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A REVIEW OF THE ANT GENERA LEPTOTHORAX MAYR AND TEMNOTHORAX MAYR (HYMENOPTERA, FORMICIDAE) OF THE EASTERN PALAEARCTIC

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Nineteen species of the genera *Leptothorax* and *Temnothorax* are distributed from Mongolia to the Pacific Ocean, these are revised and a key to their identification is provided. Four new species, *Temnothorax cuneinodis, T. xanthos, T. pisarskii* and *T. michali* are described from North Korea. *L. galeatus* WHEELER is synonymised with *T. nassonovi* (RUZSKY) and *L. wui* WHEELER is raised to species rank (in the genus *Temnothorax*).

Key words: ants, *Leptothorax*, *Temnothorax*, taxonomy, new species, key, East Palaearctic

INTRODUCTION

The genus *Leptothorax* was described by MAYR in 1855, and a few years later he described the closely related genus *Temnothorax* (MAYR, 1861). For many years, the latter was regarded by different authors either as a good genus or as a subgenus of *Leptothorax*, but during the last decade it was considered to be a junior synonym of *Leptothorax* (BOLTON, 1995).

BINGHAM (1903) designated *Formica acervorum* FABRICIUS, 1793 as the type-species of the genus *Leptothorax*. About the same time RUZSKY (1904) described the genus *Mychothorax*, to which *F. acervorum* was also assigned as type species (by original designation); later *Mychothorax* was considered as a subgenus of *Leptothorax*, insomuch that EMERY (1912, 1921) designated *Myrmica clypeata* MAYR, 1853 as the type species of *Leptothorax*. All subsequent authors placed the species with 11-jointed antennae in the subgenus *Mychothorax* and those with 12-jointed antennae in the subgenus *Leptothorax* s. str. Eventually, M. R. SMITH (1950) synonymised *Mychothorax* with *Leptothorax* as they have the same type-species (hence the synonymy is absolute) and described *Myrafant* as new subgenus of *Leptothorax*, with the type-species *L. curvispinosus* MAYR, 1866. Then, species from the former subgenus *Leptothorax* s. str. (*sensu* EMERY, 1912) were transferred to the subgenus *Myrafant*, and those that were in *Mychothorax* were considered to be *Leptothorax* s. str. (*sensu* BINGHAM, 1903).

Essentially, there are many differences between *Leptothorax* s. str. and the subgenus *Myrafant* and the possibility of separating them into two genera was dis-

cussed by many myrmecologists (i.e. BUSCHINGER, HEINZE, pers. comm.). Consequently, BOLTON (2003) formally separated them as genera, revived several genera from synonymy, and provided new synonyms. He proposed the following arrangement of former *Leptothorax* (s. l.) (only Holarctic taxa are given here; for details see BOLTON, 2003: 247–253; 270–272):

Genus *Leptothorax* MAYR, 1855
= *Mychothorax* RUZSKY, 1904
= *Doronomyrmex* KUTTER, 1904
Genus *Temnothorax* MAYR, 1861
= *Myrafant* M. R. SMITH, 1950
Genus *Nesomyrmex* WHEELER, 1910

The main differences between *Leptothorax* and *Temnothorax* are (after BOLTON, 2003: 270–271):

Leptothorax	*Temnothorax*
Workers and queens	
antennae 11-segmented	antennae 12-, rarely 11-segmented
median clypeal carina absent	median clypeal carina present
transverse crest present on stipes of maxilla	transverse crest absent on stipes of maxilla
Males	
mandibles reduced, with short masticatory margin, blunt, edentate	mandibles with distinct masticatory margin and with 3–5 teeth
antennae 12-segmented	antennae 13-, rarely 12-segmented
antennal scape very short	antennal scape relatively long
antennal funiculus filiform	antennal funiculus with 3- or 4-segmented club

Leptothorax (s. l.) was the largest Palaearctic ant genus, and even *Temnothorax* contains 187 species in this region; only 11 *Temnothorax* species are known from the Afrotropical and Oriental Regions and more than 120 species occur in the New World. On the contrary, the genus *Leptothorax* (s. str.) includes only 16 free living and socially parasitic Holarctic, mainly boreal, species.

Species of *Leptothorax* and *Temnothorax* are small ants (1.7–4.5 mm); they frequently have an arboreal habit but often nest in soil, rock crevices, leaf litter, under stones, etc. The species of these genera live in very diverse habitats – from cold forests in the forest-tundra zone to the dry steppe or even semi-desert.

Twelve *Leptothorax* (s. l.) taxa have been described from the East Palaearctic region (i. e. from Mongolia to Japan) (SMITH 1874, FOREL 1901, KUZNETSOV-UGAMSKY 1928, WHEELER 1927, 1928, 1929, TERANISHI 1940, PISARSKI 1969*b*,

AZUMA 1977). For most of the last century the taxonomy of East Palaearctic *Leptothorax* (s. l.) was very poorly known and there were no keys to their identification. However, a series of papers have been published in the last decade, describing several new species and giving taxonomic reviews of *Leptothorax* (s. l.) from this region (KUPYANSKAYA 1990, RADCHENKO 1994*a,b*, 1995*a,b,c*, 1996, RADCHENKO & HEINZE 1997, TERAYAMA & ONOYAMA 1999, IMAI *et al*. 2003). Only two *Leptothorax* (s. l.) species are recorded from China in the monograph of WU and Wang (1995), surely a huge underestimate.

In this paper I describe four new *Temnothorax* species from North Korea, and provide a key to the identification of *Leptothorax* and *Temnothorax* from the continental parts of the East Palaearctic. As a whole, 19 species, distributed from Mongolia to the Kuril Islands (including one species from Taiwan), are considered in this paper. Japanese species are not included because they were reviewed by TERAYAMA & ONOYAMA (1999). One specific name (*L. galeatus* WHEELER) is synonymised with *T. nassonovi* (RUZSKY) and *T. congruus wui* (WHEELER) is raised to species rank. Probably one more species from China should be included: *L. reduncus* (WANG & WU) was originally described from the Sechuan Province, Western China (WANG *et al*. 1988) as a *Tetramorium* species (see also BOLTON 1995). However, despite my best efforts, I could not inspect either types or non-type material of this species and, therefore, I have not included it in the key. According to its original description and drawings, *L. reduncus* seems to be similar to either *T. nassonovi* or *T. argentipes* (WHEELER).

MATERIAL AND METHODS

Source of material

This revision is based on the personal examination of the types of *Leptothorax* and *Temnothorax* species and infraspecific forms from the studied region, and on non-type material (about 500 specimens) from the following museums: Museum of Comparative Zoology, Harvard University, USA (MCZ), Museum d'Histoire Naturelle, Genève, Switzerland (MHNG), Hungarian Natural History Museum, Budapest, Hungary (HNHM), Finnish Museum of Natural History, Helsinki, Finland (FMNH), Museum and Institute of Zoology of Polish Academy of Sciences, Warsaw, Poland (MIZ), Yagellonian University, Krakow, Poland (YUK), Institute of Zoology of Ukrainian National Academy of Sciences, Kiev, Ukraine (IZK), Zoological Museums of Moscow State University, Russia (ZMMU), Soil and Biological Institute of Russian Academy of Sciences, Vladivostok, Russia (BPI).

Measurements and indices

In this paper I am using the following measurements and indices:

HL – length of the head in full face view, measured in a straight line from the middle of the anterior clypeal margin to the middle of the occipital margin;
HW – maximum width of the head in full-face view behind the eyes;
SL – maximum straight-line length of the antennal scape seen in profile;
AL – diagonal length of the alitrunk seen in profile, from the neck shield to the posterior margin of the metapleural lobes (workers) and from the most antero-dorsal point of the alitrunk to the posterior margin of the metapleural lobes (males);
SCW – maximum width of the scutum seen from above (queens and males);
SCL – length of scutum + scutellum seen from above (queens and males);
AH – height of alitrunk, measured from upper level of mesonotum perpendicularly to the level of lower margin of mesopleura (queens and males);
PL – maximum length of petiole seen from above;
PH – maximum height of petiole in profile;
ESL – maximum length of propodeal spine in profile, measured from the mid-point of imaginary line between spine's base to the tip of spine.

Indices: Cephalic CI = HL / HW; Scape (1) SI_1 = SL / HL; Scape (2) SI_2 = SL / HW; Petiole PI = PL / PH; Spine-length ESLI = ESL / HW; Alitrunk AI = AL / AH; Scutum SCI = SCL / SCW.

DESCRIPTION OF NEW SPECIES

Temnothorax cuneinodis sp. n.
(Figs 1–3)

Material examined: 1 worker (holotype), North Korea, Maram ad Pyongyang, 10.viii.1959 leg. B. PISARSKI & J. PRÓSZYŃSKI. Deposited in the Museum and Institute of Zoology of the Polish Academy of Sciences (Warsaw, Poland).

Worker (Figs 1–3). Description – Head subrectangular (CI = 1.17), with parallel sides, very weakly concave occipital margin, and narrowly rounded occipital corners. Anterior clypeal margin broadly rounded. Antennae 12-segmented, antennal scape relatively short, not reaching the occipital margin by at least its maximal diameter (SI_1 = 0.69, SI_2 = 0.81).

Alitrunk with slightly flattened promesonotal dorsum, without metanotal groove. Propodeum with moderately long, basally widened, blunt spines (ESLI = 0.23). Humeri in dorsal view distinctly marked and slightly angulate. Petiole short and high (PI = 1.05), without anterior peduncle; petiolar node (seen in profile) cuneiform, with steep and very slightly concave anterior face and narrowly rounded dorsum. Postpetiole distinctly lower than petiole, subglobular.

Head dorsum with reduced sculpture, only with fine rugulae and striation on frons and near eyes, surface unpunctured, smooth and shiny. Alitrunk with relatively coarse but scattered, irregular longitudinal rugosity, punctures present only on mesopleura; surface between rugae shiny. Sides of petiole and postpetiole finely but densely punctate, petiolar and postpetiolar nodes dorsally with rugulosity, surface shiny.

