

## GOING FURTHER INTO LATE MESOZOIC MESOLYGAEIDS (HETEROPTERA, INSECTA)

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### Summary

A large collection of fossil insects has recently been recovered from the Late Mesozoic nonmarine sediments throughout East Asia, with many specimens regarded as the mesolygaeids, representing a new family Mesolygaeidae of Heteroptera. As *Lycopiera* Muller and *Eosestheria* Chen, *Mesolygaeus* Ping is the common genus of the Jehol fauna. Since some of them are geographically widespread and can be easily collected, they are significant to stratigraphic divisions and correlations in East Asia.

However, there are different opinions on the fundamental features, family position, taxonomical subdivision and paleoecological characteristics of *Mesolygaeus* (Ping, 1928; Hong, 1981, 1984a, 1984b; Hong and Wang, 1976; Lin, 1982a, 1982b; Popov, 1980, 1986). A great diversity of well-preserved mesolygaeids has recently been recognized by the author, containing over 2000 specimens regarded as *Mesolygaeus* from the Laiyang Formation at the localities of Tuanwang, Nanligeshuang, Beipozi, Huangyandi, Houzigou and Maershan in the Laiyang Basin. After making a further observation, some new ideas on these specimens are recognized as follows:

### 1. Fundamental features of *Mesolygaeus*

Hydrodephagous forms with body complanate-oval, medium-sized. Adults usually 6.5—7mm, rarely 5mm long. Head short, wider than long. Eyes medium in size, circular, lying upon anterior lateral angles of pronotum, somewhat prominent laterally. Ocelli present between eyes. Antennae thin and short, a little longer than head and pronotum combined, four-segmented, with first segment short and stout, not overreaching vertex, the second distinctly longer than the third and the fourth, lying between eyes and vertex. Proboscis long, reaching basal part of posterior coxa, four-segmented, with first and second segments, while the third obviously long. Pronotum transverse, narrowed anteriorly, divided into two parts at middle, with anterior margin cavatus posteriorly. Scutellum not large, triangular. Hemelytra developed; clavus large; corium and membrane divided clearly; clavus and corium thickened, darker in color than membrane; embolium narrow; costal fracture cleft, with hians much deeper; veins stout, with four large wing cells on corium, and five large ones entirely occupying membrane. R+M furcating at middle of corium. Anterior and middle legs thin and short; posterior ones evidently long, with coxae developed, nearly half as long as femora. Tarsi distinctly long, but slightly shorter than tibiae, three-segmented, with first segment extraordinarily short, oval, usually indistinguishable, and the second clearly longer than the third; claws long and sharp. Abdomen eight-segmented; connexivum not fracted upward. Male gonapophyses large, semicircular; female one visible, straight backward. Larvae closely similar to adults. Body usually 3.5—5mm long. Pronotum with anterior and posterior margins straight. Tarsi with one or two segments distinguishable.

## 2. Family position of *Mesolygaeus*

Ping (1928) established *Mesolygaeus* and placed it in the family Lygaeidae (Lygaeoidea, Heteroptera). Some Chinese paleoentomologists have retained this genus to represent the first appearing true lygaeid bug ever since (Hong, 1981, 1984a, 1984b; Hong and Wang, 1976; Lin, 1982a, 1982b), but the present author believes that, with five closed wing cells on membrane, *Mesolygaeus* has a great difference in wing venation from all genera of Lygaeidae. This genus shows more or less an affinity to those of Saldidae (Saldoidea, Heteroptera) according to the features of antenna, proboscis, hemelytrum and tarsus. Nevertheless, some differences from the members of Saldidae occur in *Mesolygaeus*, such as the divided pronotum, obviously long tarsus, hydrodephagous habit and characteristics, which ensure useful potential for separating them. For this reason, the author tends to establish a new family, Mesolygaeidae (Saldoidea, Heteroptera).

## 3. Taxonomical subdivision

Based on the known materials and specimens at hand, the family Mesolygaeidae include two genera, *Mesolygaeus* Ping and *Schizopteryx* Hong, both living in Late Mesozoic. The former contains only a single species, *Mesolygaeus laiyangensis* Ping, which was widely distributed in East Asia. The latter consists of two species, *Schizopteryx shandongensis* Hong and *S. lacustris* sp. nov., which are yielded from the Laiyang Formation of Shandong Peninsula, China.

*Enicocoris manlaicus* Popov was found from the Mogotuin Formation in Manlay of South Gobi, Mongolia (Popov, 1980), while *E. tibialis* Popov from the Gurvaneren Formation at Gurvan-Ereniy-Nutu of Gobi-Altai, Mongolia (Popov, 1986), but the present author regards both specimens as belonging to *M. laiyangensis*.

*Xishania fusiformis* Hong was known from the Lushangshufen Formation of West Hills near Beijing (Hong, 1981), while *Jiaodongia maershanensis* Hong was recorded from the Laiyang Formation at Maershan in Laiyang City (Hong, 1984a). Both of them are extremely close to *M. laiyangensis* and are here regarded as conspecific.

The reason for the alteration of these specific taxa will be illustrated later in this paper.

