

- Pteroecephaliid Biomere in the Great Basin, United States. -U. S. Geol. Surv. Prof. Pap. 493.
- Richter, R. et E., 1940: Die Saukianda Stufe von Andalusien. Abh. Senckenberg Natuf. Ges., 450.
- Hupé, P. R., 1953: Contribution a l'étude du Cambrien inférieur et du Precambrien III de l'Anti-Atlas Marocain. Service Geol. Maroc (Rabat), Notes et Mem., 103.
- Rusconi, C., 1954: Trilobitas cambricos de la Quebrada Oblicua, sud del Cerro Aspero. -Revista Mus. Hist. nat., Mendoza, 7.
- Rushton, A. W. A., 1967: The Upper Cambrian trilobite *Irvingella munrotonensis* (Sharman), -Palaeontology, 10 (3).
- Schrank, V. E., 1974: Kambrische Trilobiten der China-Kollektion V. Riechthofen. I. Die *Chuangia* zone von Saimaki, Z. Geol. Wiss. 2(5).
- Shergold, J. H., 1972: Late Upper Cambrian trilobites from the Gola Beds, Western Queensland, -Bur. Miner. Geol. Geophys. Resour. Aust. Bull. 112.
- , 1975: Late Cambrian and Early Ordovician trilobites from the Burke River Structural Belt, Western Queensland, Australia. -*Ibid.*, Bull. 153(1).
- , 1980: Late Cambrian trilobites from the Chasworth Limestone, Western Queensland. -*Ibid.* Bull. 186.
- , Cooper, R. A., Machinnon, D. I. & Yochelson, E. L., 1976, Late Cambrian Brachiopoda, Mollusca and Trilobita from northern Victoria Land, Antarctica. -Palaeontology. 19 (2).
- Walcott, C. D., 1911: Cambrian geology and palaeontology II, Cambrian faunas of China. -Smiths. Misc. Coll., 57(4).
- , 1913: Cambrian faunas of China. Carnegie Inst. (Washington) Pub. 54. Research in China, 3.
- , 1924: Cambrian and Lower Ozarkian trilobites. -Smithson, Misc. Coll. 75(2).
- Westergård, A. H., 1947: Supplementary notes on the Upper Cambrian trilobites of Sweden. -Sver. geol. Unders. (C), 489, arsb., 41, (8).
- , 1949: On the geological age of *Irvingella suecica* Westergård. -Geol. Förl. Förl. Stockh. 71.
- Ившин, Н. К., 1962: Верхнекембрийские Трилобиты Казахстана, Часть 11. Алма-Алта, Изд. АН. Каз. ССР.
- Чернышева, Н. Е., 1968: Новый вид *Irvingella* (Кембрийский Трилобит). Труды Нинга Мин. Геол. СССР, 155.

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## NEW ZONATION AND CORRELATION OF THE UPPER CAMBRIAN CHANGSHANIAN STAGE IN NORTH CHINA

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### Summary

Through a preliminary study of the Changshanian trilobites collected from the Taizihe Valley of Liaoning by the Taizihe stratigraphical team (Wang et al., 1954), from the Qingshuihe region of Nei Monggol by F. H. Chia and Q. L. Kao in 1952, and from the Kushan and Tai'an areas of Shandong by Lu and Dong (1953). 12 new genera and 17 new species are identified (pls. I—III), and six faunal zones and two subzones are established. They are as follows in descending order:

VI. Zone with *Acanthometopus obesus* gen. et sp. nov. (Pl. III, figs. 1—4):

- V. Zone with *Kaolishania pustulosa*:  
*Kaolishania pustulosa* Sun, *Petaloccephalus laevis* gen. et sp. nov. (Pl. III, figs. 5—9), *Ampullatocephalina bifida* gen. et sp. nov. (Pl. II, fig. 1), *Elaephraella microforma* gen. et sp. nov. (Pl. II, figs. 9, 10), *Taishania taianensis* Sun, *Yokusenina* sp., *Pagodia* sp., *Mansuyia* sp., *Pseudagnostus* sp.
- IV. Zone with *Shirakiella xiaoshiensis*:  
*Shirakiella xiaoshiensis* sp. nov. *Parakoldinioidia* sp., *Mansuyia* sp., *Taishania* (?) sp.

### III. Zone with *Changshania conica*-*Irvingella taitzukoensis*:

*Changshania conica* Sun (Pl. II, fig. 12), *Irvingella taitzukoensis* Lu (Pl. II, fig. 11), *Qingshuiheella bisulcata* gen. et sp. nov. (Pl. II, fig. 8), *Q. truncata* gen. et sp. nov. (Pl. II, fig. 7), *Mansuyia* sp., *Taishania* (?) sp.

### II. Zone with *Chuangia*:

#### B. *Chuangia subquadrangulata* subzone:

*Chuangia* (*Pterochuangia*) *nobilis* subgen. et sp. nov. (Pl. I, figs. 1—3), "*Chuangia*" *tawenkouensis* Sun, *Chuangia subquadrangulata* Sun, *C.* (*Leptochuangia*) *benxiensis* subgen. et sp. nov. (Pl. III, figs. 10, 11), *C.* (*Aspidochuangia*) *cata* subgen. et sp. nov. (Pl. I, figs. 11—13), *Shan-chenziella elongata* gen. et sp. nov. (Pl. II, fig. 2), *Xiaoshiella convexa* gen. et sp. nov. (Pl. II, fig. 5), *X. striata* gen. et sp. nov. (Pl. II, figs. 3, 4), *Parachangshania hsiaoshihensis*

Chien, *Pagodia* (*Idamea*) *nodosa* sp. nov. (Pl. II, fig. 6), *Pseudagnostus* sp., *Yokusenina* sp.