Head with sparse short standing hairs, alitrunk and waist with more abundant and longer standing hairs, which distinctly longer than the minimal eye diameter.

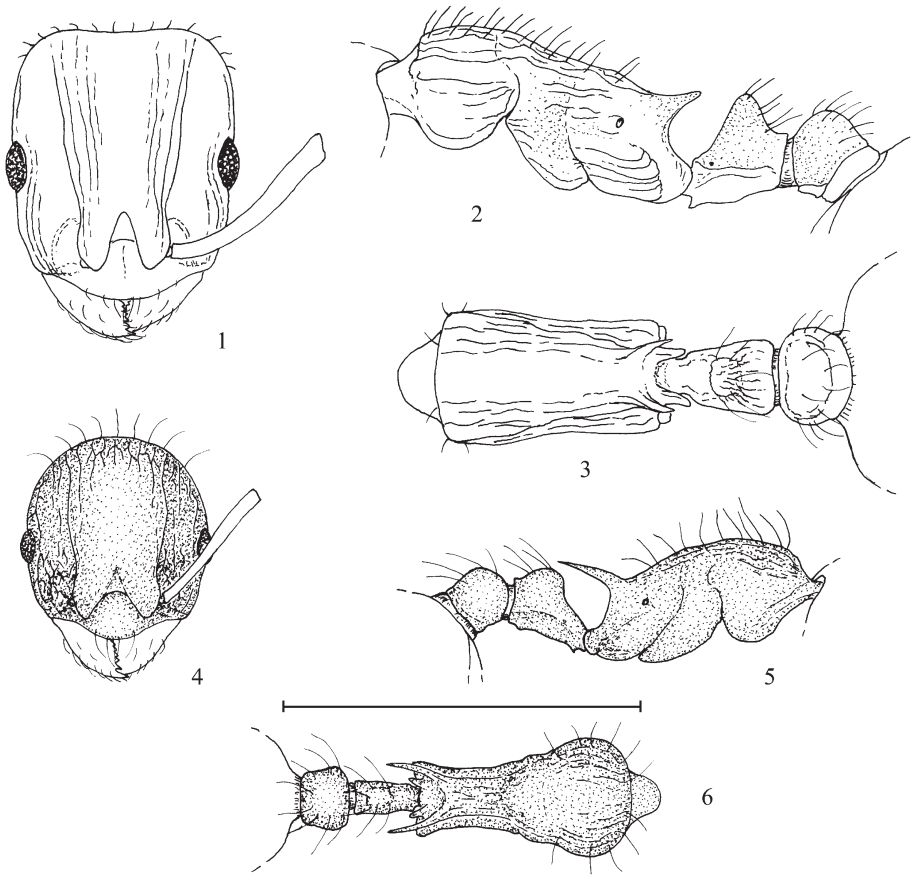
Head, alitrunk and waist dark reddish, gaster reddish-brown, appendages somewhat lighter than the alitrunk.

Queens and males are unknown.

Ecology is very poorly known. The single known specimen was collected on a dry open slope of a hill near a stream valley in sparse and young mixed forest.

Etymology. The species is named after the peculiar, cuneiform shape of its petiole.

Differential diagnosis. T. cuneinodis is a quite conspicuous species and well differs from all known Eastern Palaearctic (including Japanese) *Temnothorax* species with 12-segmented antennae by the combination of several features: distinctly



Figs 1–6. Details of structure of *Temnothorax cuneinodis* (holotype, worker, 1–3) and *T. xanthos* (holotype, worker, 4–6). (1, 4) Head, dorsal view; (2, 5) alitrunk and waist in profile; (3, 6) alitrunk and waist, dorsal view

marked and slightly angulate humeri (Fig. 3) [except of *T. alinae* (RADCHENKO)]; high and short, cuneiform petiole; reduced sculpture on the head dorsum, etc.

T. alinae well differs from *T. cuneinodis* by the densely sculptured, rugulose and reticulate head dorsum (Figs 1 and 22); the much lower and massive petiole, which is distinctly longer than high (PI > 1.20), with a broadly rounded node dorsum (seen in profile); the longer (ESLI > 0.25), straight, not widened basally, finger-like and bluntly rounded on the tip propodeal spines; the straight, blunt, thick and short standing hairs on the alitrunk, which at most as long as the minimal eye diameter (Figs 2 and 23), etc.

Temnothorax xanthos sp. n.
(Figs 4–6)

Material examined: 1 worker (holotype), North Korea, Kongmin Vang Nung, near Kaesong, 14.viii.87, leg. E. KIERYCH. Deposited in the Museum and Institute of Zoology of the Polish Academy of Sciences (Warsaw, Poland).

Worker (Figs 4–6). Description – Head slightly longer than broad (CI = 1.14), with distinctly convex sides, broadly rounded behind the eyes, without marked occipital corners. Anterior clypeal margin broadly rounded. Antennae 12-segmented, antennal scape relatively long, almost reaching occipital margin (SI_1 = 0.76, SI_2 = 0.86).

Alitrunk with slightly convex dorsum, without metanotal groove. Propodeum with very long, not widened basally, slightly down-curved, sharp spines (ESLI = 0.35). Humeri in dorsal view broadly rounded. Petiole distinctly longer than high (PI = 1.54), with a distinct anterior peduncle; petiolar node in profile with concave anterior face and weakly convex and slightly rounded dorsal plate. Postpetiole as high as the petiole, subglobular.

Occiput and lateral parts of head dorsum finely ruguloso-reticulate; whole head densely punctate, appears dull. Alitrunk and waist densely punctate, appears dull, dorsolateral parts of the alitrunk also with fine longitudinal striation.

Occipital margin and dorsum of the alitrunk with long, thin, slightly curved standing hairs, which are longer than the maximal eye diameter.

Body and appendages ochreous-yellow.

Queens and males are unknown.

Ecology is unknown.

Etymology. The species is named after the Greek word ξανδοζ – yellow.

Differential diagnosis. *T. xanthos* well differs from all known Eastern Palaearctic (including Japanese) *Temnothorax* species by its uniform yellowish colour and its peculiar shape of head, which is broadly rounded above the eyes, without marked occipital corners, and with the distinctly convex sides.

Temnothorax pisarskii sp. n.
(Figs 7–15)

Material examined: worker (holotype), North Korea, Myohyang Mts, 6.viii.1959, No. 2291, leg. B. PISARSKI & J. PRÓSZYŃSKI. Deposited in the Museum and Institute of Zoology of the Polish Academy of Sciences (Warsaw, Poland); paratypes: 9 workers from the holotype nest; 1 worker, same locality and collectors, but 5.viii.1959, No. 2282; 4 workers, N. Korea, Pyongyang city, near Tomb of King Tongmen, 27.vi.1990, leg. E. CHUDZICKA, E. KIERYCH & R. PISARSKA; 2 workers, N. Korea, Ryongack Mt., Daebong at Pyongyang, 7.vi.1990, leg. E. CHUDZICKA, E. KIERYCH & R. PISARSKA; 1 worker, N. Korea, Pyongan-namdo, De-sang san, 12 km NE of Pyongyang, 27.v.1970, leg. S. MAHUNKA, H. STEINMANN; 17 workers, 1 queen, 6 males, N. Korea, Prov. Pyongyang City, Taesong-San (SE from Pyongyang), 28.vii.1989, Nos 1–89, leg. M. WOYCIECHOWSKI (MIZ, HNHM, YUK, IZK).

Workers (Figs 7–9). Description – Head subrectangular (CI = 1.17–1.25), with subparallel sides, weakly convex occipital margin and narrowly rounded occipital corners. Anterior clypeal margin broadly rounded. Antennae 12-segmented, antennal scape relatively long, reaching occipital margin (SI_1 = 0.73–0.78, SI_2 = 0.88–0.94).

Alitrunk with slightly flattened dorsum, without metanotal groove. Propodeum in profile with short, basally wide, sharp spines (ESLI = 0.18–0.25). Humeri in dorsal view broadly rounded. Petiole only slightly longer than high (PI = 1.10–1.21), with a very short anterior peduncle; petiolar node in profile subtriangular, with an almost straight anterior face and very narrowly rounded dorsum. Postpetiole as high as the petiole or very slightly lower, subglobular.

Head dorsum densely punctate, appears dull, fine striations present near the eyes only. Alitrunk and waist densely punctate, appears dull, only dorsolateral parts of the alitrunk additionally with fine longitudinal striation.

Occipital margin and dorsum of the alitrunk with moderately long, slightly curved standing hairs. Head dorsum, alitrunk and waist ochreous-yellow to brownish-yellow, gaster brown, with basal ¼ of its first tergite yellow.

