Oldhamina and Palaeoldhamina (Permian Brachiopoda) from Thailand

Koga, Seiji
Faculty of Sciences, Kyushu University

Ishibashi, Takeshi
Faculty of Sciences, Kyushu University

Fujikawa, Masayuki
Faculty of Sciences, Kyushu University

https://doi.org/10.5109/1546087

出版情報：九州大学大学院理学研究院紀要 : Series D, Earth and planetary sciences. 30 (2), pp.59-69, 1998-12-28. 九州大学大学院理学研究院
バージョン：
権利関係：

Mem. Fac. Sci., Kyushu Univ., Ser. D, Earth & Planet. Sci., Vol. XXX, No. 2,
pp. 59-69, text-figs. 1-3, table 1, plate 1, December 28, 1998

Oldhamina and *Palaeoldhamina* (Permian Brachiopoda) from Thailand

Seiji KOGA, Takeshi ISHIBASHI and Masayuki FUJIKAWA

Zusammemfassung

Die Familie Lyttoniidae, Brachiopoda, gehört zu der Superfamilie Lyttoniiacea der Suborder Oldhaminidina. Ihre Verbreitung im höheren Paläozoikum ist weltweit gut bekannt. Die Lyttoniiden Brachiopoden haben im Allgemeinen eine sehr auffällige Form, da ihre kalkige und costate Platte im medianen Bereich sehr unterschiedlich zu anderen Brachiopoden ist.

Die zuesrt beschriebenen Gattungen von Lyttoniidae sind *Leptodus* von KAYSER (1882) und *Oldhamina* von WAAGEN (1883). Diese Gattungen sind sehr typische Gattungen der Lyttoniidae und viele Publikationen beschäftigen sich mit ihnen. Aus Thailand liegen aber nur Arbeiten über Lyttoniidae von YANAGIDA (1967, 1970, 1988), WATERHOUSE und PIYASHIN (1970), GRANT (1976), WATERHOUSE (1983) vor.

Das Untersuchungsgebiet liegt nahe am Doi Pha Phlung im Bezirk Lampang, Nord Thailand. Der 795 m hohe Doi Pha Phlung wird hauptsächlich aus Kalkstein und untergeordnet aus schwarzem Schieforton aufgebaut. In diesem Gebiet können vier Fomationen ausgeschieden werden, die vom Ober Perm bis in die Unter Trial reichen. Eine dieser Formationen, die Huai Thak Formation, wird zur Zeit untersucht. Sie führt u.a. *Palaeofusulina sinensis* SHENG und *Reichelina* cf. *changhsingensis* SHENG et CHANG und wird somit in das Ober Perm eingestuft. Die Formation wird hauptsächlich aus Schieferton, Kalkstein, Psephiten und Sandsteinen aufgebaut und führt eine reiche Fauna (Bachiopoden, Bryozoen, Trilobiten, Korallen, Nautiliden und Fusuliniden).

Aus dieser Formation beschrieb bereits WATERHOUSE (1983) *Oldhamina squamosa* HUANG und die folgenden Brachiopoden: *Enteletina kwangtungensis* ZHAN, *Acosarina antesulcata* WATERHOUSE, *Meekella kueichowensis* HUANG, *Orthotetina* sp., *Erismatina coopen* WAT., ?*Glyptosteges percostatus* WAT., *Tschemzschewia geniculata* ZHAN, *Lampangella lata* WAT., *Transennatia pitakpaivani* WAT., *Spinomarginifera kueichowensis* HUANG, *S. plana* WAT., *Attenuatella piyashini* WAT., *Cruricella subspeciosa* LIAO, *Semibrachythyrina anchunenses* LIAO, *Squamularina postgrandis* WAT., *S. nodosa* CHAO. *Oldhamina squamosa* HUANG wird häufig aus dem Ober Perm Chinas (Guizhou, Hubei, Sichuan und Fujian) beschrieben.

Oldhanima cf. anshunensis wird hier zum ersten Mal aus Thailand beschrieben. Sie tritt hier zusammen mit der Fusulinide *Gallowayinella guidingensis* LIU, XIAO und DONG sowie Trilobiten (*Pseudophillipsia* (*Nodiphillipsia*) aff. *ozawai* KOBAYASHI et HAMADA), Nautiliden (*Siamnautilus ruchae* ISHIBASHI *et al.*), Bryozoen, Korallen und Muscheln auf. *Oldhamina anshunensis* HUANG war bisher nor aus dem Ober Perm Chinas (Guizhou, Sichuan, Guangdong und Anhui) und Japans (Hiroshima) bekannt.

Außerdem beschreibe ich *Oldhamina* aff. *decipiens* aus dem Unter Perm mit reicher Fusulinidenfauna (*Paraschwagerina* sp., *Triticites* sp.), die von YANAGIDA (1967) als neue Art *Palaeoldhamina kuzishanensis* LIANG aus dem Unter Perm Chinas beschrieben (WANG *et al.*, 1982). Dadurch wird die Gattung *Oldhamina* auf Mittel-und Ober Perm begrenzt.

Manuscript received August 31, 1998 ; accepted October 22, 1998.

