

Khumerspira*, a new Genus of Bellerophontidae, and some Middle Permian Gastropods from Cambodia

(Contributions to the Geology and Palaeontology of Cambodia, Part 4)

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(With 2 Text-figures and 2 Plates)

Introduction and Acknowledgments

The Permian limestone in west Cambodia is well known for its yield of a rich fauna of marine invertebrates. The stratigraphical and paleontological studies of the Permian limestone have been published by DEPRAT (1912, 1913), MANSUY (1913, 1914), GUBLER (1935a, b), DELPEY (1941-1942), SKINNER and WILDE (1954), SAURIN (1959), VIEN (1959), CHI-THUAN (1961), FONTAINE (1961, 1965, 1967), SERRA (1966), ISHII and NOGAMI (1964), ISHII (1966), and by ISHII, KATO and NAKAMURA (1969).

A small collection of gastropods including a peculiar form of the Bellerophontidae, was collected from the upper part of the Sisophon Limestone exposed at Phn.**** Bak and Phn. Tup, west of Sisophon, Cambodia by the senior author in 1967. The majority of the specimens collected from the north of Phn. Tup are poorly preserved. However, nearly a dozen of well preserved bellerophontids were collected from the east of the Phn. Bak area. As the result of a paleontological study, the junior author describes six species of gastropods distributed among six genera, among which one species is described as new to science, and one new generic name *Khumerspira* is proposed.

The writers here offer their cordial thanks to Dr. Kotora HATAI, Professor Emeritus of the Tohoku University, and Dr. Ichiro HAYASAKA of the Tamagawa University, for their kind advice on the paleontological study. The writers also express their sincere thanks to Professor Koichiro ICHIKAWA, Osaka City University, for his kind encouragement and advice during this study. Thanks are due to Dr. Makoto KATO, Hokkaido University for his collaboration in the field work in 1967.

Stratigraphical note of the Sisophon Limestone at the fossil locality

The Lower and Middle Permian Sisophon Limestone is developed typically in the west of Sisophon, forming limestone monadnocks, and was subdivided lithologically by ISHII (1966) and ISHII, KATO and NAKAMURA (1969), into the four members of A, B, C and D in ascending order.

Member A consists of pale green to reddish brown andesitic tuff and tuff-breccia over

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**** Abbreviation for Phnom, meaning mountain in Cambodian language.

