

Taxonomic and Ecological Studies in the Family Parholaspidae (Acari, Mesostigmata) from Japan

(Part 1)

By

Kazuo ISHIKAWA

Biological Laboratory, Matsuyama Shinonome Junior College, Matsuyama

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I. Introduction

The free-living soil mesostigmatid mites are abundant in the number of both species and individuals, and are regarded as the main constituent of soil mites. However, studies of these mites have so far been neglected because of their small size and of the ignorance of their role in human life.

After the Second World War, the acarology made a rapid progress in Europe and America; especially in Europe, ecological role of the soil mites has been increasingly evaluated for the past two decades. In Japan, on the contrary, soil mites were hardly studied with the exception of Cryptostigmata; free-living mesostigmatid fauna of the soil was not taken up by any specialists for their subject of study. It is for this reason that the present author has undertaken the taxonomic study of the free-living mesostigmatid mites of the Japanese soil.

In the present paper, the taxonomy and ecology of the family Parholaspidae of Japan are dealt with. Examining about 2,500 specimens collected at 550 different localities all over the Japanese Islands, the author has concluded that twenty-seven species belonging to seven genera exist in Japan. Of these, one genus and nineteen species are erected by the author, including six species previously published (ISHIKAWA, 1966, 1969), and eight species are newly recorded from Japan.

The ecology of the parholaspid mites has not yet been studied at all. During the course of this study, the complete life history of one of the species dealt with was observed by breeding; such behaviors as egg-laying, copulation and predation were also observed, and natural enemies were found. Besides, with the aim of elucidating ecological role of the suborder Mesostigmata and of the family Parholaspidae, community ecological research was performed; zoogeographic relationships of the Japanese parholaspid mites were discussed.

The type-series used for this study are deposited in the collection of the Department of Zoology, National Science Museum (Nat. Hist.), Tokyo. Some duplicate specimens are retained in the collection of the Biological Laboratory, Matsuyama

Shinonome Junior College, Matsuyama. This paper is a part of the dissertation presented for the degree of the doctor of Science at Hiroshima University.

II. History

The mites of the family Parholaspididae were first studied by BERLESE. He described two species, *Holostaspis* (*Gamasholaspis*) *gamasoides* and *Holostaspis* (*Holaspulus*) *tenuipes* from Italy in 1904. The ensuing year, in 1905, he described *Holaspulus viduus* from Java, and in 1918, *Chalholaspis superbus* from U.S.A. and *Parholaspis desertus* from Java. All these species were placed by him in the family Gamasidae. After that, VITZTHUM (1926) published the description of *Parholaspis caelebs* from Java and established the family Macrochelidae, in 1930. WILLMANN (1940) described *Parholaspis crispus* from Yugoslavia. In 1956, EVANS reviewed the family Macrochelidae and within this family established a subfamily Parholaspidinae, to which all the species mentioned above were assigned together with seven new species of the three new genera, *Tricholaspis*, *Neparholaspis* and *Parholaspulus*. KRANTZ (1960) re-evaluated EVANS' subfamily Parholaspidinae, and based upon the following characters, he raised it to the familial rank: 1) presence of a straight peritreme, 2) epigynial shield lacking accessory lateral sclerites, 3) palpal tarsus lacking a prominent sensory rod. At the same time, he proposed three new genera, *Neoparholaspulus*, *Lattinella* and *Parholaspella*, and described ten new species. Further, he regarded *Tricholaspis* EVANS, 1956, as a synonym of *Neparholaspis* EVANS, 1956, and described in 1963 *Calholaspis trianothrix* from Costa Rica.

In the Soviet Union, BREGETOVA and KOROLEVA (1960) described *Evansolaspis browni* and recorded *Parholaspulus alstoni* EVANS. PETROVA (1967 a) proposed *Krantzholaspis ussuriensis* and *Neparholaspis unicus*, and interpreted the genus *Evansolaspis* BREGETOVA et KOROLEVA, 1960, as a synonym of the genus *Gamasholaspis* BERLESE, 1904. She (1967 b) also reported *Euparholaspulus primoris* and seven species of the genus *Gamasholaspis*.

In Japan, the author first described three species of *Parholaspulus* and a species of *Gamasholaspis* in 1966, and added two more species of *Parholaspulus* in 1969.

III. Materials and Methods

Samples of litter, humus and/or soil containing mites were brought back to the laboratory in cotton bags (30×40 cm) as soon as possible. Extraction of the mites from the samples was done by using modified Tullgren apparatus (MORIKAWA, 1967), which was based on the Berlese funnel. This apparatus drove arthropods deeper into the substrate by the heat of a light bulb (40 watts), and the animals dropped into a glass jar containing 70% ethanol and placed on the floor. One litre of the sample was put into the apparatus, and kept three days for the purpose of extraction. Sorting of the mites was made by taking the sample into petri-dish and examining it under ten

to fifty power stereoscopic microscope. To facilitate the observation by microscope the mites sorted out were placed in lactophenol (lactic acid 50 parts, phenol crystals 25 parts, distilled water 25 parts) for a minimum of 48 hours in 37°C incubator. Lactophenol-treated specimens were washed in five rinses of 50% ethanol, and mounted by Hoyer's solution (distilled water 50 grams, gum arabic crystal 30 grams, chloral hydrate 200 grams, glycerine 20 grams).

Sketching of the mites was done by means of Abbe's apparatus.

Breeding was done on *Parholaspulus ochraceus* collected in the temperate evergreen grove at Kuwabara in Matsuyama City, in May, 1970. Receptacles for breeding the mites of this family were deep petri-dishes (90 mm in diameter, 60 mm in depth) and glass tubes (30×60 mm) containing a substance prepared by mixing plaster of Paris and active carbon in a ratio of five to ten percentage, solidified to a thickness of 1 cm. The receptacles were renewed every three to five days. Several decaying leaves were put into the receptacle. The mites were fed with eggs or larvae of collembolans, free-living nematods in soil and sometimes dry yeast (*Saccharomyces cerevisiae*).

IV. General External Morphology

Dorsum (Figs. 1, 3, 99). Larva and nymph:— The dorsum of the larva has a podonotal shield with a series of various setae (nine pair of simple ones in *Parholaspulus ochraceus* for example), and the unsclerotized cuticle posterior to the podonotal shield also carries a series of setae (seven pair in cited species). The protonymph has an opisthonotal shield in addition to the podonotal one, both not being fused together. In *P. ochraceus*, the podonotal shield bears eleven pair of setae, the setae M1 being absent, while the opisthonotal shield bears ten pair of long simple setae. In the deutonymph, the dorsal scuta join medially, having a deep incision on each side between the two, which is wider laterally than medially. In *P. ochraceus*, eighteen pair of setae including M1 occur on the anterior region.

Adult:— The dorsal shield is entire, sclerotized and variously ornamented. Its shield bears twenty-seven or more pair of simple, spatulate or lanceolate setae. In *P. ochraceus*, thirty pair of simple setae occur on the shield.

Venter (Figs. 4–6, 103–104). Larva:— The tritosternum in the larva has an elongate base and a pair of pilose laciniae. The sternal shield is not defined, though three pair of simple setae occur on the sternal region. The anal shield bears a pair of long preanal setae and a postanal one as shown in Fig. 4. The remainder of the opisthogastric region is provided with three pair of setae. The stigmata and peritremes are absent.

Protonymph:— The tritosternum is well developed. The sternal shield is well defined, having three pair of simple setae and two pair of pores. The fourth pair of setae occur in the intercoxal region IV, being homologous with the genital setae of the adult. The presternal, metasternal, epigynial and ventral shields are not defined.

The anal shield bears three pair of setae as in the larva. Chaetotaxy of the remaining part of opisthogastric region is as shown in Fig. 5. The stigmata are located antero-lateral to the coxae IV, the peritremes being very short.

Deutonymph:— The tritosternum is similar to that of the adult. Four pair of sternal setae and two pair of pores are present on the sternal shield, the sternal setae IV corresponding to the metasternal setae. The anal shield is provided with three perianal setae and a pair of opisthogastric ones. The unsclerotized cuticle of the opisthogastric region posterior to the sternal shield bears eight or more pair of setae. The stigmata are situated between and lateral to the coxae III and IV; peritremes are well developed and varied in their extension according to species. In *Parholaspulus ochraceus*, for example, they extend to the coxae I. The peritrematal shields are conspicuous.

