: ALE anterior lateral eyes, AME anterior median eyes. Male palp: C conductor, E embolus, M membrane, Pc paracymbium, S subtegulum, T tegulum, TA 1–3 tegular apophyses 1–3. Copulation: P pseudocopulation, C 1–3 copulatory sequence 1–3.

Depository: CTh THALER collection; HUI Hebrew University of Jerusalem; MHNG Muséum d'Histoire naturelle, Genève; MHNP Muséum d'Histoire naturelle, Paris; NMB Naturhistorisches Museum Basel; NMW Naturhistorisches Museum Wien.



Figs 7–14. *Neottiura bimaculata* (LINNÉ) (7, 10, 11); *N. herbigrada* (SIMON) (9); *Theridion varians* HAHN (8, 12–14). Male prosoma, lateral (7, 8), ventral (9, 12), dorsal (10, 13) and frontal (11, 14). Scale lines: 0.5 mm (7–10, 12), 0.3 mm (11, 13, 14).

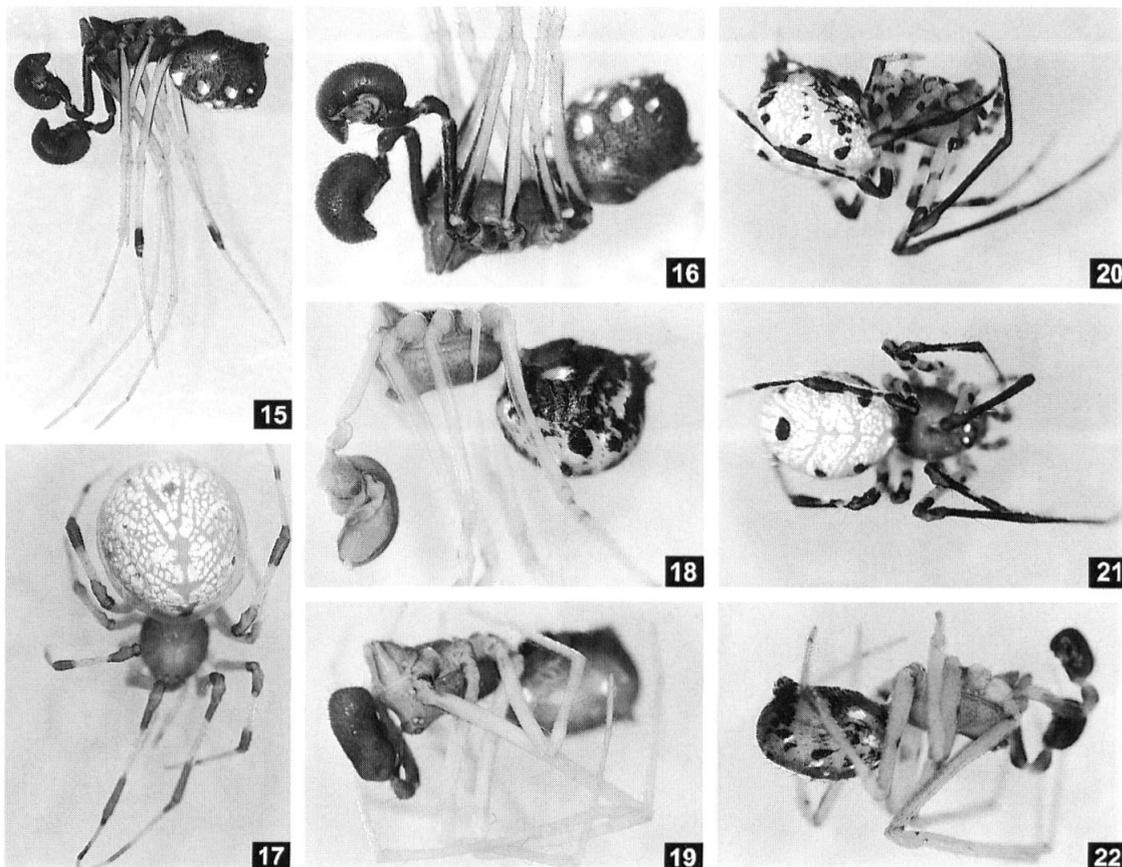
TAXONOMY

Neottiura MENGE, 1868

Etymology: nest guardian, from gr. neottia = nest, oureo = guardian (MENGE, 1868), referring to the brood care behaviour of the females. Type species: *N. bimaculata* (LINNÉ, 1767).

Diagnosis: Total length 2.0–3.7 mm. Carapace longer than wide (Fig. 10). Eye region of male raised, clypeus projecting (Fig. 7). Chelicerae with broad base and short fang, cheliceral apodeme not reaching to anterior eyes (Fig. 11), promargin with 1–2 teeth. Stridulatory organ inconspicuous. Legs long and slender (Figs 1–5). Colulus absent. Male palp large, femur elongate (Fig. 23). Male epigaster not protruding. Integument shiny, with short hairs. Coloration sexually dimorphic, males dark, females bright. Egg-sac attached to spinnerets and held with one leg IV (Fig. 6), carried around when disturbed. This kind of brood-care also observed in *Coleosoma* and *Rugathodes*. Copulation of *N. bimaculata* involves two to three copulatory sequences, each followed by sperm induction. Copulatory posture almost without leg contact. Most species live in the low vegetation layer.

Male palp large, femur and patella sometimes dorsally swollen. Femur 0.6–1.3 mm long (Fig. 23). Tibia ventrally enlarged, dorsally rather constricted, one or



Figs 15–22. *Neottiura suaveolens* (SIMON), male (15, 16, Austria); *N. curvimana* (SIMON), female (17, France), male (18, France); *N. uncinata* (LUCAS), male (19, Mallorca); *N. herbigrada* (SIMON), female (20, 21, Croatia), male (22, Cyprus). Photos from specimens preserved in alcohol.

two retrolateral trichobothria present. Cymbium modified, asymmetrical, extending beyond alveolus, forming a deep cap, narrow in dorsal and ventral view and broad in lateral view. Paracymbium hood-like (Figs 65–68). Subtegulum occupies a considerable part of ventral bulbus (Figs 44–47). Tegulum on dorsal side, therefore largely hidden by cymbium (Figs 56–59). Sperm duct in *N. bimaculata* and *N. uncinata* highly convoluted in tegulum. Conductor as a retrolateral outgrowth of tegulum, strongly sclerotised in *N. bimaculata*, membranous in other species (Figs 50–55). Two to three tegular apophyses present (TA 1–3, Figs 56–64), connected by large membranes, therefore difficult to separate; all without sperm duct. TA 1 elongate, transverse in dorsal-prolateral position, clearly defined, as its dorsal end fits into the paracymbial hood and therefore locks the bulbus internally (= median apophysis sensu LEVI & LEVI, 1962, = theridiid tegular apophysis sensu CODDINGTON, 1990). TA 2 directed in longitudinal axis of bulbus and sometimes bipartite, one part covered with scales. Microsculpture presumably indicates TA 2 as a contact sclerite. TA 3 probably a separate part of TA 2, small and in central position close to the embolus, sometimes missing (*N. curvimana*). Embolar base with condylus which locks into a small tegular pit. Distal embolus short (0.1 mm) in *N. bimaculata*, but up to 2.6 mm long in *N. curvimana*, guided by conductor and sometimes by TA 3. In *N. uncinata* the embolus apparently cannot penetrate the female ducts and therefore may function as a contact embolus (“Anschlußembolus” sensu WIEHLE, 1961).

Neottiura shares the following characters with representatives of the *Theridion varians*-group, which includes the type species of *Theridion*, *T. pictum* (WALCKENAER, 1802): colulus absent, paracymbial hood, cheliceral dentation, number of dorsal setae on tibiae I–IV 2/2/1/2, metatarsus III with trichobothrium; two long hairs on anterior ocular area in male. Characters which may help to separate *Neottiura* from *Theridion*:

| | <i>Neottiura</i> | <i>Theridion</i> |
|--------------------------------------|---------------------------------------|-----------------------------------|
| Male clypeus | projecting (Fig. 7) | not projecting (Fig. 8) |
| Cheliceral apodeme | not reaching to AME (Fig. 11) | almost reaching to AME (Fig. 14) |
| Prosoma and sternum | long (Figs 9, 10) | comparatively short (Figs 12, 13) |
| Legs | long and slender | comparatively stout |
| Male epigaster | not protruding | protruding |
| Integument | glossy, sparse hairs | dull, hairy |
| Male palp | large (Figs 1–5, 15–22) | comparatively small |
| Femur of male palp | long, 0.6–1.3 mm (Fig. 23) | short, 0.3–0.6 mm (Fig. 23) |
| Cymbium | modified, extending beyond alveolus | not modified |
| Tegular apophyses | at least 2 apophyses | at most 2 apophyses |
| Copulatory posture | almost without leg contact (Figs 3–5) | leg contact continuous |
| Sperm induction at end of copulation | yes (Fig. 84) | no (as in Fig. 83) |

Further representative: *Neottiura margarita* (YOSHIDA, 1985), nov. comb.: *Coleosoma margaritum* YOSHIDA, 1985: 177, fig. 19 ♂ ♀. This species was placed

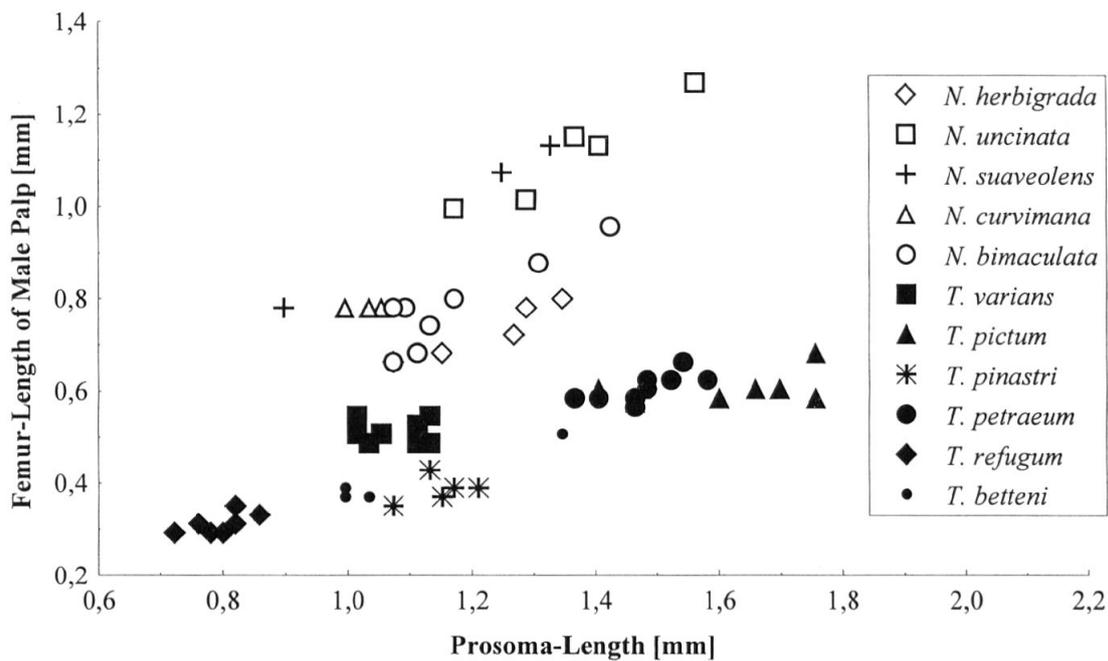


Fig. 23. Relationship of prosoma-length and femur-length of male palp in species of *Neottiura* and *Theridion*.

among *Theridion* by ZHU (1998). The following arguments may justify this further transfer: male palp large, its femur very long; eye region raised, clypeus projecting. Furthermore carapace longer than wide and legs long and slender. General appearance, coloration, pattern and genital organs are similar to *N. herbigrada*. *N. margarita* occurs in Japan and China (YOSHIDA, 1985; CHIKUNI, 1989; ZHU, 1998; SONG *et al.*, 1999).

Distribution: Figs 69, 70. Apart from the widespread trans-palaeartic *N. bimaculata*, *Neottiura*-species show a rather restricted range of distribution. *N. curvimana* is confined to SW. Europe and probably also in NW. Africa, whereas *N. herbigrada* occurs widely along the Northern coast of the Mediterranean Sea from S. France to Israel. The range of *N. uncinata* includes the whole Mediterraneis. *N. suaveolens* is present further north, along a narrow belt in South mid-Europe from W. France to the Urals. *N. margarita* is hitherto known from Japan and China.

Mating behaviour: Figs 1–5, 84. GERHARDT (1924) observed twelve copulations of *N. bimaculata* on June 9, 10 (see also HUBER, 1998). Each palp was inserted once for five minutes and then sperm induction followed (n=8). No further insertions are mentioned. Copulatory posture: female in inclined position, male horizontal (Figs 3–5). These observations were probably incomplete, see below.

Copulatory behaviour of *N. bimaculata* was observed from three pairs from S. Tyrol (Brixen-Bressanone, end of May 1996). Copulation consisted of two to three copulatory sequences, each of them comprising two insertions of left and right palp alternately and followed by sperm induction (Fig. 84). The insertions of the first copulatory sequence lasted on average 3.6 min (min–max 2.8–5.0 min, n=6). Mean insertion duration of the following sequence was lower, $\bar{x}=2.4$ min (min–max

2.0–3.5 min, n=8). After each sequence the male left the female and built the sperm web. Sperm induction proceeded comparatively slowly, 3.5 min on average (min–max 2.7–4.1, n=5); spinning of sperm web took only 30%, the induction itself 70% of that time. The male dipped his palps 31–38 times into the relatively large, white droplet.

