New Observations of Shiroishi-ohsawa, Mt. Yokokura, Kochi Prefecture with Palaeontological Studies on the Cephalopods and Trilobites from the Locality

Teiichi KOBAYASHI * and Jiro KATTO **
and Takashi HAMADA ***

Abstract

This scientific report consists of three sections. Section I is new observations of Shiroishi-ohsawa by Katto. Lithofacies of Silurian rocks in this location is composed of massive to brecciated limestone, limestone breccia, acidic tuff and siliceous shale. Limestone is interpreted as resedimentation in origin.

Section II is description of Silurian cephalopods from the locality by Kobayashi. This cephalopod faunule comprising five new species of *Michelinoceras*, *Arionoceras*, *Orthocycloceras* and (?) *Protokionoceras* is Upper Silurian and most probably early Ludlovian in age. As a result of its comparison with other Asian cephalopods it is found that the faunal connection was maintained from Central Europe to Eastern Asia through Middle Asia and Southern Tibet in the age.

Section III is an advance report on a new trilobite collection from the locality by Kobayashi and Hamada. Among the trilobites eight species in six genera and five families including three new species of *Bumastus* were distinguished. The early Upper Silurian age of the *Cerauroides orientalis* horizon at Gomi limestone quarry is further confirmed with this collection.

INTRODUCTION

This paper is a "omnibus" paper in which three independent sections are included: the geology of Shiroishi-ohsawa in Mt. Yokokura, Shikoku and two palaeontological papers on cephalopods and trilobites.

The fossils described in this paper were originally collected and offered to Katto by Messrs. Yukio Sako of Kushimoto, Wakayama Prefecture and Tomihiro Mizobuchi of Kochi City. Katto examined the outcrop where the fossils were obtained and a brief account of observation is presented in the first section. The cephalopod fossils from Shiroishi-ohsawa were studied by Kobayashi and is described in the second section. Trilobite fossils were examined by Kobayashi and Hamada and an advanced report is presented in the third section.

We would like to express our gratitude to Dr. Asahiko Taira of Kochi University for his assistance in the field work and Messrs. Yukio Sako and Tomihiro Mizobuchi for providing their fossil collections.

---

* The Japan Academy, Tokyo
** Department of Geology, Kochi University
*** The University of Tokyo

Section I.

New Observations of Silurian rocks in Shiroishi-ohsawa, Mt. Yokokura, Kochi Prefecture, Shikoku

by Jiro KATTO

Mt. Yokokura is situated in the Kurosegawa tectonic zone which extends along the outer zone of southwest Japan (fig. 1A). It is famous for various Paleozoic and Mesozoic fossils found within a few square kilometers of area (fig. 1B; pl. II, figs. 1~2). The geology and paleontology of this area has been described by many authors (e. g. Kobayashi and Hamada, 1974).

Shiroishi-ohsawa, a mountain stream, has been known as one of the most fossiliferous locations in Mt. Yokokura (fig. 1B). It is situated in the eastern side of Mt. Yokokura starting from about 700m of altitude down to the village of Shiroishi at 200m altitude.

The section along this route is composed of massive to brecciated limestone, limestone breccia, acidic tuff and siliceous shale. There is a structural discontinuity at the altitude of 540 meters where an east-west trending fault is inferred. Below this, the beds strike N70°E and dip 85°S while beds strike N40°E and dip 70°E in the route above the fault (fig. 1C). The beds below the fault is probably overturned.

Columnar section of the route below the fault is shown in Fig. 2. A sequence of 100 meter thick is observed and divided into three lithofacies units: lower, middle and upper units. The lower unit is about 13 meters thick and composed of massive limestone, bedded acidic tuff and siliceous shale with slump structures. The limestone includes a block of red sandstone. The middle unit is composed of interbedded massive limestone and brecciated limestone which includes blocks and lenses of granitic rocks and red clastic rocks. Brecciated limestone and limestone breccia with tuffaceous shale and red clastic matrix are major constituents of the upper unit (pl. I, fig. 2). Cephalopods occur from the upper units.

The limestone exposed in this route is apprantly resedimentation origin. Kobayashi and Hamada (1974) pointed out that the *Cerauroides orientalis* horizon of breccia-type limestone represents submarine talus deposits along the outer slope of the wave resistant reef front. The limestone in this route probably is a similar origin. Recently Kuwano (1983) reported reworked Ordovician conodonts from this section. As the limestone is resedimentation origin, such reworking can be interpretable.

Red clastic sediments contain quartz, plagioclase, sedimentary rock fragment and minor amount of volcanic rock fragments and heavy minerals. They also contain calcareous fossil fragments and are cemented by carbonate crystals.

It is noted that the basement rock of Silurian reef limestone included Mitaki granites, possible Ordovician strata and red beds of unknown age.

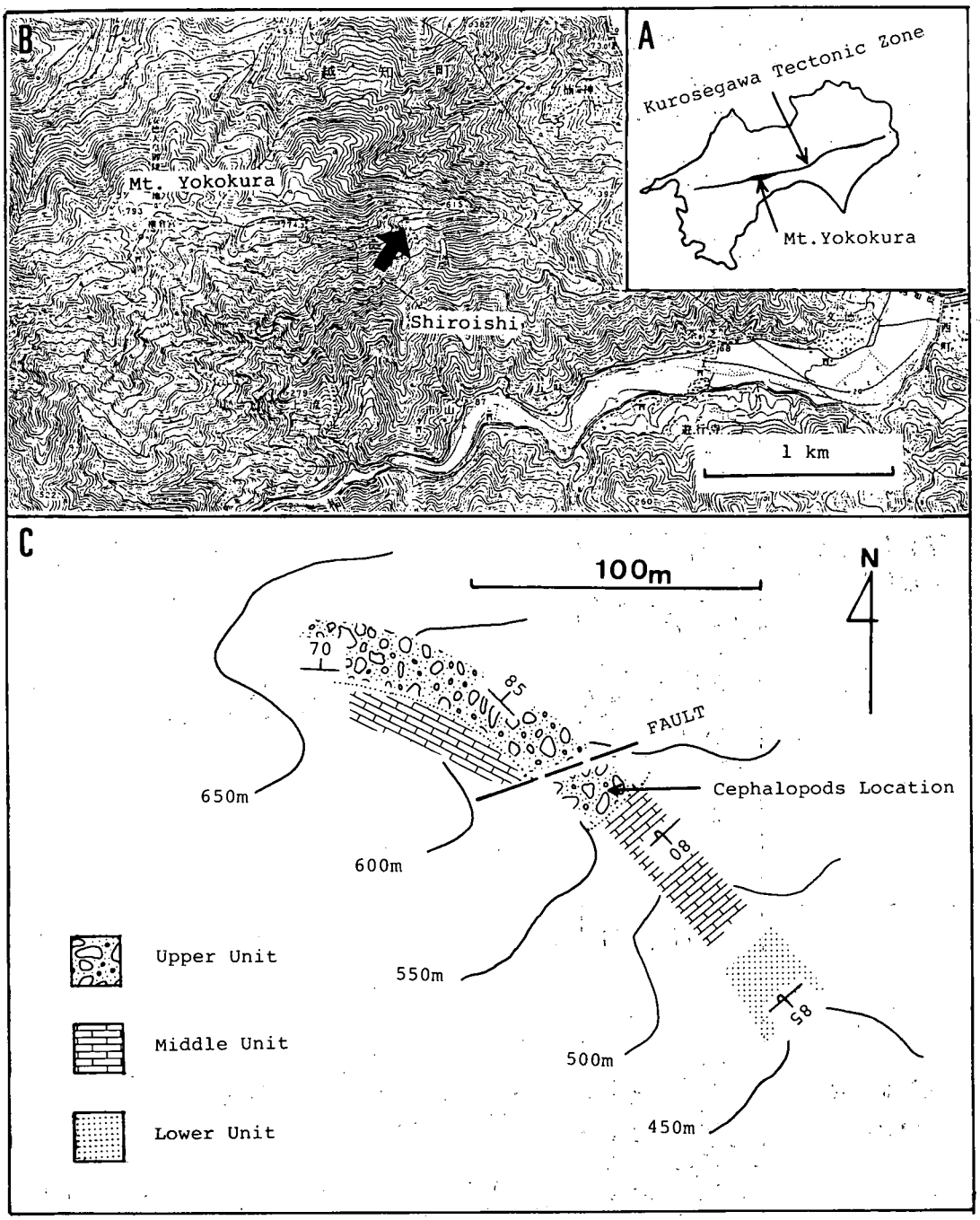


Fig. 1. Location map and route map of the Shiroishi-ohsawa section. A = Map of Shikoku, B = Map of Mt. Yokokura. C = Route map of the Sirulian rocks of Shiroishi-ohsawa.

