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## Upper Cambrian Fossils from Peninsular Thailand\*

By

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With Two Plates

It is an important question in regional geology whether the Phuket series in the central and western parts of Peninsular Thailand is really Cambrian, because little is known of the Eo-Palaeozoic stratigraphy of this part of Asia. It consists of dark coloured pebbly shale, shale and fine-grained sandstone, but in many places they are metamorphosed into schist, slate, quartzite and argillite; pebbles are quartz, quartzite and medium grained biotite granite. Its thickness is estimated about 1,220 m. The Mergui series, or a part of it, in Lower Burma is presumed to be the possible equivalent of the Phuket series. Therefore it is possible that the series is the oldest sediments in the geosyncline in the stretch from the Shan plateau to Malaya.

Fucoidal impressions were found in a dark gray shale or slate of the Phuket series at the northeast promontory of Tengkhah harbour on Phuket island, on the west coast of Peninsular Thailand (BROWN et al., 1953). DUNCAN assigned them *Eophyton* (?) and called attention to the occurrence of *Planolites* (?) in the Cambrian of Yunnan (MANSUY, 1912). Were the problematicum really a Cambrian fossil, Phuket island is the southernmost locality of the Cambrian system in Eurasia, but this does require any undeniable fossil evidence for its decision.

On the occasion of the ECAFE\*\* meeting held at Tokyo, in June, 1956, Mr. Saman BURAVAS, chief of the Geological Survey Division, Royal Department of Mines, Bangkok, brought me a small collection of Palaeozoic fossils for examination. Subsequently some

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\*\* Economic Commission for Asia and the Far East.

additional specimens were sent to me. He is so kind to donate them to the collection of our institute. They were procured in recent years from the Thai-Malaya borderland. I am happy to see in the collection that six slabs of sandstone contains a few genera of definitely late Cambrian in age. My cordial thanks are due to Mr. BURAVAS.

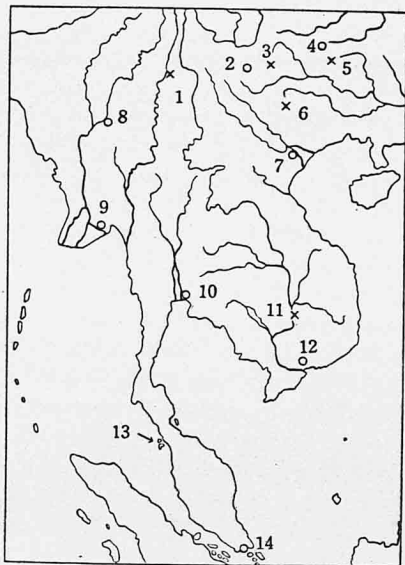


Fig. 1. Locality Map.

1. Paoshan (保山)
2. Kunming (昆明)
3. Chütsing (曲靖)
4. Kueiyang (貴陽)
5. Santu (三都)
6. Changpoung (長蓬)
7. Hanoi
8. Mandalay
9. Rangoon
10. Bangkok
11. Stung Treng
12. Saigon
13. Tarutao Island
14. Singapore

According to him this hard compact micaceous sandstone is exposed at various places on the west coast of Tarutao island. Its general trend is meridional. Stratigraphically, it lies below the Thungsong black limestone series which is considered Middle Ordovician, because *Actinoceras* sp. was found at Ron Phibun in association with bryozoans, crinoid stems and fragments of brachiopods.

In the sandstone slabs before hand there are fossils as follows:

*Apheoorthis* (?) sp.

Brachiopod, gen. et sp. indt.

*Pagodia thaiensis* KOBAYASHI, new species

*Thailandium solum* KOBAYASHI, new genus and species.

"*Eosaukia*" *buravasi* KOBAYASHI, new species

*Saukiella tarutaoensis* KOBAYASHI, new species

*Coreanocephalus planulatus* KOBAYASHI, new species

PA 2294-2-11 → Opisthoparian free cheeks, gen. et sp. indt. (pl. II, fig. 11).

Agnostid, gen. et sp. indt.