All movements of the male are rather slow and cautious. The female usually stays more or less motionless, if not aggressive. Distant courtship was quite indistinct before the first copulatory sequence, but intensive after sperm induction. The male then courted for 6.5 min (n=5) by swinging his palps up and down synchronously or alternately and by intensive, rhythmical body vibration sequences. Male forelegs are moved carefully forwards and backwards in alternation, resulting even in slight plucking at the end of each body vibration sequence. All movements increase in intensity and frequency until the next approach. When close to the female he extends his legs straight downwards (as in Figs 3, 4) and moves in the same way, sometimes touching briefly a female's leg, but often without contact. The female's legs are also extended downwards at the beginning of insertion. Interestingly the male does not move his palps any more during contact courtship. Palpating is only done by the female and is her only distinct movement. Male palps remain immobile, while in *Theridion* palpating is the main movement of contact courtship (KNOFLACH, 1998).

Just before insertion the male moves his palp, which is extended straight forward, slowly to the epigynal protuberance (Fig. 3). Along with this cautious male movement the female changes her position from horizontal to inclined, thereby making insertion possible. Then the palp locks swiftly to the epigynum. No unsuccessful insertion attempts were observed. When locked, the cymbium adjoins the epigastric furrow. Male pumping movements result in a rapid swelling of the haematodochae, which become very voluminous (Figs 4, 5). Because of the position of the haematodochae and sclerites, contralateral insertion must be assumed. Even during insertion the male's legs move continuously forwards and backwards alongside the female. As there is no continuous leg contact, the main contact between male and female is achieved by genitalia coupling alone. With advance of insertion the male pivots and vibrates his opisthosoma intensively against the carapace, which indicates stridulatory activity. In the end the haematodochae deflate gradually, the palp is removed and the opposite one immediately applied in the same manner. During the first copulatory sequence haematodochae inflate only once as in the *Theridion varians*-group. During the following sequences haematodochae inflate typically only in the first half of insertion. Then they abruptly become smaller and pulsate rhythmically, 33–48 times in a 2.2–2.5 min insertion. The meaning of these pulsations is not clear. The entire copulation lasted 30–40 min, with total insertion time of 10–16 min (c. 40%); sperm induction occupied 20% of copulation time. After the last induction the females refused further courting.

These observations only partially agree with GERHARDT (1924): the number of copulatory sequences, of insertions and of sperm inductions is higher. As GERHARDT does not mention haematodochal pulsations, he probably observed only the first sequence.

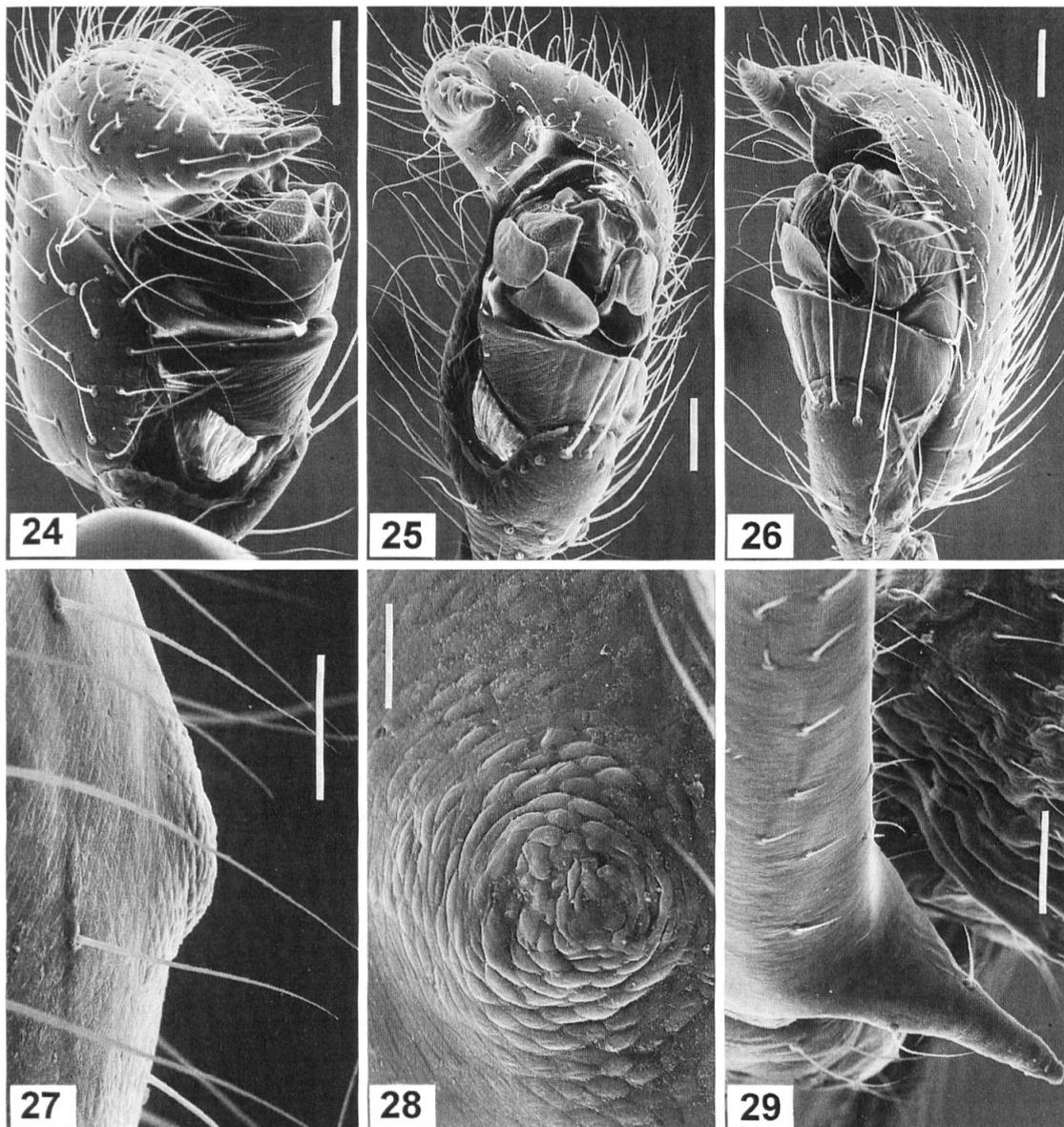
The copulation of *N. bimaculata* is close to the *Theridion*-type (KNOFLACH, 1998), as sperm induction is part of copulation. The male approaches the female for copulation, there is no mating thread as in the *Steatoda* group. The species differs from the *T. varians*-group as follows. There is no close leg contact between male

and female during insertion, number of insertions low, final sperm induction at end of copulation (Fig. 84). In the *T. varians*-group the first copulatory sequence is not preceded by sperm uptake and is a pseudocopulation (KNOFLACH, 1998), which may serve for synchronisation. This sequence of insertions without sperm transfer differs from the true copulatory sequences by short insertion duration and increased number of insertions. Since in *N. bimaculata* insertion duration of the first sequence is highest (Fig. 84), pseudocopulation probably cannot be assumed.

Key to the European species of Neottiura:

- | | | |
|---|--|----------------------|
| 1 | ♂♂ | 2 |
| – | ♀♀ | 6 |
| 2 | Femur IV with posterior spur at base (Fig. 29), sternum with small, central knob (Fig. 28). Cymbium curved and sharply pointed, with additional tooth (Figs 26, 44, 47). Opisthosoma uniformly dark, legs uniformly light yellow (Figs 1–5), conductor characteristic, finger-like (Figs 26, 50) | <i>N. bimaculata</i> |
| – | Femur IV without spur, sternum plain. Cymbium broadly rounded. Opisthosoma usually with pattern. Legs usually with dark markings | 3 |
| 3 | Opisthosoma with tubercle, dorsum dark, with several white spots (Figs 15, 16, 19), palps completely dark. Eyes about equal in size | 4 |
| – | Opisthosoma without tubercle, dorsum brown, with black and white spots (Figs 18, 22), palps only partially dark. Anterior median eyes smaller than others | 5 |
| 4 | Cymbium strongly curved and swollen (Figs 16, 51), bulbus comparatively small. Total length 2.1–2.9 mm | <i>N. suaveolens</i> |
| – | Cymbium long and straight (Figs 19, 53), bulbus strongly developed, embolus conspicuous, straight (Figs 48, 60, 63). Total length 2.6–3.7 mm ... | <i>N. uncinata</i> |
| 5 | Prosoma with median notch on posterior margin; stridulatory ring of opisthosoma forming two lobes. Femora of legs and palps rugose, ventrally covered with hairy warts. Femur and patella of palp swollen (Fig. 22). Cymbium comparatively small, 0.6 mm long. Tegular apophysis 2 distinctly pointed, sickle-shaped (Figs 45, 54, 61) | <i>N. herbigrada</i> |
| – | Posterior margin of prosoma and stridulatory ring of opisthosoma not modified. Femora of legs and palps smooth. Cymbium voluminous (Figs 18, 49, 52, 55), 0.9 mm long. Embolus long, thread-like | <i>N. curvimana</i> |
| 6 | Opisthosoma usually with white to yellow median band on dorsum (Figs 2–4) or completely dark, venter dark. Legs uniformly light yellow. Epigynum strongly protruding (Figs 2, 34, 35) | <i>N. bimaculata</i> |
| – | Opisthosoma speckled, dorsum usually bright white with dark spots (Figs 17, 20, 21), venter dark apart from a transverse median white patch close behind epigastric furrow and small white spots beside spinnerets. Legs light yellow with dark annulations (Figs 6, 17, 20). Epigynum not protruding | 7 |
| 7 | Opisthosoma with tubercle, sometimes inconspicuous. Epigaster unswollen. Palps with dark markings. Introductory ducts forming one or two coils | 8 |
| – | Opisthosoma without tubercle. Epigaster swollen. Palps uniformly light yellow. Introductory ducts strongly coiled, forming a double helix (Figs 38, 39), distal sclerotised part visible through integument | <i>N. curvimana</i> |
| 8 | Tubercle of opisthosoma large, opisthosoma rather high. Total length 3.2–3.4 mm, largest species. Introductory orifices separate, in anterior position, ducts coiled twice, receptacula large (Figs 42, 43) | <i>N. uncinata</i> |

- Tubercle of opisthosoma small, in starved specimens rather inconspicuous. Total length 2.3–3.1 mm 9
- 9 Palps dark brown, only tarsi light. Femora of legs light yellow apart from dark apices. Eyes about equal in size. Epigynum with median hood, introductory orifices separate, in posterior position, ducts forming two coils without overlap (Figs 40, 41) *N. suaveolens*
- Palps annulated. Femora of legs with numerous dark markings. Anterior median eyes smaller than others. Epigynal atrium distinct, introductory ducts short, with only one coil (Figs 36, 37) *N. herbigrada*



Figs 24–29. *Neottiura bimaculata* (LINNÉ), male (N. Tyrol). Left male palp, pro-lateral (24), ventral (25) and retrolateral view (26); sternal knob, lateral (27) and ventral (28), spur on femur IV (29). Scale lines: 0.1 mm (24–26, 29), 0.05 mm (27), 0.02 mm (28).

Neottiura bimaculata (LINNÉ, 1767)

Figs 1–5, 7, 10, 11, 23, 24–35, 44, 47, 50, 56, 64, 65, 84.

Material examined (only southern records):

ITALY: Lombardia: Lake Garda, Val Ampola, 1 ♂, 1 ♀ (CTh), 15.6.1964, leg. THALER. Piemonte: Torino, Val Mastallone, Campello Monti Rimella 12–1920 m, 1 ♂ (NMW), 12.7.1994, leg. KOPE. Southern Alps, Mergoscia, 1 ♂ (CTh), 1.7.1962. Trentino: Trento, Levico-surroundings, 1 ♂ (CTh), 27.8.1991, leg. MINELLI. Veneto: Venice, 1 ♀, July 1985, leg. HANSEN.
TURKEY: Prov. İçel, NW Mersin, E. Arslanköy, 1000 m, 2 ♂♂ (CTh), 12.6.1983, leg. ASPÖCK & RAUSCH.
FRANCE: Corsica: Ostriconi, 15 km N. Ile Rousse, 2 ♂♂ herbage near river, 1 ♀ moist litter in stand of alder, 1 ♀ herbage in wasteland, June 1984, leg. H.G. MÜLLER (all MHNG).
ALGERIA: Aïn Baniou (not localised), 1 ♀ (MHNP, AR 2769), sub *Theridion tamaricis* SIMON, n.nud., together with 1 ♂ of *Theridion melanostictum* O.P.-CAMBRIDGE, 1876.

Description: WIEHLE (1937), LOCKET & MILLIDGE (1953), LEVI (1956), MILLER (1971), BRIGNOLI (1967; ♀), PALMGREN (1974), ROBERTS (1995), ZHU (1998).

Measurements (♂/♀, n=5/5, min–max): Total length 2.3–2.5 / 2.1–3.1, carapace length 1.1–1.2 / 0.9–1.0, width 0.8–0.9 / 0.7–0.9, length femur I 1.8–2.3 / 1.6–1.9, tibia I 1.7–2.3 / 1.3–1.6. Femur of male palp 0.7–0.8 mm long (Fig. 23). Legs: 1423. Number of dorsal setae on tibiae I–IV 2/2/1/2. Trichobothria in pro-dorsal/retrodorsal row on tibia of female palp 2/1, of legs I, II, IV 2/2, III 1/2 (1 ♂, 1 ♀ examined). Metatarsi I–III with 1 trichobothrium, position on I in ♂ 0.52, in ♀ 0.46; ♂ (♀) metatarsi I–IV 3.2 (2.5), 2.5 (1.8), 1.9 (1.8), 2.5 (2.1) times longer than tarsi, c. 1.2 times longer than tibiae. Tarsal claws with 5–6 side teeth.