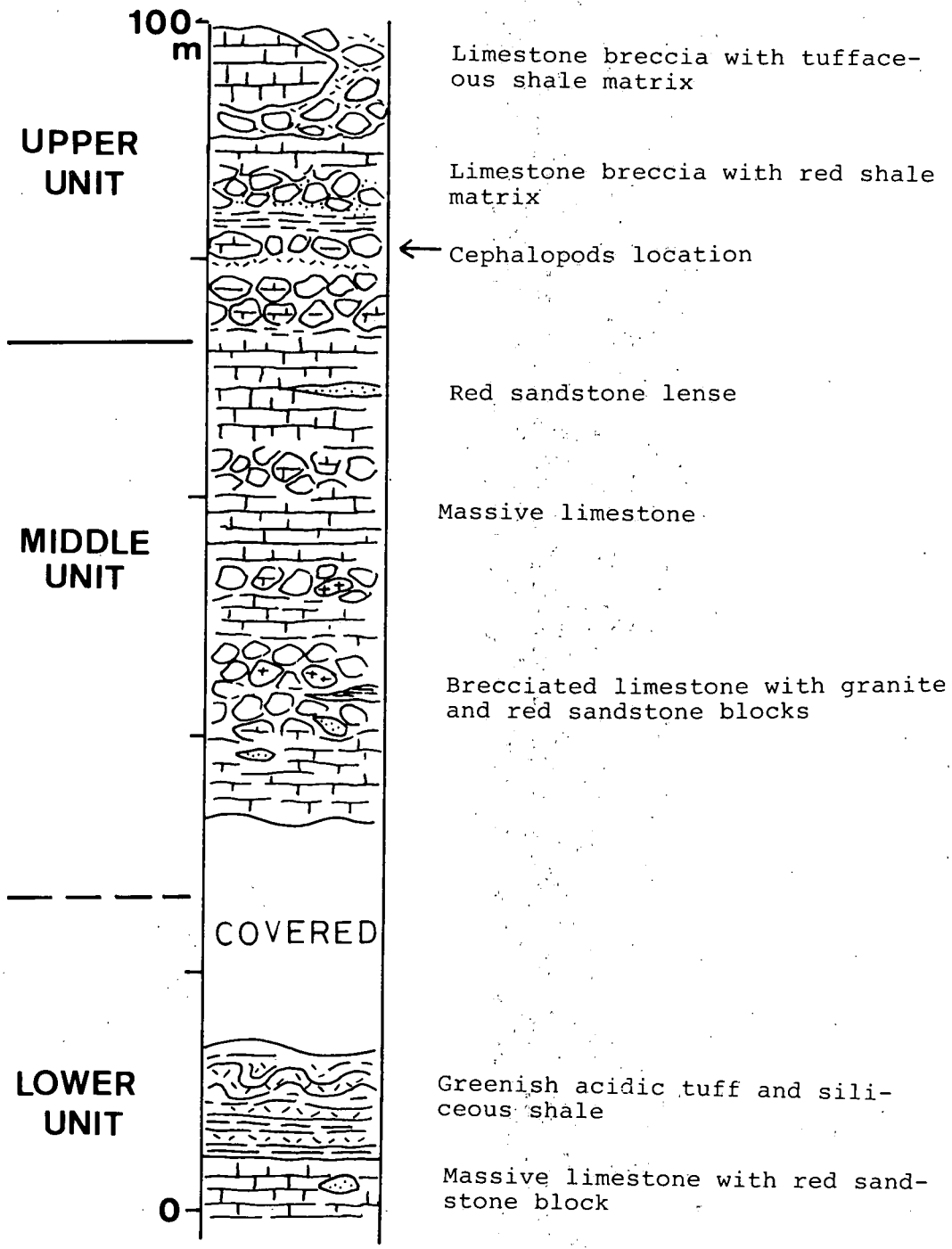


Fig. 2. Columnar section of Silurian rocks in Shiroishi-ohsawa.

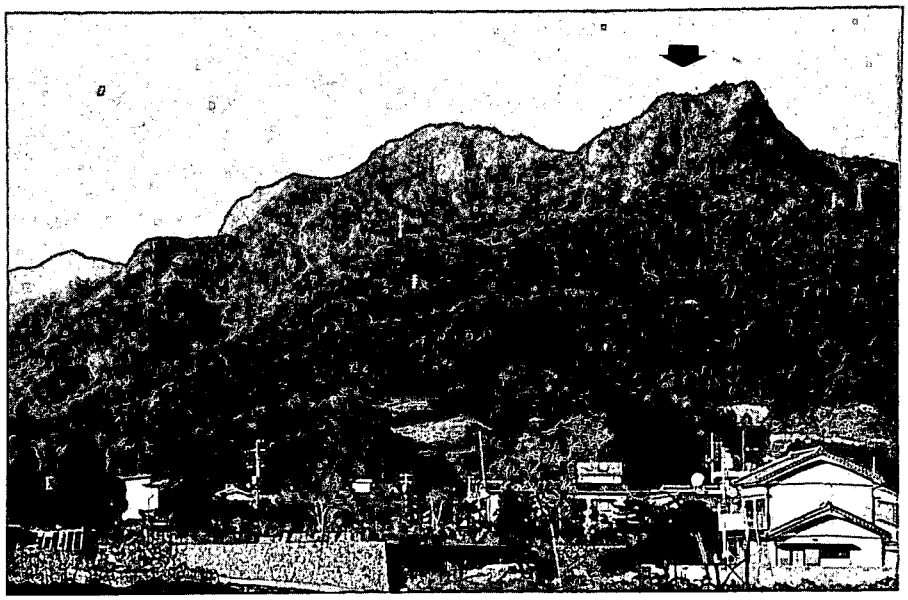


Fig. 1. A view of Mt. Yokokura (744.3m) from Ochi Town. The arrow indicates the fossil location at Shiroishi-ohsawa.

Fig. 2. Fossiliferous limestone breccia in the upper unit.

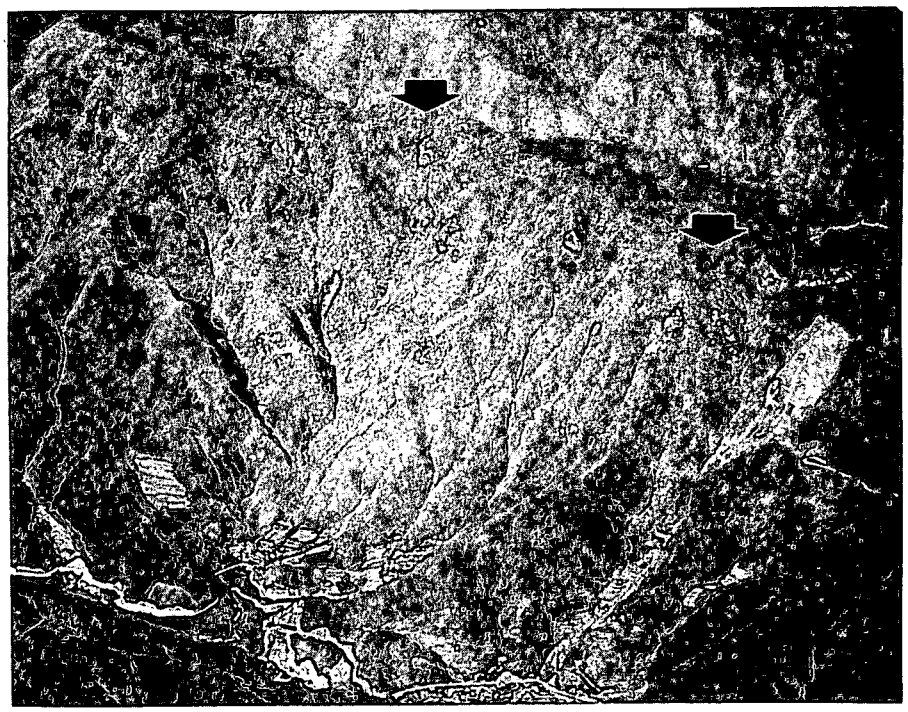


Fig. 1. An air view of the southern side of Mt. Yokokura. The Shiroishi-ohsawa tributary is shown by an arrow to the right and Bakadameshi cliff to the left.

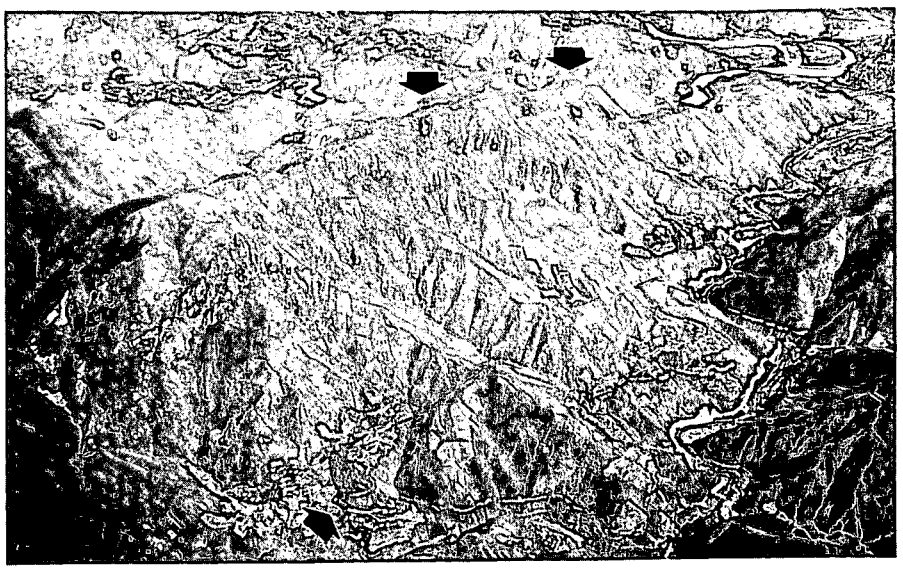


Fig. 2. An air view of Mt. Yokokura looking toward ENE direction. Arrows from left to right indicate Ohira (Devonian plant location), Bakadameshi cliff (Silrurian limestone) and Shiroishi-ohsawa respectively.

References

Hirata, S. (1966): Yokokurayama, Shikoku, Japan (in Japanese) *Chigaku-kenkyu*, vol. 17, no. 10, 11, 12, pp. 258—273.

Kawai, M. (1971): Geologic stracture of the Yokokura-yama area, Shikoku-Late Mesozoic crustal movements in Shikoku, Outer Zone of Southwest Japan. Part I - *Prof. H. Matsushita Mem.* vol., pp. 91—101.

Kobayashi, T. and Hamada, T. (1974): Silurian trilobites of Japan in comparison with Asian, Pacific and other faunas. *Palaeont. Soc. Japan, Spec. Pap.*, no. 20, 202 pp, 13 pls.

Kuwano, Y (1983): Reworked Ordovician conodonts from Yokokurayama, Shikoku, Japan. *Jour. Geol. Soc. Japan*, vol. 89, p. 245—248.

Noda, M. (1955): Stratigraphy and Geological Structure of the Palaeozoic Formations in the Vicinity of Yokokura-yama, Kochi Prefecture (In Japanese with English Summary). *Rep. Earth Sci., Kyushu Univ.*, vol. 1, pp. 47—60.

——— (1964): Some Silurian Brachiopods from Yokokura-yama, Kochi Prefecture, Japan. *Rep. Earth Sci., Dept. General Educ., Kyushu Univ.*, vol. 1, pp. 47—60.