#### A. *Prochuangia mansuyi* Subzone:

*Prochuangia mansuyi* Kobayashi, *P. granulosa* Lu, *Paracoosia* sp., *Pseudagnostus* sp. *Yokusenina* sp.

#### I. Zone with *Luotuoilingia glossocephala*:

*Luotuoilingia glossocephala* gen. et sp. nov. (Pl. I, figs. 4—6), *L. constricta* gen. et sp. nov. (Pl. I, fig. 7), *Liaoningella carinata* gen. et sp. nov. (Pl. I, figs. 8, 9), *Dikelocephalites giganteometopus* sp. nov. (Pl. I, fig. 10).

The Changshanian trilobite faunas are widely distributed in China, Korea, Iran, Turkey, Kazakhstan, Australia, Antarctica, and also occurred sporadically in the middle Late Cambrian of Europe and North America. They can be correlated with each other by means of the typical changshanian forms and some cosmopolitan genera, although they represent quite different faunal realms and several faunal provinces. A correlation table is given below:

### Zonation and Correlation of Upper Cambrian Changshanian Stage of Taizihe (Liaoning), SW.

China, Asia, Australia, Antarctica, Siberia, N. America and Europe

Taizihe, Liaoning		E. Guizhou & W. Hunan (Chien, 1961, Yang, 1978)	Iran (King, 1937; Kobayashi, 1967)	Korea (Kobayashi, 1966, 1971)	W. Queensland of Australia (Opik, 1963; Shergold, 1971, 1975, 1980; Henderson, 1976)	Antarctic (Shergold et al, 1976)	Spain (Calchen, 1967)	Great Basin of U. S. A. (Palmer, 1965)	N. Siberia (Pokrovskaya, 1961)	Kazakhstan (Ivshin & Pokrovskaya, 1961)	Sweden (Westergard, 1947)	England (Rushton, 1967)
Changshanian Stage	Doishan Member	<i>Acanthomelampus obesus</i> zone	<i>Lotagaspis</i>							<i>Protopellura</i>	<i>Leptoplasius</i>	<i>Leptoplasius</i>
		<i>Kaolishania pusillula</i> zone	<i>Hedinaspis</i>							<i>Lotagaspis</i>	<i>Leptoplasius</i>	<i>Leptoplasius</i>
		<i>Shirakiella xiaoshiensis</i> zone	<i>Pseudopygospira</i>	<i>Malodiadella</i>						<i>Lotagaspis</i>	<i>Leptoplasius</i>	<i>Leptoplasius</i>
		<i>Changshania conica</i> zone	<i>Irvingella</i>							<i>Irvingella</i>	<i>Irvingella</i>	<i>Irvingella</i>
		<i>Irvingella taitzukoensis</i>								<i>Irvingella</i>	<i>Irvingella</i>	<i>Irvingella</i>
		<i>Chuangia</i> zone	<i>Stigmatopora</i>	<i>Chuangia</i>	<i>Stigmatopora</i>	<i>Stigmatopora</i>	<i>Chuangia</i>			<i>Irvingella</i>	<i>Irvingella</i>	<i>Irvingella</i>
Doishan Member		<i>Chuangia subquadrangulata</i> subzone	<i>Chuangia</i>	<i>Changshania-cephalus</i>	<i>Prochuangia</i>	<i>Prochuangia</i>	<i>Prochuangia</i>			<i>Irvingella</i>	<i>Irvingella</i>	<i>Irvingella</i>
		<i>Prochuangia mansuyi</i> subzone	<i>Prochuangia</i>							<i>Irvingella</i>	<i>Irvingella</i>	<i>Irvingella</i>
		<i>Luotuoilingia glossocephala</i> zone	<i>Glyptagnostus reticulatus</i>							<i>Irvingella</i>	<i>Irvingella</i>	<i>Irvingella</i>
										<i>Irvingella</i>	<i>Irvingella</i>	<i>Irvingella</i>
										<i>Irvingella</i>	<i>Irvingella</i>	<i>Irvingella</i>
										<i>Irvingella</i>	<i>Irvingella</i>	<i>Irvingella</i>

Endo (1944, p. 52) and Kobayashi (1967, p.285) listed the *Prochuangia* zone as the first zone on the base of the Changshanian stage. Through a detailed stratigraphic work in the Taizihe Valley, there has been found out in

several localities a new fossil horizon below the *Prochuangia* subzone, it is named the *Luotuoilingia glossocephala* zone, from which 2 new genera and 4 new species of trilobites are collected as listed above and figured on Pl. I.

*Prochuangia* is usually associated with *Chuangia*, but more frequently very abundant below the beds containing *Chuangia*, therefore the zone of *Chuangia* is separated into two subzones — the *Prochuangia mansuyi* Subzone below and the *Chuangia subquadrangulata* Subzone above. *Prochuangia* is reported by Henderson (1974, p. 354) to occur in association with *Yuepingia* and *Stigmatoa* in the *Stigmatoa diloma* zone of W Queensland. These genera are the important members of the *Chuangia-Prochuangia* Zone in W Hunan and E Guizhou (Lu, 1956, p. 369; Yang, 1978, p. 36). Thus, a direct correlation of the Changshanian stage in Australia, South and North China is made possible. Moreover, the occurrence of *Prochuangia* aff. *granulosa* Lu and *Irvingella* (?) sp. in the Victoria and Antarctica (Shergold *et al.*, 1976) provides evidence that this fauna extends as far as to the southern most continent. The *Prochuangia-Chuangia* faunas extend westwards the Tethyan sea from Asia through Iran (Wolfart, 1969, 1974), Turkey (Dean & Krummenacher, 1961; Dean & Monod, 1970) to Logrono of Spain (Colchen, 1967, p. 1688).