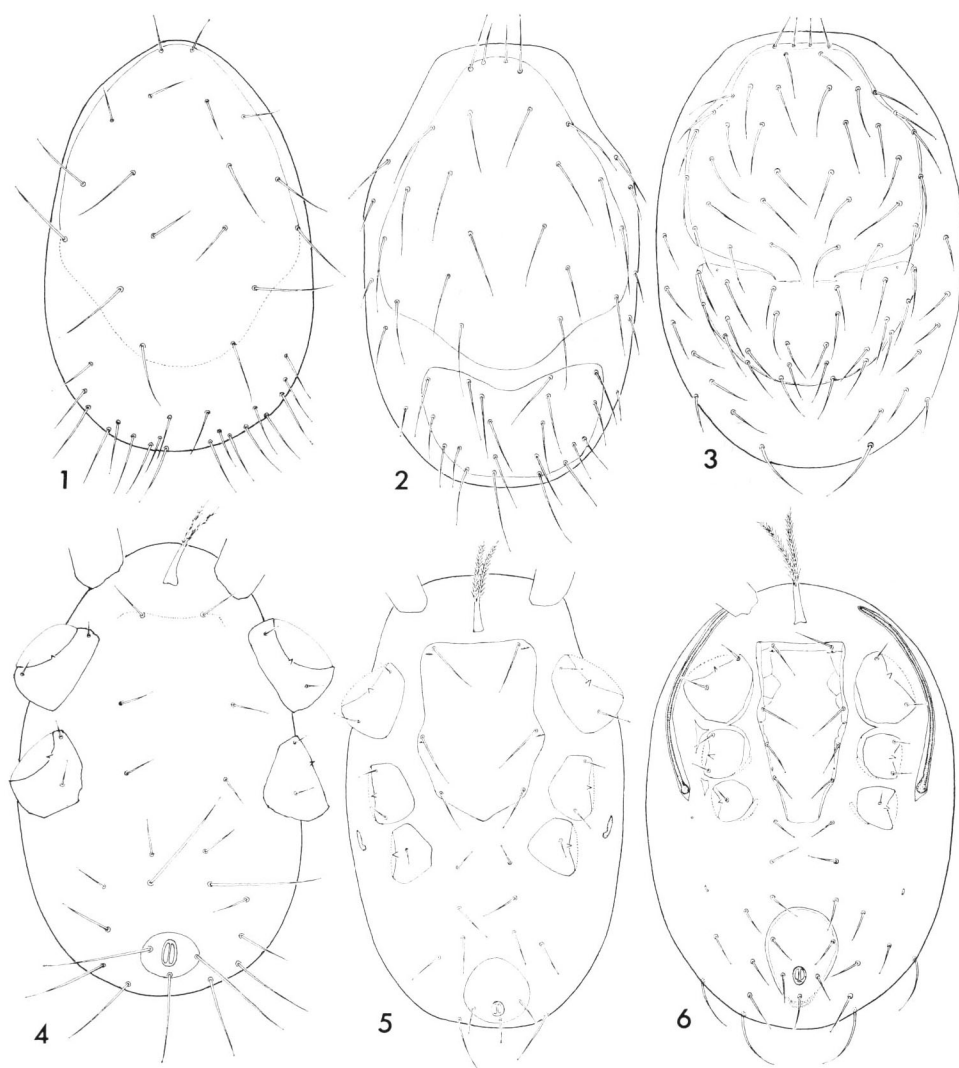
Female:— The tritosternum is well developed, the elongate base giving rise a pair of pilose laciniae. The presternal shield usually consists of one or more pairs of platelets, but is vestigial in some cases. The sternal shield is provided with three or four pair of setae and two pair of pores, and is free either from the metasternal or the endopodal shields, or from both of them. The metasternal shields are free in the interscutal membrane or fused with the sternal and/or endopodal shields. A ventri-anal, geniti-ventri-anal or fused podal-peritrematal-geniti-ventri-anal shield exists. The epigynial shield is truncated or rounded posteriorly, having a pair of setae. The ventri-anal shield is provided with three or more pair of preanal setae, varying in shape and ornamentation. Metapodal shield is lacking or consists of one or more pair of platelets. The stigmata are located lateral to the coxae III to IV; the peritremes and peritrematal shields extending near the humeral angles. Females usually carry a single egg, which occupies a great proportion of the body. In *P. ochraceus*, for example, the egg is 352 μ in body length and 230 μ in body width.

Male:— The male possesses a completely fused holoventral shield on which are inserted a series of setae. The genital orifice is situated on the anterior margin of the sternal shield. The elements of tritosternum, presternal shields, stigmata and peritremes are similar to those of the female.

Gnathosoma. The epistome shows various structures, but is primarily formed by median projection and additional lateral projections. The form of epistome is often markedly dissimilar in different nymphal stages of the same species. The pedipalp has five free segments; the internal palpal setae are simple; the palpal apotele is provided with three tines, of which the central and frequently basal tines are spatulate distally. The palpal chaetotaxial formulae are as follows:

Larva	0 - 4 - 5 - 6 - 10 apotele
Protonymph	1 - 4 - 5 - 7 - 11 apotele
Deutonymph	2 - 5 - 6 - 8 - 15 apotele
Adult	2 - 5 - 6 - 8 - 17 apotele

The chaetotaxy of the venter of hypostome consists of two pair of setae. In the protonymph, two pair of setae are added; its chaetotaxy is retained in the deutonymph



Figs. 1-6. *Parholaspulus ochraceus* ISHIKAWA, dorsum (1-3) and venter (4-6). — 1, 4. Larva. — 2, 5. Protonymph. — 3, 6. Deutonymph.

and adult. The chelicera is well developed, the fixed and movable digits bearing a well developed setal brush. The seta on the fixed digit is simple or spine-like, sometimes wedge-shaped. The male is provided with a sperm transfer organ on the movable digit of the chelicera. The corniculus is well developed, long and sword-like.

Legs. The leg is six-segmented (excluding the ambulacrum) in all stages. The larva has three pair of legs; in the protonymph is added the leg IV. The leg I is provided with claws or not, the claws, if present, being much smaller than those of the

legs II to IV. The legs II to IV each has well developed claws and pulvilli. The sensibility setae on the tarsus I are exceedingly developed. The leg II is generally stouter than the leg I, with or without distal stout spine. The femur II in the male bears a stout thumb-like apophysis; in certain species, a small spine-like process is found on the genu II, tibia II as well as tarsus II.

V. Taxonomy

Family Parholaspidae EVANS

Parholaspiinae EVANS, 1956, Proc. zool. Soc. London, **127**: 345.

Parholaspidae: KRANTZ, 1960, Acarologia, **2**: 393.

The morphological characteristics of this family are as follows: Dorsal shield entire, bearing twenty-seven or more pair of simple, spatulate or whip-like setae. Presternal shields usually composed of a single to several pair of platelets. Sternal shield provided with three or four pair of sternal setae, and free or fused with metasternal or endopodal shields. Male with a holovenral shield, and the genital orifice situated on the anterior margin of the shield. Epistome with various projections. Chelicera well developed, its movable digit with two or more teeth. Corniculus longer than three times the basal width. Tarsus I without claw or with small claws.

Notes. For classifying the species belonging to this family, emphasis has hitherto been laid on such characters as the structure of peritreme, epistome, corniculus and chelicera, the number and shape of setae on the dorsal shield, and the presence of claws on the first tarsus. In the present study, two further characters were found to be effective, namely, 1) the length relationship of the dorsal setae in D-series (=dorsal seta length) and the distance between the two setae (=seta distance), and 2) the ratio of the first tarsal length to the first tibial length (=first tarsus ratio).