The second form of the brachiopods which is not illustrated is represented by a fragmentary valve on slab 2. It is 12 mm. long, practically flat and ornamented with innumerable, very fine radial threads. This is evidently distinct in the surface sculpture, convexity and other aspects and larger than any specimen of *Apheoorthis* (?) sp. Although others are also not well preserved, *Pagodia*, *Saukiella* and *Coreanocephalus* warrant the late Cambrian age of the Tarutao faunule. *Coreanocephalus* was thought an endemic genus in South Korea. Its occurrence at Tarutao island shows the alliance of the fauna to that of the *Dictyites* zone in South Korea. *Saukiella* is a member of the Trempealeau fauna in the Upper Mississippi valley and rare in Asia. As discussed later, *Pagodia* is a leading genus in the late Upper Cambrian fauna of Eastern Asia. There are one Middle Cambrian (Taitzuan) species and several early Upper Cambrian ones of *Pagodia* which were described from South Manchuria, but their generic reference is doubtful. *Pagodia* is known from Liaotung, Shantung, Hopi and South Korea, but unknown from Central and South China or Yunnan-Tonkin borderland (KOBAYASHI, 1943).

It is a question whether *buravasi* belongs to *Eosaukia*, *Sinosaukia*, *Saukioides* or else. Nevertheless, saukids are all late Upper Cambrian trilobites with a sole exception of early Upper Cambrian *Eosaukia latilimbata* LU, 1954, from Kueichou. Specifically, *buravasi* looks similar to "*Tellerina*" *coreanica* KOBAYASHI, 1935, from the *Eoorthis* zone of South Korea on one side and to *Eosaukia* (?) *walcotti* (MANSUY) from the uppermost Upper Cambrian of the Changpoung series on the Yunnan-Tonkin border. Its associated pygidium is quite different from all of the Croixian saukids (ULRICH and RESSER, 1933), in the small size, broad outline and undeveloped marginal border.

In 1938 and 1944 I have noted the sea connection from South Korea to Northern Europe through Central China and Tienshan in the early Upper Cambrian period, as indicated by the distribution of *Hedinaspis*, *Proceratopyge* and a few Olenidian genera. This route

of migration was further confirmed by recent discoveries of *Proceratopyge* in Chekiang and Anhui and of the *Hedinaspis* faunule at Santa in Southeastern Kueichou. *Eosaukia latilimbata* is a member of the Santa faunule (LU, 1954).

The Changpoung series comprises several Upper Cambrian fossil zones, but bears no trilobites of the Olenidian province (MANSUY, 1915, '16, KOBAYASHI, 1944 B, '56). In East Yunnan the Gotlandian formation overlies the Lower and early Middle Cambrian unconformably (TING and WANG, 1937), the break indicating the land period of the southern projectile of the Tibetia.

According to SUN (1939), Upper Cambrian trilobites occur at some places in Paoshan (保山) district in West Yunnan. Namely, the Paoshan shale at Pupiao (蒲缥) yields the followings:

*Agnostus cyclopyge* TULLBERG  
*Quadraticephalus yunnanensis* SUN  
*Saukia acamus* (WALCOTT)  
*Saukia grabaui* SUN  
*Tsinamia* sp.  
*Xenostegium* sp.

Insofar as I can judge from the pygidia, the first species belongs most probably to *Pseudagnostus*. The relatively small eyes at about the mid-length of the cranidium reveal the alliance of *Quadraticephalus yunnanensis* with *Eosaukia* (?) *walcotti*. The pygidia of *Xenostegium* sp. may be combined with the cranidium of *Tsinamia* sp. in a species. It is probable that the species thus figured out is related to *Dictyella* (?) *mansuyi* KOBAYASHI, 1933, i. e. *Iliaenurus cere* by MANSUY, 1916.

In addition there are four fossil localities in West Yunnan (SUN and SZETU, 1947) as follows:

- (1) *Calvinella walcotti* and *Conocephalina waltheri* from Taurahsun (陶然村) and Sankousung (三棵松).
- (2) *Shirakiella laticonvexa* and *Pseudagnostus* from Shahocheng (沙河廠).
- (3) *Briscoia*, *Pseudagnostus* and *Dictyonema* at Yunchuanchieh (雲川街).