The finding of the Australia *Pagodia* (*Idamea*) in the *Chuangia* Zone of eastern Liaoning provides a possibility of correlating this zone with the Australia *Erizanium* zone, in which *Pagodia* (*Idamea*) is one of the characteristic forms (Opik, 1967, p. 260—262).

*Irvingella* is a cosmopolitan genus and is widely distributed in China, Korea, Kazakhstan (Ившин, 1962, pp. 44—56), Siberia (Чернышева, 1968, pp. 207—210), W Queensland (Opik, 1963, p. 96—97; Henderson, 1976, p. 352) Texas, Utah, Nevada of U. S. A. (Palmer, 1965, p. 45), Canada (Kobayashi, 1938, p. 176), Argentina (Rusconi, 1954, p. 31), England (Rushton, 1967, pp. 339—348) and Sweden (Westergård, 1947, p. 16). As reported by the authors it has a strict geological range in the middle part of Upper Cambrian and may be regarded as a good guide fossil for world-wide stratigraphic correlation.

The establishment of the *Shirakiella xiao-*

*shiensis* Zone is based on the occurrence of very abundant specimens of *Shirakiella xiaoshiensis* and *S. elongata* in association with a few specimens of *Kaolishania* in a horizon above the *Changshania conica-Irvingella taitzukoensis* Zone at several localities of the Taizihe Valley, E Liaoning. Kobayashi (1935, p. 323; 1966, p. 34) listed *Shirakiella elongata* and *S. laticonvexa* as diagnostic species of the *Kaolishania* Zone in S Korea, but only a few specimens of the two genera are mixed together in the transitional beds between the *Shirakiella xiaoshiensis* Zone and the *Kaolishania pustulosa* Zone in the Taizihe Valley. The *Kaolishania pustulosa* Zone is typified by the entrance of the new taxa including *Petalcephalus*, *Ampullatocephalina*, *Elaphraella* together with *Taishania*, *Mansuyia*, *Yokusenina*, *Pagodia*, *Pseudagnostus*, etc.

It remains a question whether the *Kaolishania pustulosa* Zone represents the highest Changshanian stage. In the Luotuolingzi section of Benchu, Taizihe Valley (Wang *et al.*, 1954, p. 45), there is a layer of shale containing rich specimens of *Acanthometopus obesus* gen. et sp. nov. and some small trilobites above the horizon with *Taishania*. At present, this new fossil horizon is known only in a restricted area and we can not ensure if it is necessary to establish a new faunal zone or wait until more material is available.

**The characteristic features of the new subfamily, new genera and new subgenera are briefly described as follows.**

#### **Elaphraellinae Subfam. nov.**

Shumardiidae, Cranidium semicircular, convex. Glabella large, conical, tapering rapidly forwards, angulate in front. Palpebral lobe small, situated at the level of anterior end of glabella. Pygidial axis large, convex, composed of three rings. Pleural lobe flat; pleural furrows faint. Except *Elaphraella* gen. nov., the genera *Fenghuangella* Yang, 1978, and *Koldinoidia* Kobayashi, 1930 may also be included in this subfamily.

#### **Elaphraella gen. nov.**

Type species: *Elaphraella microforma* gen. et sp. nov. (Pl. II, figs. 9, 10).

Diagnosis: Cephalon semielliptical, strongly convex; dorsal furrows deep. Glabella large, subconical, with three pairs of short lateral glabellar furrows. Occipital furrow deep. Anterior border narrow, depressed at the middle. Fixed cheek convex, narrower than the basal width of glabella. Palpebral lobe small, located at the level of anterior end of glabella. Palpebral ridge distinct, extending obliquely from the palpebral lobe.

Remarks: This genus is closely similar to *Fenghuangella* Yang (1978, p. 44), but it differs in the larger glabella, of which the basal width is wider than the maximum width of cheek, and in the absence of median depression in the anterior border. It is somewhat allied to *Cyclolorenzella* Kobayashi, 1960, but the latter is distinguished by the truncato-conical glabella, by the posterior position of palpebral lobe and by the presence of a pair of oblique furrows on the brim and an elevation in front of glabella.

#### ***Liaoningella* gen. nov.**

Type species: *Liaoningella carinata* gen. et sp. nov. (Pl. I, figs. 8, 9)

Diagnosis: Monaspidae. Glabella short, truncato-conical, with a proportion of maximum width and length about 8: 9. Fixed cheeks narrow. Border very broad, slightly depressed with a low elevation in front of glabella. Fixed cheek with a pair of side lobes.

Remarks: The new genus is similar to *Liaoningaspis taitzeensis* Chu (1959, p. 75, pl. 6, figs. 1—9) and *Monaspis daulis* (Walcott) (Walcott, 1913, p. 189, pl. 18, figs. 7, 7a,) but it differs in the truncato-conical instead of rounded glabella and in the absence of a convex ridge on the frontal border. In addition, *Liaoningaspis taitzeensis* has irregular concentric lines on the convex ridge. *Liaoningella* is differentiated from *Dikelocephalites* Sun (1935) in the presence of paired lateral lobes outside the base of glabella, in the large palpebral lobes and in the convex ridge

on the border.