Introduction

The family Lyttoniidae, Brachiopoda, is well known from the Upper Paleozoic in the world. The lyttoniid brachiopods having generally very distinct form such as a bilaterally lobated internal plate in their median area are different from other brachiopods in the morphological feature. The genus *Leptodus* established by KAYSER (1883) is the first genus in

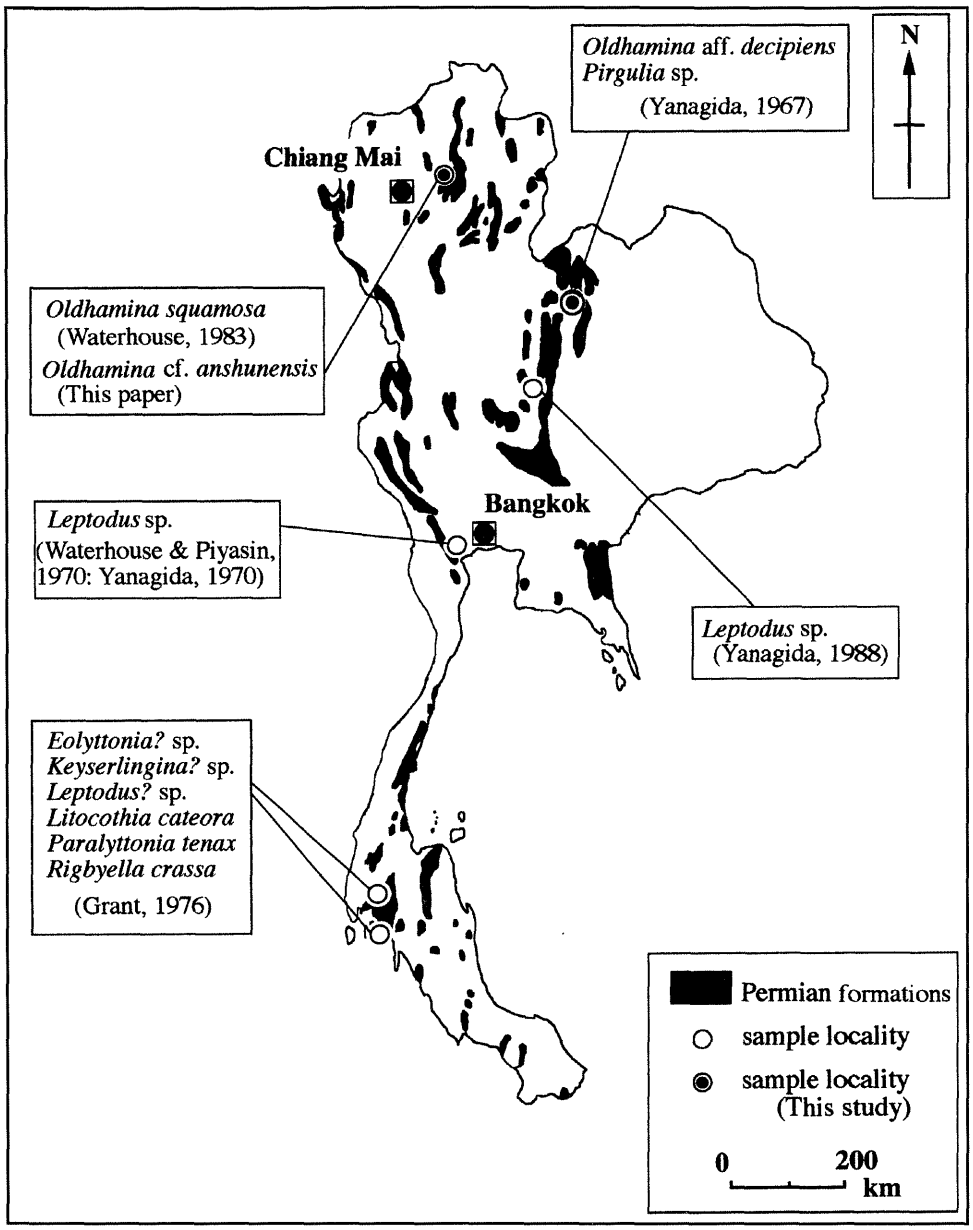


Fig. 1. Map showing the occurrence of lyttoniid brachiopods in Thailand.

Lyttoniidae, and the genus *Oldhamina* was established by WAAGEN (1883). These lyttoniids have been mainly reported from the Permian of Asia, but little from the Permian of Thailand (YANAGIDA, 1967, 1970, 1988; WATERHOUSE and PYASHIN, 1970; GRANT, 1976; WATERHOUSE,