These fossil beds are all late Upper Cambrian. *Saukia* (*Briscoia*?) *vagans* and *Prosaukia middlemissi* are described by REED (1934) from Kashmir, but their generic position is dubious. In view of *Saukia* and *Iranaspis* in Iran (KING, 1937), however, it can be ascertained that the Himalayan trough must have been the route of migration.

for the saukids. The Cambrian faunule of Tarutao island testifies the southernmost point of this sea way. At the same time it is a link between the faunas of the age in Asia and Australia, because *Pagodia* and saukids were lately found in the Macdonnell ranges and the Huckitta-Marqua region in Northern Territory, Australia. (ÖPIK, 1956, CASEY and GILBERT-TOMLINSON, 1956).

PB2294-4-1  
PB2298-4-2,4  
PB2299-4-3.

*Apheoorthis* (?) sp.

Plate IV, Figures 1-4.

Shell subquadrate, broader than long, broadest at hinge margin which is a little alate at lateral ends, rounded along antero-lateral margin. Ventral valve fairly convex and provided with a small median sinus of moderate breadth; umbo only a little projected beyond hinge line; delthyrium seemingly open; pseudospondilium not well developed. Dorsal valve strongly convex. Surface marked by many fine ribs which increase their number by branching and form bundles.

Because the preservation is poor, one cannot go very far into taxonomy. Though superficial, fasciculate ornamentation is suggestive of *Apheoorthis*, this species appears to be allied to "*Eoorthis*" *shakuotunensis* SUN, 1924, from South Korea (KOBAYASHI, 1935).

Genus *Pagodia* WALCOTT

- 1905 *Pagodia* WALCOTT, *Proc. U.S. Nat. Mus. Vol. 29*, p. 63.  
1913 *Pagodia* WALCOTT, *Cambrian Faunas of China*, p. 160.  
1933 *Pagodia* KOBAYASHI, *Japan. Jour. Geol. Geogr. Vol. 9*, p. 109.  
1953 *Pagodia* HUPÉ, *Ann. de Paléontol. Tom. 39*, p. 181.

*Genotype*:—*Pagodia lotos* WALCOTT.

*Remarks*:—Broad, subtrapezoidal cranidium, oblong glabella with obsolete furrows at sides, small eyes at about mid-length, lack of palpebral ridges and subparallel or convergent anterior facial sutures are the characteristics of this genus. The associated pygidium is broad and has a conical segmented axis, narrow pleural lobes and smooth poorly defined marginal border.

In 1933 I have discussed the genus in detail. My comments on the occurrence of *Pagodia buda* RESSER and ENDO in the Fengshanian (or Yenchou), instead of the Changshanian (or Paishan) were later



accepted by ENDO (1937). I have here a plaster cast of the type cranidium of *Pagodia hemispherica*. Because its eyes are relatively large and located fairly back and eye ridges distinctly impressed on the cast, it looks closer to *Chuangia* than *Pagodia*.

In 1937 and 1944 ENDO described 11 new species and 1 new variety of *Pagodia*. *P. subquadrata* from the Taitzuan of Hsiaoshih which has a relatively narrow cranidium and a flat depressed frontal border is more likely a *Lisania* than a *Pagodia*. Among 6 Changshanian species, *P. perquadrata* having a striated frontal rim and *P. laohuensis* with distinct eye ridges belong probably to *Chuangia*. Three pairs of clear-cut lateral furrows on the conical glabella and strong eye-ridges are quite suggestive of *Kaolishania* for *P. trisulcatus*. The cranidium called *P. circularis convexa* looks to me so aberrant that together with *P. circularis* it represents an unnamed genus. *P. angustilimbata* possesses a cranidium and fixed cheeks too narrow for *Pagodia*. The illustration and description are inadequate to add any comment on *mina*. Nevertheless, I do not hesitate to say that none of them is safely referable to *Pagodia*.

Among Fengshanian species *paraquadrata* has the cranidium so closely allied to *P. richthofeni* that their difference is thought no more than variation within a species. If *P. convexa* is a *Pagodia*, the convexity of its cylindrical glabella is very unusual. The high triangular pygidium on which *P. triangulata* is founded, appears to me out of the bound of the genus.