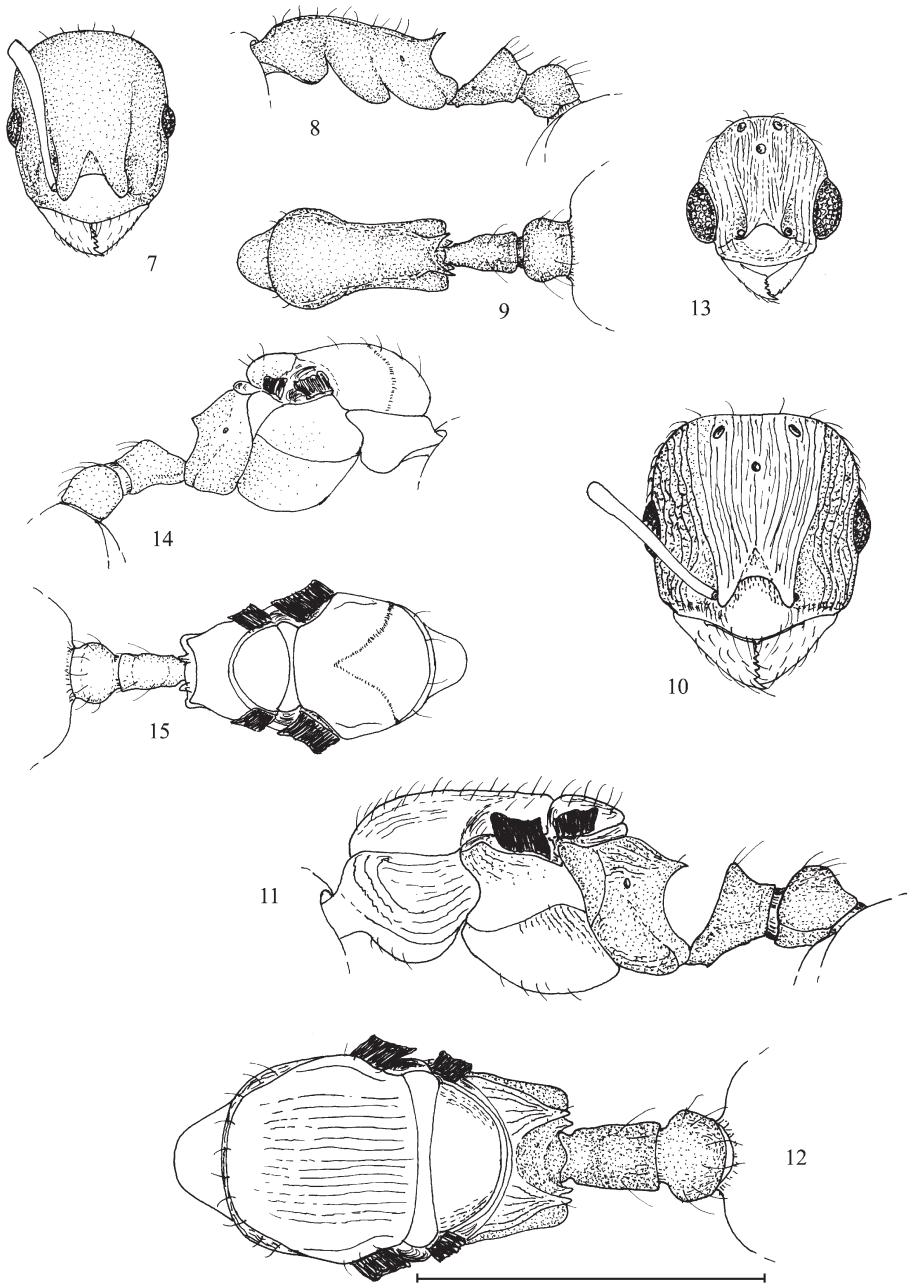
Queen (Figs 10–12). Head about as in the workers, but wider (CI = 1.09); antennal scape relatively shorter (SI_1 = 0.71, SI_2 = 0.78). Alitrunk relatively long and low (AI = 1.84, SCI = 1.33), propodeal spines relatively short (ESLI = 0.16). Petiole about as in the workers.

Frons densely longitudinally rugulose, head dorsum laterally reticulate–punctate and sinuously rugulose. Pronotum finely longitudinally ruguloso-striated, mesopleura with fine striations, propodeum striato-rugulose and punctate; scutum finely longitudinally rugulose, scutellum smooth, only laterally striate; petiole and postpetiole punctate and dorsally finely striate. The body surface appears shiny.

Alitrunk and waist yellow, appendages somewhat lighter, head dorsum reddish-yellow, gaster as in the workers.

Males (Figs 13–15). Head a little longer than broad (CI = 1.03–1.07), broadly rounded behind the eyes, without distinct occipital corners. Anterior clypeal margin widely rounded. Antennae 13-segmented, antennal scape short (SI_1 = 0.31–0.34, SI_2 = 0.32–0.37).

Alitrunk relatively short, scutum convex (AI = 1.58–1.64), scutellum in profile not projecting above the scutum. Propodeum with very short blunt denticles. Petiole low, distinctly lower than long (PI = 1.36–1.45), with a rounded node, its anterior and posterior faces almost straight, moderately sloping. Postpetiole as long as the petiole, subglobular.



Figs 7–15. Details of structure of *Temnothorax pisarskii* (holotype, worker, 7–9; paratypes: queen, 10–12; male, 13–15). (7, 10, 13) Head, dorsal view; (8, 11, 14) alitrunk and waist in profile; (9, 12, 15) alitrunk and waist, dorsal view

Head dorsum finely rugulose and striate, its sides also punctate; clypeus anteriorly transversally striate. Sides of propodeum, lower part of mesopleura and sides of petiole and postpetiole finely punctate, remaining parts of alitrunk and dorsum of petiolar and postpetiolar nodes smooth and shiny.

Head margins and dorsum of the alitrunk with scattered standing hairs.

Alitrunk ochreous-yellow, head dorsum and gaster brownish-yellow, appendages light yellow.

Ecology is poorly known. In Myohyang Mts this species was found at two sites: shrubby young forest on the dry mountain slope, and shady places with rich grass layer, nesting under stones in dry forest on the rocky slope. In Taesong this ant inhabits *Pinus–Quercus* forests, with trees 5–7 m tall and *Juniperus* shrubs, at 150 m a.s.l., nesting under stones.

Etymology. This species is dedicated to the memory of Prof. BOGDAN PISARSKI, famous Polish myrmecologist, who collected the first specimens.

Differential diagnosis. *T. pisarskii* most resembles *T. mongolicus* (PISARSKI, 1969) by the shape of the petiole, yet well differs by this feature from all other East Palaearctic bicoloured *Temnothorax* species with short propodeal spines (Figs 8, 32 and 17, 27, 31). It differs from *T. mongolicus* by longer antennal scape (SI_1 = 0.73–0.78, mean = 0.75, *vs.* 0.71–0.75, mean = 0.72, SI_2 = 0.88–0.94, mean = 0.92 *vs.* 0.82–0.88, mean = 0.85); longer propodeal spines (ESLI = 0.18–0.25, mean 0.22 *vs.* 0.09–0.22, mean = 0.15); a somewhat different colour. In *T. pisarskii* head, alitrunk and waist are from ochreous-yellow to brownish-yellow; the gaster is brown, with basal ¼ of the first tergite yellow. In *T. mongolicus* the head dorsum is brownish, distinctly darker than the ochreous-yellow or brownish-yellow alitrunk, and the gaster is entirely brown.

Temnothorax michali sp. n.
(Figs 16–21)

Material examined: worker (holotype), North Korea, Chagang Prov., Mts Myohyang San, 630 m a.s.l., valley Jsonnama, mixed forest (*Acer*, *Larix* and *Pinus*), No. 151–85, nest in soil, under stone, 22.vi.1985, leg. M. WOYCIECHOWSKI. Deposited in Museum and Institute of Zoology of the Polish Academy of Sciences (Warsaw, Poland); paratypes: 57 workers from the nest of the holotype; 5 workers, N. Korea, Chagang Prov., Mts Myohyang San, valley Manpek Dong, 860 m a.s.l., mixed forest (*Pinus*, *Quercus* and *Acer*), No. 130–85, 21.vi.85, foragers collected on the ground, leg. M. WOYCIECHOWSKI; 1 worker, N. Korea, Chagang Prov., Mts Myohyang San, valley Hyangsan, 185 m a.s.l., mixed forest (*Pinus, Acer*), No. 174–85, 22.vi.85, leg. M. WOYCIECHOWSKI; 43 workers, N. Korea, Chagang Prov., Mts Myohyang San, near Myohyang Hotel, 200 m a.s.l., deciduous forest, No. 245–85, 25.vi.1985, nest in a fallen piece of wood, leg. M. WOYCIECHOWSKI; 15 workers, same locality as the latter, No. 249–85, nest in rotten log, leg. M. WOYCIECHOWSKI; 1 queen, N. Korea, Chongjin city, Daeso-ri, 15.vi.1990, leg. E. CHUDZICKA, E. KIERYCH & R. PISARSKA; 39 workers, 1 queen, N. Korea, Chongjin city, Kyowon-ri, 16.vi.1990, leg. E. CHUDZICKA, E. KIERYCH & R. PISARSKA; 1 worker, N. Korea, N. Hamgyong Prov., Kyongson County, Sangonpo-ri, 17.vi.1990,

leg. E. CHUDZICKA, E. KIERYCH & R. PISARSKA; 11 workers, N. Korea, Kangwon Prov., Kumgang Mts, near Kuryong Falls, 22.vi.1990, leg. E. CHUDZICKA, E. KIERYCH & R. PISARSKA; 2 workers, N. Korea, Kangwon Prov., Kumgang Mts, Purjong-ri, 23.vi.1990, leg. E. CHUDZICKA, E. KIERYCH & R. PISARSKA; 3 workers, 2 queens, N. Korea, Prov. Kangwon, Mts Kumgang-san, Nr. 714, 19.ix.1980, leg. L. FORRÓ & Gy. TOPÁL; 2 workers, N. Korea, Prov., Kangwon, Kumgang-san Mts, Nr. 488, 12.x.1978, leg. A. VOJNITS & L. ZOMBORI; 1 worker, N. Korea, Prov. North Pyongan, Mts Myohyang-san, about 100 m, Nr. 930, 21.v.1985, leg. A. VOJNITS & L. ZOMBORI; 13 workers, ibid., Nr. 934, 22.v.1985, leg. A. VOJNITS & L. ZOMBORI; 2 workers, ibid., Nr. 940, 23.v.1985, leg. A. VOJNITS & L. ZOMBORI; 3 workers, N. Korea, Prov. Kangwon, Mts Kumgang-san, Nr. 949, 27.v.1985, leg. A. VOJNITS & L. ZOMBORI; 23 workers, ibid., Nr. 951, 27.v.1985, leg. A. VOJNITS & L. ZOMBORI; 1 worker, N. Korea, Prow. Kangwong, Manmul-san, Nr. 1340, 21.vi.1988, leg. O. MERKL & GY. SZÉL (MIZ, HNHM, YUK, IZK).