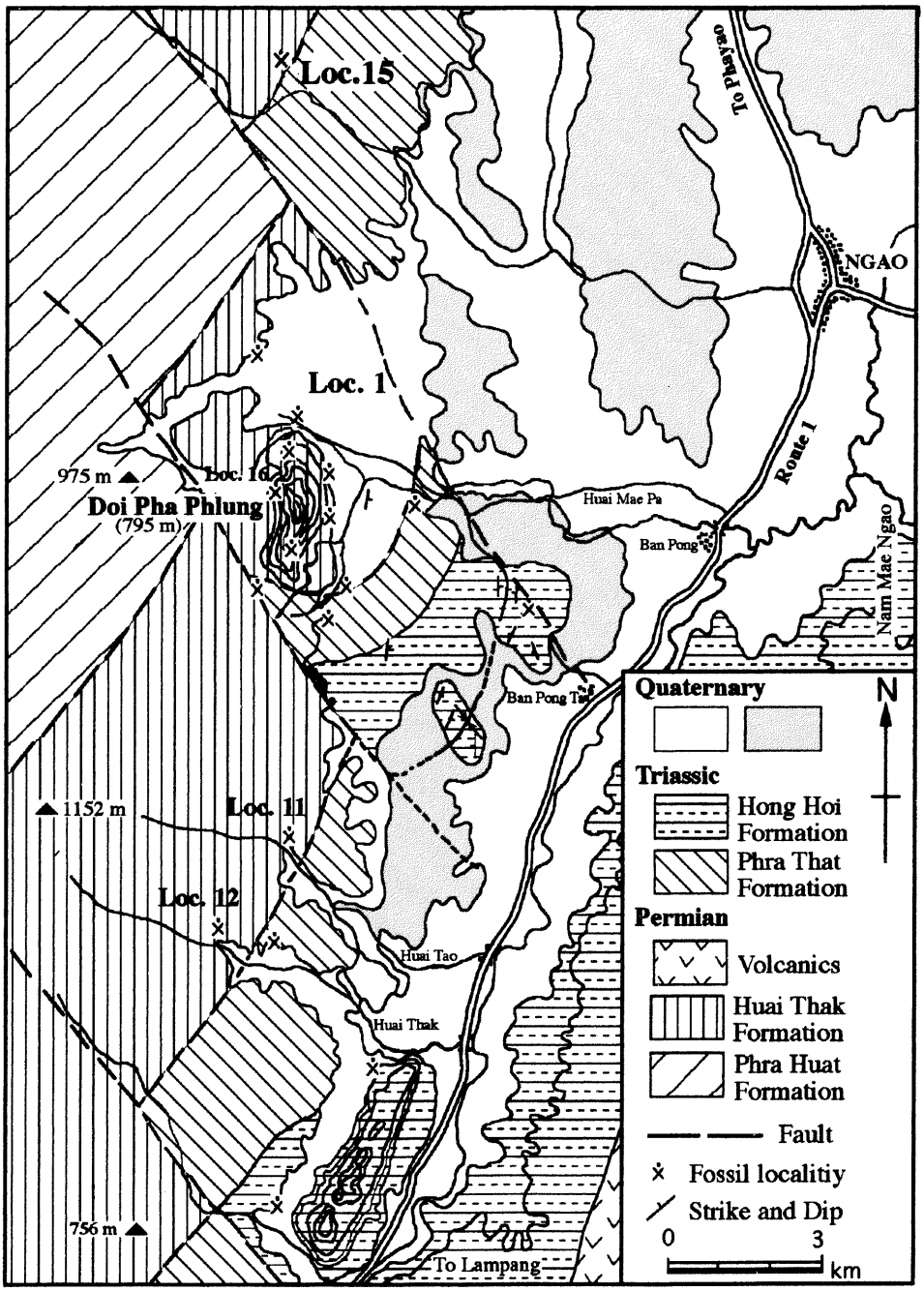


Fig. 2. Geological map and sample localities of *Oldhamina* of the Doi Pha Phlung area, Ngao.

1983). These are representative genera of lyttoniids, and their living positions and morphological analyses are reported by many authors. *Leptodus* is well known from the Permian of worldwide, but almost all species of *Oldhamina* are reported from the Upper Permian except for *Oldhamina* aff. *decipiens* which is known through Lower Permian in Thailand at present (YANAGIDA, 1967).

A number of specimens of *Oldhamina squamosa* was collected around the Doi Pha Phlung, northern area of Lampang. It has been described together with many other brachiopods (WATERHOUSE, 1983). Collected materials of *Oldhamina* aff. *decipiens*, stored in the Department of Earth and Planetary Sciences, Kyushu University, were reexamined with some specimens collected from northern Thailand in this paper. The other specimens of *Oldhamina* associated with *Gallowayinella guidingensis* (UENO and SAKAGAMI, 1991) are discriminated as *Oldhamina* cf. *anshunensis* at the Locality 1 where *Siamnautilus ruchae* has been described (ISHIBASHI *et al.*, 1994). The occurrence of *Oldhamina* is restricted in the Asian province of the Middle to Upper Permian. As *Oldhamina squamosa* from Doi Pha Phlung has been already described by WATERHOUSE (1983), two species, *Oldhamina* cf. *anshunensis* and *O. loeiensis* sp. nov. are described in this paper.

The brachiopod specimens treated in this paper with prefix of GKD and TF are kept in the Department of Earth and Planetary Sciences, Kyushu University, and the Geological Survey Division, Department of Mineral Resources, Thailand, respectively.

Geological setting of the Doi Pha Phlung area

The general geology of Doi Pha Phlung is illustrated by ISHIBASHI *et al.* (1994). The Permian and Triassic sediments are distributed at the studied area and yield a number of faunal and floral fossils around Doi Pha Phlung. The Permian consists of the Pha Huat and Huai Thak Formations in the Ngao Group in ascending order, the Triassic Phra That and Hong Hoi Formations are distributed at the eastern area of the geological map (Fig. 2). The Permian-Triassic boundary formed by fault contact is recognizable at locality 8. The Huai Thak Formation is mainly composed of limestone, shale and sandstone, and the geologic age of it is defined as the Late Dorashamian by the occurrence of fusulinids and ammonoids (UENO and SAKAGAMI, 1991; ISHIBASHI and CHONGLAKMANI, 1990; ISHIBASHI *et al.*, 1994).

The Thum Nam Maholan area, southern part of Wang Saphung, near Loei (Fig. 1) is one of locality of lyttoniid brachiopods in Thailand. The geology and occurrence of brachiopods were reported by YANAGIDA (1967). All of brachipods were collected from limestone of the Ratburi Group and its geologic age was definited as the Early Permian by the occurrence of *Paraschwagerina* sp. and *Triticites* sp. Many of Permian fusulinids (IGO, 1972), ammonoids (ISHIBASHI *et al.*, 1996) and corals have been reported from the Wang Saphung area.

Occurrence of *Oldhamina* and *Palaeoldhamina* in Thailand

The lyttoniid brachiopods including eleven species of eight genera have been reported from Thailand by YANAGIDA (1967, 1970, 1988), WATERHOUSE and PYASIN (1970), GRANT (1976) and WATERHOUSE (1983) from the Permian formations of north and south Thailand (Fig. 1). *Oldhamina* is only known at two localities, Thum Nam Maholan of Loei and Doi Pha Phlung of Lampang, northern region. YANAGIDA (1967) described *Oldhamina* aff. *decipiens* together

with many other brachiopod species from the former locality, he considered that the geologic age was the Sakmarian, Lower Permian based on the occurrence of *Paraschwagerina* sp. and *Triticites* sp. So this *'Oldhamina* aff. *decipiens'* was the oldest specimen of *Oldhamina* which