## 4. Discussion on paleoecological characteristics

Since *Mesolygaeus* is regarded as an element of the family Lygaeidae and most of them are terrestrial phyllophagous forms, the Chinese researchers practically consider this genus as belonging to an insect living on land and feeding on plants. As none of terrestrial bugs have so elongate tarsi as a tool for walking or jumping, it seems inferable that this genus may be aquatic. In addition, the features of the complanate and elongate-oval body ensures to this insect the ability of swimming easily.

According to Hong (1984a), *Schizopteryx* was regarded as the inhabitants of Cicadelloidea of Homoptera, all being terrestrial phyllophagous forms. The author takes it for granted that this genus must be aquatic, because of the available features, such as the rather elongate posterior tarsi as long as or longer than tibiae and the more complanate body which are advantageous to the genus in swimming.

The Mesolygaeidae at one time enjoyed themselves in the ancient freshwater lakes of East Asia, including several taxa with a great quantity of individuals existing in Late Mesozoic. Their disappearance was a result of physical events, such as climatic change and volcanic activity. When the lakes dried up, the lacustrine inhabitants were obliged to disembark to seek new habitats. Thus, a series of changes have taken place in themselves, and perhaps the Saldidae are their descendants.

## DESCRIPTION

## Superfamily Saldoidea Amyot et Serrille, 1843

## Mesolygaeidae fam. nov.

1980 *Enicocoridae* Popov, p. 50.

1981 *Xishanidae* Hong, p. 87.

1986 *Enicocoridae*, Popov, p. 68.

**Type genus** *Mesolygaeus* Ping

**Diagnosis** A hydrodephagous form with body medium-sized, 5—14mm long, complanate, elongate-oval. Head short, wider than long. Eyes medium in size, circular, lying upon anterior lateral angles of pronotum, somewhat prominent laterally. Ocelli present between eyes. Antennae thin and short, lying between eyes and vertex, four-segmented, with the first segment short and a little stout, not overreaching vertex. Proboscis four-segmented, with first and second segments distinctly short, and the third one obviously long. Pronotum transverse, narrowed anteriorly, divided into two parts, with anterior margin cavatus posteriorly. Scutellum medium-sized. Hemelytra developed; clavus, corium and membrane divided clearly; embolium narrow; costal fracture cleft, with four or six large wing cells on corium and three or five ones on membrane. Legs thin. Posterior legs distinctly longer than anterior and middle ones, with posterior coxae developed, nearly half as long as femora; tarsi rather long, slightly shorter, or somewhat longer than tibia, three-segmented, with the first segment extraordinarily short, oval, usually indistinguishable, the second one evidently longer than the third; claws long and sharp. Abdomen eight-segmented, connexivum not fractate upward. Male gonapophyses large, nearly semicircular; female one visible, straight backward. Larvae closely similar to adults, both being hydrodephagous forms. Pronotum with anterior and posterior margins straight. Tarsi with one or two segments distinguishable.

**Remarks** The present new family has an affinity to the Saldidae, both showing some similar features, such as the antennal position, segment number and length ratio of segments; the number of proboscis' segments and length ratio of segments; the hemelytral characteristics; and the number of tarsal segments and length ratio of segments. But the former differ from the latter in the pronotum divided into two parts; the tarsi rather elongate, somewhat shorter, or slightly longer than tibiae, the eyes medium in size; and they belong to lacustrine sarcophagous forms.

Popov (1980) established the family *Enicocoridae* based on those specimens from the Mogotuin Formation in Manlay of South Gobi, Mongolia. In 1986, he went further into diagnoses on this family and its type genus *Enicocoris* Popov, based on some new remains from the Gurvaneren Formation at Gurvan-Ereniy-Nutu of Gobi-Altai, Mongolia (Popov, 1986). The author regards both *Enicocoris* and *Mesolygaeus* as congeneric; the generic name of *Mesolygaeus* should be retained, and the family name should be *Mesolygaeidae*.

Hong (1981) also established a new family, *Xishanidae*, which include a single genus *Xishania* Hong, based on those fossils from the Lushangshufen Formation at West Hills near Beijing. The author believes that *Xishania* and *Mesolygaeus* are congeneric, and thus the names of *Xishania* and *Xishanidae* should be discarded.

**Distribution and Age** China, Mongolia; Late Mesozoic.

## Key to genera of Mesolygaeidae

## Adult

Antennae visible, with the second segment distinctly longer than the third; proboscis reaching basal part of posterior

- coxa; hemelytra with hians lying at terminal part of embolium; R+M furcating at middle of corium, with four wing cells on corium, and five ones entirely occupying membrane; tarsi slightly shorter than tibiae; body 5—7 mm long. .... **Mesolygaeus Ping**
- Antennae rather thin and short, usually indistinguishable, with the second segment nearly as long as the third; proboscis rather short, usually extending forward, with segments indistinguishable in number; hemelytra with hians lying at middle of embolium; R+M furcating near basal part of wing; with six wing cells on corium, and three ones only occupying basal half of membrane; tarsi as long as or longer than tibiae; body 6.6—14mm long. .... **Schizopteryx Hong**

### Larva

- Antennae visible; proboscis reaching basal part of posterior coxa; tarsi shorter than tibiae; body 3.5—5 mm long. .... **Mesolygaeus Ping**
- Antennae rather thin and short, usually indistinguishable; proboscis rather short, usually extending forward; tarsi as long as or longer than tibiae; body 6—8.5 mm long. .... **Schizopteryx Hong**

## Genus *Mesolygaeus* Ping, 1928

- 1928 *Mesolygaeus* Ping, p. 43.  
 1976 *Mesolygaeus*, Hong and Wang, p. 87.  
 1980 *Enicocoris* Popov, p. 50.  
 1981 *Xishania* Hong, p. 88.  
 1982 *Mesolygaeus*, Lin, p. 80.  
 1982 *Mesolygaeus*, Lin, p. 151.  
 1984 *Xishania*, Hong, p. 157.  
 1984 *Jiaodongia* Hong, p. 32.  
 1986 *Enicocoris*, Popov, p. 70.