Workers (Figs 16–18). Description – Head subrectangular (CI = 1.17–1.26), with subparallel to slightly convex sides, straight occipital margin and rounded occipital corners. Anterior clypeal margin broadly rounded. Antennae 12-segmented, antennal scape relatively long, reaching or slightly surpassing the occipital margin (SI_1 = 0.77– 0.83, SI_2 = 0.94–1.00).

Alitrunk with convex dorsum, without metanotal groove. Propodeum with short, moderately wide basally, sharp spines (ESLI = 0.18–0.27). Humeri in dorsal view broadly rounded. Petiole distinctly longer than high (PI = 1.35–1.54), with a distinct anterior peduncle; petiolar node in profile with slightly concave anterior face and widely rounded dorsum. Postpetiole as high as the petiole or very slightly lower, subglobular.

Head dorsum usually with dense but not coarse longitudinal rugulosity, punctures developed on its sides; occasionally frons and occiput may bear only longitudinal striation and well developed punctation. Sides of pronotum longitudinally rugulose, mesopleura and propodeum with longitudinal striations and punctures, waist punctate; pronotum with not coarse reticulation, mesonotum punctate. All punctate parts of the body appear dull.

Occipital margin and dorsum of the alitrunk with moderately long, slightly curved standing hairs.

Alitrunk and waist ochreous-yellow to brownish-yellow, head dorsum brownish, darker than alitrunk; gaster of the same colour as alitrunk or only slightly darker, without light spot at the base of first tergite.

Queens (Figs 19–21). Head about as in the workers, but wider (CI = 1.12–1.14), antennal scape relatively shorter (SI_1 = 0.75–0.79, SI_2 = 0.86–0.88). Alitrunk relatively long and low (AI = 1.75– 1.78, SCI = 1.32–1.34). Shape of the petiole about as in the workers.

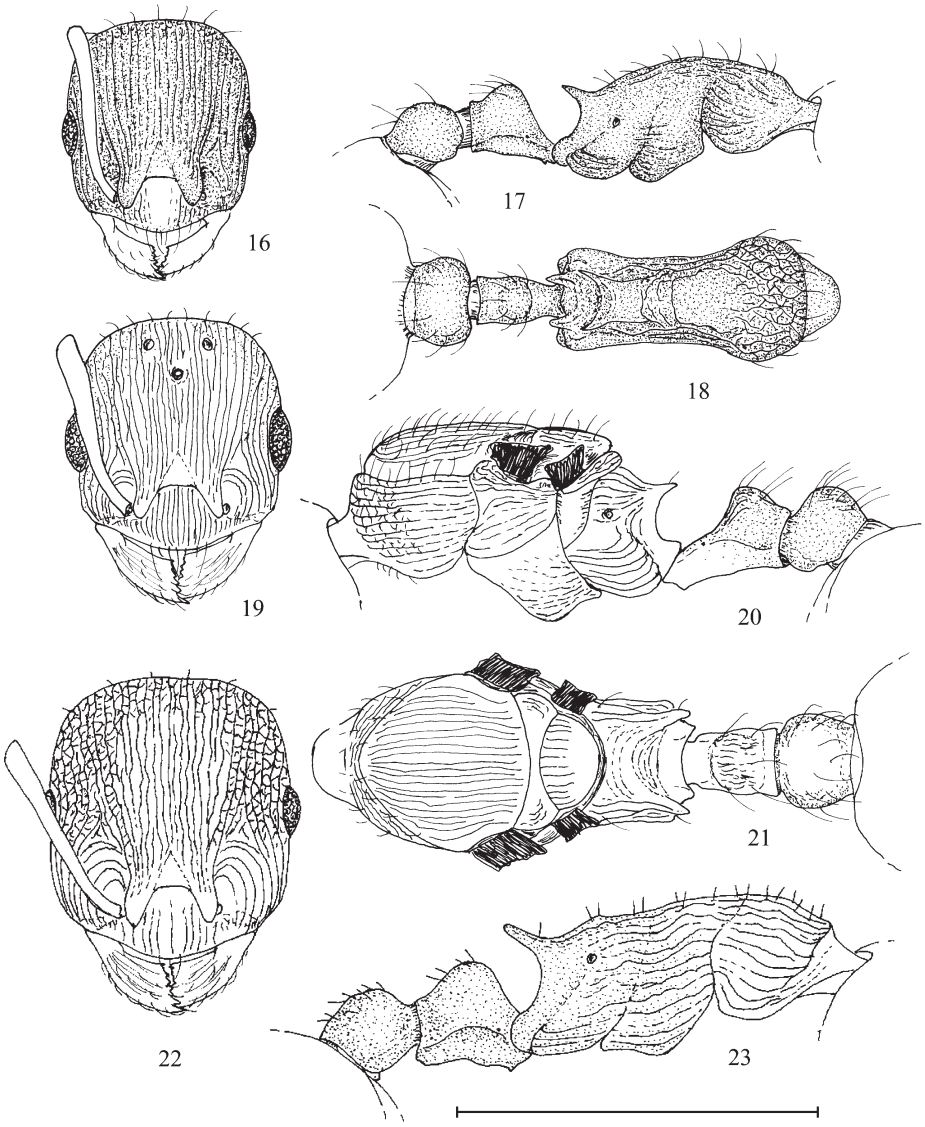
Sculpture of the head about as in the workers. Pronotum longitudinally rugulo-reticulate, mesopleura and propodeum rugulose, scutum longitudinally rugose, scutellum basally rugulose; petiole and postpetiole punctate and finely striate dorsally.

Alitrunk and waist ochreous-yellow, head dorsum darker, gaster brownish.

Ecology. In Myohyang Mts this species inhabits deciduous and mixed forests (*Quercus, Acer, Pinus* and *Larix*) at low altitudes (between 185 and 860 m a.s.l.). Nests in soil, under stones or in rotten wood.

Etymology. This species is dedicated to Prof. MICHAL WOYCIECHOWSKI, Polish myrmecologist, who also collected this species.

Differential diagnosis. *T. michali* most resembles *T. kaszabi* (PISARSKI, 1969) and differs from it by its distinctly longer antennal scape (SI_1 0.77–0.83 *vs.* 0.68–0.70, SI_2 0.94–1.00 *vs.* 0.77–0.80) and the distinctly lighter gaster, which is concolourous with the alitrunk or only slightly darker, without the pale spot at the



Figs 16–23. Details of structure of *Temnothorax michali* (holotype, worker, 16–18; paratype queen, 19–21) and *T. alinae* (paratype, worker, 22, 23). (16, 19, 22) Head, dorsal view; (17, 20, 23) alitrunk and waist in profile; (18, 21) alitrunk and waist, dorsal view

base of the first tergite (in *L. kaszabi* the gaster is brown, distinctly darker than the alitrunk and with a distinct pale spot at the base of the tergite). *T. michali* is also similar to the Japanese *T. arimensis* (AZUMA) but differs from the latter by the more developed rugulosity of the head dorsum, including clypeus, by somewhat longer propodeal spines, somewhat lighter colour of the body, etc.

Notes. KUPYANSKAYA (1990) has recorded from the Russian Far East *T. volgensis* (RUZSKY), a steppe species distributed from Southern Ukraine to Western Kazakhstan. According to her description, this material could belong to the newly described *T. michali*; yet for a definitive opinion one should examine KUPYANSKAYA's material.

REVIEW OF THE SPECIES

Genus *Temnothorax* MAYR

Temnothorax alinae (RADCHENKO, 1994)
(Figs 22, 23)

Leptothorax alinae RADCHENKO, 1994*a*: 31, workers, Russia, Primorsky Region, Ussuriysky Distr., Shufanskoye plateau; 1994*b*: 153; 1995*b*: 21; BOLTON, 1995: 235.
Temnothorax alinae: BOLTON, 2003: 271.
Myrmoxenus gordiagini RUZSKY: KUPYANSKAYA, 1990: 145 (misidentification), *nec* RUZSKY, 1902 *et auct*.

Material examined: 6 workers (holotype and paratypes), "Primorsky Region, Ussuriysky Distr., Shufanskoye plateau, *Larix* forest, 8.vi.1973, leg. A. KUPYANSKAYA" (ZMMU, BPI, IZK).

Distribution. Known from the type locality only.
Ecology. *T. alinae* was found in a nest of *L. acervorum* in a *Larix* forest. It may be a social parasite of the latter species, but this question needs additional investigations.

Notes. Superficially *T. alinae* is similar to the species of the genus *Leptothorax*, particularly to *L. muscorum* (NYLANDER) and *L. scamni* RUZSKY, 1905, but well differs from them by its 12-segmented antennae. A comparison of *T. alinae* with *T. cuneinodis* is given above.

This species was dedicated to Alina KUPYANSKAYA, a well-known Russian myrmecologist.

Temnothorax argentipes (WHEELER, 1928)
(Figs 24, 25)

Leptothorax argentipes WHEELER, 1928: 25, workers, queen, China, Ausu near Foochow; CHAPMAN & CAPCO, 1951: 110; BOLTON, 1995: 236; RADCHENKO, 1994*b*: 153, 1996:18 (misspelled as *argentipex*).
Temnothorax argentipes: BOLTON, 2003: 271.

Material examined: 5 workers and 1 queen, syntypes, "near Ausu, Foochow (Silvestri)", "M.C.Z. Type 4–6 71023", "Syntypes *Leptothorax argentipes* WHEELER" (MCZ).

Distribution. Known from the type locality only.
Ecology is unknown.

Notes. *T. argentipes* is most similar to *T. nassonovi* and differs from it by the shape of the petiole, which has a very long anterior peduncle (PI > 1.60 *vs.* < 1.30) and a petiolar node with narrowly rounded dorsum (Figs 25 and 34); by the different sculpture of the head dorsum: frons with quite coarse longitudinal, slightly sinuous rugae, remaining parts of the head dorsum coarsely reticulate, surface between the rugae not coarsely but densely punctate (in *T. nassonovi* the head dorsum is finely striated and densely punctate, Figs 24 and 33).