*Distribution*:—Fengshanian or late Upper Cambrian; common in Liaotung and Shantung, but as yet unknown from the Taitzuho region, North Korea and Shansi basin. In Hopeh, South Korea and Peninsular Thailand the genus is represented respectively by *P. damesi*, *P. shumardoides* and *P. thaiensis*. *Pagodia* is reported to occur in the Kuznetsk basin, Siberia (YAVORSKY, 1937) and Northern Territory of Australia (ÖPIK, 1956, CASEY and GILBERT-TOMLINSON, 1956), although I have not yet seen either description or illustration.

*Pagodia thaiensis* KOBAYASHI, new species

Plate IV, Figures 5-7.

*Description*:—Cranidium subtrapezoidal, well rounded in front, as broad again as long, moderately convex, most elevated near the

PA2294-4-5,6  
PA2296-4-6

center; glabella outlined by deep dorsal furrows, moderately convex, long, parallel-sided in anterior, but posterior half is gradually expanding backward; anterior lateral furrows very short or absent, while middle and posterior ones are quite pronounced, more or less oblique and disconnected on axis; occipital furrow transversal; occipital ring narrower than lateral lobes; eye medium in size and located a little anterior to middle length; eye-ridge indiscernible; fixed cheek expanded behind the eyes as far as its breadth, becomes subequal to glabella; frontal limb absent; frontal rim wire-like and strongly arcuate; facial sutures parallel to each other, anterior to eyes and diagonal posterior to them.

*Measurements and observation*:—The holotype cranium (fig. 6) is about 4.5 mm. long and 7 mm. broad; paratype (fig. 5) about 4 mm. long.

Oxidation renders difficult to judge the original texture of the carapace, but at least it can be said that there is no distinct granulation on the crania. Close to the paratype there is an outer mould of a small pygidium (fig. 7) which belongs possibly to this species. It is nearly semicircular and slightly inflated except a narrow axial lobe which is elevated above the gently inclined pleural lobes. The axis is teretely conical and abruptly narrows near the posterior end. Surface is seemingly non-granulose.

*Comparison*:—This resembles *P. bia*, *P. damesi* and *P. buda*, but the glabella is scarcely contracted at the middle portion. In the fairly anterior position of the eyes, it disagrees with all of the genus so far known.

#### Genus *Thailandium* KOBAYASHI, new genus

The truncato-conical glabella, medium sized eyes at the mid-length of the cranium subparallel anterior sutures which are intramarginal on the border, and puacisegmented pygidium are distinguishing characters from resembling genera of the Anomocarinae and Elvininae. Further notes are given in the description of the type species, *T. solum*.



*Thailandium solum* KOBAYASHI, new gen. and sp.

Plate IV, Figures 9-12; Text-figure 2.

PA2299-4-9,10  
PA2297-4-11  
PA2296-4-12

*Description*:—Cephalon large and semicircular in outline, if genal spines are excluded; glabella slightly convex, a little elevated above flat fixed cheeks which are about half as broad as glabella at eyes; first and second lateral furrows short and rudimentary; third furrow a little oblique and joins its counter on axis; eyes of moderate size, located a little posterior to mid-length of cranidium; eye-ridge insignificant; frontal rim and limb equal in length where the former is elevated above the latter, narrowing posteriorly and produced into a long genal spine; facial sutures slightly convergent in front of eyes, abruptly cut into border and extended far inward; posterior suture nearly diagonal except for terminal part where it becomes subvertical and cuts posterior margin at some distance from genal spine.

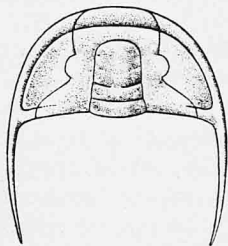


Fig. 2. *Thailandium solum* KOBAYASHI, new genus and species.

The pygidium referred to this species is lenticular in outline, the anterior margin being less convex than the other, twice as broad as long; axial lobe teretely conical, convex, composed of 4 rings and a relatively long terminal lobe, ending on the inner margin of the posterior border where it is rounded off; pleural lobe gently convex, inclined gradually in the outer side; facet delimited by a strong ridge which extends as far as the lateral margin; four pleural ribs behind it flat-topped, separated from one another by pleural furrows; interpleural furrows discernible only under cross light; these ribs and furrows truncated by a fairly thick marginal border; marginal furrow narrow and distinct.

Test smooth.

*Observation and comparison*:—In the exfoliated part of a pygidium (fig. 12) the doublure is seen twice broader than the marginal border.