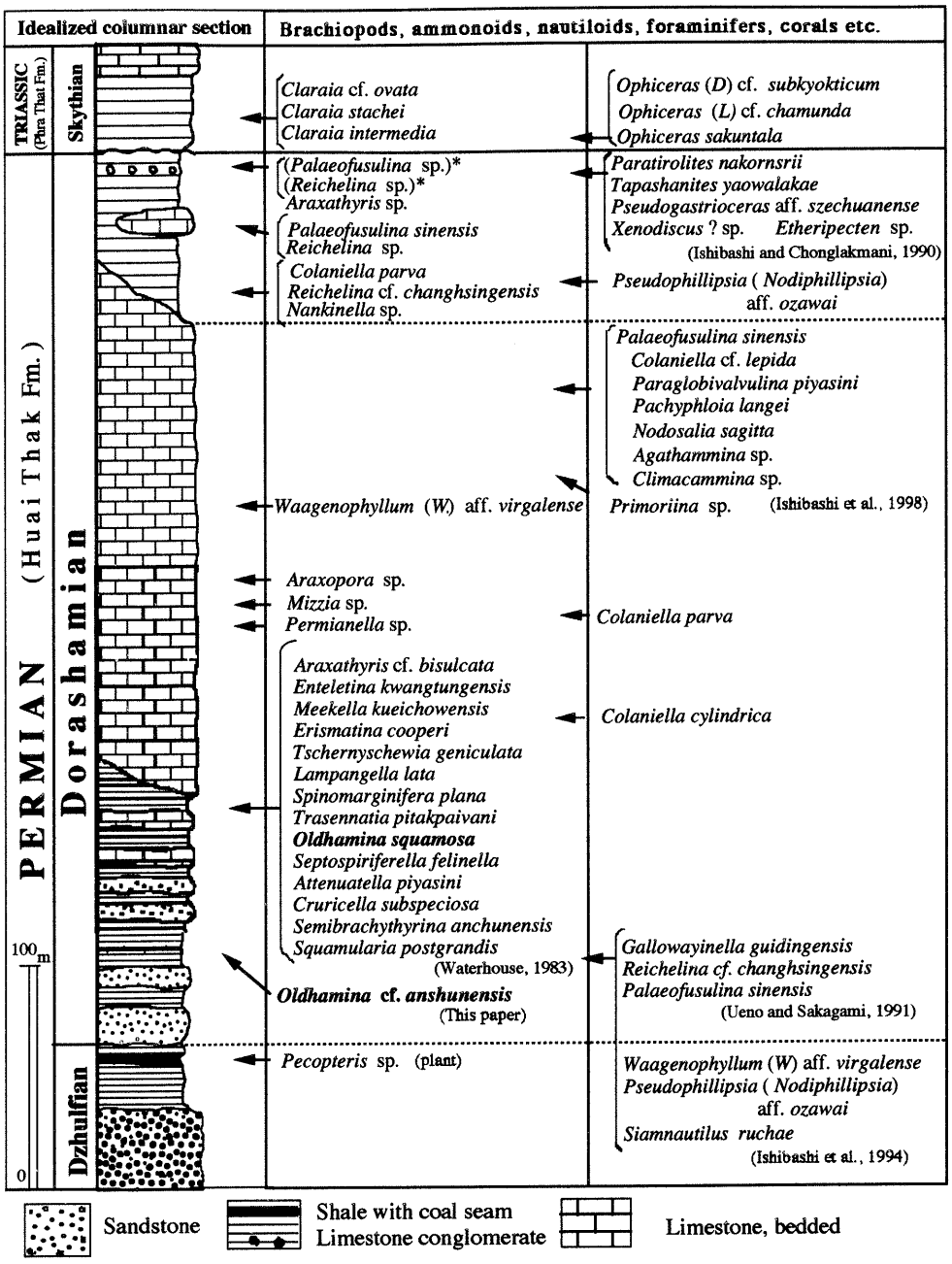


Fig. 3. Idealized columnar section of the Huai Thak Formation and associated fossils in the Doi Pha Phlung area.

Table 1. Distribution of genus *Oldhamina* in Asia and adjacent regions

Genus *Oldhamina* and species	Permian			Regions
	Lower	Middle	Upper	
O. anshunensis			●	China[Guizhou (Feng and Jiang, 1978; Liao,1980), Sichuan, Guangdong], Japan [Karita (Yanagida et al., 1993)]
O.* cf. *anshunensis			●	Thailand [Lampang (This study)]
O. decipiens		●	●	Pakistan [Salt Range (Noetling, 1905; Waagen, 1882-1885)], China [Guizhou (Feng and Jiang, 1978; Huang, 1932, 1933; Shen and He, 1994)], Malaysia [Pahang (Leman, 1993)]
O. decipiens* var. *regularis			●	China[Guizhou and Szechuan (Huang, 1932), Hupeh (Huang, 1933)]
O.* aff. *decipiens	●			Thailand [Loei (Yanagida, 1967)]
O. grandis			●	China [Guizhou (Feng and Jiang, 1978; Huang, 1932, 1933; Liao, 1980; Shen and He, 1994), Guangdong]
O. hoshanensis			●	China [Guangxi (Huang, 1936)]
O. jiaozishanensis			●	China [Guizhou (Liao, 1980; Shen and He, 1994)]
O. kitakamiensis			●	Japan [Kitakami Mountains (Tazawa, 1982)]
O. lianyangensis			●	China [Guizhou (Shen and He, 1994)]
O. minor			●	China [Guizhou (Shen and He, 1994)]
O. ovata			●	China [Sichuan (Zeng, 1997)]
O. squamosa			●	China [Guizhou (Feng and Jiang, 1978; Huang, 1932, 1933; Liao, 1980; Shen and He, 1994), Hubei, Sichuan, Fujian, East China (Wang et al., 1982)], Thailand [Lampang (Waterhouse, 1983)]
O. squamosa* var. *anshunensis			●	China [Guizhou (Huang, 1932,1933), Szechuan (Huang, 1933), East China (Wang et al., 1982)]
O.* cf. *squamosa* var. *anshunensis			●	China [Jingxian (Zhang and Ching, 1961), Szechuan and Guizhou (Huang, 1933)]
***O.* cf. *squamosa* ?**			●	China [Guizhou (Huang, 1933)]
O. subsquamosa			●	China [Guizhou (Liao, 1980; Shen and He, 1994)]
O. transkaukasia			●	U.S.S.R. [Armenia (Sarycheva, 1965)]
O. transversa			●	China [Qinghai (Ching and Ye, 1979)]

have been reported from other regions of the world (Table 1). The specimens (GKD 31233, 31234) registered at Kyushu University were reexamined for paleontologically and they should be placed in the genus *Palaeoldhamina* which established by LIANG (WANG *et al.*, 1982) in the Lower Permian of China, are also described as a new species of *Palaeoldhamina* in this paper.