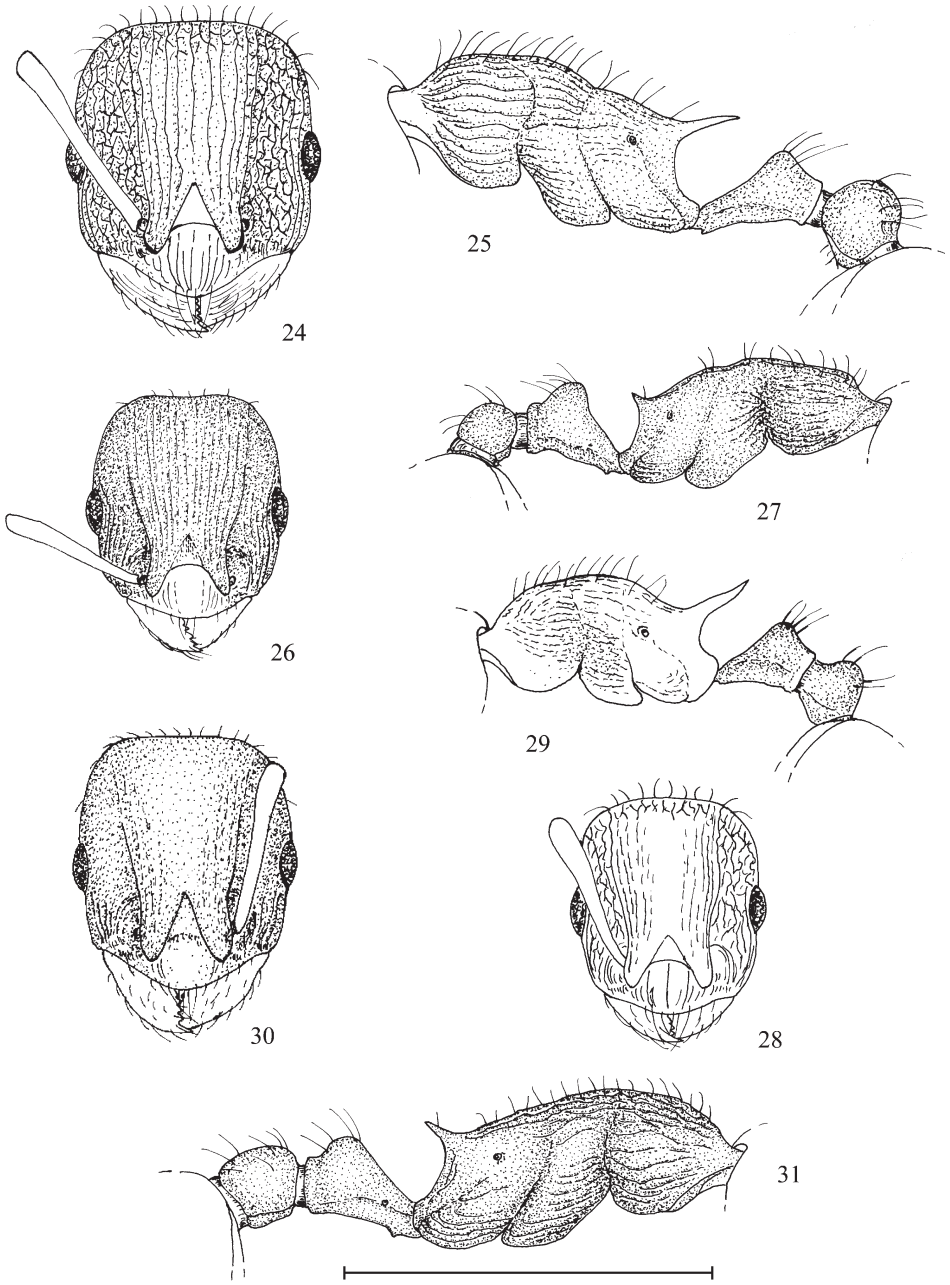
Temnothorax congruus (F. SMITH, 1874)
(Figs 26, 27)

Leptothorax congruus F. SMITH, 1874: 406, workers, Japan, Hyogo; WHEELER, 1906: 316, queens, males; EMERY, 1921: 253; CHAPMAN & CAPCO, 1951: 110; ONOYAMA, 1980: 197; TERAYAMA *et al*., 1992: 27; RADCHENKO, 1994*b*: 150; BOLTON, 1995: 237; RADCHENKO, 1996: 16; KIM, 1996: 176; 2003: 2; TERAYAMA & ONOYAMA, 1999: 83; IMAI *et al*., 2003: 157; LYU & CHO, 2003: 271, *nec* COLLINGWOOD, 1976: 303 (misidentification).
Temnothorax congruus: BOLTON, 2003: 271.

Material examined: dozens of workers from Japan, Korea and Russian Far East.

Distribution. Japan (Hokkaido, Honshu, Shikoku, Kyushu), Russia (south of Primorsky Region), Isl. Kunashir, NE China, Korean Peninsula.
Ecology. It inhabits different kinds of forests and meadows, builds nests mainly in rotten wood, but sometimes in soil, often under stones.

Notes. *T. congruus* is a small blackish-brown species with short propodeal spines. It most resembles *T. wui* and differs from it by the shape of the petiole, whose node has a wide, slightly convex dorsal plate (in *T. wui* the petiolar node is very narrowly rounded, subtriangular in profile, Figs 27 and 39); the sculpture of



Figs 24–31. Details of structure of workers of *Temnothorax argentipes* (syntype, 24, 25), *T. congruus* (syntype, 26, 27), *T. eburneipes* (syntype, 28, 29), *T. kaszabi* (paratype, 30) and *T. kurilensis* (paratype, 31). (24, 26, 28, 30) Head, dorsal view; (25, 27, 29, 31) alitrunk and waist in profile

the head dorsum: frons with longitudinal rugae and coarse punctures, remaining parts punctate (in *T. wui* the whole head dorsum finely and densely punctate, striated only near the eyes; the central part of frons with a smooth and shiny longitudinal band, Figs 26 and 39). *T. congruus* differs from *T. kurilensis* (RADCHENKO) by its much shorter antennal scape, which distinctly fails to reach the occipital margin, $SI_1 < 0.73$, $SI_2 < 0.90$ (in the latter species the scape almost reaches or slightly surpasses the occipital margin, $SI_1 > 0.75$, $SI_2 > 0.94$), and by the shorter propodeal spines (Figs 27 and 31).

The specimens from North Korea, determined by COLLINGWOOD (1976) as *T. congruus*, are in fact *Vollenhovia emeryi* WHEELER (material is in HNHM, examined).

Temnothorax eburneipes (WHEELER, 1927)
(Figs 28, 29)

Leptothorax congruus var. *eburneipes* WHEELER, 1927, workers, China, Kuliang near Kiu-Kiang (Gee).

Leptothorax eburneipes: WHEELER, 1929: 8 [raised to species rank]; BOLTON, 1995: 238; RADCHENKO, 1996: 17.

Temnothorax eburneipes: BOLTON, 2003: 271.

Material examined: 3 workers, syntypes, "Kuliang near Kiu-Kiang, China, N. Gist Gee", "M.C.Z. Type 1–9 22618", "Syntypes *Leptothorax congruus var. eburneipes* Wheeler" (MCZ); non-type material: more than one hundred workers and 9 queens from North Korea.

Distribution. China, North Korea.

Ecology. Semixerophilous species. In North Korea it lives mostly in a lower altitude, up to 500 m a.s.l., where it inhabits mainly open, relatively dry grasslands with sandy or stony soil, shrubs, rarely found in young, sparse forests (pine, oak, maple). In Myohyang Mts it inhabits also mountain meadows up to 900 m a.s.l.

Notes. *T. eburneipes* is most similar to *T. taivanensis* (WHEELER) and differs from it by the shape of the petiole, which is shorter, with relatively short anterior peduncle (PI < 1.40), and with a very weakly concave anterior face (in *T. taivanensis* the petiole is much longer, with very long anterior peduncle, PI > 1.60, and a strongly concave anterior face; Figs 29 and 37); distinctly longer propodeal spines (ESLI = 0.49–0.52 *vs.* ESLI = 0.40), and by the sculpture of head and alitrunk. In *T. eburneipes* the frons is finely longitudinally striated laterally and smooth in the middle; the lateral parts of the head dorsum reticulate, but surface appears shiny; the sides of alitrunk finely striated and partially punctate, appears shiny. In *T. taivanensis* the sides of the alitrunk and the head dorsum are quite coarsely longitudi-

nally rugose, surface between the rugae very finely superficially punctate, but on the alitrunk smooth and shiny (Figs 28, 29, 36 and 37). *T. eburneipes* differs from *T. spinosior* FOREL by relatively longer propodeal spines (ESLI = 0.49–0.52 *vs.* 0.36–0.41) and by the higher petiole with a narrowly rounded, less massive petiolar node dorsum (PI < 1.40 *vs.* > 1.50) (Figs 29 and 35). The possible relation of this species with some newly described Japanese ants (*T. anira, T. antera* and *T. macora*; TERAYAMA & ONOYAMA, 1999) needs investigations of the type material.

Temnothorax kaszabi (PISARSKI, 1969)
(Fig. 30)

Leptothorax kaszabi PISARSKI, 1969*b*: 301, workers, queens, Mongolia, Central Aimak, SE from Somon Bajanzogt; RADCHENKO, 1994*b*: 157, 1995*b*: 19 (males); BOLTON, 1995: 240.
Leptothorax tuberum sachalinensis KUPYANSKAYA, 1990: 142, workers, queen, Russia, Sakhalin Isl., synonymy by: RADCHENKO, 1995*b*: 19.
Leptothorax rabaudi BONDROIT: COLLINGWOOD, 1976: 304; TERAYAMA *et al*., 1992: 28; KIM, 1996: 177; 2003: 2, *nec* BONDROIT, 1918 *et auct*. (misidentification).
Temnothorax kaszabi: BOLTON, 2003: 271.