Section II

Silurian Cephalopods from Yokokura-yama, Kochi Prefecture, Japan*

By Teiichi KOBAYASHI
The Japan Academy, Tokyo

Little has been known of the pre-Carboniferous cephalopods in Japan. In fact, *Michelinoceras hidense* Kobayashi, 1958 was solitary for a long time. Its age was first presumed late Silurian, because it was derived from the *Favosites uniforme* subzone of the *Favosites hidense* zone in the Fukuji formation and because the zone was considered Ludlovian or Upper Silurian at that time. Subsequently, Hamada (1959) placed the zone in the Lower and Middle Devonian or probably Gedinnian-Siegenian. As the result of study on a rich trilobite fauna of the formation by Kobayashi and Hamada (1977), it is now warranted that the Fukuji fauna is within the range from Gedinnian to Eifelian and probably to early Eifelian. Thus *Michelinoceras hidense* is now proved to be a Devonian cephalopod.

The cephalopods described in this article were collected from the *Cerauroides orientalis* horizon at Gomi quarry of Mt. Yokokura in the up-stream of Shiroishi-ohsawa, 200m to the north northwest of Gomi village. The age of the horizon was determined at late Silurian by trilobites (1974) and this age is now further confirmed in the following article. It was about a half-century ago since I had studied *Plectronoceras*, the oldest cephalopod (1935). It is indeed a great pleasure for me to describe here the oldest cephalopod faunule in Japan. I wish to record my cordial thanks to Professor Jiro Katto of the Kochi University and Messrs. Tomihiro Mizobuchi and Yukio Sako, two collectors and at the same time Professor Tetsuro Hanai and Associate Professor Itaru Hayami of the University of Tokyo from whom I have received assistances in the course of this study.

Hirata (1956) was first to discover *Orthoceras* sp. at the Gomi quarry of Mt. Yokokura. Later Koizumi (1975) suggested for this cephalopod *Kailoceras* (?) sp. rather than *Parahelnites* from its external view, but this suggestion is superfluous, because nothing is known of its internal structure. In view of the present collection containing none of the Actinocerida, it is least probable that Hirata's cephalopod belongs to either *Kailoceras* or *Parahelnites*.

The following species are distinguishable in the collection before hand.

* Studies on Japanese Trilobite and Associated Fossils-XXXII.

Family Orthoceratidae
Subfamily Michelinoceratinae
Genus *Michelinoceras*
Michelinoceras alticameratum Kobayashi, sp. nov.
Michelinoceras mizobuchii Kobayashi, sp. nov.
Genus *Arionoceras*
Arionoceras densiseptum Kobayashi, sp. nov.
Subfamily Leurocycloceratinae
Genus *Leurocycloceras*
Leurocycloceras (?) sp. indet.
Genus *Orthocycloceras*
Orthocycloceras gomiense Kobayashi, sp. nov.
Orthocycloceras aff. *gomiense* Kobayashi
Family Geisonoceratidae
Genus *Protokionoceras*
Protokionoceras (?) *fessicancellatum* Kobayashi, sp. nov.

Beside them there are several indeterminable specimens. Two small ones probably belong to *Arionoceras densiseptum*. One of them is cut obliquely to the siphuncle and the other off the siphuncle. Three others are large conchs. One of them which is the largest in the collection has high camerae. It represents probably an undescribed species of *Michelinoceras*, although its internal structure is ill-preserved. In the remaining two large conchs one tapers more slowly and the other more rapidly. The septal distance is comparatively short in the former, but fairly long in the latter. Both of them belong evidently to the Michelinoceratinae.

Thus the leading group of the Mt. Yokokura cephalopods is the Michelinoceratinae and the second is the Leurocycloceratinae. All of them are straight or nearly straight conchs, but there are a gentle cyrtocone and a more curved conch, both polished sections not through the siphuncles in the collection. (pl. Ⅲ, figs. 8 and 9)

It is noteworthy that three conchs in medium size and several small ones are contained on a polish surface of a limestone slab, about 9cm by 12cm (pl. Ⅳ, fig. 4), because it is an example of gregarious occurrence of cephalopods at this locality.

According to Moore's Treatise (1964), the generic range is from Ordovician to Triassic for *Michelinoceras* and from Middle Ordovician to Middle Silurian for *Leurocycloceras*. While the former is a cosmopolitan genus known from North America, Eur-Asia and Australia, the latter's distribution was restricted to Middle (?) and Upper Ordovician of Europe (Estonia) to Middle Silurian of Europe (Czechoslovakia) and North America at that time. However, its occurrences were later reported from Upper Silurian of Middle Asia (Barskov, 1972) and Ganzhou (i. e. Kansu), China (Chen et al., 1981). Thus either one of the two genera suggests any definite age.

As noted in Treatise, *Michelinoceras* s. l. should be splitted into more ex-

actly defined genera. As stated later, *Arionoceras* Barskov, 1966, inclusive of *Pedenochonoceras* Chen, 1981 is a Silurian-Devonian genus of Eurasia. The distribution of *Orthocycloceras* Barskov, 1972 inclusive of *Euthyrocycloceras* T. W. Chen, 1981 is more restricted to the Upper Silurian of Asia. Because *Arionoceras* as well as *Orthocycloceras* are better represented than other genera in the Yokokura cephalopod faunule, its age must be late Silurian.

Now the Yokokura cephalopods are compared with those of other Asian and Western Pacific areas. Silurian cephalopods were described by Reed (1906) from Northern Shan States, Burma as follows:

Orthoceras aff. *commutatum* Giebel from the Zebingyi beds
Orthoceras aff. *mocktreense* Sowerby ?, ditto.
Orthoceras aff. *nicholianum* Blake ?, ditto.
Orthoceras aff. *tenuiannulatum* M'Coy from the Namhsim sandstones
Orthoceras sp. indet. from the Zebingyi beds

These Burmese cephalopods are compared with European species chiefly from the external view. *Leurocycloceras* (?) sp. indet. from Gomi somewhat resembles *Orthoceras* aff. *nicholianum* and *O.* aff. *tenuiannulatum*. So is *Orthocycloceras gomiense* to the latter Burmese species. The resemblances in some aspects may, however, be superficial.

The Namhsim sandstones are considered middle Wenlockian or younger and the Zebingyi beds late Silurian and possibly early Devonian. As discussed elsewhere (1977), it is now ascertained that Lower Devonian rocks are included within the Zebingyi beds.

Michelinoceras is reported by Myint Lwin Thein (1973) to occur in the so-called *Orthoceras* beds in the Lower Silurian Linwe beds in the Southern Shan State, although I have not seen any palaeontological description.

"*Fossil Cephalopods of China*", 1965 includes 190 species of Upper Cambrian-Ordovician cephalopods and 10 Devonian species (i. e. Nautilina 2, Ammonoidea 8), but no Silurian cephalopod. One year before this publication, however, Lai Chaigeen described two species of *Jangiceras* from the Middle Silurian of Sichuan and Guizhou (Kweichow).

In 1974 Chen and Liu described 21 species in 13 genera including 19 new species and 4 new genera from the Middle Silurian of Sichuan and Guizhou in the Palaeontological Atlas of Southwest China. Subsequently in 1978 the Silurian fauna was further amplified respectively from Sichuan by Wang Ruzhi and from Guizhou by Yang Shengwu. Additional descriptions were made from South Tibet by Chen Junyuan (1975) and Chen Tingen (1981). At length Chen Junyuan, Liu Genwu and Chen Tingen (1981) monographed "Silurian Nautiloids of Central and Southwest China" in which they distinguished six nautiloid assemblages as follows:

1. Medeaval Lower Silurian *Songkanoceras* assemblage
2. Late Lower Silurian *Yinhangoceras* assemblage
3. Medeaval Middle Silurian *Sichuanoceras* assemblage
4. Late Middle Silurian *Heyuncunoceras* assemblage
5. Early Upper Silurian *Euthyocycloceras* assemblage
6. Late Upper Silurian *Yunnanoceras* assemblage.

Michelinoceras (*Kopaninoceras*) *ninglangense* is a Middle Silurian species in Yunnan. Five species of *Pedanochonoceras* are all described from the medeaval Middle Silurian Xinshan formation in Sichuan and Guizhou and four species of *Euthyrocycloceras* from the early Upper Silurian Miaogao formation in Yunnan. Because *Pedanochonoceras* and *Euthyrocycloceras* are no more than subgenera of *Arionoceras* and *Orthocycloceras* respectively, the Yokokura cephalopod faunule is allied to the Middle and Upper Silurian ones of Southeast China, if considered in the generic level, although there is no identical species.

Of *Michelinoceras* there are further one species from Hubei, another from Sichuan and two others from South Tibet, all Middle Silurian in age, in addition to two Middle Silurian species and one late Silurian species of *M.* (*Kopaninoceras*) from South Tibet. Among them one species of *Michelinoceras* and all three species from South Tibet are identified with Barrande's species from Czechoslovakia, showing the Eurasiatic faunal connection.

In Kazakhstan and Middle Asia cephalopods well flourished in the Silurian period. The michelinoceratids are represented by four genera including *Arionoceras* and the leurocycloceratids by three genera including *Orthocycloceras*. *Michelinoceras alticameratum* closely resembles Barskov's *Michelinoceras michelini* from the Upper Silurian of Afghanistan. *Orthoceras michelini* Barrande, the type species of *Michelinoceras*, is more similar to *M. mizobuchii*. Their association with *Arionoceras* and *Orthocycloceras* reveals intimate relationship of cephalopods between Japan and Middle Asia in the early Upper Silurian age. The trans-Eurasiatic faunal connection must have been maintained during the middle and late Silurian period from Central Europe to the Far East through Kazakhstan and Afghanistan.

Finally, several Silurian species of cephalopods were reported to occur in Australia and Tasmania already in the latter part of last century. According to Teichert and Glenister (1952) *Cycloceras tenuiannulatum* M'Coy var. *australis* Chapman, 1912 is a distinct species of *Geisonoceras*. Four Silurian species in four genera of the Cephalopoda are described from Tasmania (Teichert and Glenister, 1953). They belong to endemic genera except for *Ephippiorthoceras* which is distributed in Eur-America and Tasmania. Little is known as yet of the relation of Silurian cephalopods between the northwestern and southwestern Pacific areas.