WATERHOUSE (1983) described the Lower Dorashamian brachiopods from three localities

(T22, 20F and 16F) around the foothill of Doi Pha Phlung. Two localities 11 (T22) and 12 (16F) of three localities which yield *Oldhamina squamosa* Huang but the locality 20F in his paper could not find this time. Many faunas such as brachiopods including *Oldhamina squamosa*, ammonoids, gastropods and bivalves of the Upper Permian are found at a new locality 15.

A small size of *Oldhamina* has been found at the localities 1 (ISHBASHI *et al.*, 1994) and 16. These specimens are described as *Oldhamina* cf. *anshunensis* in this paper. This species is associated with *Gallowayinella guidingensis* LIU, XIAO and DONG, *Pseudophillipsia* (*Nodiphillipsia*) aff. *ozawai* KOBAYASHI et HAMADA, *Siamnautilus ruchae* ISHIBASHI *et al.*, and *Waagenophyllum* (*W.*) aff. *virgalense* (WAAGEN et WENTZEL). These faunas are considered as the Lower Dorashamian in age (ISHIBASHI *et al.*, 1998).

Systematic description

Superfamily Lyttoniacea WAAGEN, 1883
Family Lyttoniidae WAAGEN, 1883
Genus *Oldhamina* WAAGEN, 1883
Type species - *Bellerophon decipiens* DE KONINCK, 1863
Oldhamina cf. *anshunensis* HUANG, 1932
[Pl. 1, Figs. 7-12]

Compare.-

1932. *Oldhamina squamosa* var. *anshunensis* HUANG, *Palaeont. Sinica*, [B], 9, (1), p. 77, pl. 6. figs. 1, 5, pl. 7, fig. 11.
1933. *Oldhamina squamosa* var. *anshunensis* HUANG, *Ibid.*, [B], 9, (2), P. 92, pl. 6, figs. 20, 21.
1961. *Oldhamina* cf. *squamosa* var. *anshunensis*, ZHANG and CHING, *Acta Palaeont, Sinica*, 9, (4), p. 409, pl. 3, figs. 18-20.
1978. *Oldhamina anshunensis*, FENG and JIANG, *Palaeont. Atlas SW-China, Guizou*, Pt. 2, Carbon. Quater., p. 271, pl. 101, fig. 23.
1980. *Oldhamina anshunensis*, LIAO, *Strat. Palaeont. Up. Permian coal-bearing fms. western Guizhou & eastern Yunnan*, Sci. Press, Beijing, pl. 5, fig. 49.
1982. *Oldhamina squamosa* var. *anshunensis*, LIU, TAN and DING, *Brachiopoda in Palaeontological atlas of Hunan*, Sci. Press, Beijing, p. 190, pl. 136, fig. 13.
1982. *Oldhamina squamosa* var. *anshunensis*, WANG *et al.*, *Brachiopoda Palaeontol. atlas of E-China, Pt. 2, Vol. Late Paleozoic*, Geol. Pub. House, Beijing p. 230, pl. 91, fig. 18.
1983. *Oldhamina anshunensis*, ZHAN, FUL, DING and QI, *Brachiopoda Palaeont. atlas of NW-China, Shaanxi, Gausu & Ningxia Vol., Pt. 2, Up. Paleozoic*, Geol. Pub. House, Beijing, p. 297, pl. 102, figs. 5,6.
1993. *Oldhamina anshunensis*, YANAGIDA, IMAMURA, and KAWAI, *Mem. Fac. Sci., Kyushu Univ.*, [D, Earth and Planetary Sci.], **28**, (1), p. 3, pl. 1, figs. 7, 10.

Material.- Ten specimens were collected, of which five are available (TF2371- 2375). They are mostly internal of pedicle valve and incomplete.

Description.- Shell small in size, wider subcircular in outline; length more than 33mm, width about 30mm. Pedicle valve almost flattened in anterior profile, slightly convex in lateral profile; lateral margins strongly convex and extend parallel to the median septum. At the beal forms an obtuse angle of about 120°. Interior of the pedicle valve with regularly and

symmetrically arranged lateral septa on each side of continuous median septum. In the present materials 15 septa are counted in maximum on one each side of pedicle valve. Their crests are very sharp and thin. These are regularly spaced and moderately convex to front at angles of about 60° near the median septum and dipping to the front in lateral profile. The spaces between them 1.0-1.5mm in width.

Remarks.- The characters of the present specimens appear to be close to those of *Oldhamina squamosa* var. *anshunensis* from the Upper Permian coal-bearing formation (Dalong Formation) of Chiaotzushan, Anshunhsien, Guizhou by HUANG (1932), in having narrow, delivate lateral septa, less flattened pedicle valve and shell margin distinctly argulating at both sides some distance from umbo, but the size of Thai specimens are smaller than that of Chinese species comparatively.

Oldhamina anshunensis is known from some regions of Upper Permian mainly in China and only two specimens in Japan as follows: Changsing Formation in Anshun, Guizhou (FENG and JIANG, 1978), coal-bearing formation in Western Guizhou (LIAO, 1980), Longtangian Stage in Anhui, eastern China (WANG *et al*., 1982), Pukou of Jing-xian in southern Hunan (LIN, TAN, and DING. 1982), the Xikou and Longdongchuan Formations in Xikou, Shaanxi, northwestern China (ZHAN, FUL, DING and QI, 1983) and the Karita Formation in southwest Japan (YANAGIDA, IMAMURA and KAWAI, 1993).