#### ***Luotulingia* gen. nov.**

Type species: *Luotulingia glossoccephala* gen. et sp. nov. (Pl. I, figs. 4—6)

Diagnosis: Cranidium narrow, elongate. Glabella long, tapering forwards, slightly truncated in front. Two pairs of faint glabellar furrows. Occipital furrow deep. Fixed cheek narrow, about one-fifth the width of glabella between the palpebral lobes. Palpebral lobe median size, located a little behind the mid-length of the glabella. Anterior border wide, tongue-shaped, extending forwards; brim broad. Postero-lateral furrow deep. Anterior facial sutures strongly divergent forwards, then strongly curving inwards and forwards to cut the anterior border in a rounded curve; posterior sutures extending almost horizontally and slightly oblique backwards. Pygidium semielliptical in outline; axis triangular, slightly elevated above the pleural lobes, composed of 4 weakly defined rings and a terminal segment. Pleural lobe broad, divided into 3—4 pairs of faint pleural furrows.

Remarks: This genus may be grouped into the family Pterocephalidae Kobayashi, 1935. It is similar to *Elkia nasuta* Walcott (1925, Pl. 18, figs. 1—3), the type species of *Elkia*, the latter is distinguished by the shorter and larger glabella, narrower fixed cheek, larger palpebral lobes and the marginal sutures, which surround the frontal border.

#### ***Xiaoshiella* gen. nov.**

Type species: *Xiaoshiella striata* gen. et sp. nov. (Pl. II, figs. 3, 4)

Diagnosis: Pterocephalidae. Cranidium subtriangular to trapezoidal, rounded in front; basal part about 3 times the width of frontal part. Glabella large, tapering rapidly forwards, nearly straight in front; basal width more than twice the width of the anterior margin. Three pairs of glabellar furrows. Occipital furrow deep; occipital ring broad in middle. Anterior border narrow, convex, arched forwards. Brim broad, about twice the width of anterior border. Fixed cheeks narrow, about

1/5 the basal width of glabella. Palpebral lobe small, situated near the front of glabella. Free cheek broad; cheek body convex; border slightly convex, with a slender genal spine. Postero-lateral limb large, triangular. Anterior facial sutures strongly diverging forwards to cut the anterior border in a very broad curve; posterior sutures extending in a slightly curving line outwards and backwards.

Remarks: This genus is related to *Olenella olenensis* Ivshin (Ившин, 1956, p. 66), but it differs in the anterior position of palpebral lobes, in the divergent facial sutures and in the larger posterior limb. It is different from *Strigambitus transversus* Palmer (1956, p. 77, pl. 16, figs. 6—10) in the rapidly tapering glabella with straight frontal margin, in the anterior position of smaller palpebral lobes and in the larger posterior limb. *Parahousia constricta* Palmer (1960, p. 77, pl. 7, figs. 16—18), the type species of *Parahousia* Palmer has a broad frontal border, while in *Xiaoshiella*, the frontal border is narrower than the brim.

#### ***Petaloecephalus* gen. nov.**

Type species; *Petaloecephalus laevis* gen. et sp. nov. (Pl. III, figs. 5—9)

Diagnosis: Glabella strongly convex, subcylindrical in outline, broadly rounded in front, with three pairs of shallow glabellar furrows, of which the posterior pair extend to the occipital furrow to separate a pair of lateral glabellar lobes. Fixed cheek narrow, about 1/6—1/5 the width of glabella. Palpebral lobe small, situated near the mid-length of glabella. Anterior border convex, broad at the middle, moderately upturned and arched forwards. Brim gently convex, as wide as the anterior border. Anterior furrow very shallow. Postero-lateral limb large, subtriangular. Anterior facial sutures diverging forwards, then bending strongly inwards to cut the anterior border in a broad rounded curve; posterior ones running slightly oblique outwards and backwards. Pygidium small, subcircular. Axis short broad and convex, with 4—5 rings; pleural lobes flat, with 2—3 pairs of wide pleural furrows, sinuated

posteriorly and separated into a pair of triangular marginal posterior spines.

Remarks: This genus is closely similar to *Yokusemia* Kobayashi, 1935, in the following three features: (1) small palpebral lobes situated near the mid-length of glabella, (2) narrow fixed cheeks and (3) large and triangular posterior border. *Petaloecephalus* differs from *Yokusemia* in the broader and upturned anterior border, in the subparallel glabella and in the sinuated pygidium with a broad border.

#### ***Qingshuiheella* gen. nov.**

Type species: *Qingshuiheella truncata* gen. et sp. nov. (Pl. II, fig. 7)

Diagnosis: Changshanidae trilobite with large, truncato-conical glabella circumscribed by deep dorsal furrows, three pairs of distinct glabellar furrows, of which the posterior pair are very deep; fixed cheek narrow, about 1/3 the width of glabella between palpebral lobes; palpebral lobe small, located a little behind the mid-length of glabella, and with a pair of transverse accessory furrows behind the anterior marginal furrow.

Remarks: At a glance, this genus resembles *Changshania* Sun, 1923, but the latter has conical instead of truncato-conical glabella, a gently curved occipital furrow, and a simple anterior furrow without accessory furrows behind it.

#### ***Chuangia* (*Aspidochuangia*) subgen. nov.**

Type species: *Chuangia* (*Aspidochuangia*) *cata* subgen. et sp. nov. (Pl. I, figs. 11—13).