The dorsal seta length is shorter than the seta distance in some species, but this is reversed in other species. For example, in *Parholaspulus trifurcatus* the dorsal seta length is shorter than the seta distance, while in *P. communis* the former is longer than the latter. The first tarsus ratio may also varies according to species; that is, in some species it is less than 1.5, in some other species, 1.5 to 2.0, and still in other species, more than 2.0. For instance, it is less than 1.5 in *Parholaspulus shigaensis*, 1.5 to 2.0 in *P. yakushimaensis*, and more than 2.0 in *P. alstoni*. It is worth noting that this character is to some extent useful for the generic classification in this family, namely, the ratio is less than 1.5 in *Parholaspis*, 1.5 to 2.0 in *Neparholaspis*, and 2.0 in *Holaspulus*. Further value of this character will be ascertained when a study is carried out in global scope.

Key to the Genera of the Family Parholaspidae in Japan

1. Peritrematal shields fused with ventri-anal shields; usually with a pair of ex-pulsory vesicles2.

- Peritrematal shields not fused with ventri-anal shields; usually without expulsive vesicles3.
- 2. Epigynial shield fused posteriorly with ventri-anal shield; dorsal seta on fixed digit of chelicera simple; tarsus I longer than twice the length of tibia I.....
.....*Holaspulus* BERLESE.
- Epigynial shield not fused with ventri-anal shields; dorsal seta on fixed digit wedge-shaped; tarsus I shorter than twice the length of tibia I.....
.....*Neparholaspis* EVANS.
- 3. Dorsal seta D1 either as long as M1 or considerably shorter than M1; anterior margin of dorsal shield usually truncate or slightly rounded 4.
- Dorsal seta M1 either considerably shorter than D1 or absent; anterior margin of dorsal shield usually rounded 5.
- 4. Epigynial and ventri-anal shields not connected; metasternal shields present....
.....*Parholaspulus* EVANS.
- Epigynial and ventri-anal shields fused; metasternal shields absent
.....*Proparholaspulus* ISHIKAWA.
- 5. Dorsal seta M1 present, shorter than D1; movable digit of chelicera longer than corniculus*Parholaspis* BERLESE.
- Dorsal seta M1 absent; movable digit of chelicera as long as or shorter than corniculus 6.
- 6. Dorsal shield provided with less than thirty pair of setae; metasternal shields present; dorsal seta on fixed digit wedge-shaped*Gamasholaspis* BERLESE.
- Dorsal shield provided with more than forty pair of setae; metasternal shield absent; dorsal seta on fixed digit simple*Euparholaspulus* PETROVA.

Genus *Holaspulus* BERLESE

Holaspulus BERLESE, 1904, Redia, 1: 266.

Dorsal shield provided with thirty pair of spatulate setae, of which the setae M1 are simple in some species. Extramarginal setae spatulate distally. A pair of pre-sternal shield present. Female with sternal shield, bearing three pair of simple setae; metasternal shield free, and with a pair of setae and pores. Epigynial shield with a pair of setae and fused posteriorly with the ventri-anal shield. Peritrematal shields fused with exopodal and ventri-anal shields. Metapodal shields conspicuous. Male with a holovertral shield, the genital orifice being situated on the anterior margin of sternal shield. Epistome denticulate along its entire anterior margin. Chelicerae long and slender; movable digit longer than corniculus. Movable digit of chelicera with a strong sperm transfer organ in the male. Leg I without pretarsus and claws in both sexes. Legs II to IV each with a pair of claws and a lobate pulvillus. Femur and genu II spurred in the male.

Type-species: *Holostaspis* (*Holaspulus*) *tenuipes* BERLESE.

The members of this genus are found for the first time in Japan.

Key to the Species

1. Dorsal shield with serrated posterior margin *H. serratus* sp. nov.
- Dorsal shield with smooth posterior margin 2.
2. Expulsory vesicles present; spermatophoral process in male longer than movable digit *H. tenuipes* BERLESE.
- Expulsory vesicle apparently absent; spermatophoral process in male shorter than movable digit *H. tweediei* EVANS.

Holaspulus serratus sp. nov.

[Japanese name: Marunoko-heragehokodani]

(Figs. 7–13)

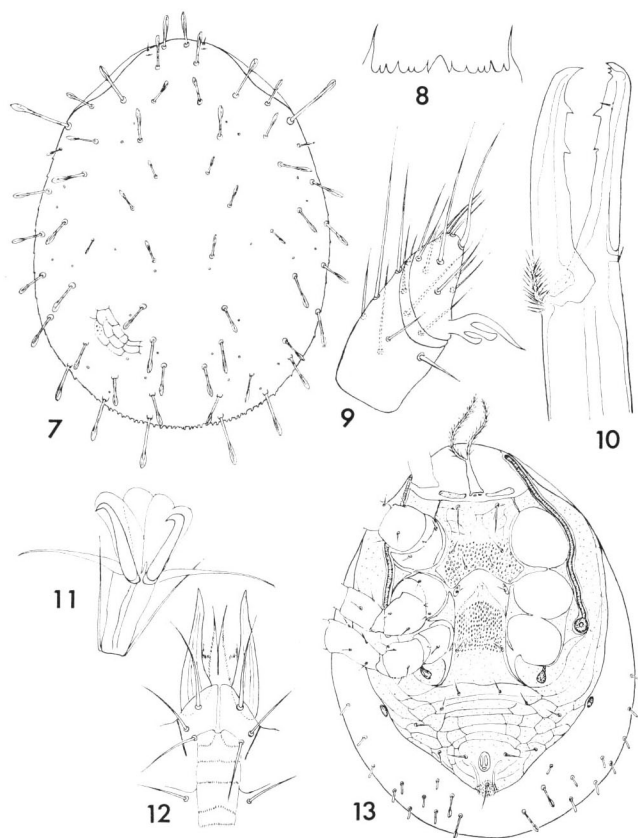
Type-series. Holotype ♀ (NSMT-Ac 9297): ex litter of *Quercus mongolica* var. *grosseserrata* (BLUME) REHDER et WILSON, Mt. Kampû-zan, Saijô, Ehime Pref., 4-V-1969, K. OKUDA. Paratypes: Shikoku — 1 ♀, same data as holotype; 2 ♀♀, Jôju (1,450 m), Mt. Ishizuchi, Ehime Pref., 8-VI-1969, K. ISHIKAWA; 2 ♀♀, Mt. Ishizuchi, 8-VI-1969, K. I*.; 6 ♀♀, Yanadani, Kamiukena-gun, Ehime Pref., 24-X-1968, K. I.; 1 ♀, Omogo Valley, Ehime Pref., 6-VIII-1962, K. I. Kyushu — 1 ♀, Nagasaki, Nagasaki Pref., 20-IX-1968, N. HIRAMATSU.

Female. Length of dorsal shield with a range of 571–645 μ , av. 603 μ ; width at the level of coxae IV with a range of 443–497 μ , av. 468 μ .

Dorsum. Dorsal shield entire, ornamented with punctations and reticulations, particularly in the postero-lateral portion. Posterior margin of dorsal shield serrated. Dorsal shield provided with thirty pair of setae, which are spatulate distally excepting simple setae M1. Extra-marginal setae of integument spatulate. The distribution and relative length of setae and pores are as shown in Fig. 7. Length of setae: verticals and D2 54 μ , D3 41 μ , D4 49 μ , D5 38.5 μ , D10 62 μ , D11 87 μ , M1 6.4 μ and humerals 100 μ .

Venter. Tritosternum bipartite distally, with an elongate truncated base and plumose laciniae. Presternal shield well sclerotized. Sternal shield reticulated and strongly punctate especially in the posterior portion, and fused with podal shields. Sternal setae I longer than setae II and III, setae III lying well inside the bases of setae II. Metasternal shields narrow, lying behind the posterior angles of sternal shield, and with a pair of simple setae and pores. Epigynial shield fused posteriorly with ventri-anal shield, with the anterior hyaline portion produced into a sharp point, bearing a pair of simple setae, and ornamented as shown in Fig. 13. Ventri-anal shield with the epigynial, podal-peritrematal shields, and provided with four pair of preanal setae and three perianal setae. A pair of expulsory vesicles situated behind coxae IV. Interscutal membrane between dorsal and ventral shields with eleven pair of setae, two of which are spatulate, and the remainings are in the form of conical

* K. I.: the abbreviation of K. ISHIKAWA.