### Type species *Mesolygaeus laiyangensis* Ping

**Diagnosis** Adults: Body 5—7 mm long. Head a little wider than long. Antennae thin but clearly visible, slightly longer than head and pronotum combined, with second segment obviously longer than the third. Proboscis reaching basal part of posterior coxa, with third segment longer than the first, second and fourth combined. Scutellum triangular. Hemelytra with hians lying at terminal part of embolium. R+M furcating at middle of corium, with four wing cells on corium and five ones entirely occupying membrane. Anterior claws longer than the third tarsal segment. Larvae: Body 3.5—5 mm long. Antennae and proboscis clearly visible, each with four segments. Tarsi shorter than tibiae.

**Remarks** This genus is related to *Schizopteryx*. However, both of them may be distinguished from each other, as indicated in the key to genera of Mesolygaeidae mentioned above.

Popov (1980) established the genus *Enicocoris*, and made a revision of its diagnosis in 1986. The revised features of this genus (Popov, 1986) are identical with those of *Mesolygaeus*, and thus both are congeneric.

Hong (1981) discussed how to distinguish *Xishania* from *Mesolygaeus* by two aspects: firstly, *Mesolygaeus* is terrestrial, with much shorter and three-segmented tarsi, whereas *Xishania* is lacustrine, with two tarsal segments complanate and elongate; secondly, *Mesolygaeus* ranged from Late Jurassic to early Early Cretaceous, but *Xishania* lived in middle—late Early Cretaceous. The author considers that since the tarsal features of *Xishania* are totally identical with those of *Mesolygaeus*, it is rational to merge *Xishania* into *Mesolygaeus*; then, like the Laiyang Formation, the Lushangshufen Formation is considered as Late Jurassic in age.

According to Hong (1984a), *Jiaodongia* was known from the Laiyang Formation at Maershan in the Laiyang Basin; it differs from *Mesolygaeus* in having a large poststigma on hemelytrum, costal area narrower than radial area, R running oblique, terminal part of M unconnected

with R, different shape of pronotum and large scutellum. The author confirms that a mistake has been made by Hong (1984a) based on those ill-preserved specimens, for both *Jiaodongia* and *Mesolygaeus* do not show any difference in the features of wing venation; nevertheless, those fossils from Maershan are usually ill-preserved.

**Distribution and Age** East China, North China, Southeast Mongolia, West Mongolia; Late Jurassic.

### *Mesolygaeus laiyangensis* Ping

(Pl. I, figs. 1—7; Pl. II, figs. 1—8; Pl. V, figs. 1—4; Text-figs. 1—4)

- 1928 *Mesolygaeus laiyangensis* Ping, p. 43—45, Pl. III, figs. 3—6.  
 1928 *Mesolygaeus rotundoccephalus* Ping, p. 45—46, Pl. III, figs. 7, 8.  
 1976 *Mesolygaeus laiyangensis*, Hong and Wang, p. 87, Pl. 52, figs. 2, 3.  
 1980 *Enicocoris manlaicus* Popov, p. 50—51, Pl., figs. 1, 2.  
 1981 *Xishania fusiformis* Hong, p. 88, Pl. I, fig. 1; Pl. II, figs. 1, 2.  
 1982 *Mesolygaeus laiyangensis*, Lin, p. 80, Pl. 32, fig. 4.  
 1982 *Mesolygaeus laiyangensis*, Lin p. 151, Pl. 64, fig. 9.  
 1984 *Xishania fusiformis*, Hong, p. 157, Pl. 59, figs. 1, 2.  
 1984 *Jiaodongia maershanensis* Hong, p. 32—34, Pl. 2, figs. 3, 4.  
 1986 *Enicocoris tibialis* Popov, p. 70, Pl. IV, figs. 4—7.