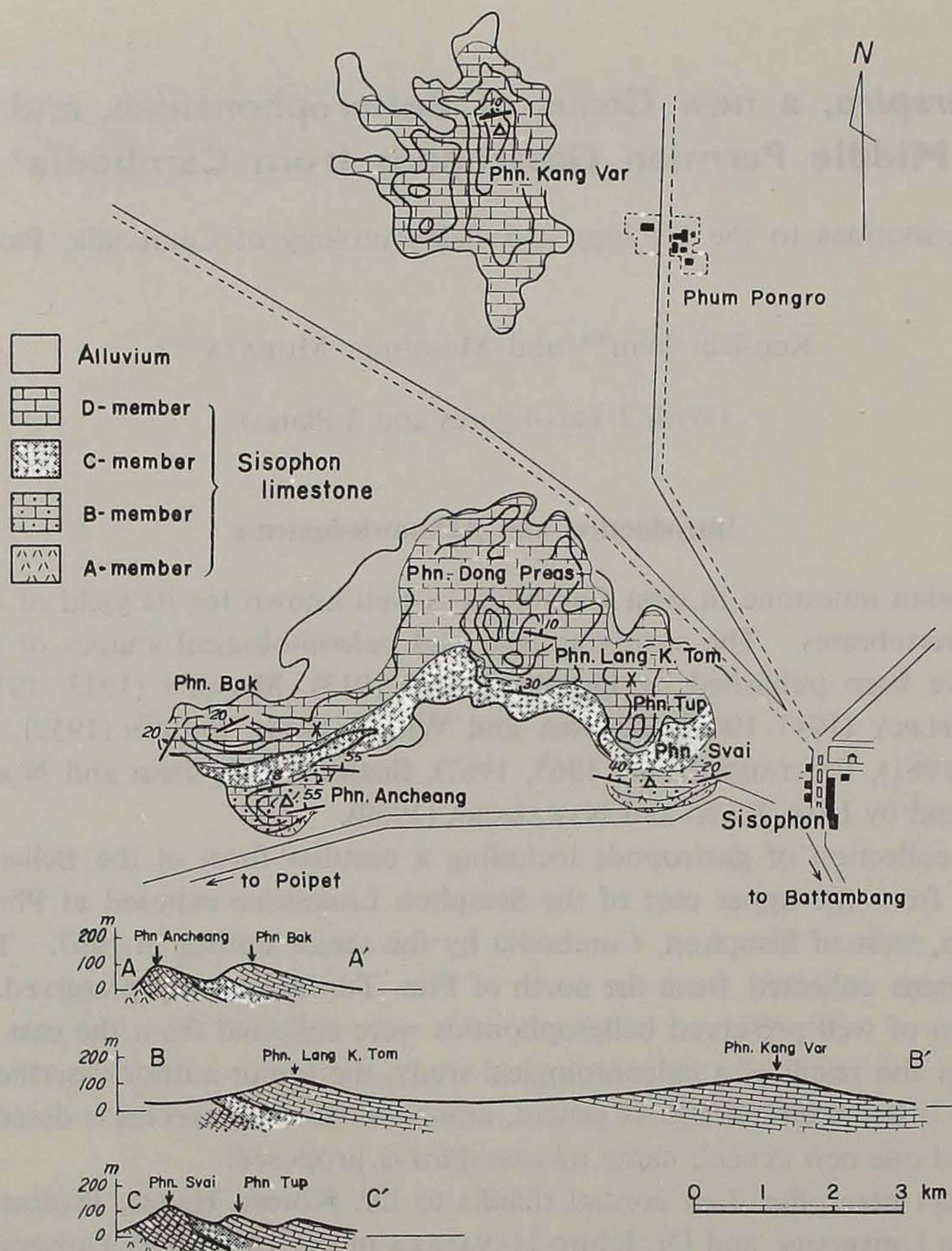


Fig. 1. Geologic map of the Sisophon region, west Cambodia. (after ISHII, KATO & NAKAMURA, 1969), ×; fossil locality of gastropods

five meters in thickness. Small lenses of limestone are often intercalated in the upper part of the member. This member corresponds to "niveaux 1°" of FONTAINE (1967) in the Phn. Svai area. Several species of fusulinids including *Pseudodoliolina pseudolepida* (DEPRAT) and *Pseudodol. dunbari* (GUBLER), nine species of corals and eight species of brachiopods were listed by ISHII, KATO and NAKAMURA (1969) from the Member A. Their distribution charts of the mentioned fossils show that most of the species of the fusulinids and brachiopods range up to a higher horizon.

Member B is an alternation of dark gray to milky white, massive limestone and bedded limestone, measuring about 40 meters in thickness. The limestone of this member is composed of skeletal-micrite and -sparite of fragmental crinoids, calcareous algae, corals, brachiopods and fusulinids. The upper part of the Member B consists of brecciated limestone and stromatolites. FONTAINE's "niveaux 2°-4°" corresponds to Member B in this paper. The Member B yielded a rich fauna of marine invertebrates. ISHII, KATO and NAKAMURA (1969) listed several tens of species of fusulinids, corals and brachiopods from

the Member B, and showed that *Sumatrina annae longissima* DEPRAT, *Colania asiatica* (ISHII), *C. douvillei* (OZAWA), *Neoschwagerina* aff. *margaritae* DEPRAT and *Verbeekina* sp. occurred from the uppermost part of this member.

Member C consists of reddish or brownish calcareous mudstone, varying in thickness. In the Sisophon area, the thickness of this member attains 60 meters, but it thins toward the south to only eight meters at Phn. Takream of the Battambang area. This member may correspond to "niveaux 5°-7°" of SAURIN (1959) and "niveaux 5° and 6°" of FONTAINE (1969). The lower part of this member is considered to be partially synchronous with the upper part of Member B. Many species of corals and brachiopods were listed from the upper part of this member by ISHII, KATO and NAKAMURA (1969), but the fusulinids were rather less numerous than that of Member D. *Lepidolina multiseptata multiseptata* (DEPRAT), *Sumatrina annae longissima* DEPRAT and *Pseudofusulina* cfr. *crassa padangensis* (LANGE) were reported from the top part of this member.