Diagnosis: Glabella large, narrowing anteriorly, widely rounded in front. Anterior border very narrow, carinated transversely. Fixed cheek convex, about 1/3 the width of glabella between palpebral lobes. Palpebral lobe large, bow-shaped, located a little behind the mid-length of cranidium. Ocular ridge weakly marked, running obliquely forwards from palpebral lobe. Posterior limb small. Anterior facial sutures running slightly divergent forwards; posterior sutures extending outwards and slightly backwards. Pygidium semielliptical in outline. Axis strongly convex,

divided into 4 rings and a terminal segment extending to the margin. Pleural lobe gently convex; pleural furrows very shallow and wide, border indistinct.

Remarks: *Aspidochuangia* differs from *Chuangia* in the large glabella, narrower fixed cheeks, longer palpebral lobes situated anteriorly and very narrow anterior border.

***Chuangia* (*Pterochuangia*) subgen. nov.**

Type species: *Chuangia* (*Pterochuangia*) *nobilis* subgen. et sp. nov. (Pl. I, figs. 1—3).

Diagnosis: Cranidium subquadrate (excluding the postero-lateral limb). Glabella moderately convex, tapering gradually forwards, nearly straight in front, and constricted at a position 1/4 its length from the frontal margin. Anterior border narrow, convex, sloping down anteriorly, border furrow very narrow. Fixed cheeks flat, about one-half the width of glabella between the palpebral lobes. Palpebral lobe median-size, semicircular in shape, located at the middle level of glabella. Posterior limb narrow, a little wider than the width (tr.) of occipital ring. Anterior facial sutures subparallel; posterior ones running outwards and slightly backwards. Pygidium subelliptical, with prominent marginal border. Axis convex, faintly segmented. Pleural lobe gently convex, marked by shallow pleural furrow.

Remarks: *Pterochuangia* is distinguished from *Chuangia batia* Walcott by its narrower and constricted glabella, a very narrow anterior furrow, large palpebral lobes, subparallel anterior facial sutures, large pygidial axis and the distinct pygidial border.

***Chuangia* (*Leptochuangia*) subgen. nov.**

Type species: *Chuangia* (*Leptochuangia*) *benxiensis* subgen. et sp. nov. (Pl. III, figs. 10, 11).

Diagnosis: Glabella slightly tapering forwards, truncated in front, expanding posteriorly; 3 pairs of glabellar furrows, anterior 2 pairs very shallow, posterior ones wider and deeper, strongly oblique backwards. Occipital

furrow shallow; occipital ring narrow. Fixed cheek of median width, about 1/2 the breadth of glabella between palpebral lobes. Palpebral lobe median-size, located at the mid-length of glabella. Border broad, transversely carinated, sloping down forwards, with remarkable terrace-lines. Posterior limb and postero-lateral border very wide, broader than the basal width of glabella. Posterior furrow deep and wide. Free cheek wider than long, hook-shaped, border sloping down forward, with terrace-lines in outer margin: posterior portion flattened, convex, with tiny genal spine.

Remarks: The new subgenus differs from *Chuangia* (*Aspidochuangia*) in the broader posterior portion of glabella, smaller palpebral lobes and very wide posterior limb. It differs from *Chuangia* (*Pterochuangia*) mainly in the expanding posterior part of glabella, the presence of terrace lines on the anterior border and in the divergent instead of subparallel anterior facial sutures.

***Shanchengziella* gen. nov.**

Type species: *Shanchengziella elongata* gen. et sp. nov. (Pl. II, fig. 2).

Diagnosis: Glabella elongate, truncate-conical, tapering forwards, extending to the deep anterior furrow. Brim absent. 3 pairs of glabellar furrows occupying 1/3 the breadth of glabella, posterior pair deep. Occipital furrow deep, arched anteriorly in middle. Fixed cheek very narrow, about one-fourth the breadth of glabella between the palpebral lobes. Palpebral lobe short, about 1/5 the length of glabella, situated in front of the mid-length of glabella. Eye-ridge strongly convex, oblique. Anterior border very narrow, transversely carinated, arched forwards. Posterior limb very broad, as wide as the basal breadth of glabella. Anterior facial sutures short, subparallel; posterior ones long and oblique.

Remarks: This new genus is somewhat similar to *Paokannia magna* Qian et Yao (in Zhang et al. 1980, p. 197, pl. 55, fig. 13; pl. 56, figs. 1, 2). but differs in having a strongly marked eye-ridge, larger posterior limb, smaller

palpebral lobe located in an anterior position. This genus is tentatively included in the family Yinitidae Hupé, 1953.

### *Acanthometopus* gen. nov.

Type species: *Acanthometopus obesus* gen. et sp. nov. (Pl. III, figs. 1—4).

Diagnosis: Small Solenopleuridae trilobite. Glabella large, convex suboval to cylindro-oval-shaped, with three pairs of faint glabellar furrows. Occipital and dorsal furrows deep. Occipital ring broad (tr.). Anterior border broad, slightly upturned. Brim slightly convex, about twice the width (sag.) of the border. Palpebral lobe large, bow-shaped, with 7—8 small spines. Free cheeks broad, connected with each other, with large nodes. Border convex, produced posteriorly into long and slender genal spines. Anterior facial sutures marginal. Surface marked with tubercles, those on the glabella and occipital ring are larger than those on other parts of the cranidium. Thoracic segment with narrow axis, broad and deep pleural furrows, and long pleural spines.