**Description** Adults: Body about 2.5 times as long as wide, brown or dark brown in color. Head medium-sized, slightly wider than long. Eyes medium in size, circular, lying upon anterior lateral angles of pronotum, light yellowish-brown in color. Proboscis massive, reaching basal part of posterior coxa, with first segment somewhat stout, twice as long as the second; second segment much lighter in color, usually yellowish; third segment evidently longer than the first, second and fourth combined; fourth segment barely longer than the first; segments in the length ratio of 10:5:35:12. Antennae visible, with first segment the shortest, slightly stouter and shorter than the fourth; second segment the longest, about 1.5 times as long as the third; fourth segment shorter than the third; segments in the length ratio of 6:13:9:7. Pronotum divided into two parts nearly at middle, with upper part trapezoid, 2.5 times as wide as long while lower part rather transverse, three times as wide as long, and twice as wide as upper part. Scutellum equilateral triangular but with terminal angle round. Anterior and middle legs short; femora, tibiae and tarsi nearly equal in length; claws fully developed, longer than the third tarsal segment. Posterior legs distinctly long, with coxae about half as long as femora; tibiae longer than femora; tarsi (excluding claws)  $4/5$ — $5/6$  as long as tibiae, three-segmented, with the first segment extraordinarily short, oval, usually indistinguishable,  $1/10$ — $1/7$  as long as the second; second segment about 1.3 times as long as the third; claws half as long as the third tarsal segment; middle parts of tibiae and tarsi usually darker in color than remainder, and composed of minute reticulum (see text-fig. 3E—G). Hemelytra 2.5—3 times as long as wide; clavus, corium and membrane clearly divided; wing veins massive; embolium narrow, darker in color, usually dark brown, sometimes with complicated network venation (see text-fig. 1). Ca thin; Cp stout; Sc rather thin. Hians narrow and extremely long, reaching upper part of fork of R+M furcation at middle of corium, much lighter in color around it. Basal part of M oblique downward, and fractate behind m-cu, running subparallel to R. Basal part of CuA subparallel to R+M, fractate downward behind m-cu, furcating near hind margin of wing; angle of CuA<sub>1</sub> to CuA<sub>2</sub> about 180°, with the former long, running oblique towards wing apex, while the latter rather short and stout, connected with terminal part of clavus. CuP extraordinarily thin but straight. Both A<sub>1</sub> and A<sub>2</sub> stout, with the former straight, and the latter sinuous. Membrane nearly lipochromous and

translucid, with five large wing cells, each rather transverse. Abdomen eight-segmented, with widest part lying between the third and fourth segments, nearly as wide as pronotum. Male gonapophyses large, semicircular; female one clearly visible, straight backward.

Body 6.5—7 mm (rarely 5 mm) long, 2.7—3 mm (rarely about 2 mm) wide.

Larvae: Closely similar to adults, but with head usually semicircular or obtuse-triangular. Antennae, proboscis and legs more massive. Tarsi usually with one or two segments visible. Pronotum with anterior and posterior margins straight.

Body 3.5 mm long, 2.4—2.8 mm wide.

**Remarks** Since many places in the Laiyang Basin yielded a great quantity of remains regarded as *Mesolygaeus laiyangensis*, it is possible to make a discussion on the individual variation within this species. The adult body usually presents brown or dark brown coloration, but sometimes may be light-brown or yellowish-brown (rarely black brown) in some specimens. Whenever the body is lighter in color, its hemelytra show nearly achromous and hyalinus, while the veins appear in light brown or yellowish-brown. There are two branches of Rs running subparallel to each other and forming a narrow closed wing cell on membrane (see text-figs. 1B, 3D). In some sample—however, the posterior branch runs curved downward, and is connected with M (see text-fig. 1A). The vertex is wide and arched, but sometimes shows narrower and obtuse-angulate.

Ping (1928) described simultaneously two species: *M. laiyangensis* and *M. rotundocephalus* from the Laiyang Formation in Shandong Peninsula. But the author considers the latter as a synonym of the former, according to Ping's (1928) description.

*E. tibialis* may be merged into *M. laiyangensis* because of no difference between them. Nevertheless, it seems that an error has been made in the tarsal features drawn by Popov (1986), based on those specimens (No. 3149/855, 3149/862). All the adult tarsi should be three-segmented, and are distinctly elongate, only slightly shorter than the tibiae; however, there are at most two tarsal segments distinguishable in larva. Thus, the so-called third one (see Popov, 1986: p. 69, text-fig. 36B) is in fact absent.

According to Popov (1980), *E. manlaicus* which has a remarkable wing venation greatly differs from *M. laiyangensis* (= *E. tibialis*). However, he failed to discuss how to differentiate between both species by this characteristic (Popov, 1986). The present author tends to believe that probably there is a mistake in the description of this species due to those ill-preserved samples from southeast Mongolia. It is possible that both *E. manlaicus* and *M. laiyangensis* possess an identical wing venation, and therefore they are conspecific.

To contrast *X. fusiformis* described by Hong (1981) with *M. laiyangensis*, all the derivable features are completely identical, such as posterior tarsi, antennae, proboscis and wing venation. There is no doubt that those specimens regarded as *X. fusiformis* from the Lushangshufen Formation should be referred to *M. laiyangensis*.

*Jiaodongia maershanensis* was identified by Hong (1984a), based on fossils from the Laiyang Formation at Maershan in the Laiyang Basin. The author has already collected a great number of specimens from the same site. Although usually ill-preserved, those remains show wholly identical with *M. laiyangensis* in all the available features, and thus both species are conspecific.

**Horizon and Locality** Laiyang Formation; Tuanwang, Nanligeshuang, Beipozi, Huangyandi, Houzigou and Maershan of Laiyang, Shandong.