Member D attains 100 meters in maximum thickness. The lower and middle parts of this member consist of gray to dark gray bedded limestone forming a unit ranging from several tens of centimeters to several meters in thickness. The upper part of the member becomes muddy and is intercalated with many layers of siliceous nodules. The Member D yielded a rich fauna of fusulinids and corals. The fusulinid fauna of Member D includes *Lepidolina multiseptata multiseptata* (DEPRAT) (including *Lep. elongata* (DEPRAT)*), *Lep. multiseptata gigantea* (GUBLER), *Verbeekina verbeeki* (GEINITZ), *Chusenella cambodgensis* (GUBLER) and *Chu. globularis* (GUBLER). The gastropods described in this article are from the lower and middle parts of this member.

Biostratigraphical studies of the Sisophon Limestone have been reported by many authors. And recently, ISHII, KATO and NAKAMURA (1969) subdivided the Sisophon Limestone biostratigraphically on the basis of the fusulinids, corals and brachiopods as shown in Fig. 2.

Paleontological Note

The gastropods described in the present article are from two localities, located about one kilometer east of Phn. Bak and nearly 800 meters north of Phn. Tup, in the west of Sisophon, Cambodia. The former belongs to the lower part of Member D, while the latter belongs to the middle part of Member D of the Sisophon Limestone.

The gastropods, treated in this article, are as follows:-

from the Phn. Bak area

Khumerspira ishii MURATA, n. gen. n. sp.

Bellerophon (*Bellerophon*?) aff. *regularis* (WAAGEN)

from the Phn. Tup area

Straparollus (*Euomphalus*?) sp.

Worthenia cf. *schirjaeensis* (STUCKENBERG)

Palaeostylus (*Leptozyga*?) sp.

Meekospira sp.

Most of the specimens from Phn. Tup area could not be identified to species level because of the unfavorable preservation. However, the specimens show much resemblance with

* microspheric form of *Lep. multiseptata multiseptata*.