Figs. 7–13. *Holaspulus serratus* sp. nov., female. — 7. Dorsum. — 8. Epistome. — 9. Palpal tarsus and tibia. — 10. Chelicera. — 11. Pretarsus II. — 12. Venter of gnathosoma. — 13. Venter.

spur. Metapodal shields conspicuous, located lateral to the second preanal setae. Stigmata situated on the level between coxae III and IV but lateral to them. Peritremes extending anteriorly beyond coxae I.

Gnathosoma. Epistome with spinose median projection, and with several short spines on either side and a pair of elongate lateral extensions. Pedipalp five-segmented; apotele of palpal tarsus bearing three tines, two of which are spatulate distally. Fixed digit of chelicera with a large tooth, three small teeth and a pilus dentilis; movable digit ($146\ \mu$) bidentate, and longer than corniculus ($110\ \mu$).

Legs. Tarsus I without claws and pulvilli; sensory setae of apical portion well developed. Tarsus I ($177\ \mu$) more than twice the length of tibia I ($84\ \mu$). Tarsi II to IV with well developed claws and pulvilli. Length of leg I $565\ \mu$, II $470\ \mu$, III $423\ \mu$ and IV $592\ \mu$.

Male. Unknown.

Remarks. The present species can be readily separated from *Holaspulus tenuipes* BERLESE, 1904, originally described from Italy, which possesses the following characteristics: the posterior margin of dorsal shield smooth, not serrate; expulsory vesicles large, situated behind coxae IV; preanal setae I to III located on a straight line. The most remarkable feature of this species is the serrated posterior margin of the dorsal shield.

It is interesting that the present species is collected only in montane areas of Shikoku and Nagasaki Prefecture of western Kyushu. Its individual number is smaller than that of the other two species of the genus.

Holaspulus tenuipes BERLESE

[Japanese name: Nogama-heragehokodani]

(Figs. 14–20)

Holostaspis (Holaspulus) tenuipes BERLESE, 1904, Redia, 1: 266.

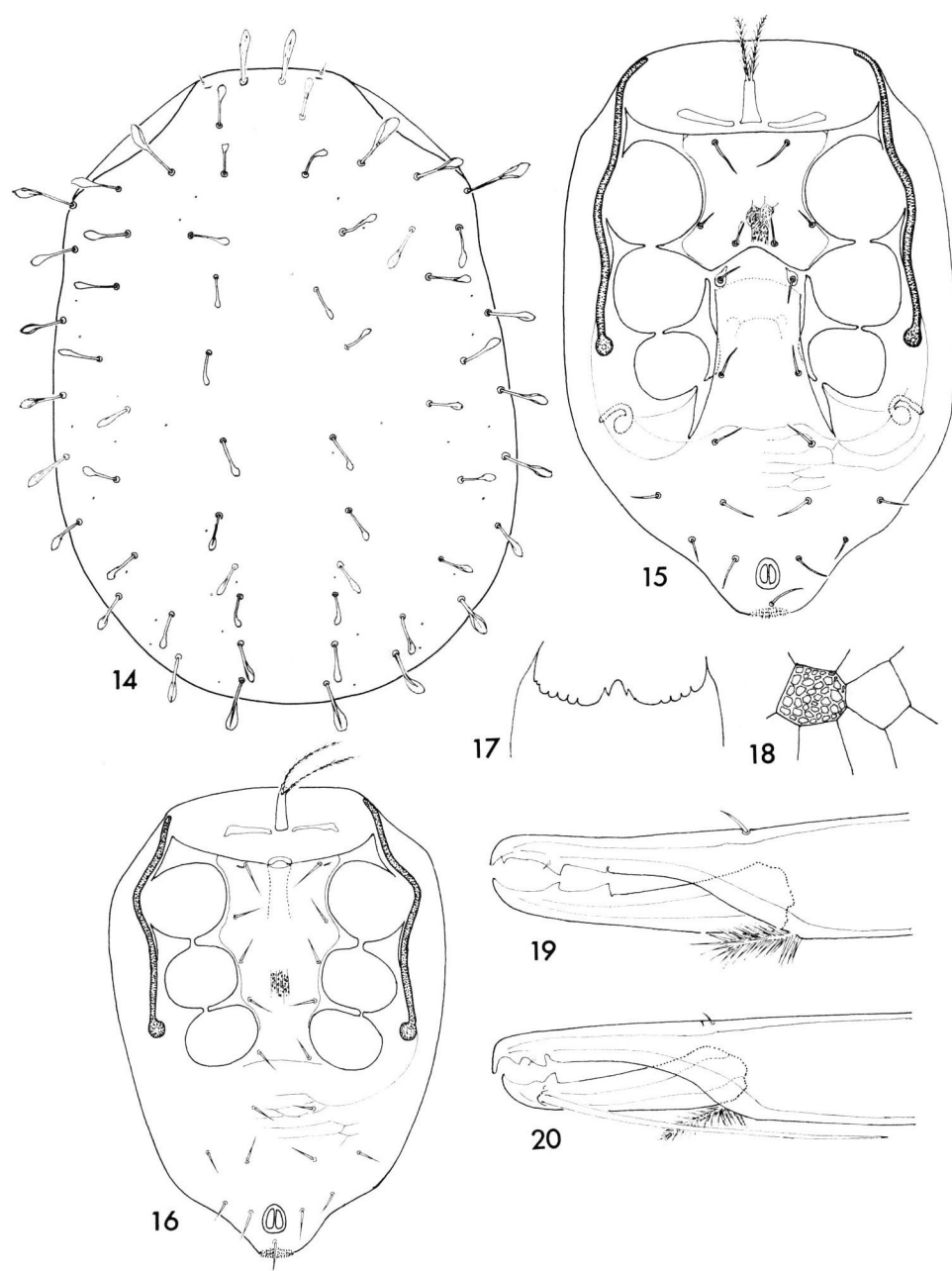
Holaspulus tenuipes: EVANS, 1956, Proc. zool. Soc. London, 127: 354; KRANTZ, 1960, Acarologia, 2: 399.

Specimens examined. Honshu — 2 ♀♀, Shirahama, Wakayama Pref., 10–IV–1967, M. TANAKA; 2 ♀♀, 1 ♂, ex litter of *Camellia japonica* LINNAEUS, Ise, Mie Pref., 28–II–1969, K. ISHIKAWA; etc. Shikoku — 6 ♀♀, 2 ♂♂, ex litter of *Camellia japonica*, Ōshima Is., Niihama City, Ehime Pref., Y. UENO; 1 ♀, ex litter of *Pinus thunbergii* PARLATORE, Shiroyama, Kōchi City, 24–X–1968, K. I.; 1 ♀, 1 ♂, Bizan, Tokushima City, 7–IV–1969, M. YOSHIDA.

Female. Length of idiosoma: av. 654 μ ; length of dorsal shield with a range of 561–638 μ , av. 598 μ ; width of dorsal shield at the level of coxae IV 355–441 μ , av. 399 μ .

Dorsum. Dorsal shield sclerotized and ornamented with punctations and reticulations, especially in the posterior third. Lateral interscutal membrane strongly striated. Dorsal shield bearing thirty pair of spatulate setae, of which the setae M1 are simple. Extra marginal setae spatulate. Length of setae: verticals 54 μ , M1 5 μ , D1 44 μ , D3 36 μ , D4 38 μ , D5 36 μ , D11 44 μ and humerals 64 μ .

Venter. Tritosternum with a pair of strongly pilose laciniae. A pair of pre-sternal shield well developed. Sternal shield ornamented with a network of ridges and coarsely set punctations; its posterior margin deeply emarginate; three pair of simple setae present, setae III lying inside the bases of setae II. Metasternal shields free, and with a pair of setae. Epigynial shield with a pair of simple setae and fused posteriorly with ventri-anal shield. Ventri-anal shield fused with the epigynial, podal and peritrematal shields, and with four pair of preanal setae. A pair of expulsory vesicles located posterior to coxae IV. Metapodal shields well sclerotized. Stigmata situated at a position antero-lateral to coxae IV. Peritremes extending beyond coxae I.