Remarks: This genus is similar to both Solenopleuridae and Hystricuridae. It is comparable with *Hystricurus* in the broad brim, oval glabella and deep dorsal furrows, but differs in the course of marginal facial sutures and in the presence of small spines on the palpebral lobe. It is distinguished from the Solenopleuridae by the larger palpebral lobe, broader brim, distinct glabellar furrows and marginal facial sutures.

### *Ampullatocephalina* gen. nov.

Type species: *Ampullatocephalina bifida* gen. et sp. nov. (Pl. II, fig. 1).

Diagnosis: Cranidium subtrapezoidal in outline. Dorsal furrow deep and on sides. Glabella convex, elongate, vase-shaped, strongly contracted at the anterior one-third, with a greatest width at the base. Three pairs of deep glabellar furrows, posterior pair extending strongly backwards and inwards, almost reaching to the occipital furrow. Occipital furrow deep and broad, straight in middle, oblique forwards laterally; occipital ring broad at the middle, with a small occipital node. Anterior border narrow, convex, middle part slightly pointed forwards. Fixed cheek gently convex, very narrow between the palpebral lobes. Palpebral lobe small, lying near the mid-length of glabella. Posterior limb large, subtriangular, as wide as glabella at base, separated from the posterior border by deep and broad posterior furrow. Anterior facial sutures short, slightly diverging forwards; posterior ones long, strongly oblique outwards and slightly backwards.

Remarks: This new genus is somewhat similar to *Menomonina calymenoides* (Whitfield) (Walcott, 1916), the type species of *Menomonina*, but differs from the latter in (1) longer glabella, which is contracted at the anterior one-third; (2) in the anterior position of palpebral lobes and (3) in the very narrow anterior border.

## 图 版 说 明

标本保存在中国科学院南京地质古生物研究所。

### 图 版 I

1—3. *Chuangia* (*Pterochuangia*) *nobilis* subgen. et sp. nov.

1. 头盖, Holotype, ×6, 野外号: BE440, 登记号: 73138。

2. 头盖, ×3, 野外号: BE440, 登记号: 73139。

3. 尾部, ×2, 野外号: BE440, 登记号: 73140。

辽宁辽阳烟台当十岭, 上寒武统长山组 *Chuangia* 带 *C. subquadrangulata* 亚带。

4—6. *Luotuolingia glossocephala* gen. et sp. nov.

4. 头盖, Holotype, ×5, 野外号: BE119, 登记号: 73141。

5. 尾部, ×5, 野外号: BE119, 登记号: 73142。

6. 头盖, ×5, 野外号: BE390, 登记号: 73143。

辽宁本溪营子北沟二道沟, 上寒武统长山组 *Luotuolingia glossocephala* 带。

7. *Luotuolingia constricta* gen. et sp. nov.

头盖, Holotype, ×8, 野外号: BE119, 登记号: 73144。

辽宁本溪营子北沟二道沟, 上寒武统长山组 *Luotuolingia glossocephala* 带。

8, 9. *Liaoningella carinata* gen. et sp. nov.

8. 头盖, Holotype, ×4, 野外号: BE390, 登记号: 73145。

9. 头盖, ×3, 野外号: BE390, 登记号: 73146。  
辽宁本溪营子北沟二道沟, 上寒武统长山组 *Luotoulingia glossocephala* 带。
10. *Dikelocephalites gigantometopus* sp. nov.  
头盖, Holotype, ×4, 野外号: BE390, 登记号: 73147。  
辽宁本溪营子北沟二道沟, 上寒武统长山组 *Luotoulingia glossocephala* 带。
- 11—13. *Chuangia* (*Aspidochuangia*) *cata* subgen. et sp. nov.  
11. 头盖, Holotype, ×8, 野外号: BE130, 登记号: 73148。  
12. 头盖, ×8, 野外号: BE130, 登记号: 73149。  
13. 尾部, ×2, 野外号: BE130, 登记号: 73150。  
辽宁本溪营子北沟二道沟, 上寒武统长山组 *Chuangia* 带 *Chuangia subquadrangulata* 亚带。

## 图 版 II

1. *Ampullatocephalina bifida* gen. et sp. nov.  
头盖, Holotype, ×6, 野外号: BW73, 登记号: 73151。  
山东泰安蒿里山 (英雄山)。上寒武统长山组 *Kaolishania pustulosa* 带。
2. *Shanchengziella elongata* gen. et sp. nov.  
头盖, Holotype, ×10, 野外号: BE955, 登记号: 73152。  
辽宁本溪小市南十五里山城子, 上寒武统长山组 *Chuangia* 带 *Chuangia subquadrangulata* 亚带。
- 3, 4. *Xiaoshiella striata* gen. et sp. nov.  
3. 活动颊, ×2.5, 野外号: BE392, 登记号: 73153。  
4. 头盖, Holotype, ×3, 野外号: BE392, 登记号: 73154。  
辽宁本溪小市南十五里山城子, 上寒武统长山组 *Chuangia* 带 *Chuangia subquadrangulata* 亚带。
5. *Xiaoshiella convexa* gen. et sp. nov.  
头盖, Holotype, ×5, 野外号: BE392, 登记号: 73155。  
辽宁本溪小市南十五里山城子, 上寒武统长山组 *Chuangia* 带 *Chuangia subquadrangulata* 亚带。
6. *Pagodia* (*Idamea*) *nodosa* sp. nov.  
头盖, Holotype, ×6, 野外号: BE546, 登记号: 73156。  
辽宁烟台燕州城, 上寒武统长山组 *Chuangia* 带 *Chuangia subquadrangulata* 亚带。
7. *Qingshuiheella truncata* gen. et sp. nov.  
头盖, Holotype, ×3, 野外号: LS34, 登记号: 73157。  
内蒙古清水河, 上寒武统长山组 *Changshania conica-Irvingella taitzuhoensis* 带。
8. *Qingshuiheella bisulcata* gen. et sp. nov.