This cranidium is similar to that of *Elvinia* WALCOTT, 1924, but the glabella is more conical, eye-ridge stronger, frontal limb and fixed cheek are larger and anterior sutures divergent in that genus.

This species agrees with *Annamitia spinifera* MANSUY, 1916, in the course of the facial suture and several other features, but the glabella is much larger, free cheek smooth, the posterior margin of the cephalon straight and the nuchal spine absent. Furthermore, eyes are smaller and eye-ridges effaced in this species.

Compared to "*Anomocare*" *flava* WALCOTT, furrows on the glabella are not so much obsolete, eyes smaller, and anterior facial sutures by no means divergent in this species. The pygidium has one or two segments less in number than WALCOTT'S.

#### Genus *Eosaukia* LU

1954 *Eosaukia* LU, *Acta Pal. Sinica*, vol. 2, No. 2, p. 144.

*Type species*:—*Eosaukia latilimbata* LU. (Text-fig. 3).

*Remarks*:—The genus is represented by monotypic *latilimbata* which was established on the basis of a sole but complete shield. This species bears special importance not only because of its older age than all other saukids, but also because of possession of 11 thoracic segments and broad semi-circular pygidium. In *Saukia acuta* ULRICH and RESSER as well as *Tellerina crassimarginata* (WHITFIELD) the thorax is known to have 12 segments. In the typical Saukinae the pygidium is longer, well rounded and multisegmented; pleural and interpleural furrows are often well marked. The latter is, however, effaced in *E. latilimbata*. This pygidium better agrees with those of *Asioptychaspis* and *Quadraticephalus* in outline and segmentation, although their cephalae are different. The eyes are smaller and located far anteriorly and the glabella is commonly drooping in the Ptychaspinae.

*Calvinella* (?) *walcotti* (MANSUY), *Sino-saukia pustulosa* SUN, *Saukioides jeholensis* (KOBAYASHI), "*Prosaukia*" *brizo* (WALCOTT),

"*Saukia*" *iranicus* (KING) and a few other Asiatic saukids have small but relatively broad paucisegmented pygidia, insofar as can be judged from their association with the cranidia. Therefore it is a question whether they are congeneric with the Croixian species.

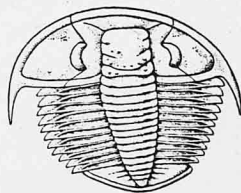


Fig. 3.  
*Eosaukia latilimbata* Lu.

The effacement of interpleural furrows varies among them. They are clearly seen in *brizo* and *iranicus*, but indiscernible in *walcotti* (KOBAYASHI, 1956).

*Distribution*:—Early Upper Cambrian of Yangtze basin. At Santu, Kueichou, the type species is found associated with *Lotagnostus*, *Hedinaspis* and *Charchaqa*.

“*Eosaukia*” *buravasi* KOBAYASHI, new species

Plate V, Figures 1-10, 13-20.

PA 2296-5-1,2.  
PA 2299-5-3,4,6,9;  
19,20  
PA 2298-5-3,7,8,14  
PA 2294-5-10,13,15.  
PA 2295-5-18  
PA 2297-5-16,17.

*Description*:—Cranidium strongly inflated; glabella surrounded by deep dorsal furrows, strongly convex, highly elevated above cheeks, abruptly slant forward, one and half times as long as broad, slowly expanding in posterior; anterior and middle lateral furrows rudimentary; posterior one well developed, oblique and confluent with its fellow on axis; occipital furrow transversal; occipital ring of uniform thickness, devoid of median spine; eye fairly large, longer than a third the length of cranidium; fixed cheek most elevated at eye where it is narrower than a half of glabella, but its posterior limb is widely dilated laterally; eye-ridge absent; frontal border as thick as anterior fixed cheek, delimited on two sides by divergent furrows and separated from glabella by a deep frontal groove; anterior facial sutures parallel to axis and posterior ones diagonal. Free cheek convex; ocular platform surrounded by pronounced depression and then convex border which is in turn produced into a genal spine.

Pygidium sublenticular; anterior margin broadly arcuate; the other margin more strongly rounded and nearly straight or somewhat sinuate behind axial lobe. This lobe outlined by deep furrows on lateral sides, strongly convex, elevated above pleural lobes, composed of three rings and small terminal lobe which are distinctly separated by furrows from one another; pleural lobe fairly well inflated; two or three furrows well seen on the lobe near axis; marginal border very narrow and depressed.