Figs. 14–20. *Holaspulus tenuipes* BERLESE (14, 15, 17–19, female; 16, 20, male). — 14. Dorsum. — 15–16. Venter. — 17. Epistome. — 18. Ornamentation of dorsal surface. — 19–20. Chelicera.

Gnathosoma. Epistome with a denticulate anterior margin. Pedipalp five-segmented; palpal apotele with three tines, two of which are spatulate distally. Gnathosoma provided with four pair of simole setae ventrally. Rostral setae considerably longer than the other three pairs. Fixed digit of chelicera tridentate, and movable digit ($149\ \mu$) bidentate, longer than corniculus ($120\ \mu$).

Legs. Tarsus I ($185\ \mu$) much longer than tibia I ($80\ \mu$), without claws and pulvilli, sensory setae well developed. Length of leg I $617\ \mu$, II $513\ \mu$, III $415\ \mu$ and IV $532\ \mu$.

Male. Length of idiosoma av. $566\ \mu$; length of dorsal shield with 516 – $572\ \mu$, av. $539\ \mu$; width of dorsal shield at the level of coxae IV 343 – $407\ \mu$, av. $373\ \mu$.

The chaetotaxy and ornamentation of dorsal shield are basically the same as in the female. Genital orifice situated on the anterior margin of holovertral shield, with nine pair of simple setae and three perianal setae on its shield. Fixed digit of chelicera bidentate; movable digit ($148\ \mu$) unidentate, and with conspicuously long sperm transfer organ (approximately $176\ \mu$), and considerably longer than corniculus ($120\ \mu$). Femur and genu II spurred. Length of leg I $485\ \mu$, II $530\ \mu$, III $418\ \mu$ and IV $525\ \mu$.

Known distribution. Italy, in greenhouse; Switzerland, in greenhouse; England, soil and organic matter under *Caryota mitis* in the Aroid House, Royal Botanic Gardens, Kew; Mexico, on *Laelia gouldiana*.

Remarks. The known distribution mentioned above and its occurrence in the litter of *Camellia japonica* strongly suggest its origination in a warmer region. It is found for the first time in Japan.

Holaspulus tweediei EVANS

[Japanese name: Kuroshio-heragehokodani]

(Figs. 21–27)

Holaspulus tweediei EVANS, 1956, Proc. zool. Soc. London, **127**: 357; KRANTZ, Acarologia, 1960, **2**: 400.

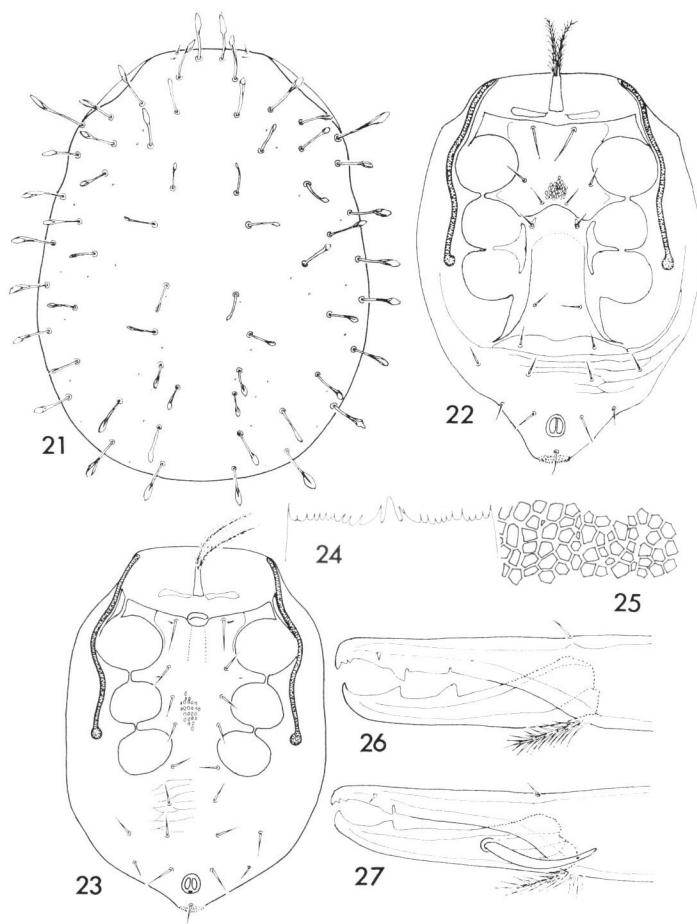
Specimens examined. Honshu — 12 ♀♀, Shiga Heights, Nagano Pref., 19–X–1967, K. ISHIKAWA, 2 ♀♀, 3–VI–1968, K. I.; 4 ♀♀, 2 ♂♂, Kusatsu, Gunma Pref., 23–VIII–1968, K. I.; 1 ♂, Shirahama, Wakayama Pref., 10–IV–1967, M. TANAKA; 1 ♀, Otanomôtsuno-taira, Mt. Shiga, 24–VIII–1968, K. I.; 3 ♀♀, Biwaike, Shiga Heights, 26–VII–1968, K. I. Shikoku — 1 ♀, ex litter of *Tsuga sieboldii* CARRIERE, Omogo Valley, Ehime Pref., 6–VII–1962, K. ISHIKAWA, 5 ♀♀, 28–X–1966, K. I.; 1 ♀, 1 ♂, Mt. Omogo, 6–VII–1968, K. MORIKAWA; 1 ♀, Mikawa, Ehime Pref., 2–III–1968, Y. INOUE; 2 ♀♀, Oshima Is., Niihama City, 5–V–1968, Y. UENO; 3 ♀♀, Misho, Minamiuwa, Ehime Pref., 8–II–1969, T. WATANABE; 2 ♀♀, Tsuchigoya, Mt. Ishizuchi, 6–VIII–1969, K. I.; 6 ♀♀, 2 ♂♂, ex litter of *Fagus crenata* BLUME, Mt. Omogo, 7–VIII–1969, K. I.; 1 ♀, 1 ♂, Cape Ashizuri, Kôchi Pref., 2–III–1969, Y. TAN; 2 ♀♀, Mt. Kinobe, Myôzai-gun, Tokushima Pref., 23–IV–1969, M. YOSHIDA. Ryukyus —

1 ♀, 1 ♂, Yakushima Is., 12–II–1969, R. NAGANO; 5 ♀♀, 2 ♂♂, Ôtomi, Iriomote Is., 18–VII–1969, K. I.

Female. Length of idiosoma: av. 639 μ ; length of dorsal shield 550–685 μ , av. 601 μ ; width of dorsal shield at the level of coxae IV 385–487 μ , av. 421 μ .

Dorsum. Dorsal shield sclerotized and ornamented with punctations and reticulations, especially in the posterior area. Dorsal shield provided with thirty pair of setae, which are spatulate distally excepting simple setae M1. Lateral interscutal membrane heavily striated. Length of setae: verticals 51 μ , D2 46 μ , D3 38 μ , D4 39 μ , D5 33 μ , D10 54 μ and humerals 80 μ .

Venter. Tritosternum well developed, with a pair of pilose laciniae. Pre-



Figs. 21–27. *Holaspulus tweediei* EVANS (21–22, 24–26, female; 23, 27, male). — 21. Dorsum. — 22–23. Venter. — 24. Epistome. — 25. Ornamentation of dorsal surface. — 26–27. Chelicera.

sternal shields composed of a pair of platelets. Sternal shield strongly sclerotized and heavily ornamented with a network of ridges. Three pair of sternal setae simple. Each metasternal shield free, and provided with a simple seta and pore. Epigynial shield fused posteriorly with ventri-anal shield and with a pair of simple setae. Endopodal shield in the anterior area of coxae II completely fused with sternal shield. Ventri-anal shield fused with epigynial, podal and peritrematal shields; bearing four pair of preanal setae in addition to three perianal setae. Metapodal shield conspicuous. Expulsory vesicles of ventri-anal shield absent. Stigmata located at a position antero-lateral to coxae IV. Peritremes extending to the level of coxae I.