Occurrence.- Locality 1, Doi Pha Phlung, Amphoe Ngao, Northern Thailand. Thouse specimens were collected from dark brown, massive shale bed of Huai Thak Formation, together with *Gallowayinella guidingensis*.

Genus *Palaeoldhamina* LIANG, 1982

Type species - *Palaeoldhamina kuzishanensis* LIANG, 1982

Palaeoldhamina loeiensis sp. nov.

[Pl. 1, Figs. 5-6]

1967. *Oldhamina* aff. *decipiens*, YANAGIDA, *Geol. Palaeont. Southeast Asia*, 3, p. 88, pl. 21, figs. 4, 6.

Holotype.- GK-D31233 (Pl. 1, Fig. 5)

Derivation of name.- The specimens were collected from near Loei, northern Thailand.

Material.- Two specimens, fragmentary pedicle valve, GK-D31233 and an incomplete pedicle valve, GK-D31234.

Diagnosis.- Shell moderate in size, strongly convex in both anterior and lateral profiles. Lateral lobes arrange on both sides of median lobe descreasing width anteriorly and convexly toward the anterior direction with an angle of about 50°-60°.

Description.- Shell moderate in size, strongly convex in anterior and lateral profiles; subcircular in outline suggesting length nearly equal to width. This size is not determinable since these specimens are not complete but it can said that these never below 50mm. Pedicle valve exterior only partly preserved, shows fine growth lines which are not parallel with lateral lobes. Lateral lobes arrange on both sides of broad median lobe descreasing width anteriorly about 5mm wide at median anterior portion and convexly toward the anterior direction with an angle of about 50°-60°, each lobe usually about 3mm in width.

Remarks.- These specimens were described as *Oldhamina* aff. *O. decipiens* from highly

fossiliferous, white to white-gray limestone outcroppings in Thum Nam Maholan, about 3km SE of Ban Nong Hin, kilometre 164 on Highway 21, which make a steep cliff more than two hundred metres high by YANAGIDA (1967). He remarked these were closely related to *O. decipiens* having its large size, rather circular outlines, and broad lateral lobes and distinguished from latter by its more transverse outline and less convex pedicle valve.

The genus *Palaeoldhamina* is established only one specimen as new genus and species by LIANG (WANG *et al*., 1982, p. 230, pl. 99, fig. 6), from Early Permian of east China. This specimen is internal view of brachial valve. The shell is specially small size, having a linear length of 1.55mm and width of 1.6mm. The outline of this margin appears egg-shaped. It is inflated, especially in the earlier half of it. The median lobe has uniform width 0.06mm measured. The lateral lobes are moderately convex toward the front, the curvature being strongest near the inner ends where they slope obliquely to meet the median lobe. This specimen resembles Thai specimens in having, moderate arched shell, few lateral septa, broad lateral lobe, inclined toward the front at angles of 60°, but the Chinese species differs from the present specimens in having too small size shell, originality form, probably revieling a young stage of growth. The present specimens bear thouse characters to identify the specific name.

Occurence.- White to white-gray limestone outcroppings in Thun Nam Maholan, about 3km SE of Ban Nong Hin, kilometre 164 on Highway 21. This species is together with *Paraschwagerina* sp. and *Triticites* sp. Early Permian.

Concluding remarks

Two species of *Oldhamina, Oldhamina squamosa* HUANG and *O.* cf. *anshunensis* HUANG are recognized in Thailand. *Oldhamina* aff. *decipiens* described by YANAGIDA (1970) from the Lower Permian in Loei area, north Thailand was designated as *Palaeoldhamina loeiensis* sp. nov. The biostratigraphic horizon of *Oldhamina* is restricted to the Middle to Upper Permian.

Acknowledgements

We are deeply appreciated to Professor Dietrich HELMCKE of Göttingen University for reading German abstract. We are also indebted to Professor Jun-ichi TAZAWA of Niigata University for kindly giving us useful suggestion to brachiopod descriptions. We should like to express our sincere thanks to Mr. Nikorn NAKORNSRI and other staffs of Geological Survey Division, Department of Mineral Resources of Thailand. Sincere thanks are due to Miss. Wilaiporn PUNSWAN, Mr. Yan YANG, Mrs. FONG, Sita AMPOK and other many personnels of Ngao City, Lampang Prefecture, Thailand.

References

CHING and YE (1979): Cephalopoda, Brachiopoda, in *Palaeontological Atlas of southwest China; Fascicle Qinghai, Part 1*. Geological Publishing House, Beijing (in Chinese).

FENG, R. and JIANG, Z. (1978): Phylum Brachiopoda. in Geological and Palaeontological Team of Guizhou (ed.), *Palaeontological Atlas of southwest China; Guizhou, Part 2. Carboniferous to*

Quaternary. 231-305, pls. 85-108. Geological Publishing House, Beijing (in Chinese).

GRANT, R. E. (1976): Permian brachiopods from southern Thailand. *Jour. Paleont.* **50**, (2) suppl. Paleont. Mem. 9.

HUANG, T. K. (1932): Late Permian Brachiopods of southwest China. *Palaeont. Sinica*, [B], **9**, (1), 1-138, pls. 1-9.

——(1933): Late Permian Brachiopods of southwest China. *Palaeont. Sinica*, [B], **9**, (2), 1-172, pls. 1-11.

——(1936): On the occurrence of Lyttoniidae in the Wolfcamp series of the Glass Mountains of Texas with notes on Lyttoniids southwestern China. *Bull. Geol. Soc. China*, **15**, (3).

IGO, H. (1972): Fusulinacean Fossils from Thailand. Part 6. Fusulinacean Fossils from north Thailand. *Geol. Palaeont. Southeast Asia*, **10**, 63-116, pls. 9-19, Univ. Tokyo Press.