Somatic features: Figs 1–5, 7, 10–11, 24–29. Eye region raised, cheliceral apodeme not reaching to anterior eyes (Fig. 11). Eyes about equal in size. Chelicerae with two denticles on promargin. Sternum with central knob. Femur IV with posterior spur at its base. Legs long and slender. Male stridulatory organ inconspicuous. Epigaster not protruding. Colulus absent. Hairs short, integument shiny.

Coloration (mid-European specimens, Figs 1–5): Carapace brown, with dark postcephalic region; females with fine, dark margin. Sternum, gnathocoxae and chelicerae brown. Legs uniformly bright yellow. Cymbium and tibia of male palp black. Female palp yellow. Opisthosoma uniformly dark in males, in females usually with broad white to yellow median band on dorsum, sometimes dark.

Geographic variation: Specimens from Mediterranean countries differ in colour or dimensions. It is not yet possible to judge precisely this variation.

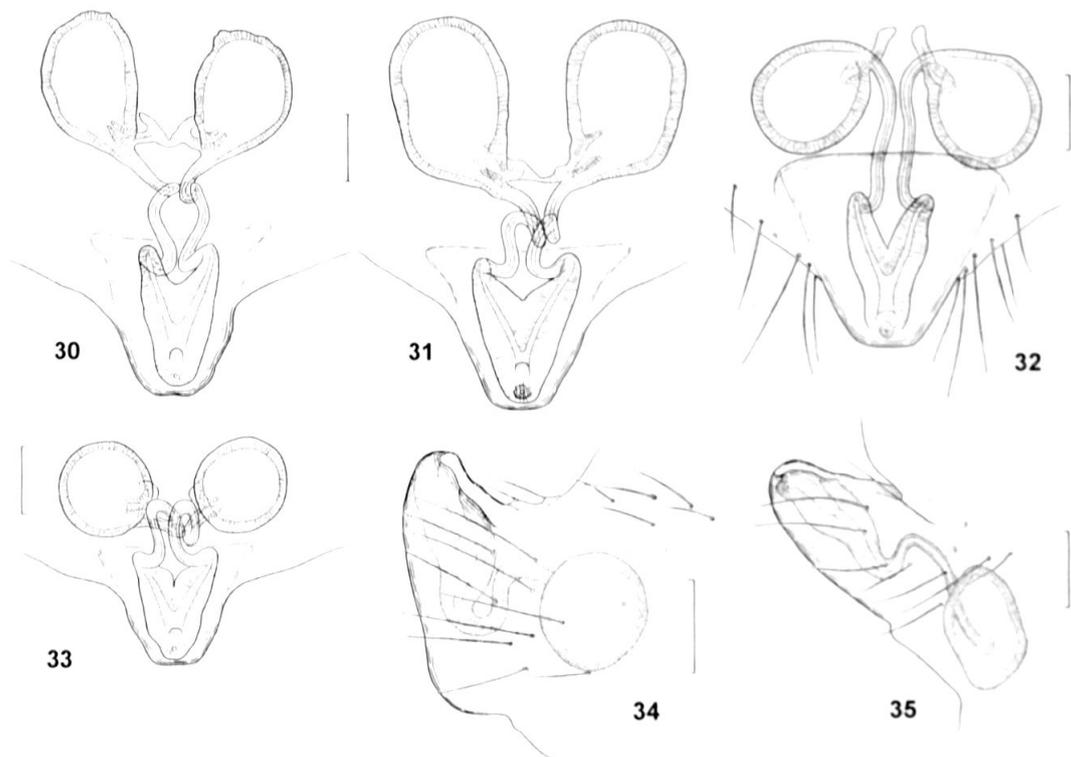
SIMON (1873a) described *N. pellucida* from Corsica and later (1914) downgraded it as a subspecies, *N. bimaculata pellucida*. It differs from mid-European specimens by lighter coloration: carapace, sternum, labium yellow; gnathocoxae and chelicerae yellow in female, reddish-brown in male; opisthosoma light brown, one female with faint white band. Male palps light reddish-brown, cymbium also light brown. Sternal knob inconspicuous, femoral spur present. Body size similar to mid-European specimens (♂/♀, n=2/2, min–max, total length 2.2–2.5 / 2.5–2.9, carapace length 1.1–1.2 / 1.0, width 0.9–1.0 / 0.8–0.9), but legs longer (length femur I 2.3–2.6 / 2.1–2.2, tibia I 2.3–2.5 / 1.8–1.9). Male palps correspond likewise, but distal part of cymbium more slender and cymbial tooth slightly more protruding (arrow, Figs 47 vs 44). Epigynum/vulva: sclerotised parts of ducts more diverging than in mid-European females, receptacula noticeably larger (Figs 30, 32 vs 31).

The single female from Algeria again differs by its pale yellow colour. Carapace with dark margins and median stripe, opisthosoma bright white, except a dark transverse patch on venter between epigynum and spinnerets. Measurements similar to mid-European females (total length 2.3, carapace length 0.9, width 0.8, length femur I 1.6, tibia I 1.3).

Two males from Turkey differ from mid-European conspecifics by larger size: Total length 2.8–3.2, carapace length 1.3–1.4, width 1.0, length femur I and tibia I 2.5–2.6. Femur of male palp 0.9–1.0 mm long. The spur on femur IV is twice as long as in the males from N. Tyrol, Italy and Corsica, 0.26 (n=2) vs 0.13 mm (n=7). Palpal structures fit well to mid-European ones.

Male palp: Figs 24–26, 44, 47, 50, 56, 64, 65. Patella dorsally slightly swollen. Tibia 0.3 mm long, ventrally enlarged; two retrolateral trichobothria present. Cymbium 0.7–0.8 mm long, asymmetrical, extending far beyond alveolus and ending as strongly curved, sharply pointed tip on prolateral side, with additional tooth near tip (Figs 25, 26, 44, 47, 50). Paracymbium hood-like (Fig. 65). Subtegulum on ventral side of bulbus, tegulum on dorsal side and therefore largely hidden by cymbium. Sperm duct highly convoluted in tegulum (Fig. 56), altogether 3 mm long, tegular loops 2 mm. Conductor as strong, finger-like, retrolateral outgrowth of tegulum, distally broadened, with shallow concavity for embolus (Figs 26, 44, 47). Three tegular apophyses present. TA 1 elongate, in dorsal-prolateral position, with broadly rounded ventral end (Fig. 24). TA 2 close to it, bipartite, basal part smooth, distal part covered with scales. TA 3 is probably a separate part of TA 2, small and close to embolus, its distal end lamellate, weakly sinuous, tapering (Fig. 64). Embolar base broad when compared with distal part, with condylus as a locking mechanism into small tegular pit. Distal embolus starts on proximal, ventral side of base, and turns distally, rather short (0.1 mm), guided by conductor and also by TA 3 (Fig. 64).

Epigynum/vulva: Figs 30–35. Epigynum strongly protruding forwards (Figs 34, 35), posterior sclerotised part 0.20–0.25 mm long. Epigynal atrium tiny



Figs 30–35. *Neottiura bimaculata* (LINNÉ), female (30, 32, 33–35 N. Tyrol; 31 Corsica). Epigynum/vulva, oral (30, 31, 33), aboral (32), lateral view (34, 35). Scale lines: 0.1 mm.

(0.02 mm wide), on top of protuberance. Introductory ducts heavily sclerotised near entrance, lumen narrow compared with thick walls. Distal ducts slender and less sclerotised, coiled or straight (Figs 30–33). Total length of introductory ducts c. 0.4 mm. Receptacula with regular microsculpture.

Habitat, natural history: *N. bimaculata* is classified as euryoecious, with tendency to hygrophily (BRAUN & RABELER, 1969). It is present in a wide spectrum of habitats, from the sea coast to the montane zone of the Alps, often in meadows, but also in forests and gardens, with preference for moist and open places (see HÄNGGI *et al.*, 1995). In the Alps not above 1000 m. One wind-blown juvenile was even found at the summit of Mt. Sulzkogel at 3000 m (THALER, 1994; KNOFLACH & THALER, 1998). High records in the Pyrénées are at 1800 m (DENIS, 1951), in Andorra 1025–1080 m (DENIS, 1938), in Sicily 1100 m (BRIGNOLI, 1968), and in Turkey 1000 m. *N. bimaculata* is stenochronous in summer, males are mature at end of May and in June and July. Females guard their cocoon from July onwards, attached to the spinnerets and held with one leg IV. Egg-sac bright white, globular, with fine, outer envelope and rough, woolly inner layer, containing 20–40 eggs (HOLM, 1940). Two females brought together tried to take the cocoon from each other (NIELSEN, 1932a, 1932b). The snare consists of a few delicate irregular threads, most of them provided with viscid droplets (NIELSEN, 1932a). No parasites are known from this common species. *Ero furcata* (VILLERS, 1789) was observed once as predator (BRISTOWE, 1941).

Distribution: Trans-palaeartic (MARUSIK, 1994; MIKHAILOV, 1997, 1998), holartic (PLATNICK, 1997), also present in China (ZHU, 1998; SONG *et al.*, 1999), Mongolia (MARUSIK & LOGUNOV, 1998), Japan (CHIKUNI, 1989) and on the Pacific coast of North America (LEVI, 1956). *N. bimaculata* is widespread throughout Europe, northernmost records come from Fennoscandia, Finland at 64°N (PALMGREN, 1974), S. Sweden (TULLGREN, 1949), but in Norway further north up to Northern Finmark (HAUGE, 1989). In Southern Europe it is known from almost all countries on the northern border of the Mediterranean sea: France (Var, DENIS, 1935; Pyrénées, BOSMANS & DE KEER, 1985; VANUYTVEN *et al.*, 1994), Portugal (BACELAR, 1928), Spain (VANUYTVEN *et al.*, 1994), Italy (Sicily, BRIGNOLI, 1968; Calabria, BRIGNOLI, 1969; Venice, HANSEN, 1988), Croatia (CHYZER & KULCZYŃSKI, 1894). Further records from Balkan countries, Serbia (STOJIČEVIĆ, 1929), Macedonia and Bulgaria (DRENSKY, 1936; DELTSHEV, 1992). Its distribution in North Africa and the Near East is insufficiently known. The female from Algeria probably is the first record of *N. bimaculata* from North Africa. The species apparently does not occur in Israel (LEVY, 1998), but is now recorded from Anatolia. – *N. b. pellucida* has been recorded from Corsica (SIMON, 1873a), Italy, Lazio (BRIGNOLI, 1967) and Spain (GALIANO, 1910).

Neottiura curvimana (SIMON, 1914)

Figs 17, 18, 23, 38, 39, 49, 52, 55, 69.

Material examined:

FRANCE: Landes de Gascogne: Mimizan, Sabres, ft de Seugnos, 3 ♂♂, 2 sad♂, 1 ♀ (MHNP AR 2541), det. SIMON (SIMON, 1914; type serie). Pyrénées Orientales: Banyuls, 1 ♀ (MHNP AR 2824), det. FAGE. "Gallia", 7 ♀♀ (MHNP AR 2542, sub *T. suaveolens*, det. SIMON).

ALGERIA: Dj. Edough near Annaba, 2 ♀♀ (MHNP AR 2771, sub *T. herbigrada*, det. SIMON).

Description: SIMON (1914), VANUYTVEN *et al.* (1994).

Measurements (♂/♀, n=3/7, min–max): Total length 2.2 / 2.0–3.0, carapace length 1.0 / 0.8–1.0, width 0.8–0.9 / 0.6–0.9, length femur I 1.8–1.9 / 1.3–1.8, tibia I 1.6–1.8 / 1.0–1.6. Femur of male palp 0.8 mm long (Fig. 23).

Somatic features: Anterior median eyes smaller than others. Opisthosoma without tubercle (Figs 17, 18). Coloration: Carapace, sternum and chelicerae brown. Male palps brown, darker than legs, female palps light yellow, only distal half of tarsi weakly darkened. Legs of male yellow brown with slightly darkened patellae and dark distal tibiae and metatarsi. Female legs light yellow, with more extensive dark annulations than in male. Male opisthosoma light brown, with black and white patches on dorsum; venter dark, apart from a transverse median white patch close behind epigastric furrow and two small white spots beside spinnerets. Female opisthosoma bright white on dorsum (Fig. 17), usually with two paramedian rows of small dark spots and one single median spot posteriorly. Venter as in male.

Male palp: Figs 49, 52, 55. Patella dorsally swollen. Tibia c. 0.4 mm long, with one retrolateral trichobothrium. Cymbium 0.9 mm long, broadly rounded and slightly bent, covering a large part of prolateral bulbus. Tarsal organ in distal position, alveolus rather large. Tegulum and TA 1 largely hidden by cymbium, tegulum with only one loop of sperm duct (Fig. 55). The long, membranous conductor arises from retrolateral side of tegulum and projects beyond cymbium. Tegular apophyses elaborate, with large membranes. TA 2 finger-like, arched, covered with scales. Embolus longer than male body, c. 2.6 mm, thread-like. It runs along subtegulum, emerges dorsally and turns along alveolus to furrow of conductor, forming a distal coil. Embolar base retrolateral, lobed.

Epigynum/vulva: Figs 38, 39. Epigaster distinctly swollen. Epigynal atrium small, 0.04 mm wide. Introductory ducts c. 2.2 mm long, heavily coiled, forming a double helix, a large outer one winding posteriorly and an inner one winding anteriorly. Before entering the receptaculum each duct turns to mid-line and becomes strongly sclerotised, with narrow lumen. This sclerotised portion is visible through the integument.

Distribution, habitat: Fig. 69. *N. curvimana* apparently is confined to SW. Europe, known only from W. and S. France (SIMON, 1914) and Spain (VANUYTVEN *et al.*, 1994). In the Paris museum a vial from Algeria was found, which probably indicates the occurrence of this species also in North Africa. In the type locality (Landes de Gascogne) it was collected from low vegetation in a plantation of cork-oak (SIMON, 1914): “sur les herbes dans les bois de chênes-liège”.