Gnathosoma. Epistome denticulate on its anterior margin. Pedipalp composed of five segments; palpal apotele with three tines, two of which are distally spatulate. Gnathosoma provided with four pair of simple setae, of which the rostrals are longer than the other three pairs. Fixed digit of chelicera quadridentate; movable digit ($126\ \mu$) bidentate and longer than corniculus ($105\ \mu$).

Legs. Tarsus I with neither claws nor pulvilli; sensory setae well developed. Tarsus I ($195\ \mu$) approximately twice as long as tibia I ($81\ \mu$). Tarsi II to IV each with well developed claws and pulvilli. Length of leg I $530\ \mu$, II $467\ \mu$, III $382\ \mu$ and IV $475\ \mu$.

Male. Length of idiosoma; av. $580\ \mu$; length of dorsal shield $534\text{--}605\ \mu$, av. $584\ \mu$; width of dorsal shield at the level of coxae IV $347\text{--}425\ \mu$, av. $402\ \mu$.

The chaetotaxy and ornamentation of dorsal shield are essentially the same as in the female. Genital orifice located on the anterior margin of holovertral shield. Holovertral shield between coxae II to IV ornamented with a network of ridges and punctations, and with five pair of simple setae. Ventri-anal portion bearing four pair of simple setae and three perianal setae. Fixed digit of chelicera bidentate; movable digit ($121\ \mu$) unidentate and much longer than sperm transfer organ ($69\ \mu$). Femur and genu II spurred. Length of leg I $545\ \mu$, II $506\ \mu$, III $397\ \mu$ and IV $502\ \mu$.

Known distribution. Singapore, inside a rotting tree.

Remarks. This species has not been recorded since it was first collected in Singapore in 1956, so that its occurrence in Japan is of considerable interest. The mite may have been carried by the Black Current. This species is commonly found in the southern part of Japan.

Genus *Neparholaspis* EVANS

Neparholaspis EVANS, 1956, Proc. zool. Soc. London, **127**: 361.

Dorsal shield reticulated, with twenty-nine or thirty pair of simple or spatulate or whip-like setae. Presternal shield composed of a single or two pair of platelets. Sternal shield with three pair of simple setae. Metasternal shields in the female fused with sternal and/or endopodal shields, or free. Peritrematal shield fused with ventri-anal and exopodal shields. Female usually with a pair of expulsory vesicles situated at a position posterior to or postero-lateral to coxae IV. Male with a holovertral

shield, genital orifice opening on the anterior margin of sternal shield. Gnathosoma normal for the family. Cheliceral chelae dentate, movable digit of male bearing a sperm transfer organ. Corniculus long and slender. Legs I with or without claws. Tarsus I shorter than twice the length of tibia I.

Type-species: *Neparholaspis spatulatus* EVANS.

This is the first record of the genus in Japan. Three different species have hitherto been found, all being new to science.

Key to the Species

1. Peritrematal shield well developed, extending posteriorly beyond coxae I and with unusually deep incision *N. shinanonis* sp. nov.
- Peritrematal shield not extending beyond coxae IV 2.
2. Dorsal setae M1 present; sternal setae III short; movable digit of chelicera with two large teeth and a number of small teeth *N. serratichela* sp. nov.
- Dorsal setae M1 absent; sternal setae III exceedingly long, about twice the length of setae II; movable digit of chelicera with two large teeth, without small tooth *N. monticola* sp. nov.

Neparholaspis shinanonis sp. nov.

[Japanese name: Shinano-koshibirohokodani]

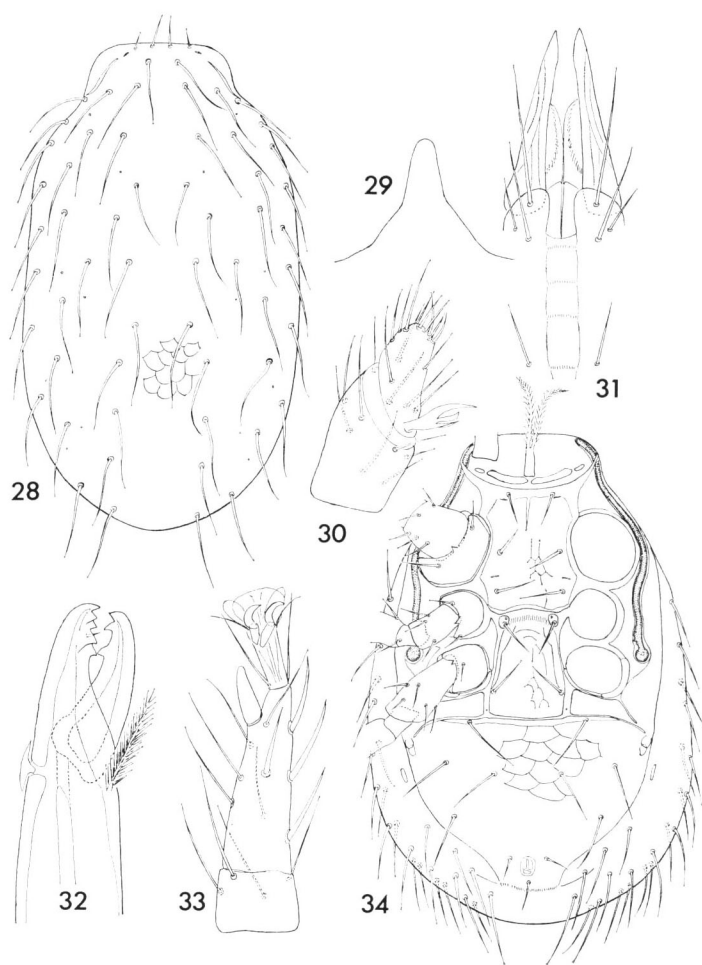
(Figs. 28–34)

Type-series. Holotype ♀ (NSMT-Ac 9298): ex litter of *Betula ermani* CHAMISSE and *Tsuga diversifolia* MASTERS, Otanomôsunô-taira, Mt. Shiga, Nagano Pref., 19–X–1967, K. ISHIKAWA. Paratypes: Honshu — 4 ♀♀, the same place as holotype, 3–VI–1968, 2 ♀♀, 24–VIII–1968, K. I.; 1 ♀, Shizumo, Nagiso, Nagano Pref., 20–VIII–1968, K. I.

Female. Length of dorsal shield with a range of 763–855 μ , av. 820 μ ; width at the level of coxae IV with a range of 435–492 μ , av. 468 μ .

Dorsum. Dorsal shield entire and reticulated, especially in the posterior third; anterior margin truncated. Dorsal shield provided with thirty pair of simple setae; setae D1 twice as long as M1. The distribution and relative length of setae and pores are as shown in Fig. 28. Length of setae: verticals 51 μ , D2 108 μ , D3, 4, 6 133 μ , D5 123 μ , D7 141 μ , D8 149 μ , D9, 12 131 μ , D11 128 μ , M1 25.5 μ and Mg2 110 μ .

Venter. Tritosternum well developed, with a pair of strongly plumose laciniae, and flanked at its base by two pair of presternal shields. Sternal shield bearing three pair of simple long setae, and fused with podal and peritrematal shields. Metasternal shields free, and with a pair of long simple setae and pores. Epigynial shield nearly rectangular, slightly longer than wide; genital setae located on the lateral side at a quarter from the posterior end. A pair of small platelets situated in the integument postero-lateral to epigynial shield. Ventri-anal shield fused with podal and peri-



Figs. 28–34. *Neparholaspis shinanonis* sp. nov., female. — 28. Dorsum. — 29. Epistome. — 30. Palpal tarsus and tibia. — 31. Venter of gnathosoma. — 32. Chelicera. — 33. Tarsus II. — 34. Venter.

trematal shields, and provided with four pair of long preanal setae. Perianal setae much shorter than preanal setae. Expulsory vesicles located antero-lateral to ventrianal shield. Interscutal membrane between dorsal and ventral shields provided with twenty-three pair of simple setae. Metapodal shields narrow, elongate, and placed as illustrated. Stigmata located antero-lateral to coxae IV; peritremes extending antero-dorsally to the middle of coxae I.