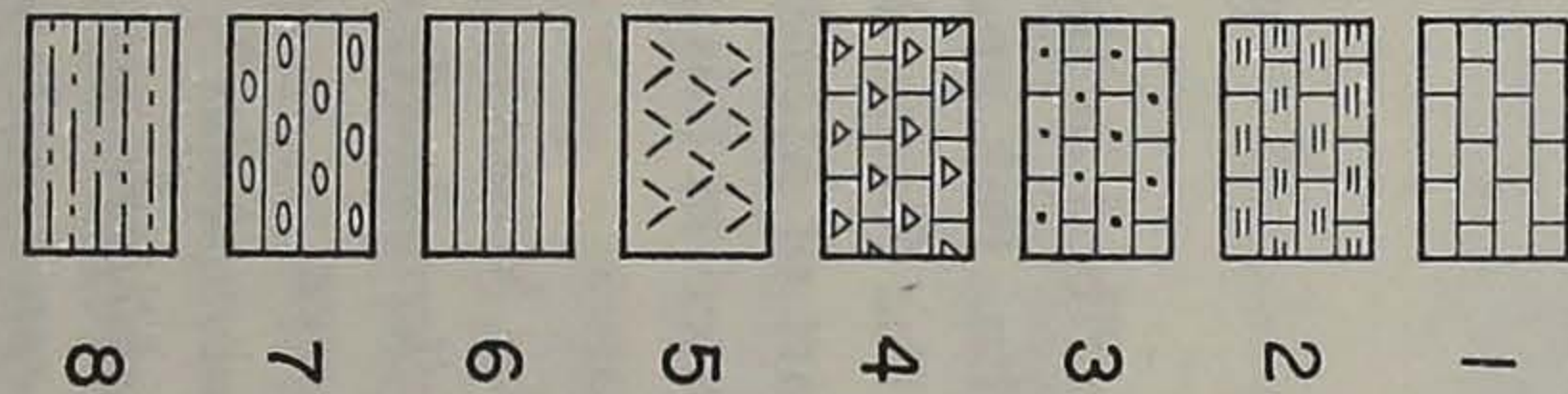
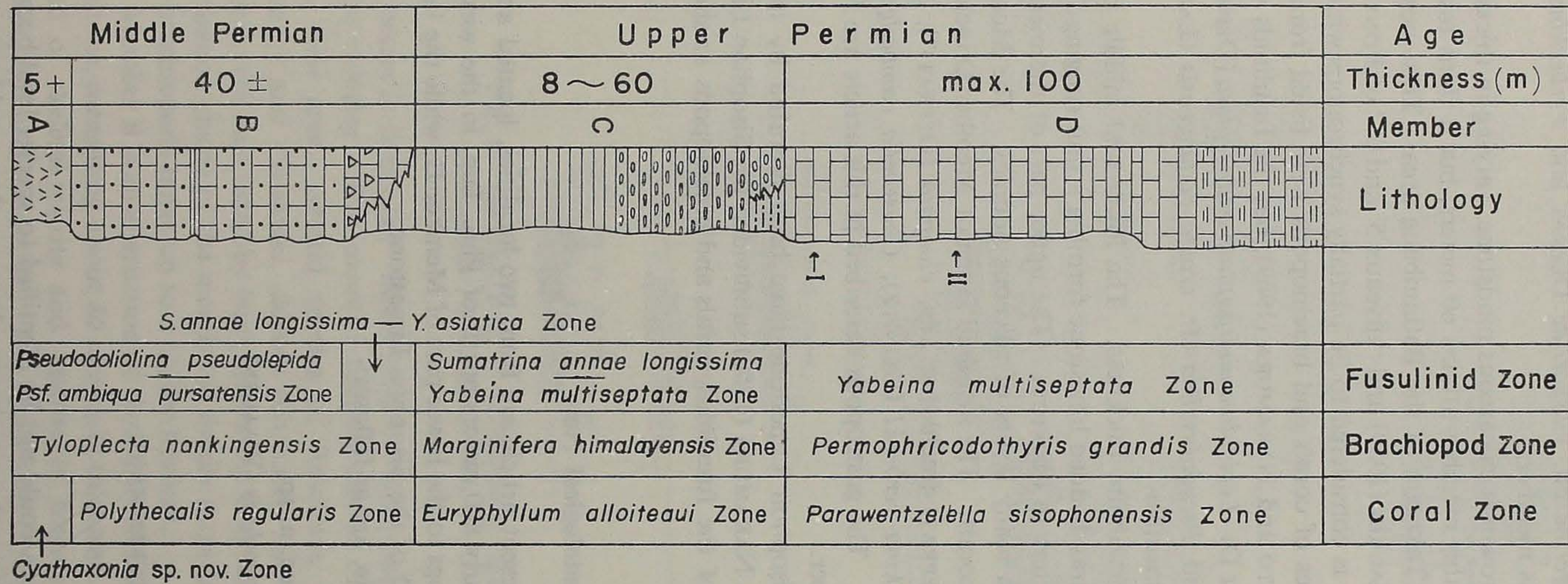


Fig. 2. Generalized columnar section of the Permian of west Cambodia. (after ISHII, KATO & NAKAMURA, 1969)

1: bedded limestone, 2: muddy limestone or micritic limestone, 3: crinoidal limestone, 4: limestone breccias, 5: tuff breccias or tuff, 6: reddish shale, 7: reddish brownish calcareous mudstone with calcareous nodules, 8: drusy coating skeletal limestone (grainstone).

I: *Khumerspira ishii*, *Bellerophon* (*Bellerophon*?) aff. *regularis*, II: *Straparollus* (*Euomphalus*?) sp., *Worthenia* cf. *schirjaevensis*, *Palaeostylus* (*Leptozyga*?) sp., *Meekospira* sp.

Notes: For *Y. asiatica* read *Colania asiatica* and for *Yabeina multiseptata* read *Lepidolina multiseptata* in this paper.

the gastropod fauna described from Calcaires a Productus in Indochine by MANSUY (1913, 1914) and DELPEY (1941–1942). On the other hand, nearly a dozen of bellerophontids from Phn. Bak area are relatively well preserved, and are additional to the Middle Permian gastropods of Cambodia.