Neottiura herbigrada (SIMON, 1873)

Figs 6, 9, 20–23, 36, 37, 45, 54, 58, 61, 67, 69.

Theridion pusillum KULCZYŃSKI, 1905; ♂ ♀, n.sp., p. 442, figs. 6, 9, 10, 21, Madeira, **nov. syn.**

Theridion pusillatum ROEWER, 1942, nom. nov. for *T. pusillum*, preoccupied; **nov. syn.**

Theridion pustuliferus LEVY & AMITAI, 1982; ♀, n.sp., p. 119, figs 76–78, type locality: Israel, Jerusalem; **nov. syn.**, examined.

Theridion pustuliferum; LEVY (1998), ♀, p. 215, figs 409–410.

Theridion herbigrada; VANUYTVEN *et al.* (1994), ♂, fig. 9.

Achaearanea herbigrada; PLATNICK (1997).

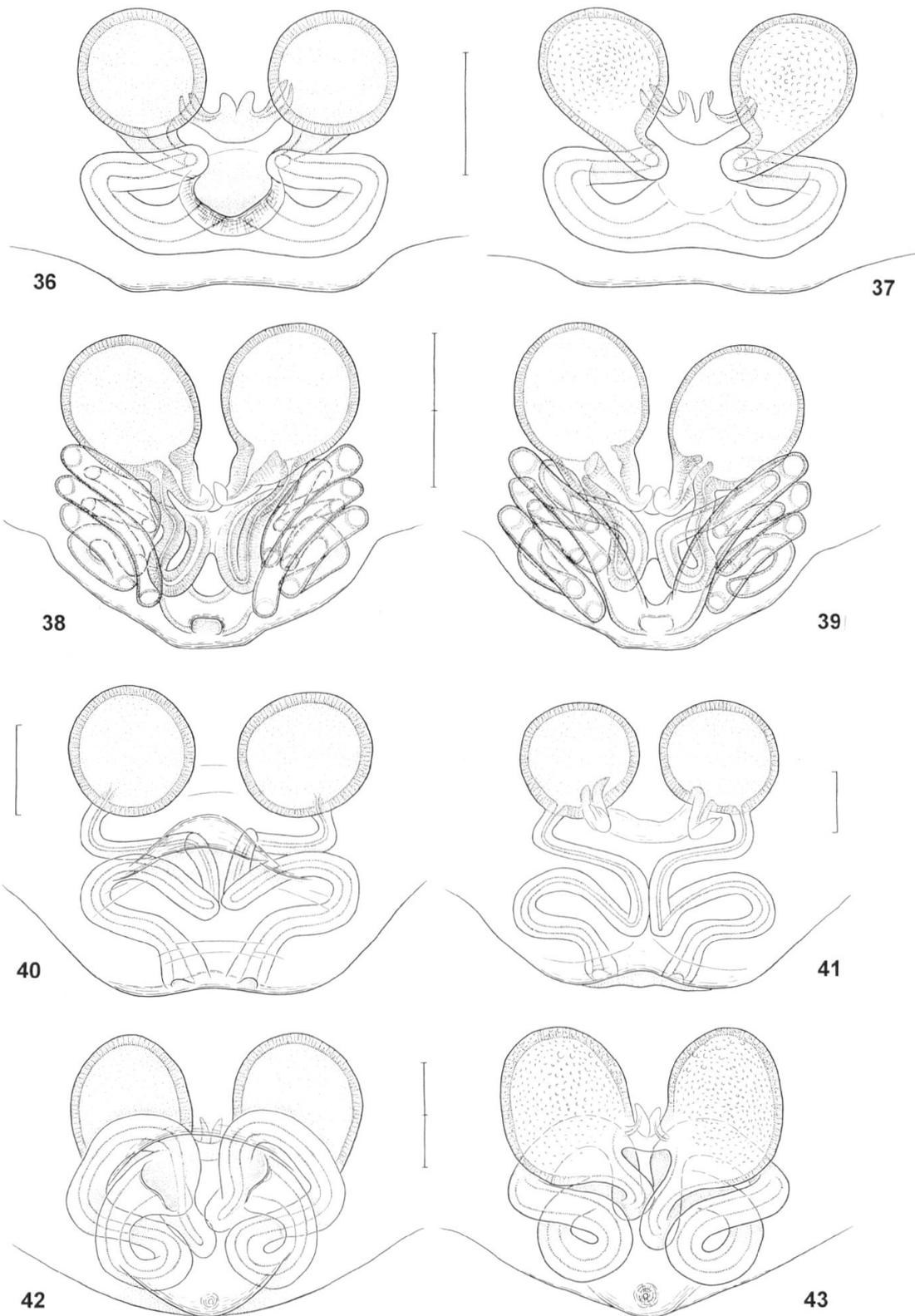
Material examined:

FRANCE: Cagnes near Nice, vallée des Vaux, 1 ♀ (MHNP AR 2545), det. SIMON. Menton near Nice, 1 ♂, 3sad♂ (MHNP AR 2793), 22.5.1915, det. SIMON. Corsica: 2 ♂♂, 6 ♀♀ (MHNP AR 2538), det. SIMON.

ITALY: Lombardia: Lake Garda, Riva, Mt. Brione, 1 ♀ (CTh), 13.6.1964, leg. THALER.

CROATIA: Istria, Rovinj, 1 ♀ (CTh), 30.7.1965, leg. THALER. Dalmatia, S. Dubrovnik, Mlini, 2 ♀♀ (NMW, HUI), 9.6.1998, leg. BUCHAR.

GREECE: Corfou, Dasia, Kato Korakiana 100 m, Olive grove, under stone, 1 ♀ (CTh), 30.5.1996, leg. KNOFLACH & THALER. Attica, Sounion, 1 ♂ (NMB), 11.4.1979, leg. DÉTHIER. N-Peloponnesos, Gerania, Loutraki, 2 ♂♂ (CTh), 24.4.1994, leg. HEISS. S-Peloponnesos, Lakonia, Githio,



Figs 36–43. *Neottiura herbigrada* (SIMON) (36, 37 Lake Garda); *N. curvimana* (SIMON) (38, 39 France); *N. suaveolens* (SIMON) (40 France; 41 Austria); *N. uncinata* (LUCAS) (42, 43 Peloponnesos). Epigynum/vulva, ventral (36, 38, 40, 42), dorsal (37, 39, 41, 43). Scale lines: 0.1 mm (36, 37, 40, 41), 0.2 mm (38, 39, 42, 43).

Elos-Scala, 1 ♂ (HUI), 29.4.1994, leg. HEISS. NW-Crete, Akrotiri, Gouverneto, Agia Triada, 1 ♂ (NMW), 28.4.1990, leg. SCHEDL.
 CYPRUS: Limassol, Curium, 2 ♂♂ (CTh), 15.2.1994 (adult at end of February). Akamas, Fontana Amorosa, Isad♂, 16.2.1995 leg. KNOFLACH & THALER.
 ISRAEL: Kefar Gil'adi, 1 ♀ (HUI 13004), 6.4.1975, leg. AMITAI (holotype of *T. pustuliferum*).

Description: SIMON (1881), VANUYTVEN *et al.* (1994).

Measurements (♂/♀, n=5/5, min–max): Total length 2.3–3.1 / 2.0–2.7, carapace length 1.2–1.3 / 0.8–1.0, width 0.9–1.0 / 0.7–0.9, length femur I 1.7–2.0 / 1.2–1.6, tibia I 1.5–1.8 / 1.0–1.2. Femur of male palp 0.7–0.8 mm long (Fig. 23).

Somatic features: Anterior median eyes smaller than others. Opisthosoma with small tubercle in female, absent in male (Figs 20–22). Male: Femora of palps and legs covered ventrally with rows of hairy warts, on femur I often absent. Posterior border of carapace with median notch, petiolus freely visible. Sclerotised ring of opisthosoma divided into two lobes. Coloration: Carapace, sternum and chelicerae uniformly reddish-brown in males, in females light to dark brown, carapace with reticulate pattern on margin and postcephalic region. Legs light yellow, with dark patches and stripes of variable extent, distal rim of coxae darkened, femora with dark spots (Figs 6, 20–22). Male palps dark, female palps light brown, distal joints darker. Male opisthosoma on dorsum brown, with pattern of black and white patches, female white, with several black paramedian spots and one median spot on tubercle. Venter dark, similar to *N. curvimana*, see Fig. 6.

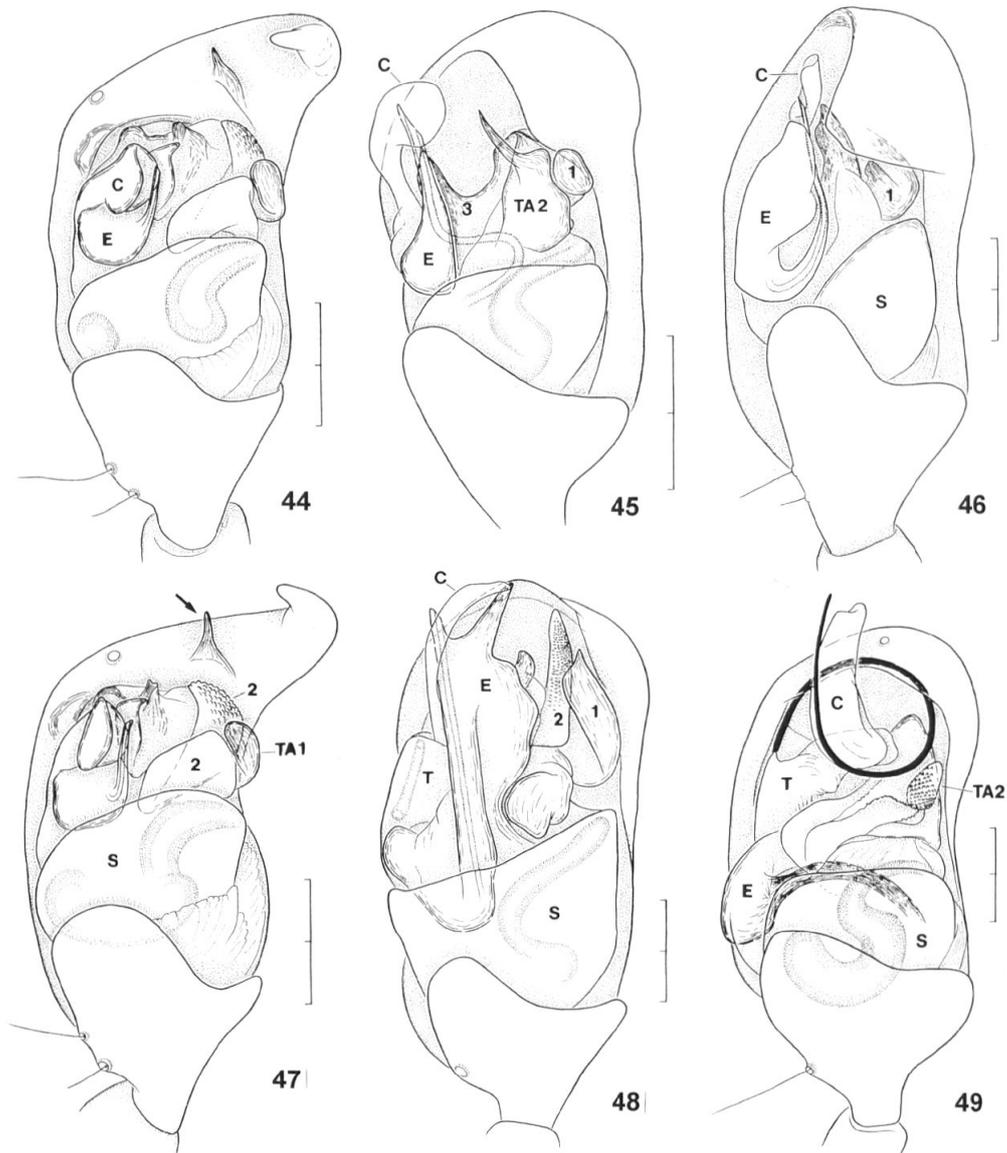
Male palp: Figs 45, 54, 58, 61, 67. Femur and patella distally swollen. Tibia 0.3 mm long, with one trichobothrium. Cymbium comparatively small, 0.6 mm long, broadly rounded, distal end slightly bent to prolateral side. Paracymbial hood retrolateral, distal (Fig. 67). Tegulum small as compared with its congeners, with straight course of sperm duct (Fig. 58). Sperm duct c. 1 mm long. Conductor membranous, broad at end. TA 1 elongate, rounded at both ends. TA2 conspicuous, pointed, in side view sickle-shaped (Figs 58, 61). TA 3 present, all sclerites connected by large membranes. As in *N. bimaculata* a triangular part of TA3 supports the embolus. Embolar base small, distal embolus rather short (0.15 mm long) and straight, starting from apical part of base and therefore without turn (Figs 45, 54, 61).

Epigynum/vulva: Figs 36, 37. Epigynal atrium 0.06 mm wide. Introductory ducts 0.2 mm long, rather broad, evenly sclerotised, forming one coil, entrance into receptacula broad. Receptacula with regular microsculpture (Fig. 37).

Synonymy: *Theridion pustuliferum* LEVY & AMITAI, 1982 corresponds well to *N. herbigrada*: Epigynal atrium and course of introductory ducts are almost identical, see LEVY & AMITAI (1982) and LEVY (1998). Somatic characters agree with *N. herbigrada*: total length 2.0–2.9 mm, coloration, opisthosoma with tubercle. Records of *T. pustuliferum* from China (ZHU, 1998; SONG *et al.*, 1999) should be corroborated by capture of males. The identity of the "*Achaearanea*" *herbigrada* female drawn by DENIS (1962) still must be investigated.