ISHIBASHI, T., and CHONGLAKMANI, C. (1990): Uppermost Permain ammonoids from northern Thailand. *Jour. Southeast Asian Ear. Sci.*, **3**, (3), 163-170.

——, NAKORNSRI, N. and NAGAI, K. (1994): Permian-Triassic boundary and fauna at Doi Pha Phlung, Northern Thailand. *Mem. Fac. Sci. Kyushu Univ.* [*D. Earth and Planetary Sci.*], **28**, (2), 23-40, pl. 3.

——, FUJIKAWA, M. and NAKORNSRI, N. (1996): Permian ammonoids from Loei area, Northeast Thailand. *Ibid.*, **29**, (2), 175-196, pls. 11-13.

——, FUJIKAWA, M., YODA, M. and NAKORNSRI, N. (1998): Dorashamian biostratigraphy of the Doi Pha Phlung area in Thailand. *Proc. Geol. Soc. Victoria, Australia* (in press)

KAYSER, E. (1882-1883): Obercarbonische Fauna von Lo-ping. in F. von Richthofen, China, **4**, (8), 160-208, pls. 19-29.

KONINCK, L. de (1863): *Memoire sur les fossiles paleozoiques recueillis dans l'Inde par M. le Docteur Fleming*. 44p., 11pls., Liege.

LEMAN, M. S. bin (1993); Upper Permian brachiopods from northwest Pahang, Malaysia. *International Symposium on Biostratigraphy of Mainland Southeast Asia: Facies and Paleontalogy*. **1**, 203-218, pl. 1.

LIANG, W. (1982): *Brachiopoda in Palaeontological atlas of east China, Part 2, Volume of Late Paleozoic in Wang et al., 1982*., 230-231, pl. 99, Geological Publishing House, Beijing (in Chinese).

LIAO, Z. (1980): Upper Permian brachiopods from western Guizhou. in Nanjing Institute of Geology and Palaeontology, Academia Sinica (ed.), *Stratigraphy and Palaeontology of Upper Permian coal-bearing formations in western Guizhou and eastern Yunnan*. 241-277, pls. 1-9. Science Press, Beijing (in Chinese).

LIU, Z., TAN, Z. and DING, Y. (1982): *Brachiopoda in the Palaeontological atlas of Hunan*, 172-216, pls. 1-9, Sci. Press, Beijing (in Chinese).

NOETLING, F. (1905): Untersuchungen über die Gamilie Lyttoniidae WAAGEN, emend. NOETLING. *Palaeontographica*, Bd. 51, Lief. 4, 129-154, pls. 15-18.

SARYCHEVA, T. G. (1965): Oldhaminid brachiopods from the Permian of Transcaucasia. *International Geology Review*, **7**, (10), 1826-1839 pls. 1-2.

SHEN, S. and HE, X. (1994): Changhsingian brachiopod fauna from Guiding, Guizhou. *Acta Palaeontologica Sinica*, **33**, (4), 440-454, pls. 1-2 (in Chinese).

TAZAWA, J. (1982): *Oldhamina* from the Upper Permian of the Kitakami Mountains, Japan and its Tethyan Province Distribution. *Trans. Proc. Palaeont. Soc. Japan*, N. S., (128), 445-451, pl. 69.

UENO, K. and SAKAGAMI, S. (1991): Late Permian fusulinacean fauna of Doi Pha Phlung, North Thailand. *Trans. Proc. Palaeont. Soc. Japan.*, [N.S.], (164), 928-943.

WAAGEN, W. H. (1882-1885): Salt Range fossils, part 4 (2) Brachiopoda, *Palaeont. Indica*, [13], 329-770, p;s. 25-86.

WANG, K., CHING, C., JIN, Y., HU, S., LIANG, W. and LIAO, Z. (1982): *Brachiopoda in Palaeontological atlas of east China, Part 2, Volume of Late Paleozoic*. 186-256, pls. 74-102, Geological Publishing House, Beijing (in Chinese).

WATERHOUSE, J. B. (1983): A Late Permian Lyttoniid fauna from northwest Thailand. *Paper* (10),

11-153, Dept. Geol., Univ. Queensland.

——and PIYASIN, S. (1970): Mid-Permian brachiopods from Khao Phrik, Thailand. *Palaeontgraphica* 135 A (3-6), 83-197.

YANAGIDA, J. (1967): Early Permian Brachiopods from north-central Thailand. *Geol. Palaeont. Southeast Asia*, **3**, 46-94, pls. 11-23, Univ. Tokyo Press.

——(1970): Permian Brachiopods from Khao Phrik, near Rat Buri, Thailand. *Geol. Palaeont. Southeast Asia*, **8**, 68-96, pls. 14-16, Univ. Tokyo Press.

——(ed.)(1988): Biostratigraphic Study of Paleozoic and Mesozoic Groups in Central and Northern Thailand. Dev. Geol. Surv., Dept. Min. Res., Thailand.

——, IMAMURA, S. and KAWAI, M. (1993): Reexamination of the Brashiopod Fauna from the Pemian Karita Formation, southwest Japan. *Mem. Fac. Sci. Kyushu Univ.* [*D. Earth and Planetary Sci.*], **28**, (1), 1-21, pls. 1-2, text-figs. 1-8.

ZENG, Y. (1997): Changxingian brachiopods from Huayingshan, Sichuan. *Acta Palaeontologica Sinica*, **36**, (1), 747-759m pls. 1-2 (in Chinese).

ZHAN, Y., FUL, L., DING, P. and QI, W. (1983): *Brachiopoda in Palaeontological atlas of northwest China, Shaanxi, Gansu and Ningxua Volume, Part 2, Upper Paleozoic*. 244-425, pls. 88-143, Geological Publishing House, Beijing (in Chinese).