Description of Cephalopoda

Family Orthoceratidae M'Coy, 1944

The essential distinction of the Orthoceratinae from the Michelinoceratinae lies in the possession of longitudinal furrows on the body chamber. Such depressions are two on the ventral side in *Orthoceras* Bruguière, 1789, two on each lateral side in *Bifoveoceras* Balashov, 1956, and one on the dorsal side and two on the ventral side in *Ctenoceras* Noetling, 1884. These three genera are all Middle Ordovician in age. *Monofoveoceras* T. E. Chen, 1981 is an Upper Silurian genus from Yunnan having one longitudinal depression. Thus the distribution of the subfamily extends from Middle Ordovician to Upper Silurian in Eurasia.

Subfamily Michelinoceratinae Flower, 1905

Among the genera of this subfamily which are known to occur in Silurian rocks, *Arkoceras* Flower, 1945 is quite aberrant in the subquadrate cross section of the conch with a subventral siphuncle. *Plagiostomoceras* Teichert and Glenister, 1952 is distinctive in the oblique lirae parallel to the sinuous aperture. The oblique sculpture is stronger in *Merocycloceras* Ristedt, 1968.

Hemicosmorthoceras Ristedt, 1968 was originally instituted as a genus of the Sphaerorthoceratidae Ristedt, 1968, while Barskov (1972) placed it in the Michelinoceratinae. *Sinoceras chinense* (Foord) was primarily presumed a Devonian cephalopod, but it is warranted at present that this species and *Sinoceras rudum* (Yu) are two indices to the Upper and Middle Ordovician in Central China. *Sinoceras* apparently died out later in China, although two Devonian species were described in the USSR by Zhuravleva (1978). This is an unexpected recurrence devoid of any Silurian link.

Arionoceras Barskov, 1966, *Kopaninoceras* Kisselov, 1969 and *Pedanochonoceras* Chen, 1981 are three close allies to *Michelinoceras* s. str., as Chen has already accepted the second as a subgenus of *Michelinoceras*. *Arionoceras* is distinguishable from *Michelinoceras* by its rapid tapering of the conch with apical angle of 7 to 10 degrees and its short camerae. *Pedanochonoceras* may be its subgenus having the expanded connecting ring.

Genus *Michelinoceras* Foerste, 1932

This genus is divisible into two subgenera. The septum is contracted at the mural part in subgenus *Kopaninoceras* Kisselev, 1967, but not in *Michelinoceras* s. str. The former subgenus has generally large conchs, circular or oval in cross section and tapering very slowly; siphnucle central; septal neck orthochoanitic; connecting ring cylindrical; camera deposit may be present in the apical part. Its type-species is *Orthoceras jucundum* Barrande, 1870. It was distributed in the Silurian period

from Central Europe to Middle Asia and Pamir through Podolia and the Urals. Nine species of *Michelinoceras* are known now from the Middle Silurian of China as follows:

Michelinoceras gaoluense Xu, 1977, Hobei
Michelinoceras moodiense (Foerste, 1928) by Wang, 1978, Sichuan
Michelinoceras transiens (Barrande, 1968) by Chen, 1975, South Tibet
Michelinoceras chaitouense Chen, 1975, *ditto*.
Michelinoceras valens (Barrande, 1867) by T. E. Chen, 1981, *ditto*.
Michelinoceras (*Kopaninoceras*) *jucundum* (Barrande, 1870) by Chen, 1975, *ditto*.
Michelinoceras (*Kopaninoceras*) *capax* (Barrande, 1868) by Chen, 1975, *ditto*.
Michelinoceras (*Kopaninoceras*) *dorsatum* (Barrande, 1968) by Chen, 1975, *ditto*.
Michelinoceras (*Kopaninoceras*) *ninglanense* T. E. Chen, 1981, Yunnan

Michelinoceras alticameratum Kobayashi, sp. nov.

Plate Ⅲ, Figure 1

Description : - Michelinoceratid with non-annulate conch of moderate tapering, circular in cross section ; siphuncle subcentral, narrow and tubular ; septum fairly convex ; septal neck orthochoanitic ; connecting ring cylindrical ; organic deposit absent in camera and siphuncle. Further details of the species is represented by the holotype specimen.

Observation : - The holotype specimen is a conch of about 65mm in length which is polished through the siphuncle. The shell is not annulated. The terminal part of the conch in the polished section belongs to the body chamber. Therefrom eight camerae are distributed in 57mm of the siphuncular length. The siphuncle is slightly excentric and one-sixth to one-seventh as wide as the conch. The diameter of the conch increases from 6mm to 9mm through the phragmacone. The septal concavity corresponds to 1/2.5 of the camera-height. The septal neck is short and orthochoanitic, forming an obtuse angle. The connecting ring is tubular and much thinner than the septum. The camera is encrusted all around the walls with calcareous deposits of similar thickness and the remaining space is filled up with dirt, both inorganic.

Comparison : - This species resembles *Michelinoceras michelini* Barrande, the type-species of the genus, but the conch is evidently expanding more rapidly.

Michelinoceras mizobuchii Kobayashi, sp. nov.

Plate Ⅲ, Figure 2

Description : - Michelinoceratid tapering very slowly and having high camerae and septa with very weak convexity; outer shell non-annulate.

Observation: - The type specimen is a phragmocone 57mm long on which eight camerae are countable. The first and eighth camerae measure 5mm and 6mm in height respective-

ly. The conch is obliquely cut and a little displaced at the seventh camera where a calcite vein penetrates. The siphuncle is excentric, at about two-fifths from one side and very narrow, as seen in the sixth camera. The septal convexity corresponds to one-third the camera-height or less. The septal neck is orthochoanitic and very short. The connecting ring is tubular and thin. The episeptal and mural deposits are present.

Comparison : - This conch tapers more slowly than *Michelinoceras alticameratum*. This species has also high camerae. Because the septa are less convex backward in this species, the camerae look higher than those of that species.

Among the Silurian nautiloids in Asia, this species looks most similar to *Michelinoceras michelini* (Barrande, 1870) by Barskov, 1872 in figs. 1 — 3, pl. 2 from the Upper Silurian of Afghanistan in the cylindrical conch and high camerae, but the conch tapers more distinctly and the septa are less convex in this species.

Genus *Arionoceras* Barskov, 1966, em. Kobayashi

Diagnosis : - Conch longiconic, straight or nearly so, non-annulate, circular or subcircular in cross section and expanding rapidly with apical angle of 7 to 10 degrees; siphuncle central or subcentral, narrow, tubular and empty; septum moderately concave; septal neck short, orthochoanitic or suborthochoanitic; annulosiphonate deposit absent at neck; camera short; intracameral deposit may be present; body chamber about twice as long as diameter of ultimate camera.

Type species: - *Orthoceras arion* Barrande, 1866.

Remarks: - The surface of the conch is smooth or somewhat undulate, but not distinctly annulate. The septal neck varies from orthochoanitic to suborthochoanitic. The siphuncle is typically cylindrical, but the connecting ring is slightly expanded in the subgenus *Pedenochonoceras* Chen, 1981 (Type: *Pedenochonoceras contractum* Chen, 1981). Compared to this genus the conch is subcylindrical and the camera much higher in *Michelinoceras*.

Distribution: - Silurian; Eurasia.

Arionoceras densiseptum Kobayashi, sp. nov.

Plate Ⅲ, Figures 3 — 5

Description : - Arionoceratid having straight longicone with apical angle of 9 degrees or so and circular in cross section; siphuncle narrow, tubular, slightly excentric, about one-sixth as wide as conch's diameter; septal neck short, suborthochoanitic; connecting ring straight; septal concavity corresponding to about a half of camera-height; septal distance about a half to one-third of conch's diameter; camera short; body chamber fairly long.

Observation : - The holotype specimen is a phragmocone, 45.5mm long and polished through the siphuncle. The conch is a straight longicone which is tapering rapidly,

circular in cross section and not annulated on the surface. Its siphuncle is subcentral, one-sixth as wide as the conch and tubular, but more or less contracted at the septal neck. The septal concavity corresponds to about a half of the camera-height. The septum is suborthochoanitic, more or less rounded; septal neck short; connecting ring slender and straight. Some camerae in the middle part reveal the growth of the episeptal-mural and hyposeptal deposits which are quite distinct from the secondary calcareous filling.

The paratype specimen is another polished conch through the siphuncle, about 90mm in length where its body chamber occupies 23mm. In the grown stage five camerae are distributed in the length of 24mm. The ultimate camera measures 12mm in diameter. The septum is convex as much as a half of one septal distance. The siphuncle is slightly excentric, tubular and narrow. The internal structure is not so well preserved as the holotype phragmacone. The septal neck looks short and subrectangular; connecting ring slender. The camerae are filled with calcareous material.

The third specimen is a small straight conch, 37mm long, whose body chamber is 11mm long and the last camera 7mm in daimeter. Fourteen camerae are countable in 26mm of siphuncular length. The septal neck is suborthochoanitic. Organic deposits are absent in the siphuncle and camerae. The fourth specimen is a longicone, about 11cm long, and a very little arcuate. The ultimate camera is 17mm in diameter and the body chamber no less than 20mm in length. The siphuncle is a little excentric, narrow, tubular and empty. Intracameral deposits are absent.

Subfamily Leurocycloceratinae Sweet, 1964

This family was best represented in the Silurian period by seven genera as follows:

Leurocycloceras Foerste, 1928
Metaspyroceras Foerste, 1932
Bohemites Zhuravleva, 1962
Orthocycloceras Barskov, 1972
Euthyrocycloceras T. W. Chen, 1981
Obicycloceras T. E. Chen, 1981
Xianoxiangoceras T. E. Chen, 1981

Among them the diagnoses for *Orthocycloceras* and *Euthyrocycloceras*, both Upper Silurian in age, agree with each other in most items, although the correspondence of an annulus to each camera is emphasized for the former and the siphuncle is said either central or excentric in the latter, instead of central in the former. Their difference is no more than a subgeneric value.