Also *T. pusillatum* from Madeira is close to *N. herbigrada* (see KULCZYŃSKI, 1905): Opisthosoma of female with small tubercle and similar pattern, male palp large, femur 0.65 mm long, cymbium rounded, TA 2 pointed, conductor and embolus almost identical. It is placed therefore in synonymy of *N. herbigrada*. Unfortunately no material from the type region was available. The species has been recollected only once on Madeira (Rabaçal; DENIS, 1962).

Distribution, natural history: Fig. 69. *N. herbigrada* is widespread along the northern coast of the Mediterranean Sea, from France to Israel. Hitherto not known



Figs 44–49. *Neottiura bimaculata* (LINNÉ) (44 N. Tyrol, 47 Corsica); *N. herbigrada* (SIMON) (45 Cyprus); *N. suaveolens* (SIMON) (46 Austria); *N. uncinata* (LUCAS) (48 Mallorca); *N. curvimana* (SIMON) (49 Landes de Gascogne). Male palp, ventral view. Scale lines: 0.2 mm. 1–3: tegular apophyses 1–3.

from Spain, peninsular Italy, Sardinia, Sicily and N. Africa. Records come from S. France, Pyrénées Orientales (BOSMANS & DE KEER, 1985), Alpes-Maritimes (SIMON, 1914), Corsica (type locality Ajaccio; SIMON, 1881; CANARD, 1989), from Italy, northernmost record at Lake Garda; Croatia (DRENSKY, 1936), Bosnia; Greece, Attica (HADJISSARANTOS, 1940), Corfu and Crete, Cyprus and Israel (LEVY, 1998). Probably also on Madeira (KULCZYŃSKI, 1905). The female recorded from Madeira, Rabaçal (SCHENKEL, 1938) was identified as *Achaearanea acorensis* (BERLAND, 1932) by DENIS (1962). Concerning its presence in the Far East, see above.

All captures come from low elevation, near the coast. Habitat and phenology as in *N. uncinata*, stenochronous in spring (April). Adult males on Cyprus already

at end of February. Females with cocoons were found in Israel in April (LEVY & AMITAI, 1982), on Corfu in May. Egg-sac white, spherical, 2 mm in diameter (Fig. 6), containing c. 30 eggs (LEVY & AMITAI, 1982).

Affinities: *Neottiura margarita* (YOSHIDA, 1985) from Japan and China apparently is close to *N. herbigrada* in general appearance and genital morphology. Cymbium and conductor are of similar shape, but embolus curved, TA 2 less pointed. Female introductory ducts more slender.

Neottiura suaveolens (SIMON, 1879)

Figs 15, 16, 23, 40, 41, 46, 51, 59, 62, 66, 70.

Dipoena regia DRENSKY, 1929, p. 33 (WUNDERLICH, 1977: 289), mis-spellings: *D. regina* DRENSKY (1929: 69), *D. regalis* DRENSKY (1929: 76).

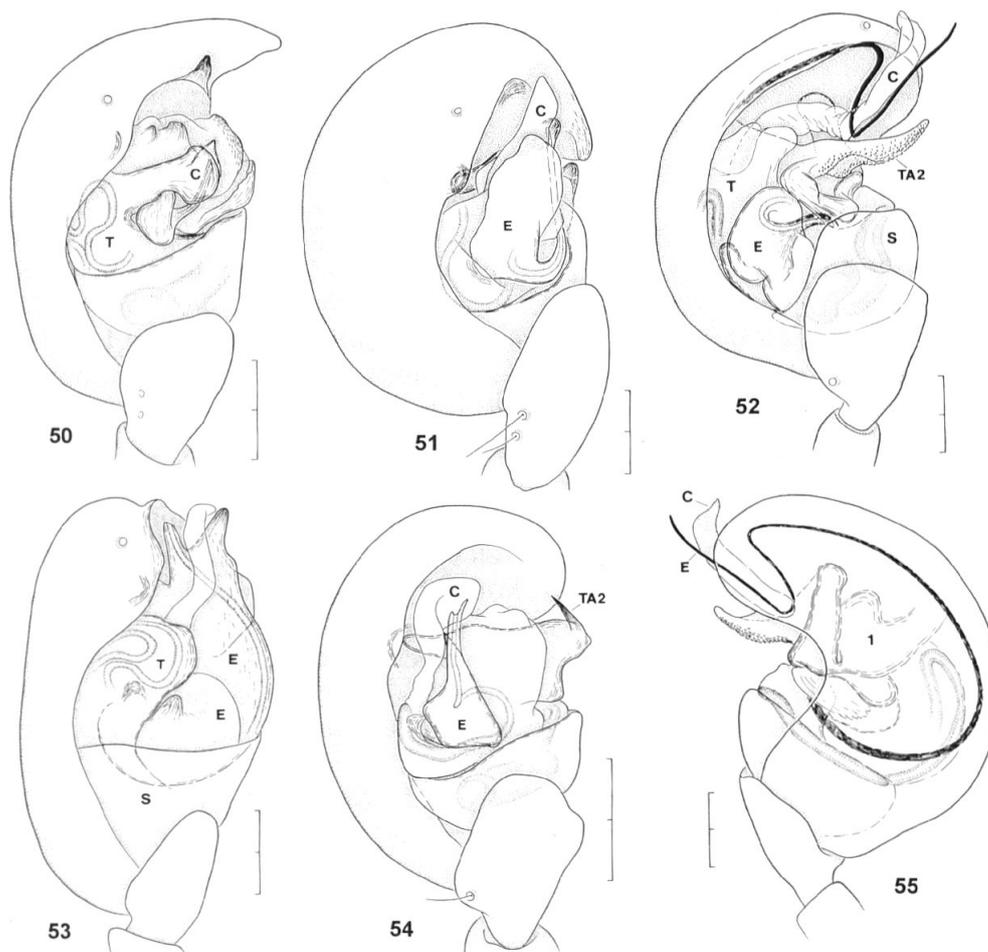
Material examined:

AUSTRIA: Burgenland: Rabenkropf near Ritzing, 1 ♂ (CTh), 11.6.1984, leg. BUCAR; Parndorf, 2 ♂♂, 1 ♀ (CTh), July 1988, leg. STEINBERGER & THALER.

SWITZERLAND: Vaud: Essertines, 1 ♀ (MHNG), 4.7.1955, leg. COMELLINI.

FRANCE: St-Saud (near Perigueux), 2 ♀♀ (MHNP AR 2546), 1918, det. SIMON.

SPAIN: Cartagena, 2 ♂♂, 2 ♀♀ (MHNP AR 2544), det. SIMON.



Figs 50–55. *Neottiura bimaculata* (LINNÉ) (50 N. Tyrol); *N. suaveolens* (SIMON) (51 Austria); *N. curvimana* (SIMON) (52, 55 Landes de Gascogne); *N. uncinata* (LUCAS) (53 Mallorca); *N. herbigrada* (SIMON) (54 Cyprus). Male palp, retrolateral view. Scale lines: 0.2 mm. 1: tegular apophysis 1.

Description: SIMON (1881), MILLER (1971) ♂ ♀; WUNDERLICH (1975) ♀; ESYUNIN & EFIMIK (1995) ♀, POZZI & HÄNGGI (1998).

Measurements (♂/♀, n=3/2, min-max): Total length 2.1–2.9 / 2.2–2.3, carapace length 0.9–1.3 / 0.9–1.0, width 0.7–1.0 / 0.8, length femur I 1.4–2.0 / 1.3, tibia I 1.8–1.9 / 1.0. Femur of male palp 0.8–1.1 mm long (Fig. 23).

Somatic features: Eyes equal in size. Opisthosoma with tubercle (Figs 15, 16). Coloration: Carapace and sternum dark brown, chelicerae reddish brown. Legs light yellow, coxae faintly darkened, femora I–IV with dark longitudinal stripes. In male distal tibiae I and IV dark, in female also patellae and distal metatarsi. Palps dark brown, in female tarsi light. Opisthosoma in male dark brown, with 10–15 white spots in 2–3 rows, one median spot on tubercle; in female dorsum white to reticulate, with few paramedian dark spots and a median one on tubercle. Venter as in *N. curvimana* and *N. herbigrada*.

Male palp: Figs 46, 51, 59, 62, 66. Patella distally swollen. Tibia 0.5 mm long, with two trichobothria. Cymbium 0.9 mm long, strongly swollen (Figs 15, 16, 51) and curved, its distal end recurved (Figs 46, 66). Subtegulum oblique (Fig. 46), tegulum with only one loop of sperm duct (Fig. 59). Sperm duct c. 2 mm long. Distal sclerites comparatively small. Conductor inconspicuous, membranous. Tegular apophyses small, close together, apparently more fused than in the other species (Figs 59, 62). TA 1 rather short, prolateral edge with scales. TA 2 broadly connected to TA 1, finger-like, covered with scales. TA 3 pointed, close to embolus. Embolar base large, with reticulate surface, embolus starting from proximal part of base, 0.5 mm long and slender.

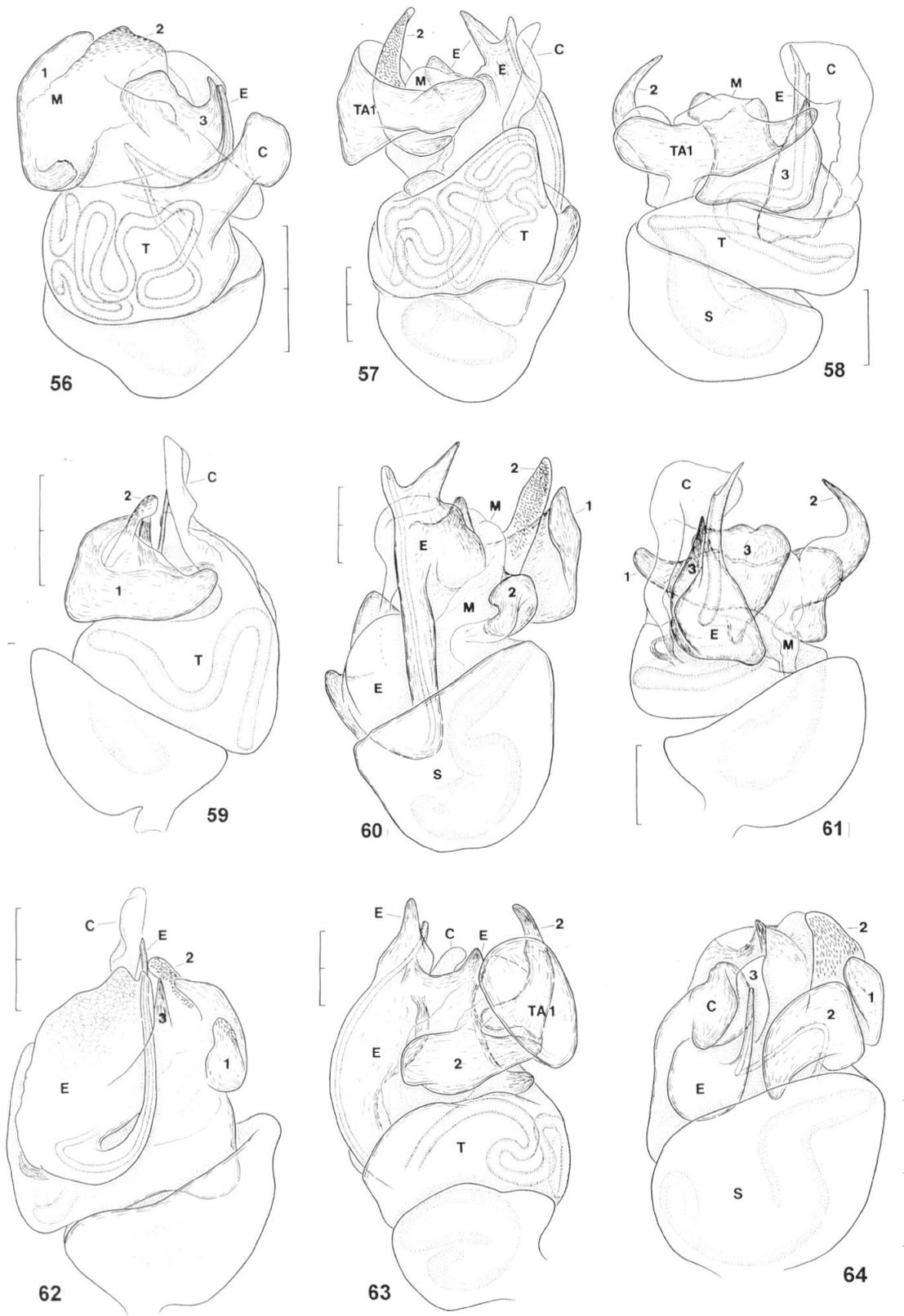
Epigynum/vulva: Figs 40, 41. Introductory orifices separate, in posterior position, not fused in common atrium. There is a conspicuous median hood, which may have a locking function. Introductory ducts evenly sclerotised, 0.5–0.7 mm long, forming a double coil almost without overlap, entrance into receptacula abrupt.

Distribution, habitat: Fig. 70. *N. suaveolens* was described from two localities from W. France (Paris, forêt de Fontainebleau; Gironde, forêt de la Teste; SIMON, 1879). Its range forms a narrow belt in S. mid-Europe, from the Atlantic coast of France to Romania (WEISS, 1984), easternmost localities in Russia in Urals (ESYUNIN & EFIMIK, 1995) and the Russian plain (MIKHAILOV, 1997). It is known from France (SIMON, 1914), Switzerland (MAURER & HÄNGGI, 1990), Germany (WUNDERLICH, 1975), Austria (KNOFLACH & THALER, 1998), Czech Republic (MILLER, 1971; BUCAR, 1992), Slovakia (GAJDOŠ *et al.*, 1992), Hungary (SAMU & SZINETÁR, 1999). Southern localities are from NE-Spain (Barcelona; ESPUNY *et al.*, 1994), N. Italy (NOFLATSCHER, 1991), Macedonia (DRENSKY, 1929; sub *Dipoena regia*) and Bulgaria (DELTSHEV, 1992). Probably the record of SIMON (1881) “nord d’Italie” also refers to S. Tyrol, as he received specimens from L. KOCH. Most records are at low elevation, in Ticino it was collected at 800–1000 m (HÄNGGI, 1992). In mid-Europe *N. suaveolens* is present only in very warm regions. It has been collected at xerothermic sites, from the herbaceous layer, in feather grass (*Stipa*) steppe (WEISS, 1984; POZZI & HÄNGGI, 1998), but also in floodland meadows in the Urals (ESYUNIN & EFIMIK, 1995). In its phenology *N. suaveolens* corresponds to *N. bimaculata*, adult males in June and July. Females carry around the white egg-sac (SIMON, 1879).