### Genus *Schizopteryx* Hong, 1984

**Type species** *Schizopteryx shandongensis* Hong

**Diagnosis** Adults: Body more complanate, 6.6—14mm long. Head quite transverse, extremely wider than long. Antennae rather thin, shorter than head and pronotum united, but usually indistinguishable, four-segmented, with first segment short and a little stout, and each of the remaining segments nearly equal in length. Scutellum transverse, obviously wider than long. Proboscis shorter than head. Hemelytra with hians lying at middle of embolium. R+M furcating near basal part of wing; with six wing cells on corium, and three ones only occupying basal half of membrane. Tarsi as long as or longer than tibiae.

Larvae: Body more complanate, 6—8.5mm long. Antennae rather thin and short, usually indistinguishable. Proboscis rather short, usually extending forward. Tarsi as long as or longer than tibiae.

**Remarks** This genus is similar to *Mesolygacus*, but differs from the latter in some features, as indicated in the key to genera of Mesolygaeidae mentioned above.

Hong (1984a) regarded *Schizopteryx* as a genus belonging to Cicadelloidea of Homoptera for several reasons. Based on the specimens recently collected from the Laiyang Formation by the author, the generic diagnosis given by Hong (1984a) is revised as follows: A genus referable to the Heteroptera rather than to the Homoptera, due to its front wings in the form of hemelytra with basal thickened corium and apical membrane, and folding flat on abdomen and with apices widely overlapping. Proboscis usually extending forward from vertex; antennae consisting of four segments as in most bugs. Both adults and larvae truly aquatic.

**Distribution and Age** Shandong, China; Late Jurassic.

**Key to species of *Schizopteryx*****Adult**

- Veins and markings on terminal half of membrane absent; scutellum semicircular; posterior tarsi longer than tibiae; body large, 10—14 mm long. .... *Schizopteryx shandongensis* Hong
- Markings on terminal half of membrane present; scutellum triangular; posterior tarsi nearly as long as tibiae; body small, 6.6—8.5 mm long. .... *Schizopteryx lacustris* sp. nov.

**Larva**

- Elongate oval form with posterior tarsi nearly as long as tibiae; body large, over 8.5 mm long. .... *Schizopteryx shandongensis* Hong
- Oval form with posterior tarsi shorter than tibiae; body small, less than 6.2 mm long. .... *Schizopteryx lacustris* sp. nov.

***Schizopteryx shandongensis* Hong**

(Pl. III, figs. 1—5; Pl. V, fig. 5; Text-figs. 5, 6)

1984 *Schizopteryx shandongensis* Hong, p. 35—37, Pl. 1, figs. 1—4; Pl. 2, figs. 1, 2; Pl. 3, fig. 3.

**Description** Adults: Nearly elliptical forms with body brown in color, large-sized complanate. Head distinctly short, twice as wide as long (excluding proboscis). Antennae rather thin, filiform, much lighter in color, usually indistinguishable, four-segmented, about 3/5 as long as head and pronotum combined, with first segment clearly short but a little stout, about half as long as the second; each of the remaining segments nearly equal in length. Eyes far away from each other, circular, light yellowish-brown in color, usually indistinguishable. Proboscis short, not longer than head, usually extending forward. Pronotum transverse, divided into two parts at middle: upper part with anterior and posterior margins curved, with the latter obviously wider than the former,

while lateral margins arcuately curved, lower part widest at middle, with posterior margin straight in median and curved in rest parts. Scutellum semicircular, rather transverse, about three times as wide as long. Anterior and middle legs usually ill-preserved. Posterior legs distinctly long, light yellowish in color, only with the second tarsal segment showing brown; femora longer than, and about twice as wide as tibiae; tarsi (excluding claws) 1.2 times as long as tibiae, with first segment extraordinarily short, usually indistinguishable, and the second 1.5 times as long as the third; claws about half as long as the third tarsal segment. Hemelytra yellowish-brown in color, three times as long as wide; veins massive. Ca thin; Cp stout and curved arcuately. Embolium narrow, without network neurulation. Hians lying at middle of embolium, and ending at fork of R+M. Fork of R+M lying near basal part of wing. R furcating near terminal part of corium, and forming cross-vein connected with Cp behind the fork. Rs with two branches, a short cross-vein connecting its anterior branch with Cp, forming a small pentagonal wing cell, and running for a short distance behind it. M simple. Cross-vein r-m running oblique and long, cutting apart two wing cells between R, Rs and M, with basal one about twice as long as terminal one, and the terminal one as large as the upper one on membrane. CuA subparallel to R+M, connected behind fork of R+M with M, with its middle part subparallel to M, connectal with m-cu, forming a narrow wing cell, and its terminal part fractate downward. A wide wing cell between CuA<sub>1</sub> and M. CuA<sub>2</sub> rather short, connected with apex of clavus. Both A<sub>1</sub> and CuP stout, straight and subparallel to each other. A<sub>2</sub> somewhat thin, fractate at middle. Terminal half of membrane without veins and markings, lipochromous and translucent. Abdomen eight-segmented, with widest part lying between the first and second segments, slightly wider than pronotum. Male gonapophyses obtuse, quadrate to subcircular; female one complex in structure, with at least two couples of valvulae.

Body 10—14mm long, 5—5.3mm wide.

Larvae: Closely similar to adults. Body elliptical and complanate. Head small, semicircular. Proboscis usually extending forward. Pronotum with anterior and posterior margins straight, widest at terminal part of wing pads. Anterior and middle legs clearly short. Posterior legs distinctly long; femora somewhat stouter than tibiae, with the latter widened terminally; tarsi usually with only a single segment distinguishable, nearly as long as tibiae; claws about 1/3 as long as tarsi. Abdomen eight-segmented, with each segment fractate upward at middle.