*Measurement*:—The holotype cranidium (fig. 5) is 15 mm. long and 23 mm. and about 16 mm. broad respectively at the base and between the eyes; glabella is 13 mm. long and 9 mm. broad. The pygidium (fig. 17) is 8.5 mm. long and 20 mm. broad; its axial lobe 6.3 mm.

at the broad anterior end.

*Observation*:—It is interesting to see the increase of the frontal drooping through growth. It can be clearly recognized by comparison between small cranidia (figs. 1-2) and large ones (figs. 18-20). Those in figs. 3-5 are intermediate in size as well as in degree of drooping.

Due to the drooping the lateral border of the free cheek is bent and extended forward and downward in the grown form (fig. 14). It is certainly a remarkable fact that 6 or more radial ridges are seen on the internal moulds which cross the lateral border near the genal angle (figs. 8-9). They are vertical lamellae similar to those of *Symphysurina woosteri* ULRICH.

The test of the carapace is granulated, as recognizable on some external moulds of cranidia and free cheeks, but furrows are generally smooth (figs. 6-7). Some external moulds are rough, but not granulated. It is difficult to say without more material, whether they are water-worn, or whether they belong to a non-granulate form.

A thoracic segment (fig. 10) has a strongly convex axial ring. It is separated from the articulating half-ring by a deep furrow. Its pleuron is a little wider than the ring and divided into two ribs by a deep furrow. Like the cephalon the elevations are granulated and depressions smooth.

*Comparison*:—The essential distinction of this species from *Eosaukia latilimbata* lies in the shorter glabella, much larger preglabellar area and well developed eyes which are located more posteriorly in that species. Further, it is said that the ocular platform is marked by insculating concentric raised lines around the eye, but such markings are not seen in this species.

This is closely allied to *Sinosaukia pustulosa* SUN, as revealed by the similarity of most features of the cranidium and free cheek. It is stated by SUN, however, that in his species the frontal brim is rather broad, smooth, flat or slightly concave and ill-defined or indistinctly separated from a narrow frontal edge ornamentated with a single row of large pustules at the margin. The associated pygidium is much longer, multisegmented and not pustulated, although its reference to *S. pustulosa* is not warranted.

*Eosaukia* (?) *walcotti* (MANSUY) has also the granulose test and

similar outline as the present species, but the frontal drooping is negligible in that species even in the grown stage. The cranium and glabella are strongly drooping in "*Tellerina*" *coreanica* KOBAYASHI. This agrees with the present species in many features of the cephalon, but the test appears smooth in the Korean species. It is probable that they are congeneric. In the Korean species the associated pygidium is subtriangular and long, but its asymmetrical outline shows that the secondary deformation is strong.

*Tellerina chinhsiensis* (SUN) has the smooth test. It is similar to *T. coreanica* in the cranium, but the frontal drooping is insignificant even in the adult stage. The associated pygidium is typical of the Saukiinae in that species.

The test is also smooth in *Saukioides suni* which is again different from the present species in the median thickening of the occipital ring, broader fixed cheek, a little smaller eyes, fairly thick frontal border and insignificant diagonal furrows on the marginal border.

*Saukiella tarutaensis* KOBAYASHI, new species

Plate V, Figure 12.

PA 2298-5-12

Represented by a cranium, 12.2 mm. long and 12.8 mm. broad at eyes. Glabella 10.3 mm. long, 6.5 and 8.6 mm. wide respectively at the anterior and posterior end, large, subquadrate and moderately inflated. Anterior and middle furrows short and weak; posterior and occipital ones strong and persistent through glabella, where the latter is nearly straight and the former arcuate. Fixed cheek very narrow; eye large, located at mid-length of cranium. Frontal border separated from glabella by a straight furrow. Facial sutures nearly parallel to each other in front of eyes and intramarginal on border. Test smooth.

Compared to *Saukiella typicalis* ULRICH and RESSER and other American species, the eyes are smaller and their position is not so posterior. Otherwise this is typical of *Saukiella*. In the low inflation of the cranium and its anterior outline this is quite different from *Saukiella* (?) *paiensis* RESSER and ENDO.