头盖, Holotype, ×2, 野外号: LS8, 登记号: 73158。  
内蒙古清水河, 上寒武统长山组 *Changshania conica-Irvingella taitzuhoensis* 带。

- 9, 10. *Elaphraella microforma* gen. et sp. nov.  
9. 头盖, ×15, 野外号: BW73, 登记号: 73159。  
10. 头盖, Holotype, ×15, 野外号: BW73, 登记号: 73160。  
山东泰安蒿里山 (英雄山), 上寒武统长山组 *Kaolishania pustulosa* 带。
11. *Irvingella taitzuhoensis* Lu  
头盖, ×5, 野外号: SD514, 登记号: 73161。  
山东沂源牛心崖, 上寒武统长山组 *Changshania conica-Irvingella taitzuhoensis* 带。
12. *Changshania conica* Sun  
头盖, ×5, 野外号: SD514, 登记号: 73162。  
山东沂源牛心崖, 上寒武统长山组 *Changshania conica-Irvingella taitzuhoensis* 带。

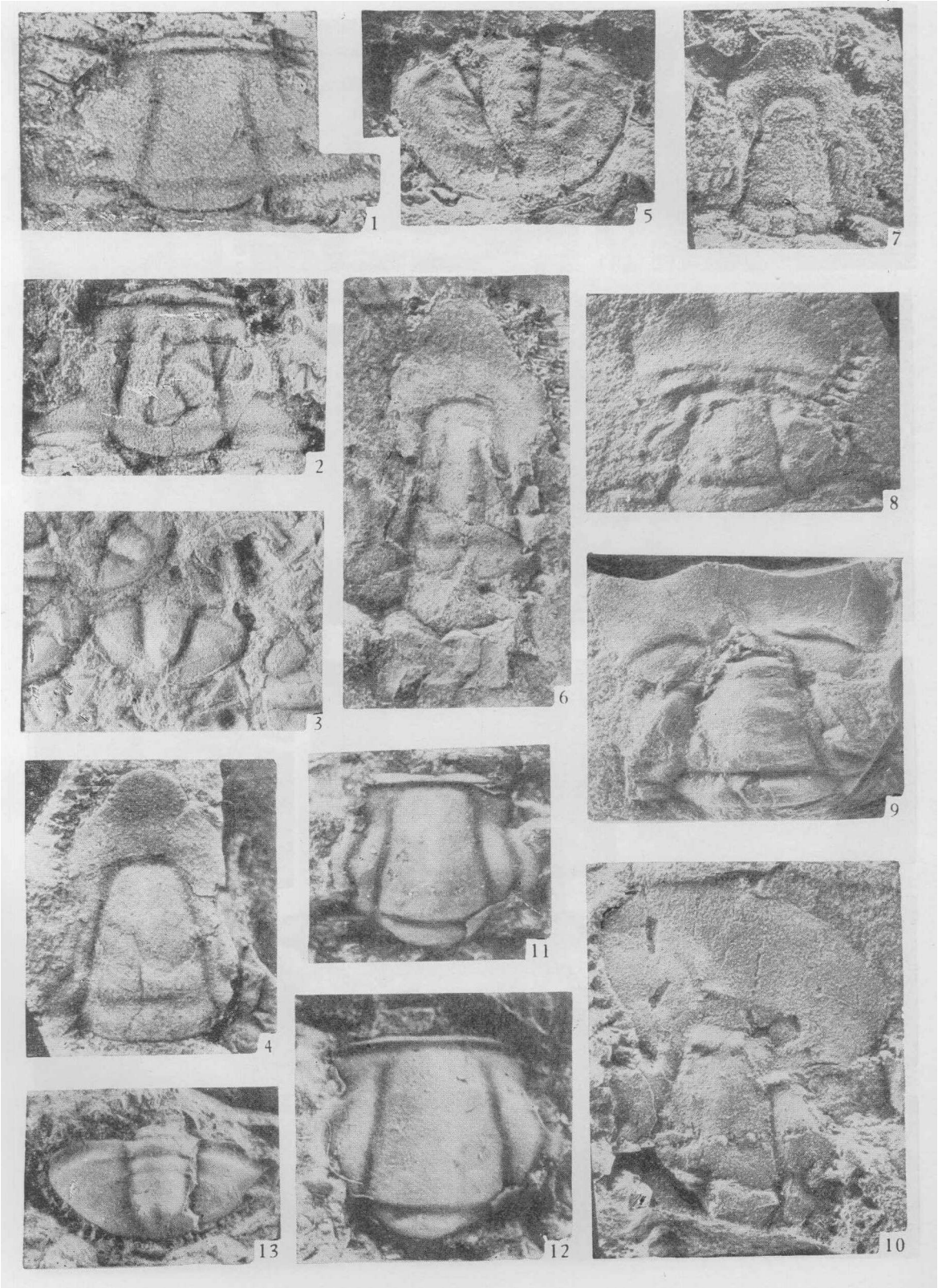
## 图 版 III

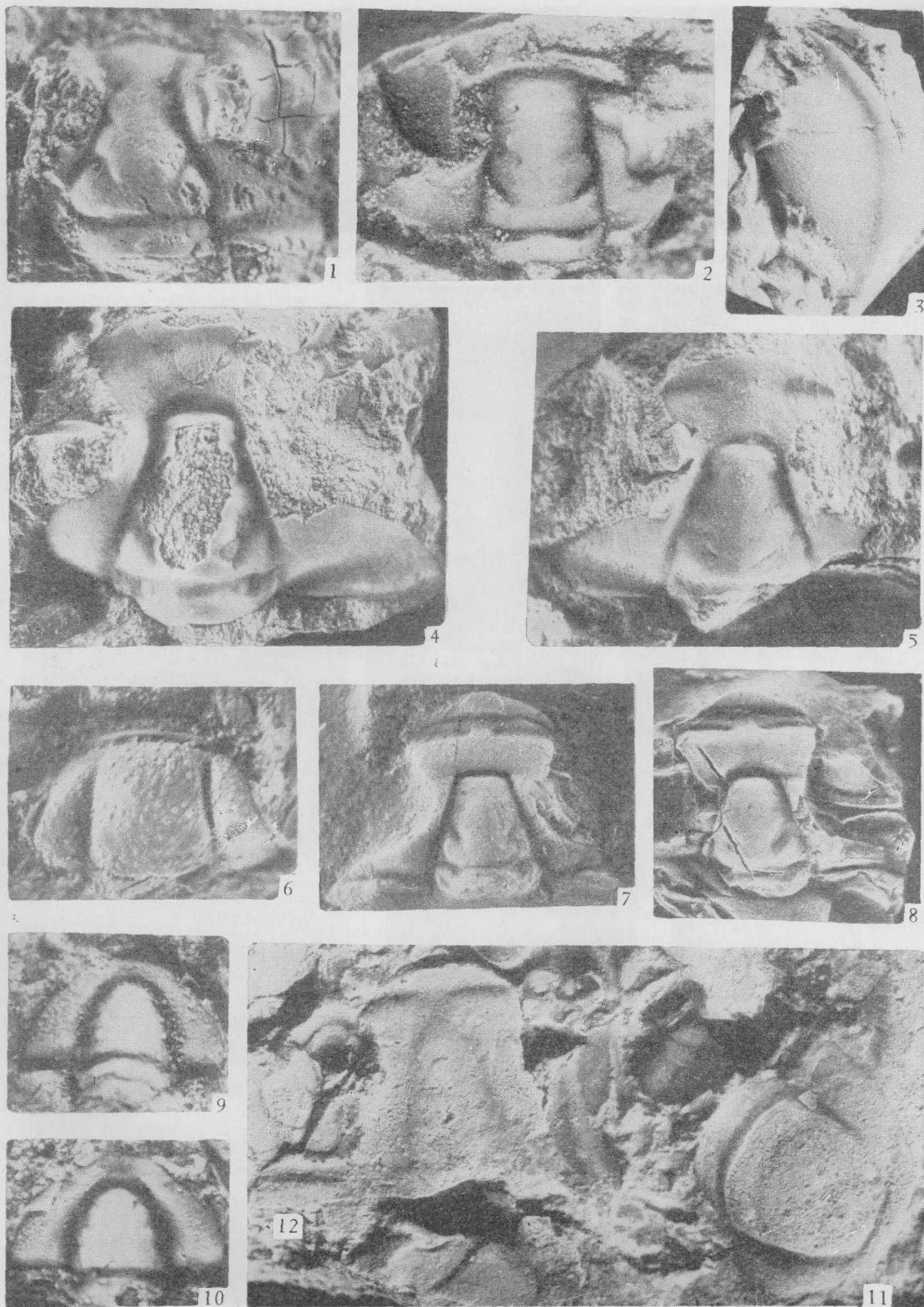
- 1—4. *Acanthometopus obesus* gen. et sp. nov.  
1. 头盖, ×10, 野外号: BE66, 登记号: 73163。  
2. 活动颊, ×10, 野外号: BE66, 登记号: 73164。  
3. 胸节 (外模), ×10, 野外号: BE66, 登记号: 73165。  