Gnathosoma. Epistome with a smooth, distally rounded projection. Pedipalp composed of five segments; palpal apotele with three tines, two of which are distally spatulate. Fixed digit of chelicera provided with four large teeth; movable

digit bidentate. Dorsal seta on chelicera wedge-shaped. Corniculus ($110\ \mu$) longer than movable digit of chelicera ($82\ \mu$).

Legs. Tarsus I ($173\ \mu$) longer than tibia I ($112\ \mu$), with small claws and pulvilli. Tarsi II to IV each with well developed claws and pulvilli. Tarsus II with a stout spine apically. Length of leg I $652\ \mu$, II $595\ \mu$, III $514\ \mu$ and IV $782\ \mu$.

Male. Unknown.

Remarks. Though the present species resembles *Neparholaspis serratichela* sp. nov., the latter is distinguished from the former by the following characteristics: dorsal shield with weakly spatulate setae; epistome with a long median extension flanked on either side by a small projection; movable digit of chelicera provided with a number of small teeth in addition to two large teeth; legs I without claws. The present species has been collected from Mt. Shiga and Nagiso, both in Nagano Prefecture.

Neparholaspis serratichela sp. nov.

[Japanese name: Nokoba-koshibirohokodani]

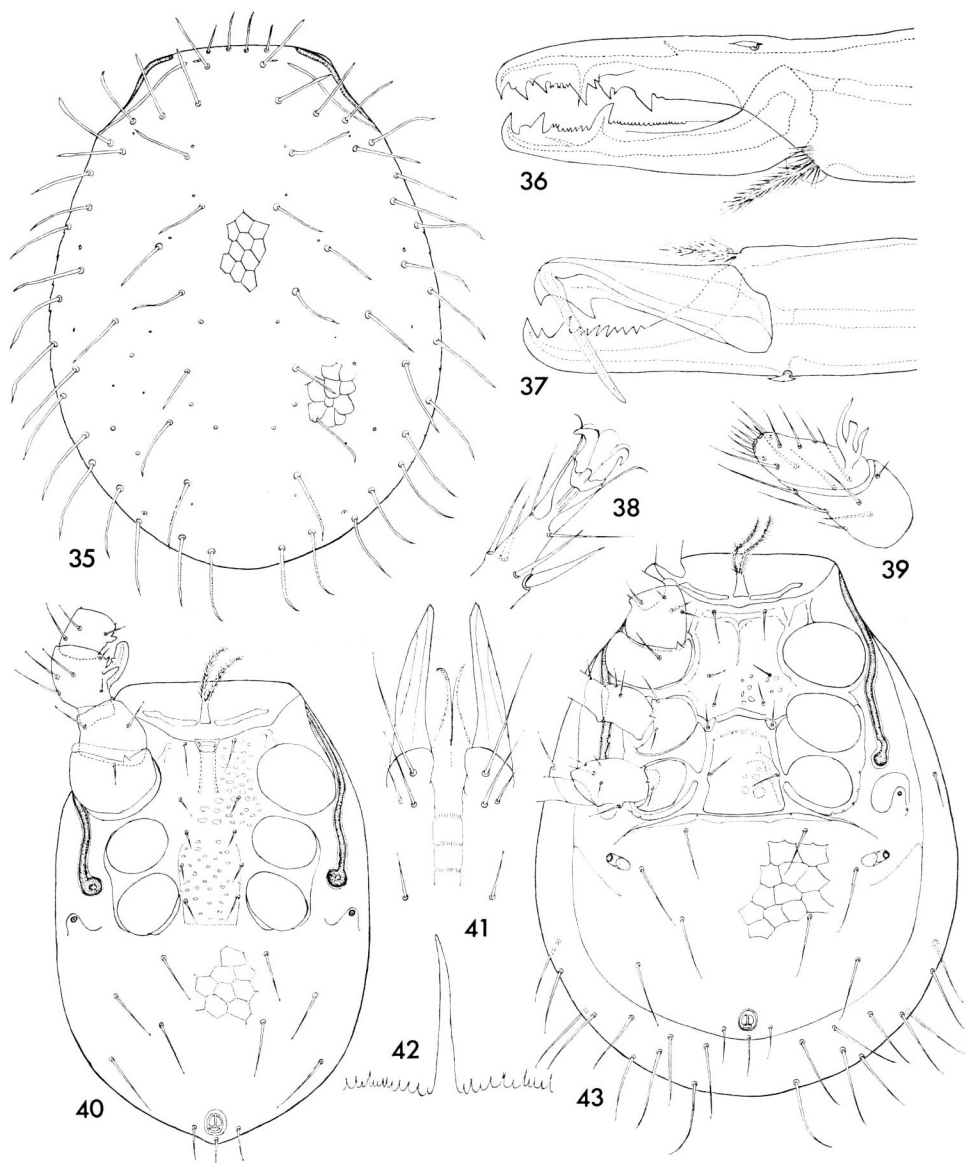
(Figs. 35–43)

Type-series. Holotype ♀ (NSMT-Ac 9299): Omogo Valley, Ehime Pref., 16–VI–1968, K. ISHIKAWA. Allotype ♂: Mt. Omogo, 16–IX–1968, K. MORIKAWA. Paratypes: Honshu — 1 ♂, Otanomôsono-taira, Mt. Shiga, Nagano Pref., 24–VIII–1968, K. I.; 1 ♂, Mt. Yokote, Nagano Pref., 27–VIII–1968, K. I. Shikoku — 1 ♀, Mt. Kinobe, Myôzai-gun, Tokushima Pref., 23–IV–1969, M. YOSHIDA; 1 ♀, the same data as holotype; 1 ♀, the same data as allotype; 1 ♀, Kurotaki, Tataki, Tanbara, Shûsô-gun, Ehime Pref., 13–IV–1968, K. OKUDA; 2 ♀♀, Tanbara, Shûsô-gun, 30–VIII–1968, K. I.; 1 ♀, Mt. Omogo, 9–VIII–1969, K. I.; 1 ♂, Mt. Nishiakaishi, Ehime Pref., 28–V–1969, K. I.; 1 ♂, Omogo Valley, 6–VIII–1969, K. I.; 1 ♂, Okinoshima Is., Kôchi Pref., 16–II–1969, M. TANIGAWA. Kyushu — 6 ♀♀, 3 ♂♂, Yakushima Is., Kagoshima Pref., 10–VI–1968, R. NAGANO.

Female. Length of idiosoma av. $984\ \mu$; dorsal shield 921 – $1020\ \mu$, av. $962\ \mu$; width at the level of coxae IV 665 – $796\ \mu$, av. $702\ \mu$.

Dorsum. Dorsal shield entire, covered with a network, with truncated anterior margin. Dorsal shield bearing thirty pair of weakly spatulate setae, setae D1 being longer than M1. The distribution of setae and pores are as shown in Fig. 35. Length of setae: verticals $67\ \mu$, D3 $106\ \mu$, D5 $89\ \mu$, D8 $125\ \mu$, D9 $128\ \mu$, M1 $43\ \mu$ and humerals $123\ \mu$.

Venter. Tritosternum well developed, its truncated base bearing a pair of elongate plumose laciniae. Presternal shields narrow. Sternal shield extending to the middle of coxae III, and fused with endopodal shields. Metasternal shield free, and located behind the postero-lateral angles of sternal shield. Epigynial shield truncated posteriorly; genital setae situated on laterals. Ventri-anal shield fused with



Figs. 35–43. *Neparholaspis serratichela* sp. nov. (35–36, 38–39, 41–43, female; 37, 40, male).
— 35. Dorsum. — 36–37. Chelicera. — 38. Tarsus II. — 39. Palpal tarsus and tibia. — 40, 43. Venter. — 41. Venter of gnathosoma. — 42. Epistome.

podal and peritrematal shields, strongly reticulated, and with four pair of preanal setae. A pair of expulsive vesicles lying postero-lateral to coxae IV. Interscutal membrane between dorsal shield and ventrals bearing eleven pair of long simple setae. Metapodal

shield absent. Stigmata situated on a level between coxae III and IV and outside of them; peritremes extending anteriorly and dorsally to a point beyond the insertions of coxae I. Peritrematal shield fused with podal, sternal and ventri-anal shields, and with a pit-like pore posterior to stigma.