Material examined: paratypes of *L. kaszabi*: 11 workers, Mongolia, Central aimak, SE from Somon Bajanzogt, 1600 m a.s.l., 27.vii.1966, No. 749, leg. Z. KASZAB (nest of holotype); same locality, 11.vi.1966, No. 519, leg. Z. KASZAB (MIZ, ZMMU); holotype and paratypes of *L. tuberum sachalinensis*: 10 workers and 1 queen, Isl. Sakhalin, Starodubskoe, 1.viii.1978, leg. A. KUPYANSKAYA (BPI); non-type material: several dozen of workers, 5 queens, 4 males of *L. kaszabi* from Mongolia, Tuva, Chita Region and North Korea.

Distribution. Mongolia, south-eastern Altai, Tuva, southern Yakutia, Russian Far East, North Korea.

Ecology. It inhabits mainly steppes, dry meadows; rarely it lives in lighted, open forests; nests are built in soil.

Notes. *T. kaszabi* is similar to the Euro-Siberian *T. tuberum* (FABRICIUS, 1775) and differs from it by the colour of the first gastral tergite (see also RADCHENKO 1994*b*). The differences between this species and *T. michali* are given in the Notes under the latter species.

COLLINGWOOD (1976) recorded from North Korea the South European species, *L. rabaudi*, but the specimens from De-song-san, 12 km NE of Pyongyang, Nr. 38 indeed belong to *T. kaszabi* (material in HNHM, examined); this COLLINGWOOD's mistake was repeated by TERAYAMA *et al.* (1992) and by KIM (1996, 2003).

Temnothorax koreanus (TERANISHI, 1940)

Leptothorax (Nesomyrmex) koreanus TERANISHI, 1940: 16, workers, Korea, Suigen; TERAYAMA *et al*., 1992: 27; BOLTON, 1995: 240; KIM, 1996: 176; TERAYAMA & OGATA, 1999: 88; IMAI *et al*., 2003: 156; KIM, 2003: 2; LYU & CHO, 2003: 272.
Temnothorax koreanus: BOLTON, 2003: 271.

I have never seen this species, so all discussions below are based on literature data.
Distribution: Korea, Japan.

Notes. *T. koreanus* is a quite conspicuous species with 11-segmented antennae. Because of this feature it could be placed in the genus *Leptothorax*, but on the other hand, it well differs from all known species of that genus by its distinctly marked and slightly angulated humeri (seen from above), and by the very long propodeal spines, which are similar to those of *T. nassonovi* and related species. I assume that the taxonomic position of *T. koreanus* is still uncertain.

Temnothorax kurilensis (RADCHENKO, 1994)
(Fig. 31)

Leptothorax kurilensis RADCHENKO, 1994*a*: 32, workers, queens, Russia, Isl. Kunashir; 1994*b*: 148; BOLTON, 1995: 240; RADCHENKO, 1996: 18.
Temnothorax kurilensis: BOLTON, 2003: 271.

Material examined: worker (holotype): Isl. Kunashir, Golovin volcano, 18.viii.1988, leg. S. BASARUKIN (IZK); paratypes: 6 workers from the nest of the holotype; 2 workers and 2 queens, Isl. Kunashir, Lake Goryachee, 25.vii.1975, leg. A. KUPYANSKAYA; 1 worker, from the same locality, 11.viii.1970, leg. A. TICHOMIROVA; 8 workers, Isl. Kunashir, Alekhino, 2.viii.1970, leg. A. TICHOMIROVA (IZK, ZMMU).

Distribution. Russia, Isl. Kunashir (Southern Kuril Islands).
Ecology is very poorly known. Workers and alate queens were found in rich deciduous forest.

Notes. *T. kurilensis* most resembles *T. congruus* (see Notes under the latter species).

Temnothorax mongolicus (PISARSKI, 1969)
(Fig. 32)

Leptothorax serviculus mongolicus PISARSKI, 1969*b*: 301, workers, Mongolia: Songino, 24 km SW from Ulan-Bator; Uburchangaj aimak, Changai Distr., 18 km S from Somon Chužirt; DLUSSKY & PISARSKI, 1970: 86.

Leptothorax mongolicus: RADCHENKO, 1994*b*: 156 [raised to species rank]; 1995*b*: 18 (queens, males); BOLTON, 1995: 241.
Leptothorax serviculus RUZSKY: KUPYANSKAYA, 1990: 140; TERAYAMA *et al*., 1992: 28; KIM, 1996: 177; 2003: 2; LYU & CHO, 2003: 273, *nec* RUZSKY, 1902 *et auct*. (misidentification).
Temnothorax mongolicus: BOLTON, 2003: 271.

Material examined: 3 workers (holotype and paratypes), Mongolia, Songino, 24 km SW from Ulan-Bator, 22.v.1962, No 3299, leg. R. BIELAWSKI & B. PISARSKI; ; paratypes: 4 workers, Mongolia, Uburchangaj aimak, Changai Distr., 18 km S from Somon Chužirt, 1830 m a.s.l., 29.vi.1964, No. 223, leg. Z. KASZAB (MIZ, HNHM); non-type material: several tens workers, 4 queens, 4 males from Mongolia, South Siberia and North Korea.

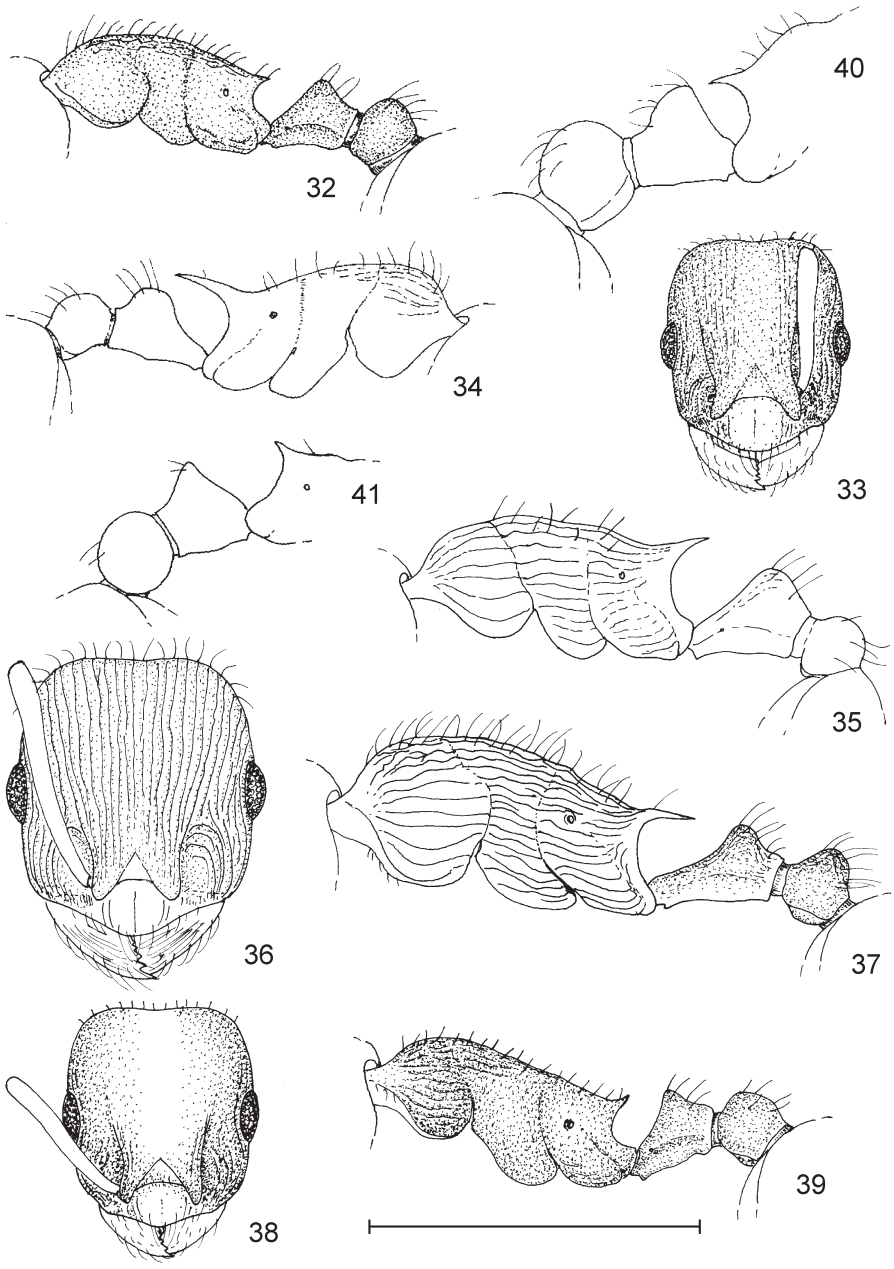
Distribution. Mongolia, Chita and Amur Regions of Russia, North Korea.
Ecology. It inhabits steppes, dry meadows and dry lighted sparse forests; nests are built in soil.

Notes. *T. mongolicus* most resembles *T. pisarskii* (see Notes under the latter). COLLINGWOOD (1976) determined a couple of specimens from North Korea as *L. serviculus*, but really they belong to *T. mongolicus* (material in HNHM, examined). This mistake was repeated by TERAYAMA *et al.* (1992) and by KIM (1996, 2003).