Neottiura uncinata (LUCAS, 1846)

Figs 19, 23, 42, 43, 48, 53, 57, 60, 63, 68, 70.

Theridion apicatum O.P.-CAMBRIDGE, 1872 (LEVY & AMITAI, 1982: 116).



Figs 56–64. *Neottiura bimaculata* (LINNÉ) (56, 64 N. Tyrol); *N. uncinata* (LUCAS) (57, 60, 63 Peloponnesos); *N. herbigrada* (SIMON) (58, 61 Cyprus); *N. suaveolens* (SIMON) (59, 62 Austria). Bulbus, dorsal (56–59), ventral (60–62, 64), prolateral view (63). Scale lines: 0.2 mm (56, 57, 59, 60, 62–64), 0.1 mm (58, 61). 1–3: tegular apophyses 1–3.

Material examined:

TUNISIA: Tunis, 1 ♂ (MHNP AR 2297).

SPAIN: Mallorca, Cala Figuera 50m, 1 ♂ (NMW), 29.4.1983, leg. SCHEDL.

FRANCE: Corsica: 1 ♂, 1 ♀ (NMW Inv. No. 807, A.D. 1882), det. L. KOCH.

ITALY: W. Sardinia: C. Mannu, Putzu Idu, Stagno Sale Porcus, 1 ♂ (CTh), 29.4.1992, in grassland near lagoon, leg. HEISS.

GREECE: N. Peloponnesos, Gerania, Loutraki, 2 ♂♂, 1 ♀ (CTh), 24.4.1994, leg. HEISS.

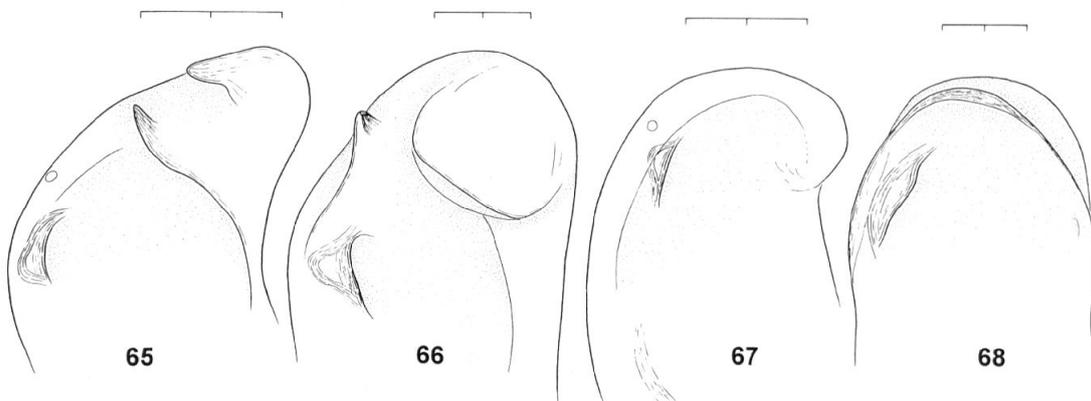
Description: SIMON (1881), LEVY & AMITAI (1982): 116, figs 69–74, ♂♀.

Measurements (♂/♀, n=5/2, min–max): Total length 2.6–3.7 / 3.2–3.4, carapace length 1.2–1.6 / 1.1–1.2, width 0.9–1.2 / 0.9–1.0, length femur I 2.4–3.2 / 2.2–2.3, tibia I 2.2–3.1 / 1.7–1.8. Femur of male palp 1.0–1.3 mm long (Fig. 23).

Somatic features: Eyes about equal in size. Opisthosoma with distinct tubercle (Fig. 19). Coloration: Carapace and sternum dark brown, chelicerae brown. Legs light yellow, coxae and trochanters faintly darkened, femora with dark longitudinal stripes. Palps very dark in male, light yellow in female, with distal joints darker. Opisthosoma in male dark brown, apart from two rows of white, paramedian spots and a median spot on tubercle, venter uniformly dark. In female dorsum white and brown spotted, venter similar to *N. curvimana*.

Male palp: Figs 48, 53, 57, 60, 63, 68. Femur slender, not swollen (Fig. 19). Patella dorsally rounded. Tibia 0.3 mm long, with one trichobothrium only. Cymbium very long (c. 1 mm), 3 times longer than tibia, broadly rounded, distal rim sclerotised (Figs 19, 48, 68). Subtegulum rather large, tegulum densely filled with loops of sperm duct (Fig. 57). Sperm duct approximately 6 mm long, twice as long as male body, tegular loops c. 5 mm long. Conductor a minute, membranous appendage. TA 1 elongate, ventral end broadly rounded, rimmed. TA 2 finger-like, straight, covered with scales, probably bipartite as in *N. bimaculata*, with smooth, basal piece (Fig. 63). Embolus very large, elaborate and strongly sclerotised, occupying main part of distal bulbus (Figs 48, 60, 63). Embolar base round, with condylus, distal part broadly attached to tegulum, with two outgrowths. Unlike in the other species this broad embolus cannot enter the female ducts, it must be regarded as a “contact embolus” (WIEHLE, 1961).

Epigynum/vulva: Figs 42, 43. Introductory orifices separate, not fused in a common atrium, in rather anterior position, posteriorly and anteriorly surrounded by a transverse, sclerotised rim. Introductory ducts broad, evenly sclerotised,



Figs 65–68. *Neottiura bimaculata* (LINNÉ) (65), *N. suaveolens* (SIMON) (66), *N. herbigrada* (SIMON) (67), *N. uncinata* (LUCAS) (68). Cymbium, ventral. Scale lines: 0.2 mm.

c. 1 mm long, convoluted, one coil backwards, another forwards overlapping the receptacula, entrance into receptacula continuous. Receptacula large, subspherical, microsculpture as in the other species.

Distribution, habitat, natural history: *N. uncinata* is distributed in the whole Mediterranean (Fig. 70), although records are rare. In N. Africa known from old records in Algeria, Morocco and Tunisia (SIMON, 1881, 1914). There are a few continental records in S. Spain, S. France and Greece. *N. uncinata* is known furthermore from Mediterranean islands, from Mallorca, Corsica, Sardinia and Malta. In the Near East it has been recorded from Israel. *N. uncinata* lives on low, dry vegetation, where the females spin a delicate web (SIMON, 1873a; DENIS, 1934). It is stenochronous in spring, adult males have been collected as early as end of April (VANUYTVEN *et al.*, 1994), on April 14 on Malta (BOSMANS & DANDRIA, 1993). In S. France a male matured on May 22 (DENIS, 1934). Females were observed there with cocoons attached to the spinnerets on May 27. Cocoon large, white and globular (DENIS, 1934).

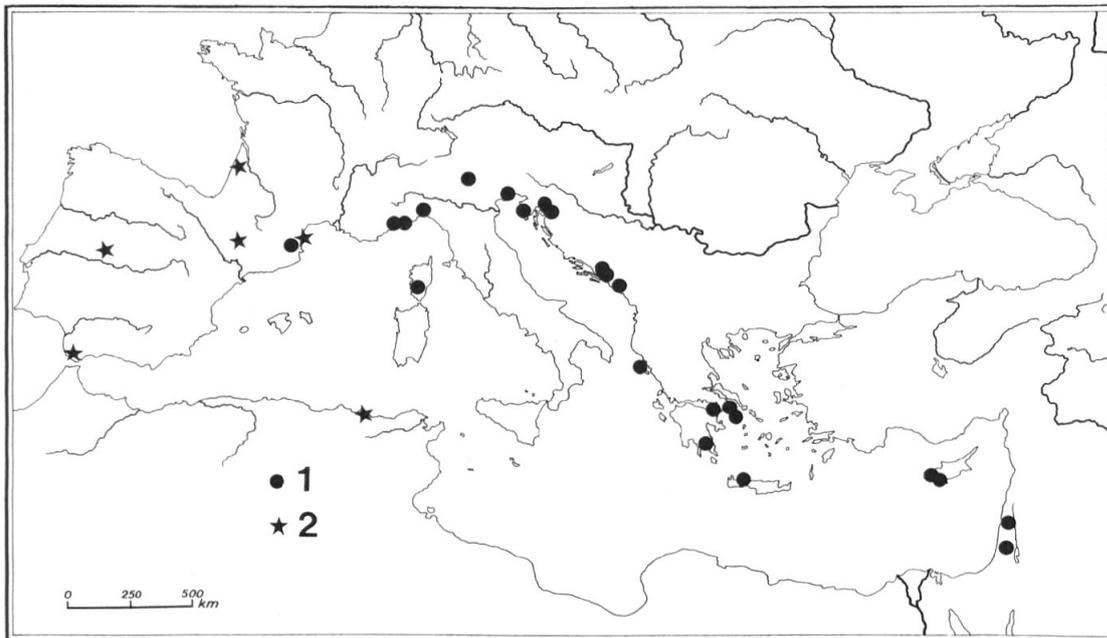


Fig. 69. Distribution of *Neottiura herbigrada* (SIMON) (1) and *N. curvimana* (SIMON) (2). Localities taken from the literature:

N. herbigrada: FRANCE: Pyrénées Orientales, Saint-Laurent-de-Cerdans (DENIS, 1933); Alpes-Maritimes, Cagnes near Nice (SIMON, 1914), Callian, near Cannes (DENIS, 1933); Corsica: Ajaccio (SIMON, 1873a; CANARD, 1989). – ITALY: Genova, Savona (GROPALI *et al.*, 1996); Veneto, Bibione (HANSEN, in litt.). – BOSNIA: Neum, Ston, near Dubrovnik (VANUYTVEN *et al.*, 1994). – CROATIA: Buccari (=Bakar), near Rijeka (CHYZER & KULCZYŃSKI, 1894, 1897). Dalmatia, Slano near Dubrovnik (VANUYTVEN *et al.*, 1994); Solin, Omis near Split (DRENSKY, 1936). – GREECE: Attica (HADJISSARANTOS, 1940). – ISRAEL: N. Galilee, Kefar Gil'adi, Jerusalem (LEVY & AMITAI, 1982).

N. curvimana: FRANCE: Landes de Gascogne, Mimizan, Sabres (SIMON, 1914). – SPAIN: Cadiz, Tarifa; Huesca, Ainsa; Caceres, Plasencia (VANUYTVEN *et al.*, 1994).

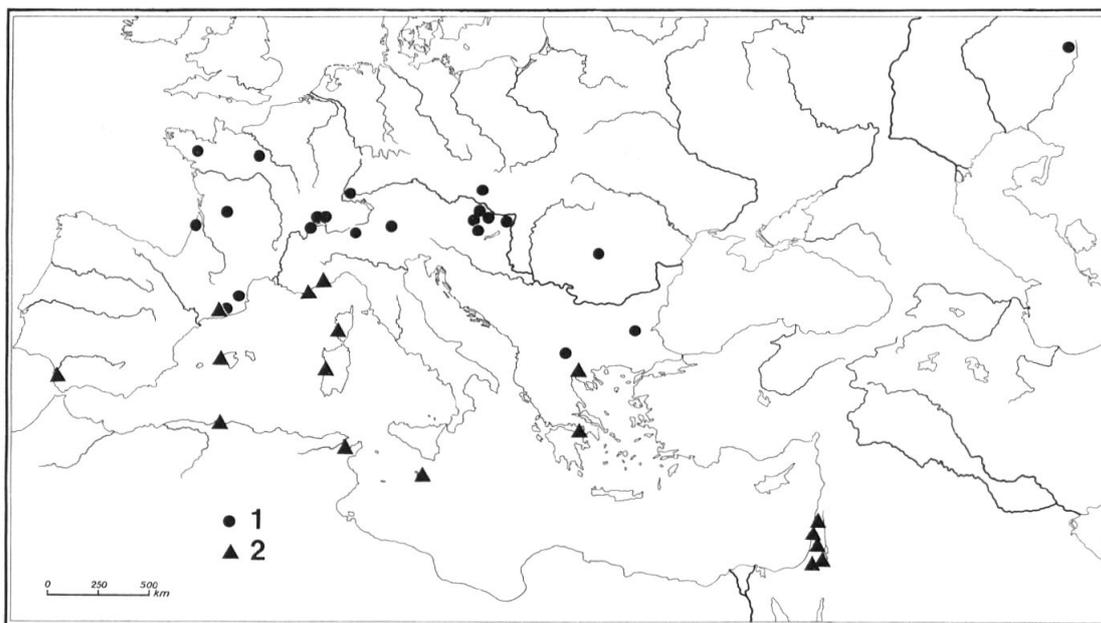


Fig. 70. Distribution of *Neottiura suaveolens* (SIMON) (1) and *N. uncinata* (LUCAS) (2). Localities taken from the literature:

N. suaveolens: FRANCE: Seine-et-Marne, forêt de Fontainebleau; Gironde, forêt de la Teste; Bordeaux, Landes de Gascogne, forêt de Seugnos (SIMON, 1879, 1914); Rennes, Ploërmel (CANARD, 1984); Pyrénées Orientales, Prats-de-Mollo (DENIS, 1933; BOSMANS & DE KEER, 1985). – SPAIN: Barcelona, Montseny (ESPUNY *et al.*, 1994). – SWITZERLAND: Genève, Vaud (POZZI & HÄNGGI, 1998); Ticino, W Locarno, Centovalli; S Bellinzona, Val Morobbia (HÄNGGI, 1992). – ITALY: S. Tyrol, Bozen, Leifers (NOFLATSCHER, 1991). – GERMANY: Freiburg, Kaiserstuhl (WUNDERLICH, 1975). – AUSTRIA: Vienna (KULCZYŃSKI, 1898), Klagenfurt (STEINBERGER, 1990), Graz (KROPF & HORAK, 1996). – CZECH REPUBLIC: Mohelno (MILLER, 1947). – SLOVAKIA: near Bratislava (GAJDOŠ, 1987; GAJDOŠ *et al.*, 1992). – HUNGARY: Sashegy, Budapest (BALOGH, 1938a), Kőszeg (BALOGH, 1938b). – ROMANIA: Sibiu, Șeica Mare (WEISS, 1984). – MACEDONIA: Bitola (=Monastir, DRENSKY, 1929). – BULGARIA: Sliven (DELTSHEV, 1992). – RUSSIA: S. Urals, Bashkiria (ESJUNIN & EFIMIK, 1995).