Gnathosoma. Epistome with a long median extension flanked on either side by small projections. Pedipalp five-segmented; palpal apotele with three tines, two of which are spatulate distally. Fixed digit of chelicera with three large teeth and several small teeth and a pilus dentilis, while movable digit with two large teeth and a number of small teeth. Movable digit of chelicera ($188\ \mu$) longer than corniculus ($164\ \mu$). Chelicera with a wedge-shaped seta on dorsal side.

Legs. Leg I without claws; tarsus I much longer than tibia I. Legs II to IV each with claws and pulvilli. Length of leg I $738\ \mu$, II $677\ \mu$, III $645\ \mu$ and IV $873\ \mu$.

Male. Length of dorsal shield $770\text{--}965\ \mu$, av. $848\ \mu$; width at the level of coxae IV $545\text{--}722\ \mu$, av. $609\ \mu$.

Dorsal chaetotaxy and ornamentation similar to those of female. Genital orifice situated on the anterior margin of sternal shield. Holoventral shield bearing nine pair of simple setae, of which the four pair at the posterior portion are very long, and with three perianal setae. Fixed digit of chelicera provided with ten teeth, while movable digit with one tooth and a sperm transfer organ. Femur II with a stout thumb-like apophysis; a small spine-like process present on genu II as well as on tibia II. Length of leg I $731\ \mu$, II $648\ \mu$, III $596\ \mu$ and IV $755\ \mu$.

Remarks. The present species is easily distinguished from *Neparholaspis monticola* sp. nov., possessing the following characteristics: the dorsal shield bearing twenty-nine pair of long whip-like setae; epistome triangular; movable digit of chelicera with only two large teeth; leg I with claws. The present species has been collected from the southern areas of Central Japan.

Neparholaspis monticola sp. nov.

[Japanese name: Takane-koshibirohokodani]

(Figs. 44–50)

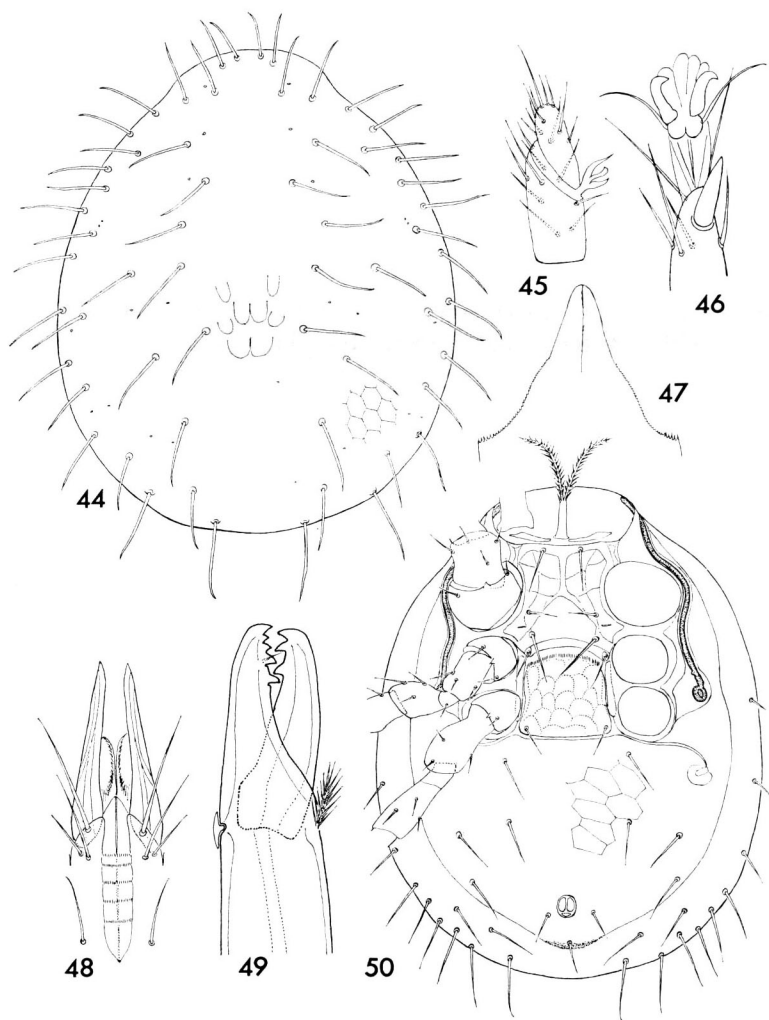
Type-series. Holotype ♀ (NSMT-Ac 9300); ex litter of *Betula ermani*, Mt. Shiga, Nagano Pref., 3–VI–1968, K. ISHIKAWA. Paratypes: Honshu — 3 ♀♀, the same data as holotype; 1 ♀, Mt. Shiga, 27–VIII–1968, K. I. Shikoku — 1 ♀, Sugitate, Matsuyama, 1–IX–1968, K. I.; 2 ♀♀, ex decayed wood of *Fagus crenata*, Mt. Narabara, Ehime Pref., 23–XI–1968, K. I.; 1 ♀, Mt. Ishizuchi, 8–VI–1969, K. I.

Female. Length of idiosoma av. $897\ \mu$; dorsal shield $840\text{--}906\ \mu$, av. $866\ \mu$; width at the level of coxae IV $638\text{--}680\ \mu$, av. $651\ \mu$.

Dorsum. Dorsal shield entire, reticulated, anterior margin weakly rounded. Dorsal shield provided with twenty-nine pair of long whip-like setae. Setae M1 absent. Length of setae; verticals $64\ \mu$, D3, 4 $85\ \mu$, D5 $80\ \mu$, D10 $121\ \mu$, D11 $136\ \mu$,

L1 97 μ , Mgl 103 μ and Mg10 108 μ .

Venter. Tritosternum well developed, with a pair of strongly pilose laciniae and narrow base. A pair of presternal shields present. Sternal shield reticulated, and fused with podal and peritrematal shields. Metasternal shield small, separated from sternal and endopodal shields, and with a pair of long simple setae. Epigynial shield nearly square, slightly wider than long, reticulated and with a pair of simple setae arising from the postero-lateral corners. Ventri-anal shield fused with podal-peritrematal shield, bearing four pair of long preanal setae in addition to the three



Figs. 44–50. *Neparholaspis monticola* sp. nov., female. — 44. Dorsum. — 45. Palpal tarsus and tibia. — 46. Tarsus II. — 47. Epistome. — 48. Venter of gnathosoma. — 49. Chelicera. — 50. Venter.

setae normally associated with anus. A pair of large expulsory vesicles located postero-lateral to coxae IV. Interscutal membrane between dorsal and ventral shields bearing eleven pair of simple setae. Metapodal shield absent. Stigmata located at a level between coxae III and IV and lateral to them; peritremes extending antero-laterally to coxae I.

Gnathosoma. Epistome triangular, with a smooth median projection flanked on either side by a small spined protuberance. Pedipalp five-segmented; palpal apotele provided with three tines, of which the central and basal ones are spatulate distally. Fixed digit of chelicera bearing four large teeth, while movable digit bidentate. Dorsal seta on chelicera spine-like. Corniculus ($131\ \mu$) much longer than movable digit of chelicera ($79\ \mu$).

Legs. Tarsus I ($174\ \mu$) longer than tibia I ($115\ \mu$), with small claws and pulvilli. Tarsi II to IV each with well developed claws and pulvilli. Tarsus II with a stout spine at the apical part. Length of leg I $658\ \mu$, II $635\ \mu$, III $566\ \mu$ and IV $790\ \mu$.

Male. Unknown.

Remarks. The present species superficially resembles *Neparholaspis evansi* KRANTZ, 1960, from Oregon, U.S.A., but the latter has the following characteristics: the dorsal shield is provided with thirty pair of whip-like setae (excluding simple setae D1 and D2); large pit-like pores are situated posterior to the stigmata.

The present species has been collected from the mountainous areas of Nagano Prefecture and Shikoku.

(To be continued.)