Systematic Description of the Gastropoda

by Masafumi MURATA

Order Archaeogastropoda THIELE, 1825

Suborder Bellerophontina ULRICH and SCOFIELD, 1897

Superfamily Bellerophontacea M'COY, 1851

Family Bellerophontidae M'COY, 1851

Subfamily Bellerophontinae M'COY, 1851

Genus *Bellerophon* MONTFORT, 1808

Subgenus *Bellerophon* (*Bellerophon*) MONTFORT, 1808

Bellerophon (*Bellerophon*?) aff. *regularis* (WAAGEN), 1880

Plate 2, figs. 9–11.

Mogulia regularis WAAGEN, 1880, p. 157, pl. 13, figs. 4a–e.

Mogulia regularis WAAGEN, KNIGHT, 1941, p. 200, pl. 8, figs. 5a, b.

Description:—Moderately well-rounded, bellerophontid gastropods having an obscure selenizone and rounded transverse costae of shell surface; shell medium in size, well rounded except for slightly expanded and rather strongly reflected lateral lips; sinus and slit unknown; selenizone rather narrow, very obscured, flush with surface in early stages and slightly depressed at maturity; ornamented with numerous, distinct, transverse costae with narrow interspaces.

The measurements of *Bellerophon* (*Bellerophon*?) aff. *regularis* (WAAGEN) are given in Table 1.

Remarks:—Two fragmental specimens, one of which is immature, are at hand. The present form seems to be closely related to *Mogulia regularis* WAAGEN, specially in the immature stages, but it becomes much larger in size in the mature stage. WAAGEN (1880) distinguished the genus *Mogulia* from *Bellerophon* by the former lacking a proper slit-band. However, KNIGHT (1941) showed the presence of an obscure selenizone as the result of a re-examination of the type specimen of *Mogulia* WAAGEN. And he (1944) placed *Mogulia* WAAGEN in the synonymy of *Bellerophon*. With regard to the ontogenical changes of the selenizone of the present form, the writer agrees with KNIGHT's (1944) opinion, but has some questions about the subgeneric position of the specimens.

Repository:—OMNH*. E301, E302.

Occurrence:—Rather rare in the upper part of the Sisophon Limestone (lower part of Member D, *Lepidolina multiseptata* Zone) on the narrow path in the east of Phn. Bak, Middle Permian.

* Osaka Museum of Natural History.

Table 1. Measurements (in mm) of the species.

<i>Bellerophon (Bellerophon ?) aff. regularis (WAAGEN)</i>					
Specimen	Length	Thickness	Width of aperture	Height of aperture	Axial width
OMNH. E301	26.8 +	26.2	31.1	18.2	16.4
" . E302 (immature)	11.1	8.8	9.3 +	4.4	6.5
<i>Khumerspira ishii MURATA, n. gen. n. sp.</i>					
Specimen	Length	Thickness	Width of aperture	Height of aperture	Axial width
OMNH. E303 (Holotype)	59.2	50.0	46.1	16.2	27.2
" . E304 (Paratype)	57.4 +	50.7	50.1	17.5	24.2
" . E305 (Paratype)	60.0 +	52.2	55.0	18.8	24.5
" . E306 (Unfigured paratype)	50.0 +	43.4	47.6	16.5	23.2
" . E307 (Unfigured paratype)	43.5 +	37.8	40.2	12.6	20.3
" . E308 (Unfigured paratype, immature)	29.4 +	23.2	27.2	10.8	14.4

Genus *Khumerspira* MURATA, n. gen.

Type-species:—*Khumerspira ishii* MURATA, new species, Sisophon Limestone, Cambodia; Middle Permian.

Diagnosis:—Bellerophontid gastropods with tightly reflexed lateral lips so wide as to cover the lateral slope of whorl; inductura commonly thick and pad-like, not extending far beyond aperture; narrow selenizone on a sharply projected median crest; ornamented with growth lines only.

Remarks:—The shell outline of the proposed genus seems to include some species of *Bellerophon (Bellerophon)* MONTFORT which have angular shoulders. However, the shoulder of the present new genus is the upper margin of a tightly reflexed lateral lip, and a narrow groove remains along the shoulder in immature stages. By the characteristic development of the tightly reflexed lateral lips, *Khumerspira* can be distinguished from all known genera of the subfamily Bellerophontinae M'COY. The new generic name is derived from the Khumer Empire.

Khumerspira ishii MURATA, n. sp.

Plate 1, figs. 1–8; Plate 2, figs. 1–8.