Body 8.5—10mm long, 4.6—5mm wide.

**Remarks** *Schizopteryx shandongensis* is close to *S. lacustris* sp. nov., but may be distinguished from the latter by several characteristics, as indicated in the key to species of *Schizopteryx* hereinbefore.

**Horizon and Locality** Laiyang Formation; Beipozi, Huangyandi and Tuanwang of Laiyang, Shandong.

### *Schizopteryx lacustris* sp. nov.

(Pl. IV, figs. 1—5; Pl. V, fig. 6; Text-figs. 7, 8)

**Description** Body brown or dark brown in color, oval or elongate-oval, complanate.

Adults: Head transverse, 2.3 times as wide as long. Eyes medium-sized, far away from each other, lying upon anterior lateral angles of pronotum, circular, usually light yellowish-brown in color but often indistinguishable. Proboscis rather short, a little longer than head, usually extending forward, with segments indistinguishable in number. Antennae rather thin, nearly achromatic and vitreous, four-segmented, nearly as long as head and pronotum united, with first segment stout, about 1/3 as long as the second; each of the remaining segments nearly equal in length. Pronotum transverse, divided into two parts at middle: upper part subtrapezoid, with anterior and posterior mar-



gins slightly curved, the latter being wider than the former; lower part rather transverse, obviously wider than upper part. Scutellum triangular, barely wider than long. Legs usually yellowish-brown, rarely light brown in color. Anterior and middle legs clearly short; tarsi nearly as long as tibiae. Posterior legs distinctly long, with femora longer than, and about twice as wide as tibiae; tarsi (excluding claws) nearly as long as tibiae, three-segmented, with first segment extraordinarily short, usually indistinguishable; second segment 1.8 times as long as the third; claws long, about half as long as the third tarsal segment. Hemelytra 2.5—3 times as long as wide; veins somewhat thin but clear. Hians wide, lying at basal part of wing, reaching fork of R+M, darker in color around it. Wing venation extremely close to that of *S. shandongensis*, but terminal half of membrane closed, with dense markings. Abdomen eight-segmented, with widest part lying between the second and third segments. Male gonapophyses nearly semicircular; female one prominent but light-colored, triangular, and straight backward.

Body 6.6—8.5mm long, 3.5—3.7mm wide.

Larvae: Closely similar to adults. Body oval, complanate, with widest part lying below centre. Head rather transverse, more than three times as wide as long. Pronotum transverse, with anterior and posterior margins straight. Anterior and middle legs clearly short. Posterior legs distinctly long; femora stouter and longer than tibiae; tarsi (excluding claws) slightly shorter than tibiae, with only a single segment; claws stout, triangular, about half as long as tarsi. Abdomen wider than long, eight-segmented, with each segment fractate upward at middle.

Body 6.1mm long, 3.9mm wide.

**Remarks** This new species has an affinity to *S. shandongensis*, but can be distinguished from the latter, as indicated in the key to species of *Schizopteryx* hereinbefore.

**Horizon and Locality** Laiyang Formation; Nanlizezhuang and Tuanwang of Laiyang, Shandong.

## 图 版 说 明

所有标本采自山东莱阳上侏罗统莱阳组, 现保存在山东省博物馆。图片由中国科学院南京地质古生物研究所胡尚卿同志摄制。

### 图 版 I

#### 1—7. *Mesolygaeus laiyangensis* Ping

1. 雄性成虫背面保存标本, ×10; 登记号: L88221。2. 雄性成虫腹面保存标本, ×10; 登记号: L88222。3. 雄性成虫背面保存标本, ×8.2; 登记号: L88225。4. 雌性成虫腹面保存标本, ×8.2; 登记号: L88224。5. 雌性成虫背面保存标本, ×8.5; 登记号: L88226。6. 成虫后足胫节和跗节, ×20; 登记号: L88231。7. 半鞘翅, ×10; 登记号: L88241。南李格庄。