Genus *Leurocycloceras* Foerste, 1928

Leurocycloceras (?) sp. indet.

Plate IV, Figures 1a—1b

A stout slowly tapering orthocone, about 85mm in length, with annulation and fine longitudinal lirae. Ten annuli are countable through the adoral 29mm and adapical 16mm. They are nearly straight, transversal low bands separated from one another by shallow interspaces and both crossed by very fine regular and numerous longitudinal lirae. At the broken end of the conch it is seen that the transverse section is subelliptical and the siphuncle is a little excentric and nearly as wide as one-fifth the shorter diameter. Because little is known of the internal structure, its exact taxonomic position is indeterminable.

Leurocycloceras tushukense Barskov, 1972 (pl. 3, fig. 2) from the Upper Silurian of Fergana closely resembles this form in the low transverse annulation. *Leurocycloceras raymondi* Foerste, 1928, from the Niagaran of Wisconsin which is the type-species of *Leurocycloceras* is annulated obliquely and the annulus is sinuated ventrally. Among American cephalopods *Spyroceras chaleurense* Foerste, 1936, from the Niagaran of Quebec has the more similar sculpture to this species, although the annulation and longitudinal liniation appear less prominent.

Among the oriental cephalopods *Orthoceras* aff. *nicholianum* Blake (?) by Reed, 1906 from the Zebingyi beds of East Burma has the cancellate sculpture, but the rings are very narrow. *Orthoceras* aff. *tenuiannulatum* from Burma, later mentioned, has also the cancellate ornaments, but not very simlar to this species.

Genus *Orthocycloceras* Barskov, 1972

Three specimens at hand are referable to this genus.

Orthocycloceras gomiense Kobayashi, new species.

Plate III, Figure 6, Plate IV, Figure 2

Description : - Annulated longicone, nearly straight, but more or less sigmoidally undulated and circular in section; siphuncle subcentral, narrow, tubular and empty; septum moderately convex and orthochoanitic; septal neck very short; connecting ring straight; camera short and expanded laterally in accordance with annulation; camera-height comparatively reduced in grown stage; body chamber about three times as long as diameter of ultimate camera.

Observation : - The holotype specimen is a polished section of an annulated orthocone, 44mm long, in which its body chamber occupies 17mm. The conch is slowly tapering, more or less arcuate in adapical part, circular in cross section with a narrow slightly excentric siphuncle; each annulation corresponding to a camera. The diameter of the conch at the contraction measures 4mm, 5mm and 7mm at the adapical, middle and adoral part respectively. The siphuncle is tubular, one-sixth

or less the diameter of the conch and empty; septal neck orthochoanitic, very short; connecting ring straight; 10 camerae countable in the length of 18mm of phragmacone; septal convexity approximate to a half of camera-height; camera filled up with calcareous material except for the last two. The ultimate camera is unusually tall whereas the penultimate camera is much shorter than earlier one. This irregularity is probably due to senility.

The paratype specimen is another annulated conch, 48mm in length with a narrow subcentral siphuncle. It has 24 annuli which are all transversal, non-sinuate and slanting from crest more on the adapical side than the other side; very fine lirae visible on the adoral slope of the annulation.

Comparison : - This species is closely allied to *Orthocycloceras alayense* and *O. ferganense*, particularly to the former species which is the type-species of the genus, but the conch tapers more rapidly in this species than those two species. Compared to this all of the four species of *Euthyrocycloceras* have more dense camerae and their annulations look less prominent.

Orthoceras aff. *tenuiannulatum* M'Coy by Reed, 1906, from the Namhsim sandstones in East Burma whose internal structure is unknown, is a coarsely annulated cycloceroid having, in addition, longitudinal lirae. It is compared to M'Coy's Ludlovian species. This Burmese species differs from the Japanese species in the much wider concave interspace and slightly oblique annulation.

Orthocycloceras aff. *gomiense* Kobayashi

Plate Ⅲ, Figure 7

This specimen is a long straight conch about 12cm in length which is displaced along a calcite vein between the adapical and the middle-adoral parts. It is camerated all through the specimen except for the broader terminal part which belongs to the body chamber. The apical angle is about 10 degrees. It is recognizable at the narrow end that the conch is circular in section and the siphuncle located at or near the center.

Compared to the preceding species the siphuncle is a little broader as seen in the middle part. The camera is encrusted by the episeptal and mural deposits in the adapical part, but not the middle and adoral parts. Like the preceding, the conch is annulated in the adapical part, although the annulation is ill-preserved in the other part.

Family Geisonoceratidae Zhuravleva, 1959

Genus *Protokionoceras* Grabau and Shimer, 1910

Protokionoceras (?) *fessicancellatum* Kobayashi, sp. nov.

Plate Ⅳ, Figures 3a and 3b

Small conch slightly curved and more or less breviconic in adapical part; rate of

tapering quite reduced on the other side of the conch; shell surface marked with fine lattice of lirae.

Septal suture transversal as seen in the exfoliated apical part. Because the broken end of the other side is non-septate, the part must belong to the body chamber. Little is known of the interior of the phragmacone.

The lattice of lirae in this species is not so distinct as in *Protokionoceras crooki* Foerste, 1928 and even weaker than that of *Protokionoceras medullare* (Hall), the genotype species. The cancellate ornamentation is typical of *Protokionoceras*, but the conch is longiconic and orthoconic in the genus, whereas it is breviconic and somewhat cyrtoconic in the apical part of this species. In the shape of the conch it resembles polyelasmoceratids, *Turoceras* Zhuravleva, 1959, for example.

References

Barrande, J. (1865—1877), Systém silurien de centre de la Bohême. Primiére Partie: Classe de Mollusques, Ordre de Cephalopodes, pts. 1—9, Supplément, pts. 1—2.

Barskov, J. S. (1972), Late Ordovician and Silurian cephalopod Molluscs of Kazakstan and Middle Asia. 107 pp. (12 pls.)

Chao Chin-k' K'e, Laing Hsi-luo, Tsou Hsi-p'ing, Lai T'sai-ken and Chang Jih-tung (1965), Fossil Cephalopoda of China. 389 pp. 85 pls.

Chen, Yuan-chen (1975), Fossil Nautiloids from Mount Jolmo Lungma Region. p. 267—309, (9pls.). Tibetan Scientific Expedition Team, Academia Sinica: Report of Scientific Expedition in the Mount Jolmo Lungma Region (1966—1968), Palaeontology, Fasc. 1, 423 pp.

————, and Liu Genwu (1974), Silurian nautiloids, p.190—194, pls. 87—90. Nanjin Institute of Geology and Palaeontology, Academia Sinica: Hand-Book of Stratigraphy and Palaeontology of South-West Region. 454 pp. 202 pls.

————, ———— and Chen Tingen (1981), Silurian Nautiloid Faunas of Central and Southwestern China. *Mem. Nanjin Inst. Geol. Palaeont., Acad. Sinica, No. 13*, 104 pp. 40 pls.

Chen Tingen (1981), Some Nautiloids from Xizang. p. 261—282, 5 pls. *Tibetan Fossils*, Fasc. 3, 354 pp.

Flower, R. H. (1939), Study on the Pseudorthoceratidae. *Paleont. Amer., v. 2, no. 10*, p. 253—442, pls. 23—31.

———— (1943), Annulated orthoceraconic genera of Paleozoic Nautiloids. *Bull. Am. Paleont., v. 28, no. 109*.

———— (1943), Some Silurian cyrtoconic cephalopods from Indiana with notes on stratigraphic problems. *Ibid. no. 109*.

Foerste, A. F. (1928), A restudy of American orthoconic Silurian cephalopods. *Denison Univ. Bull. J. Sci. Lab. v. 23*, p. 236—320, pls. 48—75.

———— (1934), Silurian cyrtoconic cephalopods from Ohio, Ontario and other areas. *Ibid., v. 29*, p. 107—194.

———— (1936), Silurian cephalopods of the Port Daniel Areas on the Gaspe Peninsula, in eastern Canada. *Ibid. v. 31*, p. 29—92, pls. 4—26.

Hamada, T. (1959), On the taxonomic position of *Favosites hidense* and its Devonian age. *Japan. J. Geol. Geogr. v. 30*, p. 201—212, pl. 15.

Hirata, M. (1965), Discoveries of *Orthoceras* and Graptolites from the Gotlandian System of Mt. Yokokura, Ochi Town, Takaoka County, Kochi Prefecture. *Chigaku-kenkyu, v. 16, no. 8*, p. 247—248.

Kobayashi, T. (1935), On the phylogeny of the primitive nautiloids with description of *Plectronoceras liaotungense*, new species and *Iddingsia* (?) *shantungensis*, new species. *Japan. J. Geol., Geogr., v. 12*, p. 17—26, pl. 6.