Temnothorax nassonovi (RUZSKY, 1895)
(Figs 33, 34)

Leptothorax nassonovi RUZSKY, 1895: 26, workers, Russia, vicinity of Simbirsk and Orenburg Region; 1905: 579; COLLINGWOOD, 1976: 303; KUPYANSKAYA, 1990: 143–144 (queens, males); RADCHENKO, 1994*b*: 155; 1995*c*: 9; BOLTON, 1995: 240; KIM, 1996: 176; KIM, 2003: 2; LYU & CHO, 2003: 272.
Leptothorax nassonovi var. *subnudus* RUZSKY, 1905: 581, workers, China, Manchuria; synonymy by: RADCHENKO, 1995*c*: 9 (provisional).
Leptothorax galeatus WHEELER, 1927: 1, worker, China, Tsinghua; 1929: 8; CHAPMAN & CAPCO, 1951: 254; RADCHENKO, 1994*b*: 156; BOLTON, 1995: 239; WU & W*ang*, 1995: 108; RADCHENKO, 1996: 18, **syn. nov.**
Leptothorax nassonovi firssovi KUZNETSOV-UGAMSKY, 1928: 28, workers, Russia, Primorsky Region, Okeanskaya; PISARSKI, 1969*a*: 225; 1969*b*: 302 (misspelled as *frissovi*), synonymy by: KUPYANSKAYA, 1990: 143.
Temnothorax nassonovi: BOLTON, 2003: 271.

Material examined. Syntypes of *L. nassonovi*: 2 workers, vicinity of Simbirsk, vi.1894 (ZMMU); non-type material: several hundred workers, dozens of queens and males from Ukraine, Southern European Russia, South Siberia, Mongolia, North-East China, Russian Far East and North Korea; lectotype and paralectotype of *L. nassonovi firssovi*: 2 workers, "Okeanskaya, vi.[19]26, Kuznetsov-Ugamsky" (designated by RADCHENKO 1995*c*) (ZMMU); holotype of *L. galeatus*: worker, "Tsinghua, nr. Peking, China, N. Gist Gee", "M.C.Z. Type 21025", "Syntypes *Leptothorax galeatus* WHEELER" (see also Notes below) (MCZ).



Figs 32–41. Details of structure of workers of *Temnothorax mongolicus* (holotype, 32), *T. nassonovi* (33, 34),*T. spinosior* (syntype, 35), *T. taivanensis* (syntype, 36, 37) and *T. wui* (syntype, 38, 39), *Leptothorax muscorum* (40) and *L. oceanicus* (41) (32, 34, 35, 37, 39). Alitrunk and waist in profile; (40, 41) waist in profile; (34, 36, 38) head, dorsal view (in Figs 34, 35, 40 and 41 punctures omitted)

Distribution. Steppe and forest-steppe zones from the eastern Ukraine to the Pacific Ocean, Tien-Shan; absent from Japan.

Ecology. It inhabits mainly steppe and dry meadows, nests are built in soil.

Notes. Investigation of the types of *L. nassonovi* and subsp. *firssovi* confirms the synonymy established by KUPYANSKAYA (1990) (see also RADCHENKO, 1995*c*).

The types of the var. *subnudus* seem to be lost. RUZSKY (1905) noted that this variety differs from the "typical" *T. nassonovi* by the very sparse standing hairs on the body (sometimes hairs are totally absent), by a somewhat different colour of the head dorsum, and the presence of the yellow spot at the base of the first gastral tergite. The two latter features are quite variable, but the absence of standing hairs is a quite significant character. Conspecificity (or dissimilarity) of these two forms can be definitely resolved only after obtaining an additional material from the type locality (Manchuria) of var. *subnudus*.

I have investigated 2 workers of *L. galeatus*, preserved in the collection of MCZ. One worker labelled "Peking, China, P. H. Lefivre", "M.C.Z. Type 7 21025" was designated by A. Schulz in 1997 as the lectotype, and a second specimen from Tsinghua (for details see above) is labelled as paralectotype. Nevertheless, WHEELER (1927) described *L. galeatus* based only on "A single specimen from Tsinhgua (Gee)" (*loc. cit.*, p. 2), which is the holotype according to the International Code of Zoological Nomenclature. The second specimen from Peking, designated as the lectotype, does not belong to the type series.

This species without any doubt is a junior synonym of *T. nassonovi*. The differences between this species and *T. argentipes* are given above, in the Notes to the latter species.

Temnothorax spinosior (FOREL, 1901)
(Fig. 35)

Leptothorax congruus var. *spinosior* FOREL, 1901: 371, workers, Japan, Sapporo; WHEELER, 1906: 317 (queens).

Leptothorax spinosior: TERAYAMA & Satoh, 1990: 532 [raised to species]; TERAYAMA *et al*., 1992: 28; BOLTON: 1995: 245; WU & WANG, 1995: 109; RADCHENKO, 1996: 16; KIM, 1996: 177; TERAYAMA & OGATA, 1999: 93; IMAI *et al*., 2003: 156; KIM, 2003: 2; LYU & CHO, 2003: 274.

Temnothorax spinosior: BOLTON, 2003: 271.

Material examined. 2 workers, syntypes (1 worker is damaged, without postpetiole and gaster), "*L. congruus* Sm. var. *spinosior* Forel, type, Sapporo, Japan" (MHNG).

Distribution. Japan, Korean Peninsula, NE China.

Ecology. It inhabits open dry grasslands; nests are built in soil (TERAYAMA & ONOYAMA, 1999).

Notes. *T. spinosior* most resembles *T. eburneipes* (see Notes under the latter species). Among rich investigated material from North Korea (more than 100 specimens) I did not find *T. spinosior*, but *T. eburneipes* only; records of *T. spinosior* from South Korea and China need confirmation.

Temnothorax taivanensis (WHEELER, 1929)
(Figs 36, 37)

Leptothorax taivanensis WHEELER, 1929: 54; Taiwan, Funkiko; CHAPMAN & CAPCO, 1951: 11; RADCHENKO, 1994b: 148; BOLTON, 1995: 245; RADCHENKO, 1996: 18.
Temnothorax taivanensis: BOLTON, 2003: 271.

Material examined: 2 workers, syntypes, "Funkiko, Formosa, Silvestri", "Cotypes", "M.C.Z. Type 1–3 21079", "Syntypes *Leptothorax galeatus* Wheeler" (*Sic*! Without any doubt "galeatus" is later mislabelling) (MCZ).

Distribution. Known only from the type locality.
Ecology is unknown.

Notes. *T. taivanensis* is similar to *T. spinosior* and *T. eburneipes* (for their separations see Notes to *T. eburneipes,* above). This species is most similar to *T. antera* (TERAYAMA & ONOYAMA, 1999) from Southern Japan and the latter can be a junior synonym of *T. taivanensis*; to resolve this question the types of *T. antera* are to be investigated.

Temnothorax wui (WHEELER, 1929) **stat. et comb. nov.**
(Figs 38, 39)

Leptothorax congruus var. *wui* WHEELER, 1929: 7; workers, queens, males, China, Peking.
Leptothorax congruus wui: BOLTON, 1995: 246; RADCHENKO, 1996: 16.

Material examined: 3 workers, 2 queens, 2 males, syntypes, "Peking, China, Chenfu, F. Wu", "Cotypes", "M.C.Z. Type 1–3 21024", "Syntypes *Leptothorax congruus* var. *wui* Wheeler" (MCZ).

Distribution. Known only from the type locality.
Ecology is unknown.

Notes. *T. wui* is a distinct species similar to *T. congruus* (for their separations see Notes to *T. congruus*).

Genus *Leptothorax* MAYR

Leptothorax acervorum (FABRICIUS, 1793)

Formica acervorum FABRICIUS, 1793: 358, workers, Denmark.
Leptothorax acervorum: MAYR, 1855: 436; KUPYANSKAYA, 1986: 96; 1990: 137; RADCHENKO, 1994*b*: 146; 1995*a*: 23; BOLTON, 1995: 235; TERAYAMA & ONOYAMA, 1999: 75; IMAI *et al*., 2003: 157; LYU & CHO, 2003: 270.
Leptothorax acervorum var. *nigrescens* RUZSKY, 1905: 613, workers, Northern Russia, synonymy by: RADCHENKO, 1994*b*: 146.
Leptothorax acervorum subsp. *kamtschaticum* RUZSKY, 1920: 77, workers, Russia, Kamchatka, synonymy by: KUPYANSKAYA, 1986: 96.
Leptothorax acervorum subsp. *orientalis* KKUZNETSOV-UGAMSKY, 1928: 31, workers, Russian Far East, Sikhote-Alin', synonymy by: KUPYANSKAYA, 1990: 137.

Material examined: several hundreds workers and dozens of queens and males from the whole Palaearctic Region.

Distribution. The boreal zone of Holarctic, the mountains of Southern Europe, the Caucasus, Tien-Shan.

Ecology. This species is most abundant in dry and lighted coniferous forests with scarce undergrowth, it reaches to the north the Forest-Tundra zone. It also can be found in open habitats, ranging from moist peat bogs to xerothermal grasslands. Nests are built (depending on habitat) in rotten logs or stumps, in fallen branches, under bark and, more rarely, under stones or in rock crevices, also under moss; in bogs they are found in peat.

Notes. For details of the ecology and synonymy of this species in the Eastern Palaearctic see KUPYANSKAYA (1986, 1990), RADCHENKO (1995*a*), BOLTON (1995), TERAYAMA & ONOYAMA (1999).

Leptothorax muscorum (NYLANDER, 1846)
(Fig. 40)

Myrmica muscorum NYLANDER, 1846: 1054, workers, queens, males, Finland.
Leptothorax muscorum: MAYR, 1855: 167; DLUSSKY & PISARSKI, 1970: 86; RADCHENKO, 1994*b*: 147; 1995*a*: 25.
Leptothorax muscorum muscorum: KUPYANSKAYA, 1990: 139.

Material examined. Syntypes: worker and queen (dealate) on one pin, "H: fors", "W. Nyland.", "Coll. Nyland.", "Mus. Zool. H: fors Spec. typ. No. 5068"; worker and queen (dealate) on one pin, labelled as above, but type No. 5069; male, labelled as above, but type No. 5067; male, labelled as above, but type No. 5070; 3 workers on one pin, "H: fors", "W. Nyland.", "Coll. Nyland."; worker and queen (dealate), labelled as above; worker and queen (dealate), labelled as above (FMNH); non-type material: several hundred workers from the Europe, Caucasus, Siberia and Russian Far East.