ZHANG, Y. and CHING, Y. (1961): An Upper Permian brachiopod fauna from Jingxian, Anhui Province. *Acta Palaeont. Sinica*, **9**, (4), 401-417, pls. 104 (in Chinese).

Seiji KOGA, Takeshi ISHIBASHI and Masayuki FUJIKAWA

Oldhamina and *Palaeoldhamina* (Permian Brachiopoda) from Thailand

Plate 1

Explanation of Plate 1

Figs. 1-4. *Oldhamina squamosa* HUANG

Fig. 1 (TF2361, X1), internal mould of pedicle valve

Fig. 2 (TF2363, X1), internal view of pedicle valve

Fig. 3 (TF2358, X1), internal mould of pedicle valve

Fig. 4 (TF2366, X1), internal view of pedicle valve

Figs. 1-3, Locality 12 (Huai Thak), Fig. 4, Locality 11 (Huai Tao), southern parts of the Doi Pha Phlung, Ngao, Thailand

Fig. 5-6. *Palaeoldhamina loeiensis* sp. nov.

Fig. 5 (GKD31233, X1), internal view of brachial valve

Fig. 6 (GKD31234, X1), external view of incomplete pedicle valve

Locality: Thum Nam Maholan, Loei, Thailand

Fig. 7-12. *Oldhamina* cf. *anshunensis* HUANG

Fig. 7 (TF2371, X2), internal mould of pedicle valve

Fig. 8 (TF2376, X1.5), internal mould of pedicle valve

Fig. 9 (TF2375, X1.5), internal mould of pedicle valve

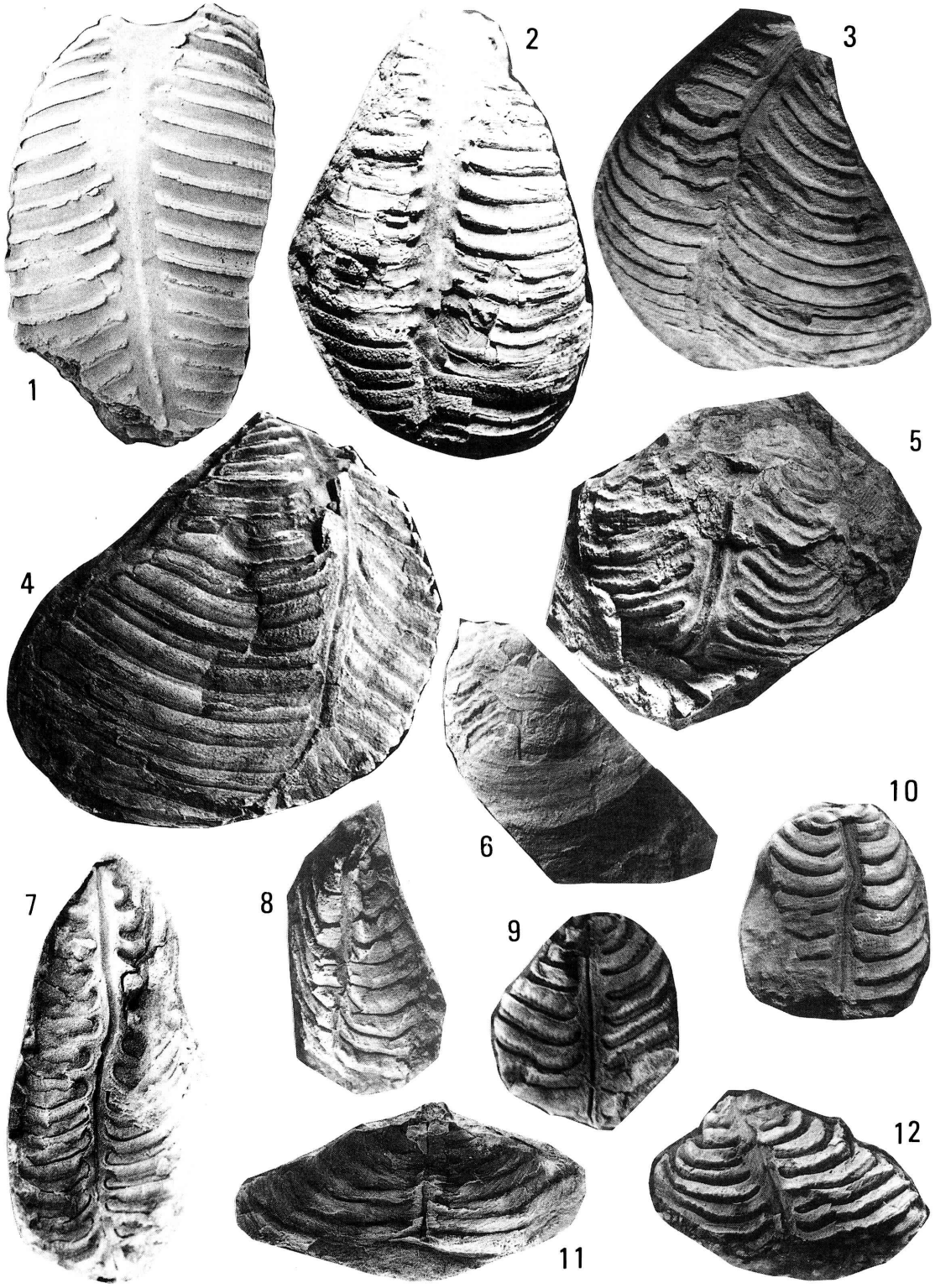
Fig. 10 (TF2372, X1.5), internal mould of pedicle valve

Fig. 11 (TF2374, X1.5), internal mould of pedicle valve

Fig. 12 (TF2373, X1.5), internal mould of pedicle valve

Locality 1, the Doi Pha Phlung, Ngao, Thailand

Mem. Fac. Sci., Kyushu Univ., Ser. D, Earth & Planet. Sci., Vol. XXX, No. 2, Plate 1



S. KOGA et al. : Permian *Oldhamina* and *Palaeoldhamina* from Thailand