Genus *Coreanocephalus* KOBAYASHI*Coreanocephalus planulatus* KOBAYASHI, new species

PA2299-4-13-14, 16-17.

PA2295-4-15.

Plate IV, Figures 13-17; Text-figure 4.

**Description:**—Cephalon semicircular, but long genal spines are present; glabella outlined by dorsal furrows, truncato-conical, somewhat more expanded in posterior, gently inflated; posterior and occipital furrows discernible; eyes of medium size, close-set to anterior of glabella; preglabellar area simple; facial sutures slightly divergent forward from eyes and then marginal; their posterior branches diagonal.

The pygidium which may go with the cephalon is long, ovate; axial lobe short, prominent, conical, abruptly narrowing in posterior whence a narrow ridge issues; another three rings well marked by furrows; pleural lobe gently convex, merges with broad, slightly concave border; an anterior ridge subangulate on top; two pleural bands behind it bisected by a short interpleural furrow; fusion advanced in posterior.

**Observation and comparison:**—Insofar as the cranidium is concerned, this species is closely allied to *Coreanocephalus kogenensis* KOBAYASHI, 1935, but in that species the eyes are larger and located more posteriorly and middle and posterior furrows poorly impressed on the glabella form two Vs. *Dikelocephalites flabelliforme* SUN, 1935, having two pairs of pits on the glabella and a well expanded preglabellar area is more distant.

In the exfoliated pygidium the doublure is seen to be considerably broadened from the lateral to the posterior part. The elongately ovate outline and notably the dilation of the rear part are characteristics which discriminate this pygidium from those of *Briscoia*, *Walcottaspis*, *Dikelocephalites* and most other dikelocephaloids.

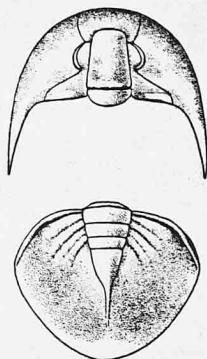


Fig. 4. *Coreanocephalus planulatus* KOBAYASHI, new species.



## Agnostid, gen. et sp. indet.

Plate IV, Figure 8.

PA 2299-4-8

A cephalon strongly convex, highly elevated, surrounded by a broad flange on anterior and lateral side where on the latter, however, soon it narrows backward; posterior margin straight. The glabella is so much obsolete that its outline and segmentation can hardly be figured out. But their obscurity may depend on erosion to a great extent. It is impossible to say any further than an agnostidian cephalon for this specimen.

List of the Upper Cambrian Fossils from  
Peninsular Thailand

Slab Number	1	2	3	4	5	6
<i>Apheoorthis</i> (?) sp.	x		x		x	x
Brachiopod, gen. et sp. indt.		x				
<i>Pagodia thaiensis</i> , cranidium	x		x			
Ditto. pygidium	x					
<i>Thailandium solum</i> , cranidium						x
Ditto. free cheek						x
Ditto. (?), pygidium			x	x		
" <i>Eosaukia</i> " <i>buravasi</i> , cranidium	x	x	x		x	x
Ditto. free cheek	x			x	x	x
Ditto. thoracic segment	x					
Ditto. pygidium	x			x		x
<i>Saukiella tarutaensis</i> , cranidium					x	
<i>Coreanocephalus planulatus</i> , cranidium						x
Ditto. free cheek		x		x		
Ditto. pygidium				x		x
Opisthoptarian free cheeks, gen. et sp. indt.,	x					
Agnostid, gen. et sp. indt.						x

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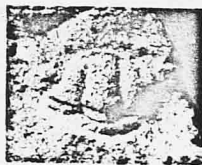
T. KOBAYASHI