N. uncinata: ALGERIA: Algiers (LUCAS, 1846). – TUNISIA: Tunis (SIMON, 1885). – SPAIN: Cadiz, Tarifa (VANUYTVEN *et al.*, 1994); Barcelona, Montseny (ESPUNY *et al.*, 1994). – FRANCE: Alpes Maritimes, Cagnes (SIMON, 1914); Var, Iles d'Hyères, Vallon de Port Cros (DENIS, 1934); Corsica, Ajaccio (CANARD, 1989). – GREECE: Thessaloniki (SIMON, 1917). – MALTA: Wardija (BOSMANS & DANDRIA, 1993). – ISRAEL: Nazareth, Jericho; Rosh Ha' Ayin; Jaffa-Rehoboth; Jerusalem (LEVY & AMITAI, 1982).

Coleosoma O.P.-CAMBRIDGE, 1882

Etymology: The generic name is derived from the modified shape of the male opisthosoma: “.. by formation of the fore part of the abdomen, which is of a cylindrical form, drawn out into a kind of sheath, into which the distinct pedicel uniting the cephalothorax and abdomen is inserted..” (CAMBRIDGE, 1882), gr. coleos = sheath. Worldwide c. 12 species are known from the tropics and subtropics (PLATNICK, 1993, 1997), with *C. floridanum* being most widespread.

Mating behaviour: Figs 75–77, 83. *C. floridanum* is the first species of this genus whose copulation has been observed. Two of four pairings ended in successful copulation.

Courtship: As soon as the male is on the female's web, he moves around with his abdomen vibrating, which indicates stridulatory activity, but without plucking.

Irregular web-spinning was performed, but no mating thread constructed. Females jerk slightly.

After 3–4 minutes the male approached the female and soon started the first sequence of insertions. The copulatory posture resembles *Theridion*, male horizontal, female inclined, but there is almost no leg contact (Figs 76, 77) as in *Neottiura*. Only the tips of the male tarsi sometimes touch the female's tarsi. As in *Theridion* copulation is interrupted for sperm induction and therefore consists of several sequences, each involving numerous alternate insertions of left and right palp. The first sequence of insertions probably is a pseudocopulation as in the *Theridion varians* group (KNOFLACH, 1998). Pseudocopulation must be assumed for *C. floridanum*, as this species shows a high number of short-duration insertions (Fig. 83). The "pseudocopulation" differs from the following copulatory sequences by lower insertion duration, mean only 3.7 s (min–max 1.4–21.9), and by increased number of insertions (140 and 230). It lasted 12 and 40 min.

Then the male abruptly left the female for the first sperm induction. Spinning the sperm web and taking up sperm was a very swift process. It took only 40–70 s altogether. The male dipped his palps 16–26 times into the sperm droplet, which was very small. He immediately returned to the female, whereas species of the *T. varians* group regularly make a pause during which the sperm mass disappears from the distal part of the palps. The first "true" copulatory sequence after filling the palps with sperm lasted 6 and 2.4 min, with 8 and 9 insertions. Mean insertion duration is four times higher (\bar{x} =15.3 s, min–max 12.9–17.9) than in the previous sequence (Fig. 83). During the insertion the male pulsates his abdomen and chews the opposite palp which will be used in the next insertion. Not all insertions are successful, insertion attempts regularly occur. The volume of the haematodochal swelling is small compared with *Theridion* and *Neottiura* (Fig. 77). As in *Theridion*, haematodochae inflate to retrolateral side (Fig. 77), and sclerites are moved prolaterally (Fig. 76), which indicates contralateral insertion, left male palp entering right female duct. This is also confirmed by the positioning of the palp during insertion.

After the second sperm induction the last copulatory sequence followed, which again was different. It lasted 20 and 26 min and involved altogether 93 and 88 insertions. During this sequence insertions changed remarkably. The first 29 and 28 were with normal haematodochal swelling, but all following ones almost without swelling. The palps remained on average 14.8 s on the epigynum (min–max 4–31 s). The function of these special palpal applications is not clear, as there is no obvious mating plug, which could seal the epigynal atrium.

Both entire copulations lasted 40 and 75 min, including two short interruptions for sperm induction. Despite this variation in time, the temporal insertion pattern (Fig. 83) was similar in both pairings. In the 40 min copulation genitalic coupling took c. 30 min with c. 240 insertions, in the 75 min copulation it took 38 min with 327 insertions. The remaining time was spent in particular in pauses during pseudocopulation (n=10), in insertion attempts and sperm induction.

C. floridanum belongs to the *Theridion*-type of copulation: Sperm induction is part of copulation; pseudocopulation (which is assumed here); sperm induction proceeds swiftly (c. 1 min); courtship with male approach to female, without mating thread, to which the female is lured for copulation. The main difference from *Theridion* concerns loose leg contact during copulation. *Coleosoma* differs from *Neottiura* by large number of insertions and small volume of haematodochal swelling.

***Coleosoma floridanum* BANKS, 1900**

Figs 71–83.

Theridium floridanum: BONNET (1959: 4473), ROEWER (1942: 492).*Coleosoma floridanum*: PLATNICK (1993: 195–196; 1997: 261).*Coleosoma saispotum* BARRION & LITSINGER, 1995; ♂, n.sp., p. 433, figs 258a–l, type locality: Philippines: Luzon Is.; **nov. syn.***Theridion antheae* BARRION & LITSINGER, 1995, ♀, n.sp., p. 447, figs 268a–d, type locality: Philippines: Luzon Is.; **nov. syn.****Material examined:**

AUSTRIA: Innsbruck, 1 ♀ (NMW), 29.8.1999, on papaya in tropical glass-house of botanical garden, leg. KNOFLACH.

SWITZERLAND: Basel, 1 ♂, 5 ♀♀ (CTh, 2 ♀♀ NMB), 19.3.1999, in tropical glass-house of botanical garden (1 ♂, 2 ♀♀ adult at end of March), leg. KNOFLACH.

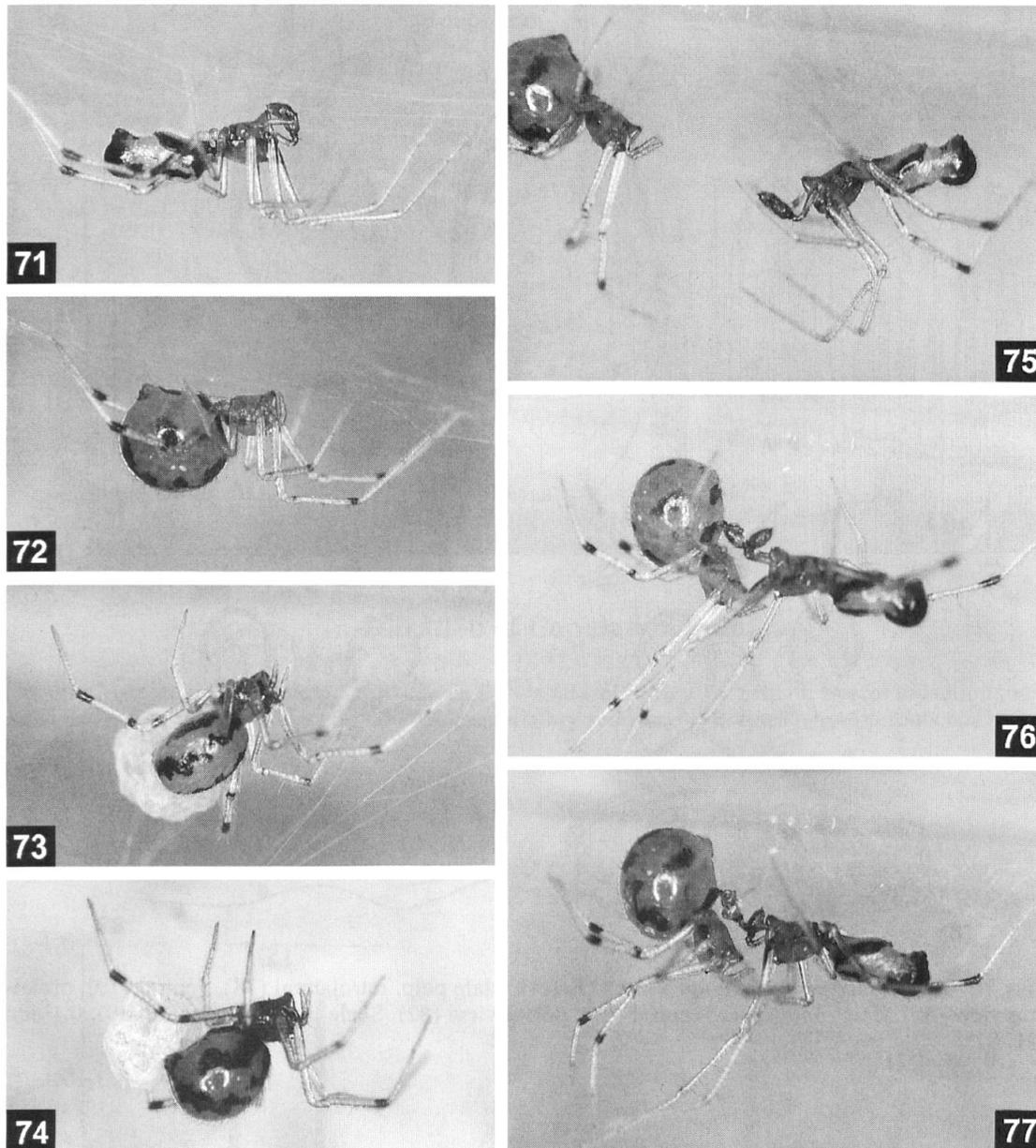
N-AMERICA: Bermudas, St. George, Biological station, 1 ♂, 2 ♀♀ (CTh), June 1971, in park under log, leg. PFALLER.

GUATEMALA: Tikal, 1 ♀ (NMW), 30.2.1976, leg. KÜBELBÖCK.

THAILAND: Chiang Mai 330m, 1 ♂ (MHNG), 27.9.1990, leg. SCHWENDINGER. Chiang Mai, Mae Hia 1 ♂ (MHNG), 14.–19.7.1987, pitfall trap in teak plantation, leg. SCHWENDINGER.

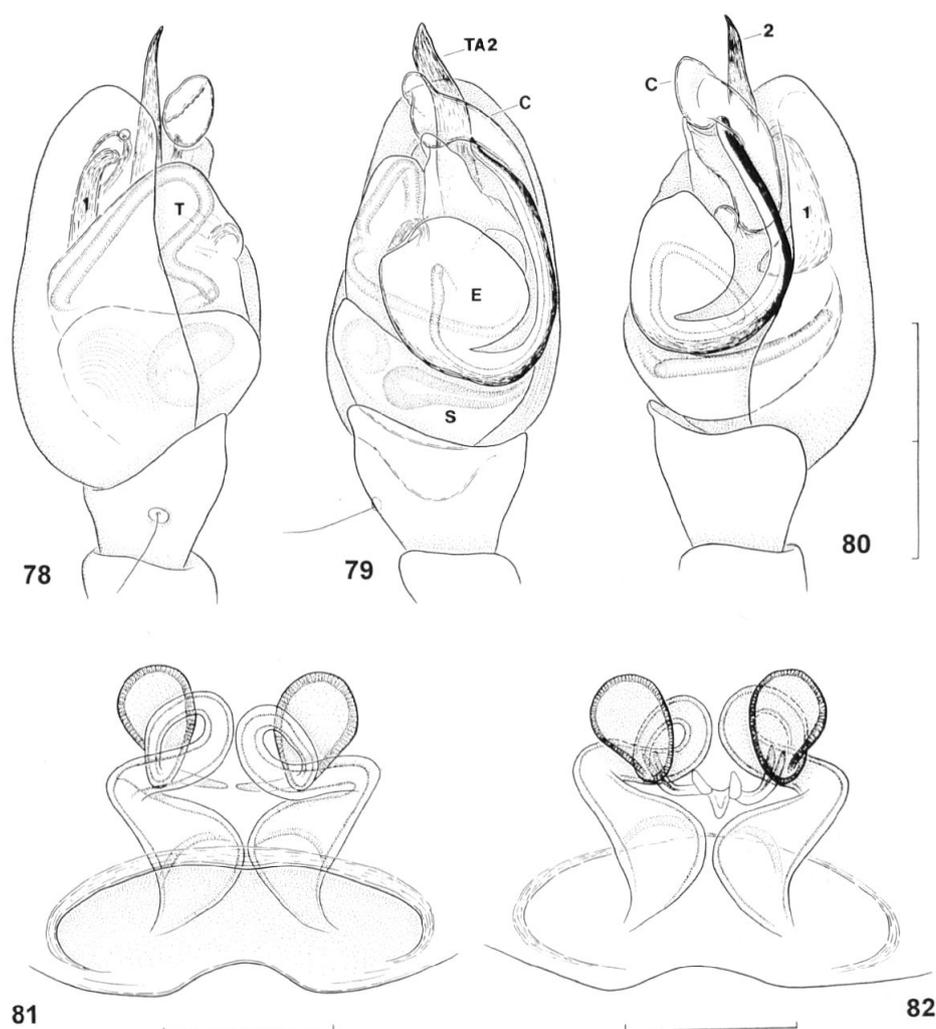
INDIA: Goa, Varea, 3 ♀♀ (CTh, NMB), 22.–24.2.1994, leg. HEISS.