### 图 版 II

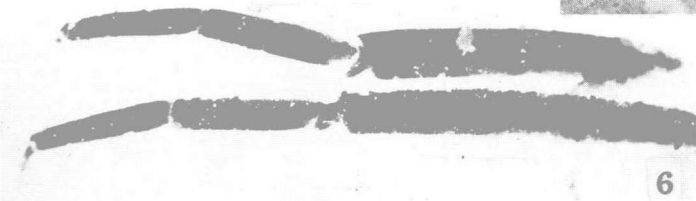
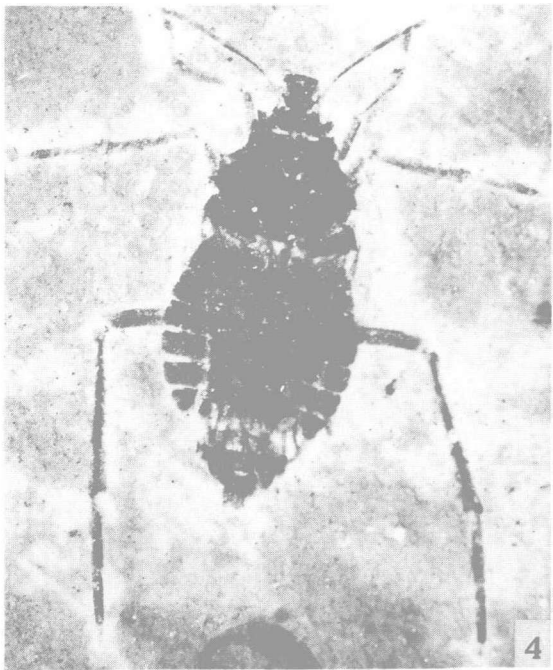
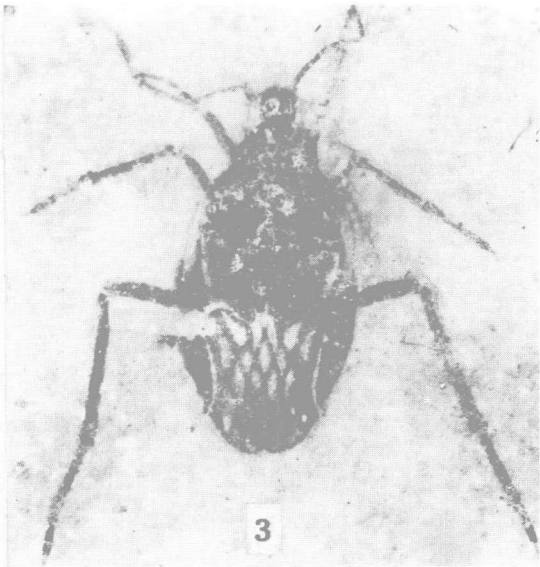
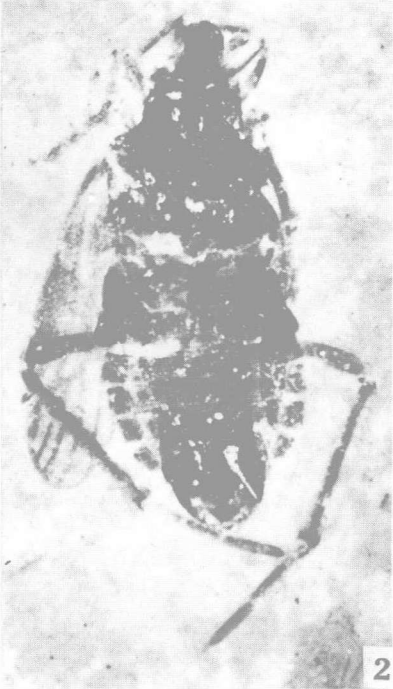
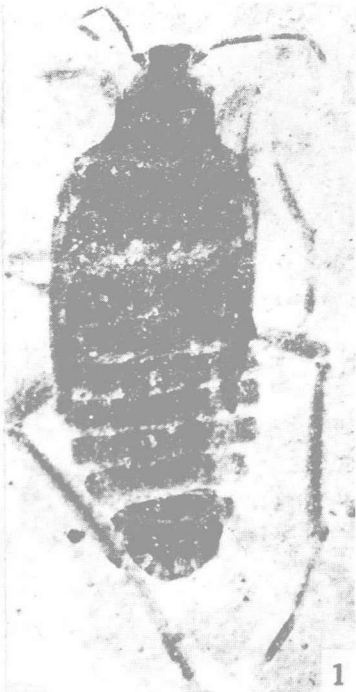
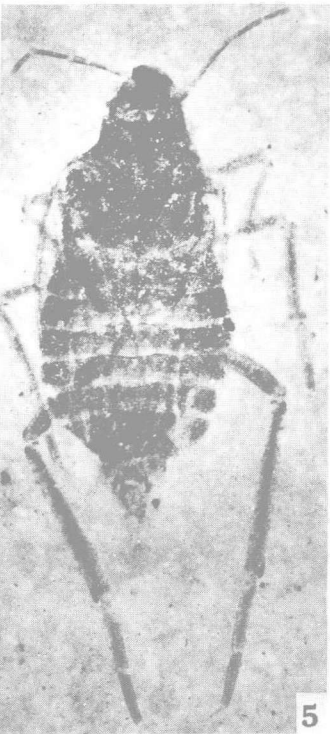
#### 1—8. *Mesolygaeus laiyangensis* Ping