Upper Cambrian Fossils from Peninsular Thailand

Plate IV

### Explanation of Plate IV

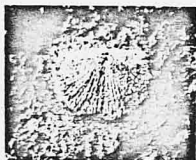
- Apheoorthis* (?) sp. .... p. 371  
Fig. 1. Ventral valve, clay-cast,  $\times 2$ , slab 1.  
Fig. 2. Ventral valve,  $\times 1.5$ , slab 5.  
Fig. 3. Ventral valve, internal mould,  $\times 1.5$ , slab 6.  
Fig. 4. Dorsal valve,  $\times 1.5$ , slab 5.
- Pagodia thaiensis* KOBAYASHI, new species.....p. 372  
Fig. 5. Paratype cranidium,  $\times 3$ , slab 1.  
Fig. 6. Holotype cranidium,  $\times 3$ , slab 3.  
Fig. 7. Associated pygidium, clay-cast,  $\times 3$ , slab 1.
- Agnostid, gen. et sp. indt.....p. 380  
Fig. 8. Cephalon,  $\times 3$ , slab 6.
- Thailandium solum* KOBAYASHI, new gen. and sp. ....p. 374  
Fig. 9. Holotype cranidium,  $\times 1$ , slab 6.  
Fig. 10. Paratype free cheek,  $\times 1$ , slab 6.
- (?) *Thailandium solum* KOBAYASHI, new gen. and sp. ....p. 374  
Fig. 11. Pygidium,  $\times 1.5$ , slab 4.  
Fig. 12. Pygidium,  $\times 1$ , slab 3.
- Coreanocephalus plamulatus* KOBAYASHI, new species .....p. 379  
Fig. 13. Holotype cranidium, clay-cast,  $\times 1$ , slab 6.  
Fig. 14. Paratype cranidium,  $\times 1$ , slab 6.  
Fig. 15. Free cheek,  $\times 1$ , slab 2.  
Fig. 16. Pygidium, clay-cast,  $\times 1$ , slab 6.  
Fig. 17. Pygidium, partly exfoliated,  $\times 1$ , slab 6.



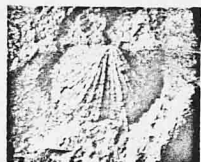
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5 PA2294



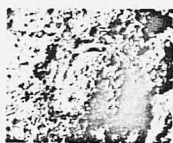
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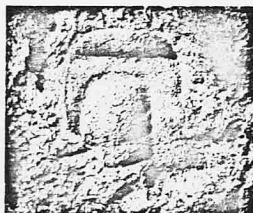
4 PB2298



3 PB2299



11 PA2297



9 PA2299



15 PA2295



12 PA2296



10 PA2299



13 PA2299



17 PA2299



14 PA2299



16 PA2299



## Explanation of Plate V

- "*Eosaukia*" *buravasi* KOBAYASHI, new species .....p. 376
- Fig. 1. Small cranidium, clay-cast,  $\times 3$ , slab 3.
  - Fig. 2. Small cranidium,  $\times 3$ , slab 3.
  - Fig. 3. Cranidium,  $\times 2$ , slab 6.
  - Fig. 4. Cranidium,  $\times 1.5$ , slab 6.
  - Fig. 5. Holotype cranidium,  $\times 1$ , slab 5.
  - Fig. 6. Cranidium, clay-cast showing texture,  $\times 1$ , slab 6.
  - Fig. 7. Free cheek, clay-cast showing a profound marginal groove and granulated text,  $\times 2$ , slab 5.
  - Fig. 8. Free cheek showing internal lamellae,  $\times 1$ , slab 5.
  - Fig. 9. Free cheek showing internal lamellae,  $\times 1.5$ , slab 6.
  - Fig. 10. Thoracic segment, clay-cast,  $\times 1.5$ , slab 1.
- Opisthoparian free cheeks, gen. et sp. indt.....p. 369
- Fig. 11. Two free cheeks,  $\times 1.5$ , slab 1.
- Saukiella tarutaensis* KOBAYASHI, new species.....p. 378
- Fig. 12. Cranidium,  $\times 1$ , slab 5.
- "*Eosaukia*" *buravasi* KOBAYASHI, new species .....p. 376
- Fig. 13. Free cheek,  $\times 1.5$ , slab 1.
  - Fig. 14. Free cheek,  $\times 1.5$ , slab 5.
  - Fig. 15. Free cheek,  $\times 1.5$ , slab 1.
  - Fig. 16. Small pygidium,  $\times 2$ , slab 4.
  - Fig. 17. Paratype pygidium,  $\times 1.5$ , slab 4.
  - Fig. 18. Full grown cranidium,  $\times 2$ , slab 2.
  - Fig. 19-20. Upper and obliquely lateral views of a full grown cranidium,  $\times 1.5$ , slab 6.