4. 头盖, Holotype, ×10, 野外号: BE66, 登记号: 73166。  
辽宁本溪营子之北骆驼岭子, 上寒武统长山组 *Acanthometopus obesus* 带。
- 5—9. *Petaloccephalus laevis* gen. et sp. nov.  
5. 头盖, Holotype, ×5, 野外号: BE65, 登记号: 73167。  
6. 胸节, ×7, 野外号: BE65, 登记号: 73168。  
7. 头盖, ×4, 野外号: BE65, 登记号: 73169。  
8. 尾部, ×10, 野外号: BE65, 登记号: 73170。  
9. 尾部, ×8, 野外号: BE65, 登记号: 73171。  
辽宁本溪营子之北骆驼岭子, 上寒武统长山组 *Kaolishania pustulosa* 带。
- 10, 11. *Chuangia* (*Leptochuangia*) *benxiensis* subgen. et sp. nov.  
10. 活动颊, ×3, 野外号: BE130, 登记号: 73172。  
11. 头盖, Holotype, ×4, 野外号: BE130, 登记号: 73173。  
辽宁本溪营子北沟二道沟, 上寒武统长山组 *Chuangia* 带 *Chuangia subquadrangulata* 亚带。



(New Zonation and Correlation of the Upper Cambrian  
Changshanian Stage in North China)

Plate I





(New Zonation and Correlation of the Upper Cambrian  
Changshanian Stage in North China)

Plate III