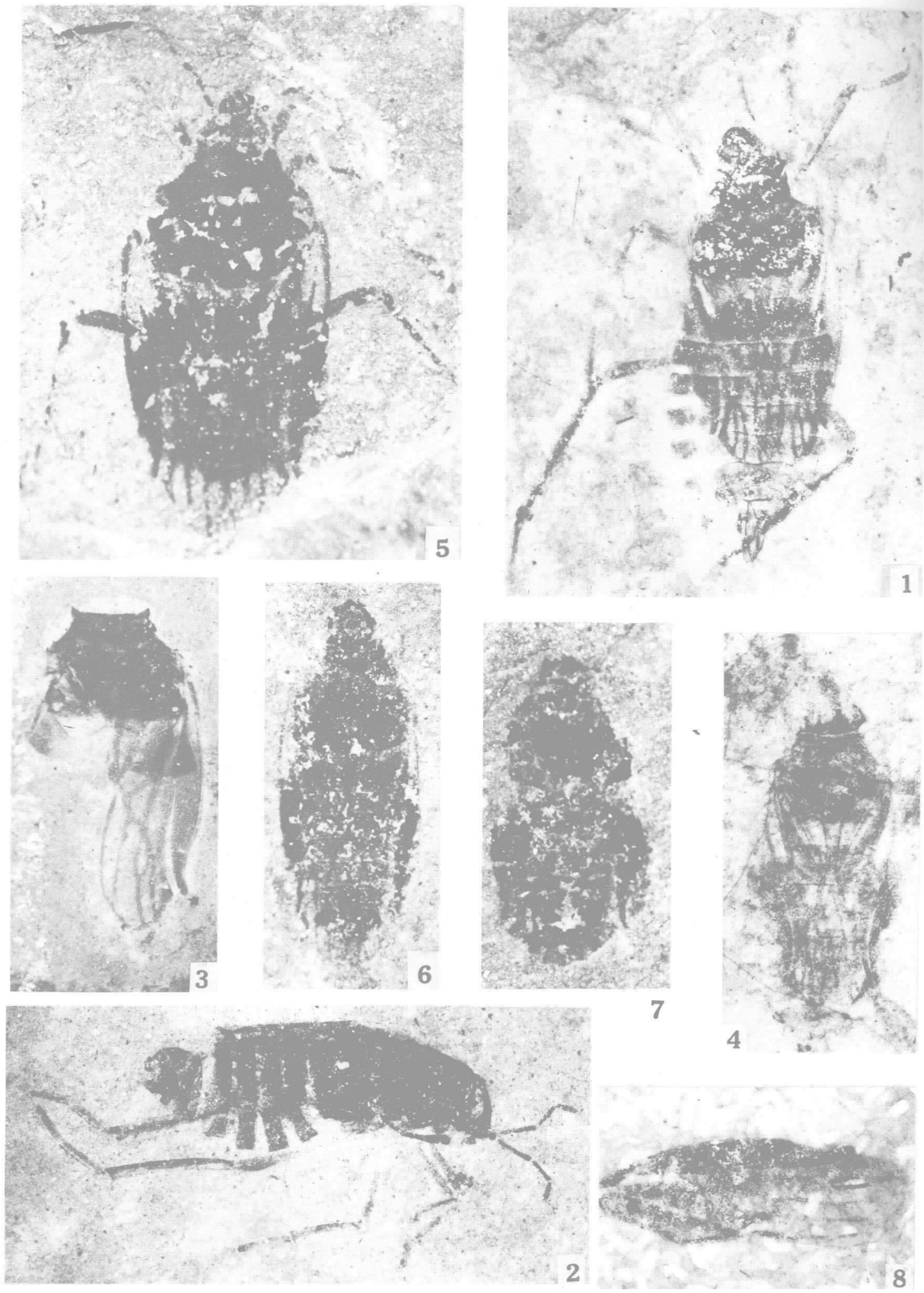
1. 雌性成虫背面保存标本, ×10; 登记号: L88242; 团旺。2. 雄性成虫侧面保存标本, ×8.2; 登记号: L88223; 南李格庄。3. 半鞘翅, ×8.5; 登记号: L86317; 南李格庄。4. 雌性成虫背面保存标本, ×10; 登记号: L88232; 团旺。5. 雄性成虫背面保存标本, ×10; 登记号: L88233; 马耳山。6. 雌性成虫背面保存标本, ×8.2; 登记号: L88234; 马耳山。7. 雄性成虫背面保存标本, ×8.2; 登记号: L88235; 马耳山。8. 半鞘翅, ×10; 登记号: L88227。南李格庄。

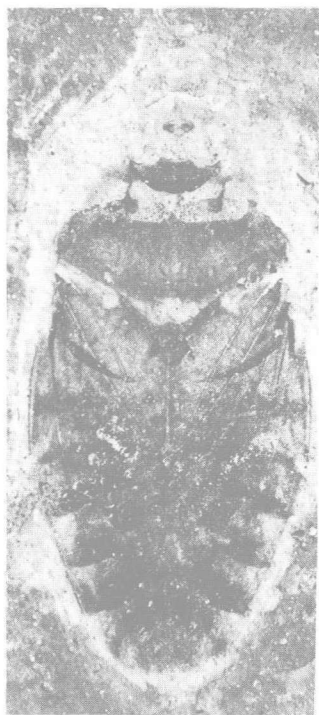
### 图 版 III

#### 1—5. *Schizopteryx shandongensis* Hong

1. 雄性成虫背面保存标本, ×7.6; 登记号: L88245。2. 雄性成虫背面保存标本, ×7.1; 登记号: L88246。3. 雄性成虫背面保存标本, ×7.5; 登记号: L88249。4. 雌性成虫背面保存标本, ×6.6; 登记号: L88248。5. 半鞘翅, ×7.1;



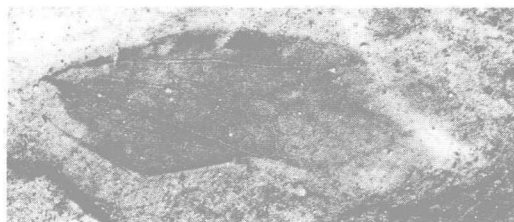




1



2



5



3



4