———— (1958), A Gotlandian nautiloid from the Hida plateau in Japan. *Trans. Proc.*

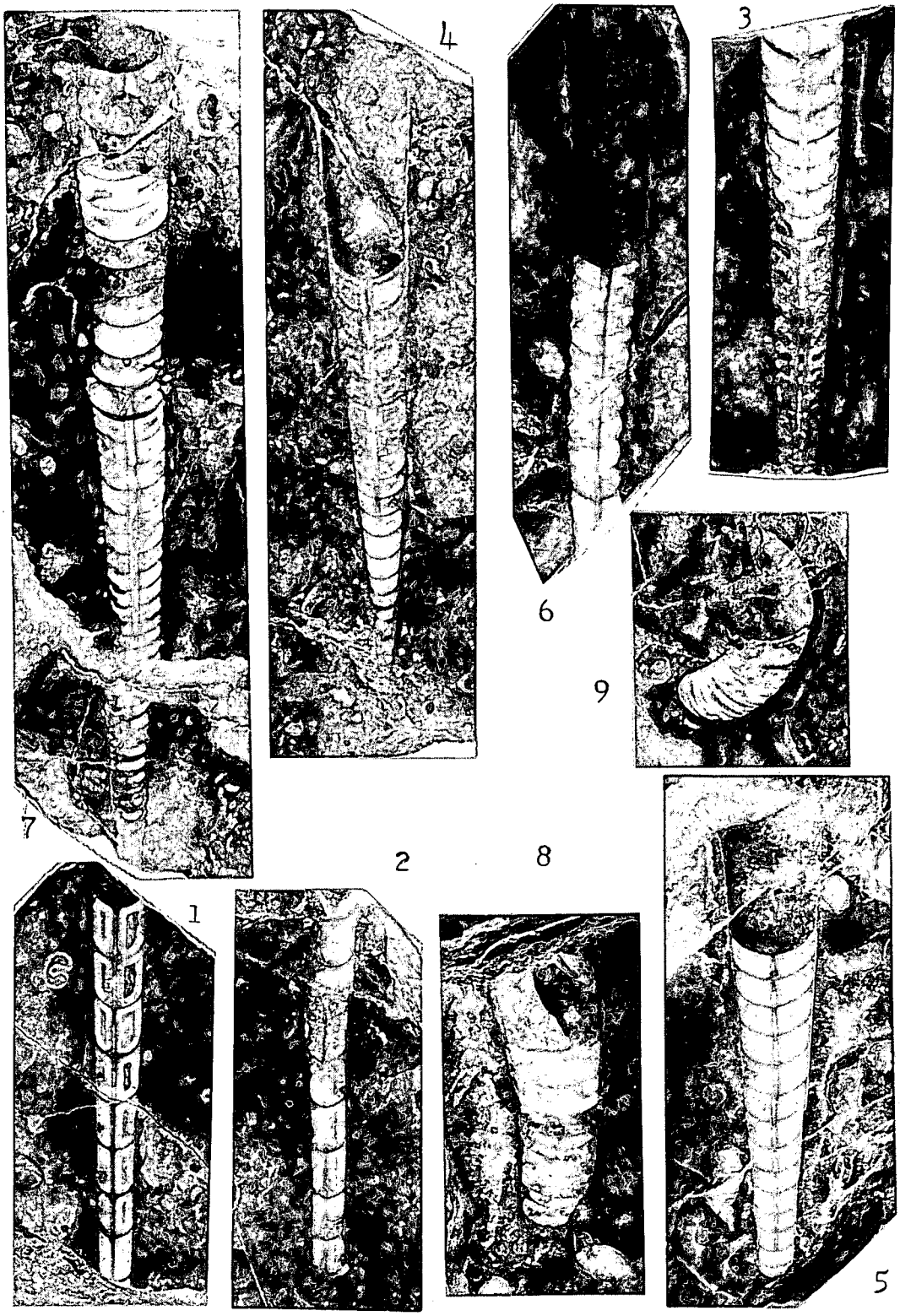
Palaeont. Soc. Japan, N. S., no. 31, p. 248—252, pl. 37.
——— and Hamada, T. (1974), Silurian trilobites of Japan in comparison with Asian, Pacific and other faunas. *Palaeont. Soc. Japan, Sp. Pap., no. 18*, 155 pp. 12 pls.
——— and ——— (1977), Devonian trilobites of Japan etc. *Ibid., no. 20*, 202 pp. 13 pls.
——— and Igo, H. (1956), On the occurrence of *Crotalocephalus*, Devonian trilobites in Hida, West Japan. *Japan. J. Geol. Geogr., v. 27*, p. 143—155, pl. 10.
Koizumi, H. (1975), Paleozoic cephalopods of Japan. 149 pp. Teiseki Bunko.
Lai, Chaigeen (1964), *Jangziceras*— a new Silurian nautiloid genus. *Acta Palaeont. Sinica, v. 12, no. 1*, p. 116—128, (pl. 1).
Reed, F. R. C. (1906), The Lower Palaeozoic fossils of the Northern Shan States, Burma. *Palaeont. Indica, N. S., v. 2, mem. no. 3*, 154 pp., 8 pls.
Ristedt, H. (1968), Zur Revision der Orthoceratidae. *Abh. Math. Nat. Kl. Akad. Wiss. Lit. Mainz Jahrg., Nr. 4*, 287, pp. 5 pls.
Shimansky, V. N., Balashov, Z. L. and Zhuravleva, F. A. (1962), Superorder Nautiloidea, p. 33—169, pls. 1—44. Orlov's *Osnoby Paleontologii*, 438 pp. 89 pls.
Shimizu, S. and Obata, T. (1935), New genera of Gotlandian and Ordovician nautiloids. *Shanghai Sci. Inst. Jour., ser. 2, v. 2*, p. 1—10.
Teichert, C. et al. (1964), Cephalopoda. Moore's Treatise on Invertebrate Paleontology, Part K, Mollusca, 3, 519 pp.
——— and Glenister, B. F. (1952), Fossil nautiloid faunas from Australia. *Jour. Paleont., v. 26, no. 5*, p. 730—752, pls. 104—108.
——— and ——— (1953), Ordovician and Silurian cephalopods from Tasmania, Australia. *Bull. Am. Paleont., v. 24, no. 144*, p. 5—54, 6 pls.
Thein, M. L. (1973), The Lower Paleozoic stratigraphy of western part of the Southern Shan State, Burma. *Geol. Soc. Malaysia, Bull. 6*, p. 143—163.
Troedsson, G. (1931), Studies on Baltic fossil cephalopods. I. On the nautiloid genus *Orthoceras*. *Lunds Univ. Arssskrift, N. F. Avd. 2, Bd. 27, Nr. 16*, p. 5—34, 4 pls.
Wang, Ruzhi (1978), Nautiloidea, p. 402—431, pls. 153—164. Southwest China Institute of Earth Sciences: *Fossil Atlas of Southwest China*, Fasc. Sichuan Region (1), Silurian-Devonian. 617 pp. 185 pls.
Yang, Shengwu (1978), Nautiloidea, p. 358—383, pls. 132—142. Guizhou Research Team of Geology and Palaeontology: *Fossil Atlas of Southwest China*, Fasc. Guizhou (1), Cambrian-Devonian. 843 pp. (214 pls.)
Zhuravleva, F. A. (1978), Devonian Orthoceroids of Superfamily Orthoceratoidea. *Trudi Paleont. Inst., tom. 168*, 222 pp. (23 pls.)

Postscript

As an advance report, "On the Silurian Cephalopod Faunule from Mt. Yokokura, Kochi Prefecture, Japan" was communicated by the author at the Japan Academy meeting, November 12, 1983. It was pointed out that the route of migration for the Silurian cephalopods was extended from Japan to Central Europe through China, Pamir, Central Asia and Podolia, and two new species, *Arionoceras densiseptum* and *Orthocycloceras gomienese* which occur in association with *Michelinoceras* α and β, n. spp., *Leuroorthoceras* (?) sp. indet. and *Protokionoceras* (?) n. sp. were briefly described in *Proc. Japan Acad. v. 59—B*, p. 293—295, 1983.

PLATES Ⅲ～Ⅳ

Explanation of Plate Ⅲ


1
2
3
4
5
6
7
8
9

Explanation of Plate IV

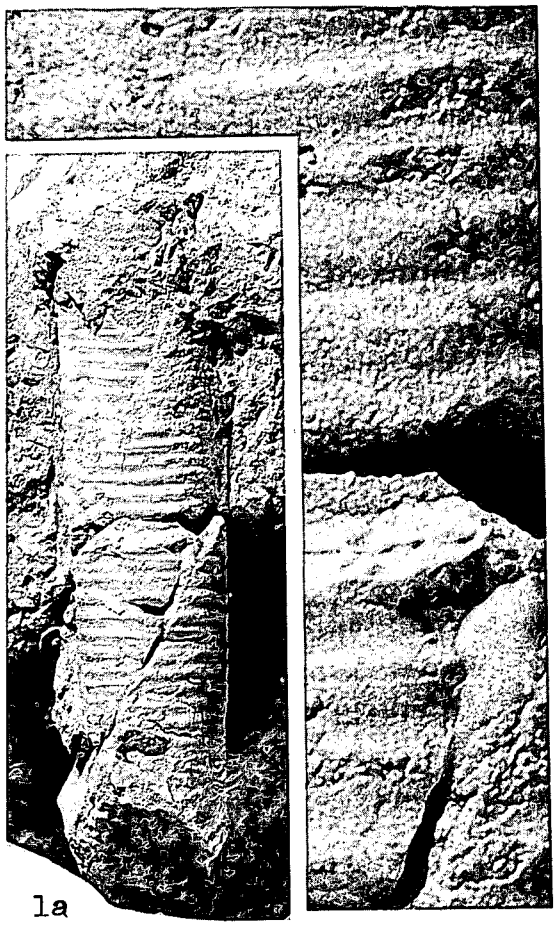
Leurocycloceras (?) sp. indet. ..... p. 248
Figure 1 a. Lateral view of annulated conch, KGS 3584
Figure 1 b. Transverse annuli and longitudinal lirae of the same specimen, × 5

Orthocycloceras gomiense Kobayashi, sp. nov. ..... p. 248
Figure 2. Lateral view of the paratype conch, with transverse annuli and longitudinal lirae, × 1, KGS 3588

Protokionoceras (?) *fessicancellatum* Kobayashi, sp. nov. ..... p. 249
Figure 3 a. Lateral view of the holotype conch, × 1, KGS 3587
Figure 3 b. Lattice of lirae on the surface of the same conch, × 7

Cephalopod-bearing limestone slab ..... p. 241
Figure 4. Three medium-sized conchs and several small ones on the polished surface.