Description:—Shell large, anomphalous, bellerophontid gastropods having an extremely wide and tightly reflexed lateral lips; whorl profile angulated subcardiform, characterized by a sharply projected median crest and sharply bent shoulders; upper surface gently curved in early growth stages and flattening with maturity, bending down abruptly to the lateral slopes; lateral slopes seems to be nearly flat, but is unknown precisely, because of whole coverage by tightly reflexed lateral lips; anterior lips well curved, bending back near selenizone to form a distinct V-shaped sinus; slit narrow, about 12 per cent of body-whorl in depth; selenizone extremely narrow and flat on projected median crest; lateral lips wide,

as twice as anterior lips, tightly reflexed to cover lateral slopes entirely; ornamented with prominent growth lines.

The measurements of *Khumerspira ishii* MURATA n. sp. are given in Table 1.

Remarks:—This species is based on ten specimens, and includes two immature and two fragmental specimens. *Khumerspira ishii* MURATA, n. sp. seems to have some resemblances in outline with some species of *Bellerophon* (*Bellerophon*) MONTFORT, such as *Bellerophon* (*B.*) *lineatus* YOCHELSON, 1960, from the Lower Permian of North Central Texas. But, the present new species is readily distinguishable from any known species of the genus *Bellerophon* by its extreme development of the tightly, reflexed lateral lips. This species is named after Dr. Ken-ichi ISHII of the Osaka City University, who offered the specimens to the writer for paleontological study.

Repository:—Holotype—OMNH. E303.

Paratypes—OMNH. E304, E305, E306, E307, E308, E309.

Occurrence:—Rather abundant in the upper part of the Sisophon Limestone (lower part of Member D, *Lepidolina multiseptata* Zone) on the narrow path of the east of Phn. Bak, Middle Permian.

Suborder *Macluritinae* COX and KNIGHT, 1960

Superfamily *Euomphalacea* de KONINCK, 1881

Family *Euomphalidae* de KONINCK, 1881

Genus *Straparollus* MONTFORT, 1810

Subgenus *Straparollus* (*Euomphalus*) J. SOWERBY, 1814

Straparollus (*Euomphalus*?) sp.

Plate 2, fig. 17.

Remarks:—Only a single specimen was examined. Most of the whorl is eroded. Several species of *Euomphalidae* have been described from the Permian formations in Cambodia and Yun-Nan by MANSUY (1912, 1913, 1914) and DELPEY (1941–1942). Although the generic and subgeneric characters are not distinct the present material shows resemblance with *Straparollus* (*Euomphalus*) *subcircularis* MANSUY, 1912, and *Straparollus* (*Euomphalus*) *khumerianus* MANSUY, 1914, in outline.

Repository:—OMNH.E310

Occurrence:—Rather rare in the upper part of the Sisophon Limestone (middle part of Member D, *Lepidolina multiseptata* Zone) at the north of Phn. Tup, Middle Permian.

Suborder *Pleurotomariina* COX and KNIGHT, 1960

Superfamily *Pleurotomariacea* SWAINSON, 1840

Family *Lophospiridae* WENZ, 1938

Subfamily *Ruedemanniinae* KNIGHT, 1956

Genus *Worthenia* de KONINCK, 1883

Worthenia cf. *schirjaevensis* (STUCKENBERG), 1905

Plate 2, figs. 12–14.

Mourlonia schirjaeensis STUCKENBERG, 1905, p. 97, pl. 12, fig. 11.

Worthenia schirjaeensis (STUCKENBERG), DELPEY, 1942, p. 355, fig. 27.

Worthenia cf. *schirjaeensis* (STUCKENBERG), BATTEN, 1972, p. 33, fig. 37.

Description:—Trochiform ruedemanniid gastropods with obscure sutural nodes rather domed convexo-concave upper whorl surface; shell small, 14.3 mm in height, 14.1 mm in width, spiral angle 85 degrees; nine spiral threads on convexo-concave upper whorl surface; selenizone with rather prominent growth lines and several fine spiral threads; concave outer whorl face with six to eight spiral threads; lower margin angulated with a spiral cord; base rather flattened, with 12 or more spiral cords of various strengths; hemiomphalus or cryptomphalus.