Distribution. The boreal zone of Holarctic (in general, more southern parts than *L. acervorum*), mountains of Southern Europe, the Caucasus; in the Eastern Palaearctic goes to the south to Central Sakhalin (appr. 50° N); absent from Japan and Korean Peninsula.

Ecology. About as in *L. acervorum*, but with a preference for drier and warmer habitats (it does not inhabit bogs). In the mountains, it lives in meadows. Nests are built under small stones, under bark, in rotten wood, sometimes in litter.

Leptothorax oceanicus (KUZNETSOV-UGAMSKY, 1928) (Fig. 41)

Mychothorax muscorum subsp. *oceanicum* KUZNETSOV-UGAMSKY, 1928: 29, worker, Russia, Primorsky Region, Ussuri Distr., station Okeanskaya.
Leptothorax muscorum oceanicum: KUPYANSKAYA, 1990: 140, worker, queen (ergatoid).
Leptothorax oceanicum: HEINZE *et al*., 1993: 177 [raised to species rank]; RADCHENKO, 1994*b*: 147; 1995*a*: 25.
Leptothorax oceanicus: BOLTON, 1995: 242 [emendation of spelling]; RADCHENKO & HEINZE, 1997: 79 [neotype designation]

Material examined. Neotype worker: Russia, Primorsky Region, Suputinsky Natural Reserve, valley of the riv. Maykha, 25.v.1967, leg. A. TICHOMIROVA (ZMMU); non-type material: 16 workers, 3 queens from Primorsky and Amursky Regions, NE China and North Korea.

Distribution. *L. oceanicus* seems to be a quite rare species and is known from several localities between 41–53° N and 125–135°E: Russia: Amursky Region, Zeya; Habarovsk; Primorsky Region: Vladivostok; Anisimovka; Borisovskoe plateau; Suputinsky Natural Reserve; North-East China: Jilin Province; North Korea: Ryanggang Province.

Ecology. This species inhabits mainly deciduous forests, but also it was found in meadows near lake shores, nests are built mostly in fallen logs, tree stumps, rarely in soil.

Notes. *L. oceanicus* most resembles *L. muscorum* but differs from it mainly by the sharply triangular petiolar node with a very narrowly rounded dorsum, (in *L. muscorum* the petiolar node has a distinct, often rounded, dorsal plate; Figs 40 and 41) (for details see RADCHENKO & HEINZE 1987).

KEY TO EASTERN PALAEARCTIC LEPTOTHORAX AND TEMNOTHORAX (WORKERS) (excluding Japan)

1	Antennae with 11 segments	2
–	Antennae with 12 segments	5

2(1) Humeri in dorsal view distinctly marked, slightly angulate
T. koreanus (TERANISHI)

– Humeri in dorsal view widely rounded 3

3(2) Tibiae and antennal scape with numerous standing hairs
L. acervorum (FABRICIUS)

– Tibiae and antennal scape without standing hairs, with decumbent pilosity only 4

4(3) Anterior and dorsal faces of petiolar node (seen in profile) meet at a rounded blunt angle, the node has a distinct, often rounded dorsal plate (Fig. 40) *L. muscorum* (NYLANDER)

– Anterior and posterior faces of petiolar node (seen in profile) meet at an acute angle, the node is sharply triangular (Fig. 41)
L. oceanicus (KUZNETSOV-UGAMSKY)

5(1) Humeri in dorsal view distinctly marked and slightly angulate (Fig. 3) 6

– Humeri in dorsal view widely rounded (Figs 6, 9, 18) 7

6(5) Head dorsum with reduced sculpture, only finely rugulose and striated, surface between them smooth and shiny (Fig. 1). Propodeal spines much shorter (ESLI 0.23), basally widened, not finger-like (Fig. 2). Petiole without anterior peduncle, about as long as high (PI 1.05), its node with narrowly rounded dorsum, cuneiform (seen in profile, Fig. 2). Standing hairs on alitrunk slightly curved, thin, distinctly longer than the minimal eye diameter (Fig. 2). Head, alitrunk and waist dark reddish, gaster reddish-brown
T. cuneinodis sp. n.

– Head dorsum with numerous, quite coarse longitudinal rugae and reticulation (Fig. 22). Propodeal spines long (ESLI > 0.25), straight, basally not widened, bluntly rounded at the tip, finger-like (Fig. 23). Petiole with short but distinct anterior peduncle, distinctly longer than high (PI > 1.20), its node with broadly rounded dorsum (seen in profile, Fig. 23). Standing hairs on alitrunk straight, blunt, thick and short, not longer than the minimal eye diameter (Fig. 23). Alitrunk and waist yellowish-red, gaster and head dorsum reddish-brown *T. alinae* (RADCHENKO)

7(5) Propodeum with long, sharp spines, ESLI > 0.33 (Figs 5, 25, 29, 35, 37) 8

– Propodeum with short spines or with sharp denticles only, ESLI < 0.28 (Figs 8, 17, 27, 31, 32, 39) 13

8(7) Whole body ochreous-yellow. Head with very broadly rounded, barely marked occipital corners (Fig. 4) **T. xanthos** sp. n.

– Body reddish-brown to dark brown or bicoloured, with alitrunk distinctly lighter than head and gaster. Head with narrowly rounded, well-marked occipital corners (Figs 24, 26, 33, 36) 9

9(8) Alitrunk yellow to brownish-yellow, head dorsum and gaster brown 10

– Whole body reddish brown to dark brown 11

10(9) Petiole with relatively short anterior peduncle (PI < 1.30), petiolar node massive, with wide, slightly rounded dorsum (seen in profile, Fig. 34). Head dorsum finely striated or at most finely rugulose and densely punctate (Fig. 33) *T. nassonovi* (RUZSKY)

– Petiole with very long anterior peduncle (PI > 1.60), petiolar node slender, with narrowly rounded dorsum (seen in profile, Fig. 25). Frons with quite coarse longitudinal, slightly sinuous rugae, remaining parts of head dorsum coarsely reticulate; surface between rugae not coarsely but densely punctate (Fig. 24) *T. argentipes* (WHEELER)

11(9) Petiole with very long anterior peduncle (PI > 1.75), anterior face in profile strongly concave (Fig. 37) *T. taivanensis* (WHEELER)

– Petiole with shorter anterior peduncle (PI < 1.60), anterior face in profile very weakly concave (Figs 29, 35) 12

12(11) Propodeal spines longer (ESLI = 0.49–0.52). Petiole relatively higher and shorter (PI < 1.40), petiolar node less massive, with narrowly rounded dorsum (Fig. 29). Antennal scape somewhat longer ($SI_1 > 0.75$, $SI_2 > 0.90$) *T. eburneipes* (WHEELER)

– Propodeal spines shorter (ESLI = 0.36–0.43). Petiole relatively lower and longer (PI > 1.50), petiolar node massive, with broadly rounded dorsum (Fig. 35). Antennal scape somewhat shorter ($SI_1 < 0.75$, $SI_2 < 0.90$) *T. spinosior* (FOREL)

13(7) Whole body reddish-brown to black 14

– Alitrunk yellow to brownish-yellow, contrasting with darker head and gaster, or the whole body ochreous-yellow 16

14(13) Antennal scape relatively long, almost reaching or even slightly surpassing the occipital margin, $SI_1 > 0.75$. Propodeum with short spines, ESLI > 0.15 (Fig. 31) *T. kurilensis* (RADCHENKO)

– Antennal scape short, distinctly not reaching the occipital margin, $SI_1 < 0.73$. Propodeum with very short sharp denticles, ESLI < 0.11 (Figs 27, 39) 15

15(14) Petiolar node in profile with wide, slightly convex dorsal plate (Fig. 27). Frons with longitudinal rugae and coarse punctures, remaining part of head dorsum punctate (Fig. 26). Antennae and legs of the same colour as body *T. congruus* (F. SMITH)

– Petiolar node in profile very narrowly rounded, subtriangular (Fig. 39). Head dorsum only finely and densely punctate, striation presents only near the eyes; a central longitudinal band on frons smooth and shiny (Fig. 38). Antennae and legs yellowish, contrasting with much darker body *T. wui* (WHEELER)

16(13) Petiole without anterior peduncle, PI < 1.25; petiolar node in profile subtriangular, with very slightly concave or almost straight anterior face and very narrowly rounded dorsum (Figs 8, 32) 17

– Petiole with distinct anterior peduncle, PI > 1.28; petiolar node in profile with distinctly concave anterior face and broadly rounded, slightly convex dorsal plate (Fig. 17) 18

17(16) Alitrunk and waist ochreous-yellow to brownish-yellow, head dorsum of the same colour as alitrunk, gaster brown, but basal ¼ of first tergite yellow. Antennal scape longer, SI_1 0.73–0.78, mean = 0.75. Propodeum with short spines, ESLI 0.18–0.25, mean 0.22 (Fig. 8) **T. pisarskii** sp. n.

– Alitrunk and waist ochreous-yellow to brownish-yellow, head dorsum brownish, distinctly darker than alitrunk, gaster entirely brown, without pale spot at the base of the first tergite. Antennal scape shorter, SI_1 0.71–0.75, mean = 0.72. Propodeum usually with short, sharp denticles, ESLI 0.09–0.22, mean = 0.15 (Fig. 32) *T. mongolicus* (PISARSKI)

18(16) Antennal scape relatively long, almost reaching or even slightly surpassing the occipital margin, $SI_1 > 0.75$. Head dorsum with distinct rugulosity and punctures (Fig. 16). Gaster concolourous with the ochreous-yellow alitrunk or slightly darker than alitrunk, first tergite without pale spot at the base **T. michali** sp. n.

– Antennal scape short, distinctly not reaching the occipital margin, $SI_1 < 0.71$. Head dorsum densely punctate and at most with fine longitudinal striation (Fig. 30). Gaster brown, distinctly darker than alitrunk, first tergite with pale spot at the base *T. kaszabi* (PISARSKI)

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