Repository of the specimens
KGS: Laboratory of Geology, Faculty of Science, Kochi University



1a

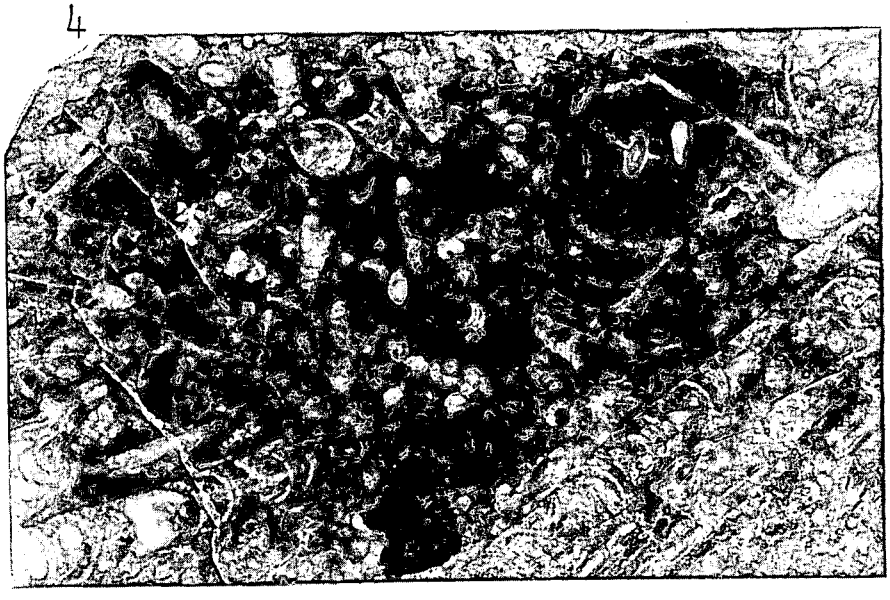
1b

3b

3a

2

4



Section III

Advance Report on a new Trilobite Collection of the Silurian Yokokura-Yama Fauna, Shikoku Island, Japan*

by Teiichi KOBAYASHI and Takashi HAMADA
The Japan Academy & the University of Tokyo

Mt. Yokokura is one of the richest trilobite areas in Japan. As shown in the Table I the authors have described already in 1974, 27 species in 14 genera and seven families of trilobites, that is, the Illaenidae, Thysanopeltidae, Proetidae, Cheiruridae, Encrinuridae, Phacopidae and Lichidae. Beside them, there were several forms exactly indeterminable. They were collected by M. Hirata and others from three localities of the mountains, i. e., Mt. summit, Sugihara shrine and Gomi, but most of them were procured at Gomi limestone quarry. These type specimens are stored either in the Kochi Prefectural Fossil Museum (KPFM) or the University Museum of the University of Tokyo (PAt). As the result of that study the age of the *Encrinurus nodai* horizon at the summit was determined to be late Middle Silurian, and those of the *Encrinurus tosensis* horizon at Sugihara shrine and the *Cerauroides orientalis* horizon at Gomi quarry to be early Upper Silurian, but the former being slightly older than the latter horizon.

Recently, a small collection comprising eleven trilobite specimens from the Gomi quarry was sent to the senior author from Professor Jiro Katto of the Kochi University for examination and the joint authors' study is now in progress. By request of Prof. Katto they prepared an advance report of their study herein. Putting aside a cranidium which is too poorly preserved the following eight species in six genera within five families are distinguishable at present.

I. Illaenidae Hawle and Corda, 1847
   1. *Bumastus agmakros* Kobayashi & Hamada, sp. nov.
   2. *Bumastus kattoi* Kobayashi & Hamada, sp. nov.
   3. *Bumastus sakoi* Kobayashi & Hamada, sp. nov.

II. Cheiruridae Salter, 1864
   4. *Pseudocheirurus* sp.

* Studies on Japanese Trilobites and Associated Fossils—XXXIII.

Table 1. Silurian trilobites from Mt. Yokokura (Kobayashi & Hamada, 1974)

Trilobites \ Locality	Summit	Sugihara	Gomi
1. *Bumastus (Bumastus) glomerosus*			X
2. *Bumastus* aff. *bariensis*			X
3. *Bumastus (Bumastus) subquadratus*			X
4. *Bumastus (Bumastella) spiculus*			X
5. *Bumastus (Bumastella) bipunctatus*			X
6. *Bumastus (Bumastella) asper*		X	X
7. *Japonoscutellum japonicum*		X	X
8. *Tosacephalus fungiformis*			X
9. *Illaenoscutellum platiceps*			X
10. *Kosovopeltis angusticostatus*			X
11. *Microscutellum primigenium*			X
12. *Proetus (Proetus) subovalis*			X
13. *Proetus (Gerastos) subcarinatus*			X
14. *Proetus (Geastos) sugiharensis*		X	
15. *Proetus (Bohemiproetus) magnicerviculus*			X
16. *Decoroproetus granulatus*			X
17. *Cerauroides orientalis*			X
18. *Cerauroides elongatus*			X
19. *Sphaerexochus hiratai*			X
20. *Sphaerexohus planirachis*			X
21. *Encrinurus yokokurensis*			X
22. *Encrinurus mamelon*			X
23. *Encrinurus nodai*	X		
24. *Encrinurus tosensis*		X	
25. *Staurocephalus* (?) sp.			X
26. *Phacops metacernaspis*			X
27. *Apolichas truncatus*			X

Ⅲ. Encrinuridae Angelin, 1854

5. *Encrinurus* sp.

6. *Staurocephalus* sp.

Ⅳ. Phacopidae Hawle and Corda, 1847

7. *Eophacops* (?) sp.

V. Lichidae Hawle and Corda, 1847

8. *Apolichas* (?) sp.

8'. Hypostome of *Apolichas* (?)

One of the significant characteristics for the Gomi faunule is the abundance of *Bumastus* in species and individuals. In adding three new species, the genus is now represented by eight species. In South China the family Illaenidae include *Ptililaenus* and two endemic genera, *Meitanillaenus* and *Wuchuanella* in the Lower Silurian fauna, but *Bumastus* is unknown from the Silurian rocks (Yin and Li, 1978), although it is contained in the Ordovician fauna (Lu, 1975).

The find of *Pseudocheirurus* at Gomi is particularly important, because it is an additional evidence for the Upper Silurian age of the Gomi faunule. *Pseudocheirurus beyrichi* (Barrande, 1846) occurs in Bohemia, Czechoslovakia in the lower Ludlovian Kopanina formation (Horny and Bastl, 1970). It is noted further that Nan's *Cheirurus strabo* (1976) from the Upper Silurian of Inner Mongolia is possibly congeneric with this species, although original *Cheirurus strabo* Weber, 1932 which was described from the Lower Devonian of Ferghana, Turkestan, is distinct from the Japanese species.

As clarified by Wu Hongji (1979), encrinuroids greatly flourished in Southwestern China in the Middle Silurian period, as well represented by *Encrinuroides* Reed, 1931, *Coronocephalus* Grabau, 1924 (*Coronocephalus* and *Coronocephalina* Ji, 1979), *Kailia* Chang, 1974 (*Kailia* and *Parakailia* Ji, 1979), *Senticuculus* Xia, 1974 and *Rongxiella* Chang, 1974. *Encrinuroides* has been known from Middle and Upper Ordovician of Eur-America, but in China it occurs in the range of the late Ordovician-middle Silurian age. All other genera and subgenera above cited are indigenous to China except for one species, *Coronocephalus kobayashii* Hamada, 1959, which must be revised in further study, from the late or medeaval Middle Silurian G_2 stage of the Gion-yama group in Kyushu.

Thus the ages of the trilobite horizons in the Gion-yama and Yokokura-yama areas are further confirmed through this study. The absence of *Bumastus* and rarity of *Encrinurus* in the Silurian fauna of Southwest China are probably due to the state that little is as yet known of the Upper Silurian trilobites there, notwithstanding the fact that the copious trilobite fauna of the older Silurian age has already been described therefrom.

Of the remainder of the new trilobite collection it is still premature for the authors to express any definite opinion. A few words, however, may be added as to *Staurocephalus* sp. It is evidently distinct specifically from *Staurocephalus* (?) sp. which the authors have described previously. This species looks to the authors particularly interesting palaeontologically in showing an example of homoeomorphic convergence with *Paraphillipsinella* Lu, 1974 which thrived in China in the late Ordovician age, as summarized by Ji Zailiang (1982).

On this occasion the authors describe three new species of *Bumastus* as below.

Description of Trilobites

Family Illaenidae Hawle and Corda, 1847

Genus *Bumastus* Murchison, 1839

Bumastus agmakros Kobayashi and Hamada, sp. nov.

Plate V, Figures 1 a, b

An unusually long pygidium, 29mm long, a little narrower than long, semiparabolic in outline, very regularly and moderately convex toward its centre; articulating margin very gently arcuate; axial lobe nearly half as wide as pygidium; axial furrows completely effaced; marginal border absent; test smooth.

Such an elongate outline of the pygidium and its simple convexity are two characteristics which easily distinguish this species from most of the Illaenidae. Its broad axis and obsolete axial furrows reveal its being a member of *Bumastus* rather than *Stenoparia*. It resembles *Illaenus weberi* Warburg, 1925 from the *Leptaena* limestone, but the Swedish pygidium is not so long as this, steeply slanting near the margin and surrounded by a less slanting narrow border. Weber's *Bumastus* sp. 2 from the Ordovician of Kazakhstan (1948) is another resembling pygidium in simple warping up toward centre, but its outline is quite different from this species.

Bumastus kattoi Kobayashi and Hamada, sp. nov.

Plate V, Figures 2 a—b, 3 a—d.

Cephalon strongly convex, most elevated between eyes and most expanded laterally through eyes; axial furrows obsolete; occipital margin about half as wide as posterior margin; genal margin well rounded; eyes prominent, very large, nearly half as long as cephalon and located fairly posteriorly; facial suture extending forward from eye, describing a gentle arc, and posteriorly cutting the posterior cheek margin at the limit of eye; test smooth.

This species is represented by two cephala. One in figures 2a-b is the holotype and the other in figures 3a-b the paratype. It is intimately related to the *Bumastus* (*Bumastella*) *bipunctatus* from which it can be readily distinguished by the absence of the median tubercle and a pair of pits on the axial furrows. Otherwise, however, these two species are almost identical.

Bumastus sakoi Kobayashi and Hamada, sp. nov.