Remarks:—Only a single specimen is at hand. The present form resembles *Worthenia schirjaeensis* of STUCKENBERG (1905) and DELPEY (1942), but is not identical. Because, the character of the selenizone of the former seems to differ from the latter. *Worthenia* cf. *schirjaeensis* described by BATTEN (1972) from Malaysia shows a less angulate outline, but has similarity with the present form in the early growth stages.

Repository:—OMNH. E311

Occurrence:—Rare from the upper part of the Sisophon Limestone (middle part of Member D, *Lepidolina multiseptata* Zone), north of Phn. Tup, Middle Permian.

Order **Caenogastropoda** COX, 1959

Superfamily Loxonematacea KOKEN, 1889

Family Pseudozygopleuridae KNIGHT, 1930

Genus *Palaeostylus* MANSUY, 1914

Subgenus *Palaeostylus* (*Leptozyga*) KNIGHT, 1930

Palaeostylus (*Leptozyga*?) sp.

Plate 2, fig. 16.

Remarks:—A single fragmental specimen is at hand. The specimen is very small, 7.9 mm in height, 3.5 mm in width, spiral angle 25 degrees, slender cyrtconoid gastropods with straight transversa costae. Number of whorls six, aperture lacking. There is some doubt in referring the specimen to this subgenus.

Repository:—OMNH. E312.

Occurrence:—Rare in the upper part of the Sisophon Limestone (middle part of Member D, *Lepidolina multiseptata* Zone), north of Phn. Tup, Middle Permian.

Superfamily Subulitacea LINDSTRÖM, 1884

Family Meekospiridae KNIGHT, 1956

Genus *Meekospira* ULRICH, in ULRICH and SCOFIELD, 1897

Meekospira sp.

Plate 2, fig. 15.

Remarks:—A single incomplete specimen, lacking the spire in the younger stages and half

of the body whorl, is at hand. The present material, 16.7 mm in height, 7.6 mm in width, with spiral angle of nearly 15 degrees is a slender turriculate form with smooth surface. Although some genera of the Subulitacea have been recorded from the Permian formations in South Eastern Asia, the present form may be referred to this genus.

Repository:—OMNH.E313

Occurrence:—Rather rare in the upper part of the Sisophon Limestone (middle part of Member D, *Lepidolina multiseptata* Zone), north of Phn. Tup, Middle Permian.

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Plate 1

Explanation of Plate 1

Khumerspira ishii MURATA, n. gen. n. sp.

- Figs. 1-6. Adapertural, right side, apertural, left side posterior and oblique adapertural views of holotype, OMNH. E303, $\times 1$.
- Figs. 7, 8. Cross sections of a paratype, OMNH. E309, to show the tightly reflexed lateral lips, $\times 1.5$.

Both specimens were collected by Ken-ichi ISHII from the lower part of Member D of the Sisophon Limestone (*Lepidolina multiseptata* Zone), east of Phn. Bak, near Sisophon, Cambodia.