Description: LEVI (1959), HILLYARD (1981), SAARISTO (1978), ZHU (1998), SONG *et al.* (1999).**Measurements** (♂/♀, n=2/5, min–max): Total length 1.8–2.2 / 1.7–2.1, carapace length 0.7–0.8 / 0.7, width 0.5–0.6 / 0.6, length femur I 0.8–1.1 / 0.9–1.0, tibia I 0.7–0.9 / 0.7. Femur of male palp 0.3–0.4 mm long.**Legs:** 1423. Number of dorsal setae on tibiae I–IV 2/2/1/2. Trichobothria in retrodorsal/prodorsal row on tibia of female palp 1/1, of legs I, II 2/1, III 1/2, IV 2/2. Metatarsi I–III with 1 trichobothrium, position on I 0.39, II 0.48, III 0.51; metatarsi I–IV 1.8, 1.5, 1.4, 1.7 times longer than respective tarsi, c. 1.1 times longer than tibiae. Tarsal claws with 5–6 side teeth.**Somatic features:** Figs 71–77. Clypeus slightly projecting. AME smaller than ALE. Chelicerae with one tooth on anterior margin. Male: Sternum posteriorly with minute, median peg between coxae of legs IV. Epigaster conspicuous, occupying more than half venter, weakly sclerotised. Sclerotised ring of opisthosoma with two lobes, each with two long setae. Opisthosoma cylindrical, typically constricted (Fig. 75). Integument shiny. Coloration: Carapace and sternum brown with dark grey margin, chelicerae brown. Legs light yellowish-brown, with few dark patches on femora and annulations on patellae and distal tibiae. Opisthosoma light brown, with two dark paramedian stripes, sometimes interrupted. Venter brown, with dark patch between epigastric furrow and spinnerets, epigaster either completely dark or with dark posterior margin, book lungs dark.**Male palp:** Figs 71, 75–77, 78–80. Slender, tibia short, cone-shaped, with one trichobothrium. Cymbium spoon-shaped as in many *Theridion*-species, with retrolateral paracymbial hood. Two tegular apophyses present, both without sperm duct. TA 1 hidden by cymbium. TA 2 striking, long, straight and pointed, extending beyond cymbium. Sperm duct running along distal rim of tegulum, with only one retrolateral loop. Conductor long and curved, its end broad and rounded, its folds forming a furrow for embolus. Embolar base with condylus, which fits to tegular pit. Distal embolus 0.2 mm long, its outer margin sclerotised.**Epigynum/vulva:** Figs 81, 82. Epigynal atrium large, transverse (width 0.2 mm). Introductory ducts start close together near anterior edge of atrium. They form two coils and enter receptacula from behind. Proximal part weakly sclerotised and blistered, total length 0.2 mm. Receptacula very small.



Figs 71–77. *Coleosoma floridanum* BANKS (Basel). Mating (75–77) and broodcare (73, 74). Male (71). Female (72). Female, egg-sac attached to spinnerets (73, 74). Approach (75). Insertion of left (76) and right palp (77).

Distribution: Pantropical, in S. and Central America (LEVI, 1959), the Bahamas, Antilles, Bermudas and Galapagos. Northernmost records in N. America from Massachusetts and New Jersey at c. 42 and 40 °N (LEVI, 1959), both probably introduced. *C. floridanum* is also known from the New Hebrides, Polynesia and India (LEVI, 1959), from China, Sichuan (ZHU, 1998; SONG *et al.*, 1999), the Seychelles (SAARISTO, 1978), Japan (TANIKAWA, 1991) and furthermore from Thailand and the Philippines. The recent introduction in European tropical glass-houses was



Figs 78–82. *Coleosoma floridanum* BANKS (Basel). Male palp, retrolateral (78), ventral (79), prolateral view (80). Epigynum/vulva, ventral (81), dorsal view (82). Scale lines 0.2 mm (78–80), 0.1 mm (81, 82).

first observed in England (HILLYARD, 1981). Records followed from Finland at c. 60° N (KOPONEN, 1990), the Netherlands (HELSDINGEN, 1995), Germany (BROEN *et al.*, 1998) and now from Switzerland and Austria. On account of the wide range of distribution of *C. floridanum* (map 2, LEVI, 1959) numerous synonyms exist (LEVI, 1959). The species probably originates from America (LEVI, 1959).

Synonymy: *Coleosoma saispotum* BARRION & LITSINGER, 1995 (♂) and *Theridion antheae* BARRION & LITSINGER, 1995 (♀), are synonymised with *C. floridanum* from the literature because of the following characters: General appearance and measurements very similar to *C. floridanum*. Opisthosoma of *C. saispotum* male with anterior stridulatory lobes, shield and posterior constriction as in *C. floridanum*. Male palp slender, with TA 2 characteristically protruding and pointed. Epigynum and vulva of *T. antheae* highly resemble those of *C. floridanum*, in atrium, course of introductory ducts, and receptacula. Material examined from Thailand and India strengthens these synonymies.

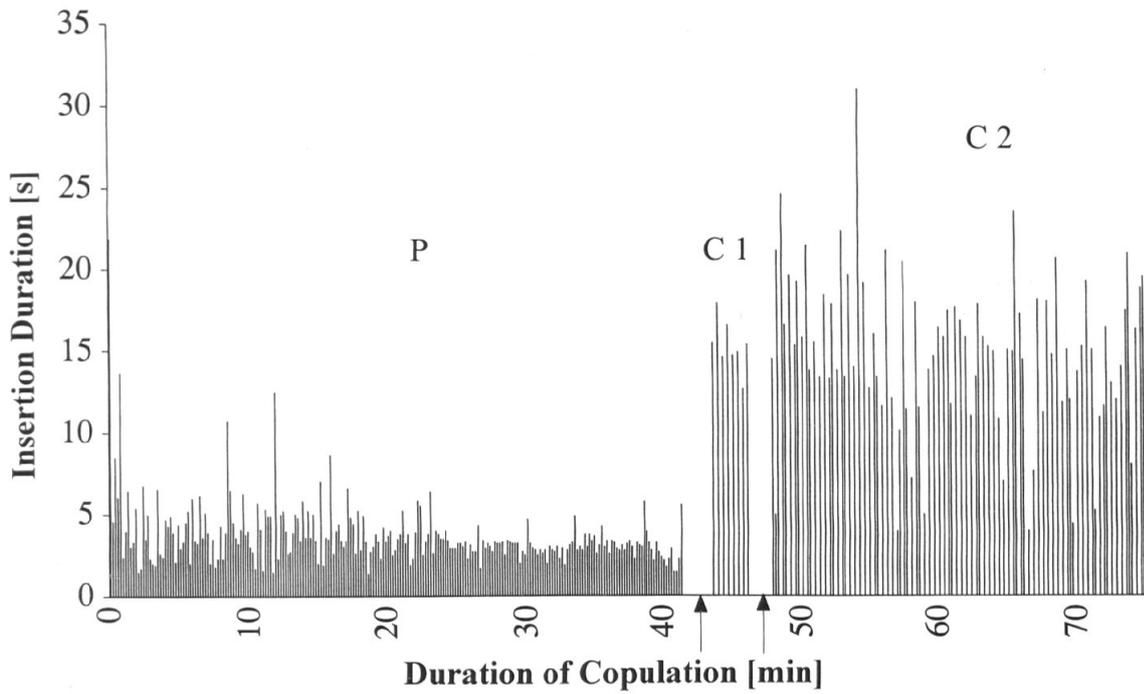


Fig. 83. Copulation in *Coleosoma floridanum* BANKS (Basel): insertion pattern. Sperm induction indicated by arrows. P pseudocopulation, C1, C2 copulatory sequence 1-2. Each bar represents one insertion.

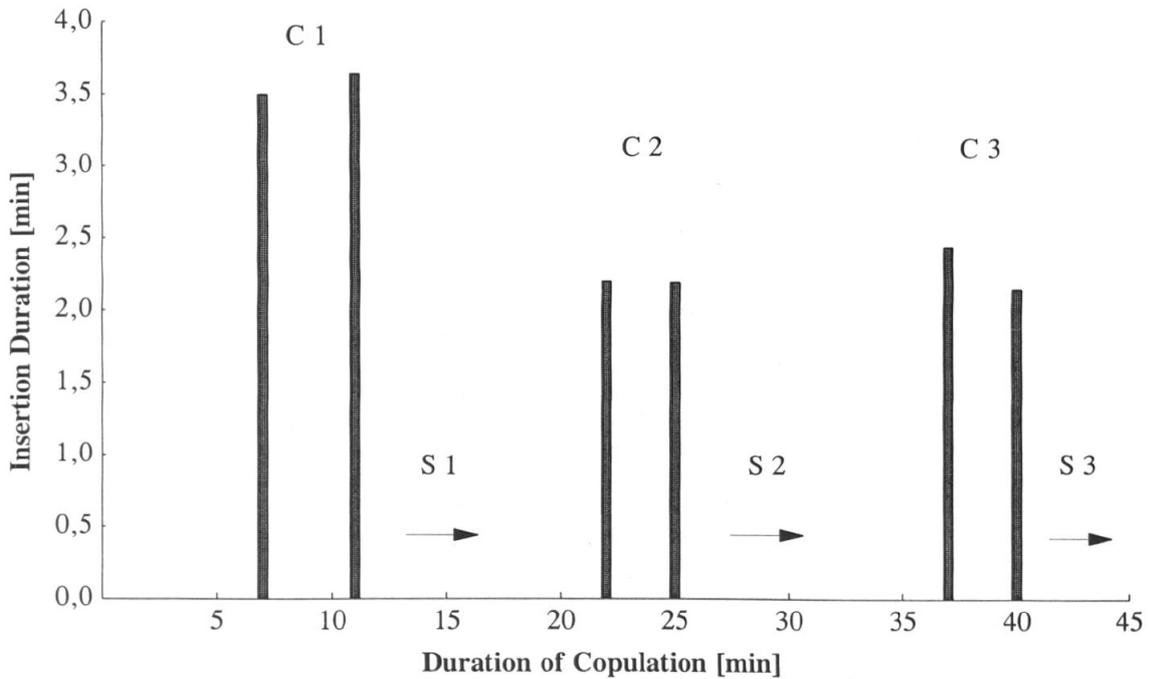


Fig. 84. Copulation in *Neottiura bimaculata* (LINNÉ) (Brixen): insertion pattern. C 1-3 copulatory sequence 1-3, S 1-3 sperm inductions 1-3. Each bar represents one insertion.

Natural history: Egg-sac white, woolly, so that eggs are visible through the envelope (Figs 73, 74). The females guard them in the same manner as *Neottiura* (Figs 73, 74) until hatching. They produce several cocoons in succession, the first c. one week after copulation, the following ones at intervals of c. 25 days. Number of eggs is low, 10–12 (n=5).

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ZUSAMMENFASSUNG

Die Gattung *Neottiura* MENGE (1868) wurde von manchen Autoren nicht anerkannt (WIEHLE, 1937; LEVI & LEVI, 1962; u.a.). Die Sondermerkmale der Typusart *N. bimaculata* (LINNÉ), Femoralsporn und Sternalhöcker der Männchen, sind bei den anderen Arten nicht vorhanden. Nach erneuter Abgrenzung von *Theridion* durch MILLER (1971) und WUNDERLICH (1975) wird hier eine Neubewertung und Gegenüberstellung der Arten vorgelegt. Die Kopula von *N. bimaculata* entspricht dem *Theridion*-Typ nur hinsichtlich des Auftretens der Spermaaufnahme während der Kopula. Besonders auffällig ist der im Vergleich zu *Theridion* kaum vorhandene Beinkontakt. *Neottiura* weist in Europa fünf Arten auf: *N. bimaculata*, *N. curvimana* (SIMON), *N. herbigrada* (SIMON), *N. suaveolens* (SIMON) und *N. uncinata* (LUCAS). Ein weiterer Vertreter ist *N. margarita* (YOSHIDA), nov. comb. (aus *Coleosoma*) aus Japan und China. *Theridion pusillatum* ROEWER, 1942, nov. syn., von Madeira und *T. pustuliferum* LEVY & AMITAI, 1982, nov. syn., von Israel werden mit *N. herbigrada* synonymisiert. Gegenüber der weit verbreiteten transpaläarktischen bis holarktischen *N. bimaculata* sind die Vergleichsarten kleinräumiger und teilweise vikariant verbreitet.

Die subtropische bis tropische Gattung *Coleosoma* ist in Europa durch einen rezenten Neuankömmling vertreten: *C. floridanum* BANKS (Nachweise nur aus Gewächshäusern, nun auch in der Schweiz und in Österreich). Zwei weitere Synonyme von *C. floridanum* unterstreichen das weite Vorkommen dieser pantropischen Art: *C. saispotum* BARRION & LITSINGER, 1995, nov. syn., und *Theridion antheae* BARRION & LITSINGER, 1995, nov. syn., beide von den Philippinen. Im Fortpflanzungsverhalten schließt sich *C. floridanum* dem *Theridion*-Typ an, mit Spermaaufnahme als fester Bestandteil der Kopula und mit Pseudokopula.

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