Plate V, Figures 4 a—d

This cranidium is fairly well convex toward its centre. Axial furrows are absent, but in the posterior view the fixed cheek is seen to be slightly depressed below the level of the glabella. Eyes are fairly large and placed far posteriorly. The breadth

between the eyes equals to the length of the cranidium. Facial sutures are relatively long, almost straight and a little divergent, but they do not extend beyond the limit of the eyes. Their posterior branches are very short and cut the posterior margin on the parallels of the eyes.

The preceding species can be easily distinguished from this species by the greater convexity of the cephalon and the larger and prominent eyes. Among the Yokokura-Yama trilobites the nearest to this species is *Bumastus* (*Bumastella*) *asper* which, however, disagrees with that species in the possession of a fine median carina on the cranidium and the smaller eyes.

References

Hamada, T. (1959): Gotlandian shelly fauna from Southwest Japan (1), *Coronocephalus kobayashii*, a new species from the Kuraoka district, Kyushu, Japan. *Japan. Jour. Geol. Geogr.*, vol. 30, pp. 71–88, pl. 6.

Harrington, H. J. et al. (1959): Arthropoda 1, Moore's Treatise on Invertebrate Paleontology, Part O, 560 pp.

Horny, E. and Bastl, F. (1970): Type specimens of fossils in the National Museum, Prague, vol. 1, Trilobita. 154 pp., 20 pls.

Ji, Zailiang (1982): Stratigraphical distribution and range of the trilobite family Phillipsinellidae in South China. *Bull. Geol. Inst., Chinese Acad.*, 57–68, pl. 1.

Kobayashi, T. and Hamada, T. (1974): Silurian trilobites of Japan in comparison with Asian, Pacific and other faunas. *Palaeont. Soc. Japan, Sp. Pap.*, no.20, 202 pp. 13 pls.

Lu, Yenhao (1975): Ordovician trilobite faunas of Central and Southwestern China. *Palaeontologica Sinica*, no. 152, 463 pp., 50 pls.

——— and Chang, Wentang (1974): Ordovician trilobites. pp. 124—136. *Nanjin Inst. Geol. Palaeont., Acad. Sinica: Handbook of the stratigraphy and palaeontology of Southwest China.* 454 pp., 202 pls.

———, ———, Chu Chaoling, Chien Yiyuan and Hsiang Leewen (1965): Trilobites of China. 2 vols. 766 pp., 135 pls. Nanjin Inst. Geol. Palaeont., Acad. Sinica. *Chinese Fossils of All Groups.*

Nan, Runshan (1976): Trilobita. pp. 333—352 in *Palaeontological Atlas of North China.* Inner Mongolia, Volume (1), Palaeozoic. 502 pp., 232 pls.

Warburg, W. (1925): The trilobites of the *Leptaena* limestone in Dalarne, etc. *Bull. Geol. Inst. Upsala*, vol. 17, 446 pp., 11 pls.

Weber, V. N. (1932): Trilobites of the Turkestan. *Mem. Comm. Geol. USSR, N. S.*, 178, 157 pp, 4 pls.

——— (1946): Trilobites of Silurian formation of USSR. *Monogr. Palaeont. USSR*, vol. 69, 113 pp., 11 pls.

Wu, Hongji (1979): Silurian *Encrinuroides* (Trilobita) from Southwestern China. *Acta Palaeont Sinica*, vol. 18, no. 2, pp. 147–150, pls. 1,2.

Yin, Gongzheng and Li, Shanya (1978): Trilobite. pp. 385—595 in *Palaeontological Atlas of Southwest China.* Fasc. Guizhou (1), Cambrian-Devonian, Acad. Sinica, pp. 843, 214 pls.

Postscript

The second bunch of trilobites which Prof. Katto sent the senior author at the end of last August contains the following species:

Scutelluidae R. & E. Richter, 1955

1. *Japonoscutellum* sp.

Proetidae Salter, 1864

2. *Proetus* (*Gerastos*) *sugiharensis* Kobayashi and Hamada, 1974

Encrinuridae Emmrich, 1844

3. *Encrinurus* a sp.
4. *Encrinurus* b sp.
5. *Encrinurus* c sp.

Encrinurus a sp. is represented by a pygidium which belongs probably to an identical species with a cephalon of *Encrinurus* listed on page 253. *Encrinurus* b sp. is indicated by another pygidium which is so similar to the preceding that they possibly reveals sexual dimorphism. *Encrinurus* c sp. comprises still another pygidium in addition to A-2 type pygidium of *Encrinurus* in Kobayashi and Hamada (1974), p. 98, pl. 10, figs. 7—8.

Beside them there are a pygidium of phacopid (?) and a cephalon of sphaerexochid (?). Thus the trilobite faunule of Mt. Yokokura will be greatly amplified with some 15 species including a few exactly indeterminable forms, attaining about 40 species in total.

(Manuscript Received : September 30, 1983)
(Published : March 23, 1984)

PLATE V

Explanation of Plate V

Bumastus agmakros Kobayashi & Hamada, sp. nov. ..... p. 256

Fig. 1a. A dorsal view of the holotype pygidium, ×2. KGS 3588

Fig. 1b. A left lateral view of the same specimen, ×2.

Bumastus kattoi Kobayashi & Hamada, sp. nov. ..... p. 256

Fig. 2a. A dorsal view of the holotype cephalon, ×3.7. KGS 3590

Fig. 2b. A right lateral view of the same specimen to show the position and the size of the eye, ×3.7.

Fig. 3a. A dorsal view of a paratype cranidium, ×2. KGS 3591

Figs. 3b-d. Frontal (b), rear (c) and right lateral (d) views of the same specimen, ×2.

Bumastus sakoi Kobayashi & Hamada, sp. nov. ..... p. 256

Fig. 4a. A dorsal view of the holotype cranidium, ×3.3. KGS 3592

Figs. 4b-d. Frontal (b), rear (c) and left lateral (d) views of the same specimen, ×3.3.

Pseudocheirurus sp.

Figs. 5a, b. An incomplete cranidium to show the glabellar lateral furrows, ×2.

Staurocephalus sp.

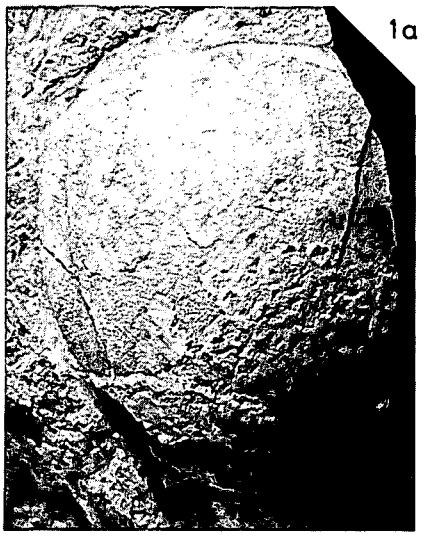
Figs. 6a, b. Dorsal (a) and left lateral (b) views of the cranidium, ×3.6.

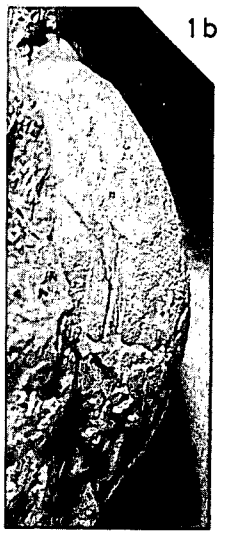
Encrinurus sp.

Figs. 7a-c. Dorsal (a), frontal (b) and left lateral (c) views of an incomplete cephalon to show the somewhat coarse granulation on the shield and a strongly bent frontal border, ×2.

Repository of the Speciemens

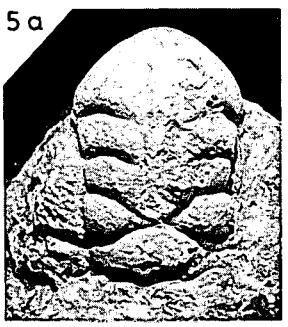
KGS : Laboratory of Geology, Faculty of Science, Kochi University


1a


1b

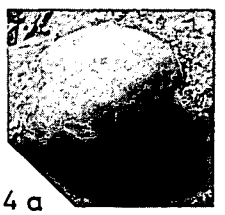

2a


2b

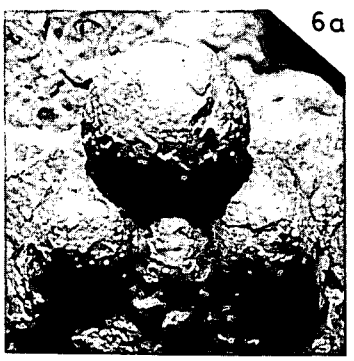

5a


5b


4b

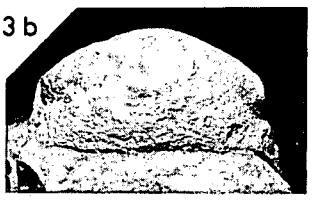

4a


3a

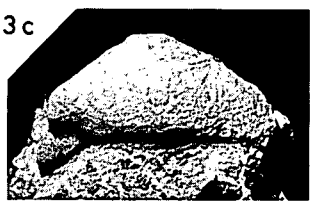

6a

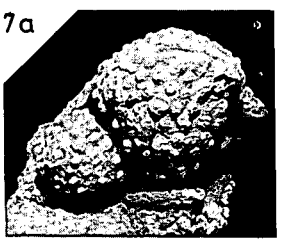

4c

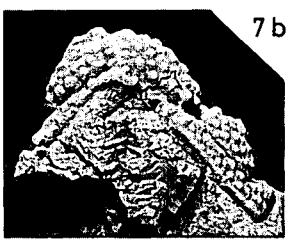

4d

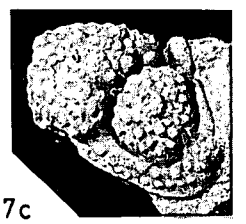

3b

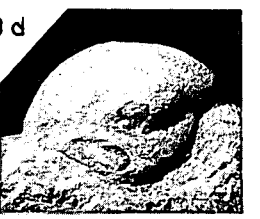

6b


3c


7a


7b


7c


3d