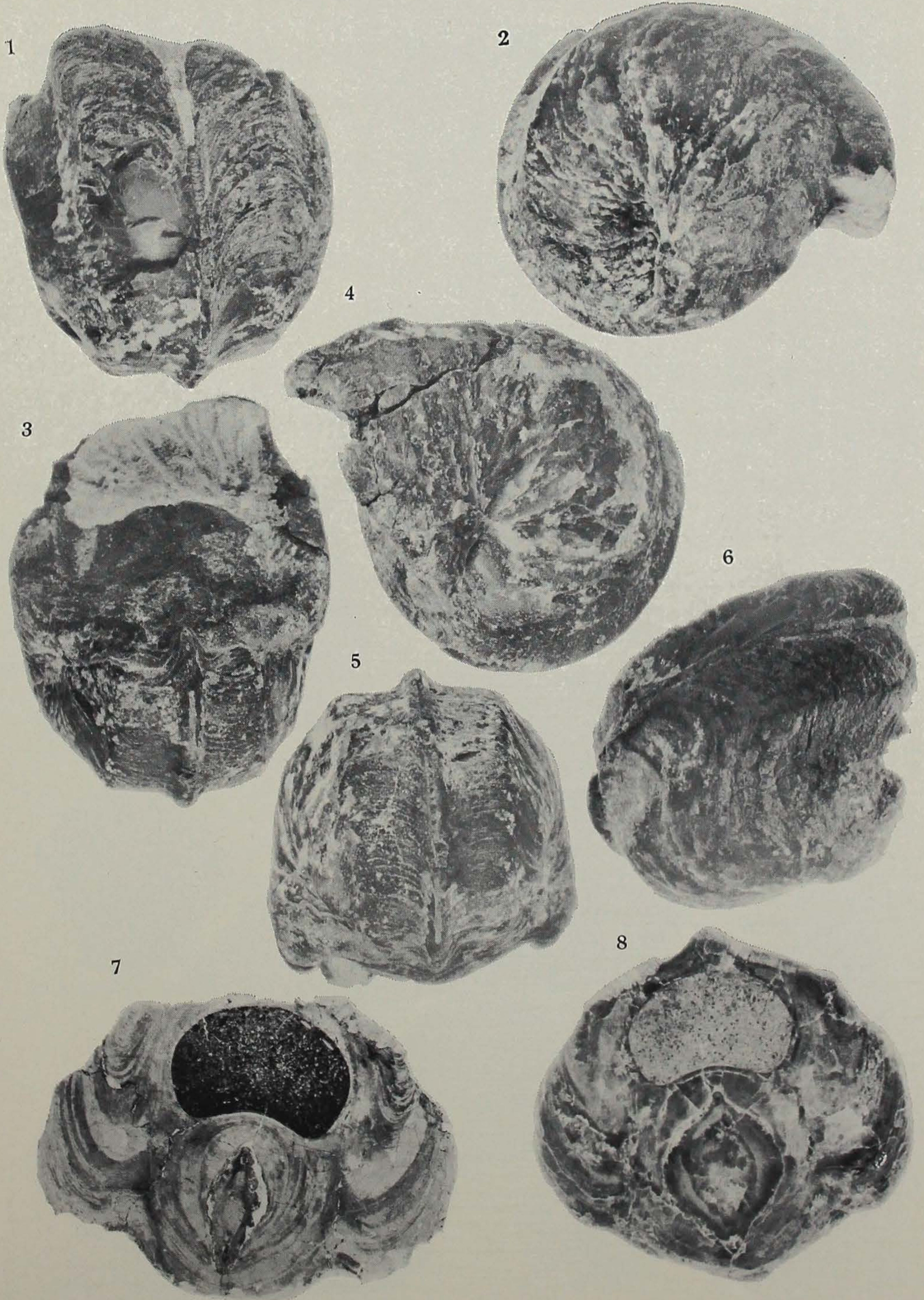


Plate 2

Explanation of Plate 2

- Figs. 1-8. *Khumerspira ishii* MURATA, n. gen. n. sp.
1-4. Adapertural, apertural, posterior and left side views of a paratype, OMNH.E 304, $\times 1$. 5-8. Adapertural, apertural, posterior and right side views of another paratype, OMNH. E305, $\times 1/2$.
Both specimens were collected from the lower part of Member D of the Sisophon Limestone (*Lepidolina multiseptata* Zone), east of Phn. Bak, near Sisophon, Cambodia, by Ken-ichi ISHII.
- Figs. 9-11. *Bellerophon* (*Bellerophon*?) aff. *regularis* (WAAGEN)
Adapertural, apertural and right side views of a specimen, OMNH. E301, $\times 1$.
Horizon and Locality; same as figs. 1-8.
- Figs. 12-14. *Worthenia* cf. *schirjaeensis* (STUCKENBERG)
Apical, basal and lateral views of a specimen, OMNH. E311, $\times 2$.
- Fig. 15. *Meekospira* sp.
Lateral view of a fragmental specimen, OMNH. E313, $\times 2$.
- Fig. 16. *Palaeostylus* (*Leptozygra* ?) sp.
Lateral view of a specimen, OMNH. E312, $\times 3$.
- Fig. 17. *Straparollus* (*Euomphalus* ?) sp.
Apical view of a specimen, OMNH. E310, $\times 1$.
The specimens illustrated in figs. 12-17 were collected by Ken-ichi ISHII from the middle part of Member D of the Sisophon Limestone (*Lepidolina multiseptata* Zone), north of Phn. Tup, near Sisophon, Cambodia.

