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Studies on the Ordovician Stratigraphy and Palaeontology of North Korea with Notes on the Ordovician Fossils of Shantung and Liautung

BY

TEIICHI KOBAYASHI

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By

Teiichi KOBAYASHI

I) Introduction

Since Professor H. Yabe[1] reported the occurrence of *Actinoceras richthofeni* Frech from the Bantatsu Bed of Ordovician age, considerable time has elapsed without any contribution having been made to the literature of the Ordovician formation of North Korea. Some years ago I[2] described *Tofangoceras* sp. undt. from Kokai near the northern boundary of Korea, *Actinoceras richthofeni* Frech, *Actinoceras nanum* Grabau, and *Stereoplasmoceras pseudoseptum* Grabau from the Bantatsu Beds near Heijo. Recently I visited the Bantatsu area in order to clear up certain obscure points regarding these Beds. The following is a brief summary of my paper[3] already published concerning the Bantatsu Beds.

The Ordovician formation of the area is divisible, in descending order, as follows:—

i) Nanso Bed.—Gray coloured, more or less crystalline, limestone. The lower part is often arenaceous with false beddings. No fossils..... ..... Thicknėss about 50–70 m.

ii) Unkaku Bed.—Fossiliferous limestone with irregular, gray dolo-

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1) Yabe, H. (1919), Report on the Anthracite Formation in Heian-do, Chosen (Korea). (Bull. Geol. Surv. Chosen, (Korea), Vol. I. Pt. 1.).

Yabe, H. and I. Hayasaka (1920), Paleontology of Southern China, p. 54, foot-note.

2) Kobayashi, Teiichi (1926–27), Ordovician Fossils from Korea and South Manchuria, (Japan. Jour. Geol. & Geogr., Vol. V.), p. 207.

3) Kobayashi, T. (1930), On the Bantatsu Bed of the Ordovician Age. (ibid., Vol. VII.).

mitic patches in black matrix. When weathered, the surface of the rock usually becomes uneven owing to different materials forming the patches and the matrix. From several places, such as Taisei-ri, Unkaku-ri, Nanso-ri, and Shoko-ri, a good collection of fossils was obtained, from which, among others, the following species have been determined:—

Bucania katoi Kobayashi.
Lophospira acuta Grabau.
Lophospira konnoi Kobayashi.
Lophospira kodairai Kobayashi.
Lophospira subpulphella Kobayashi.
Lophospira bantatsuense Kobayashi.
Lophospira morrisi Grabau.
Lophospira gerardi Grabau.
Lophospira trochiformis Grabau.
Pagodispira tetracarina Kobayashi.
Liospira barbouri Grabau.
Eotomaria concava Kobayashi.
Ophiletina (?) *shokoriense* Kobayashi.
Eccyliopterus kushanensis Grabau.
Helicotoma yabei Kobayashi.
Helicotoma tamurai Kobayashi.
Trochonema ozawai Kobayashi.
Trochonema ozawai var. *depressa* Kobayashi.
Maclurea tofangoense Kobayashi.
Vaginoceras cf. *multitubulatum* (Hall).
Cycloceras mantalense Kobayashi.
Cycloceras kawasakii Kobayashi.
Stereoplasmoceras pseudoseptum Grabau.
Actinoceras richthofeni Frech.
Actinoceras submarginale Grabau.
Actinoceras manchurense Kobayashi.
Actinoceras exogastrale Kobayashi.
Actinoceras (*Ormoceras* ?) *nanum* Grabau.

Ormoceras tani (Grabau).

Ormoceras suampanoides (Grabau).

Ormoceras harioi (Kobayashi).

.....Thickness about 60 m.

iii) Bantatsusan Bed.—Alternation of dark gray massive limestone and bluish-gray thinly bedded limestone. This formation is more resistant to erosion than the others, so that it frequently forms high ridges. Among the fragmentary fossils obtained from this bed is a specimen that belongs undoubtedly to *Stereoplasmoceras*....Thickness about 200 m.

iv) Kosei Bed.—Alternation of gray marly slate and bluish white, sometimes crystalline, limestone. When weathered, the limestone and marl assume a yellowish white tint. No fossils.

From the palaeontological evidence both the Unkaku Bed and the Bantatsusan Bed belong undoubtedly to the middle Ordovician, the former being the North Korean equivalent of the Toufangkou-Machiakou limestone of South Manchuria and North China. The "Bantatsu Beds" is a name at first given provisionally to the Ordovician formation underlying the Palaeozoic coal-bearing formation, but I restrict this name to the Beds of Nanso, Unkaku, and Bantatsusan.

Recently Professor H. Yabe and Mr. T. Sugiyama[1] described the Ordovician Stromatoporoids from four localities in North Korea as follows:—

(1) Northern foot of Bantatsu-san, (or Matatsu-san), Kwasen-do, Koto-gun, South Heian-do.[2]

(2) Shorin-ri, (or Songnim-ni), northeast of Kenjiho, Koshu-gun, Kokai-do.[3]

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1) Yabe, H. and T. Sugiyama (1930), On some Ordovician Stromatoporoids from South Manchuria, North China and Chosen (Corea) with Notes on Two New European Forms. (Sci. Rep. Tohoku Imp. Univ., Sendai, Japan, Second Series, Geology, Vol. XIV, No. 1.)

Yabe, H. and T. Sugiyama (1930), Notes on Two Stromatoporoids from Chosen (Corea). (Japan. Jour. Geol. & Geogr., Vol. VIII, Nos. 1–2.)

2) 平安南道江東郡貨泉洞晩達山 (或は馬達山).

3) 黄海道黄州郡黍二浦東北 松林里.

(3) Katorei-ri (or Hatoryong-ni), Sanjo-men, Tokusen-gun, South Heian-do.[1)]

(4) Western Hill of Seiso (So-chang), Hika-men, Tokusen-gun, South Heian-do.[2)]

The materials from the first locality were collected by Professor H. Yabe, and those from the remaining three by me.

Specific Names \ Localities	(1)	(2)	(3)	(4)
1) *Labechia variabilis*		×		
2) *Labechia regularis*	×			
3) *Labechia regularis* var. *tenuis*	×		×	
4) *Labechia coreanica*	×			
5) *Syrigostroma incrustans*				×

Notwithstanding the richness of the Toufangian fauna, nothing is known of the Wolungian and Wanwanian of North Korea. In my Ordovician research in the last mentioned region, many observations were made and much material procured, and these will be found described as we proceed.

II) The Ordovician Formation of the Tokusen, Junsen and Kogen Areas

i) When Dr. S. Kawasaki and Mr. E. Tamura[3)] examined the geology and mineral resources of South Heian-do, they observed on the

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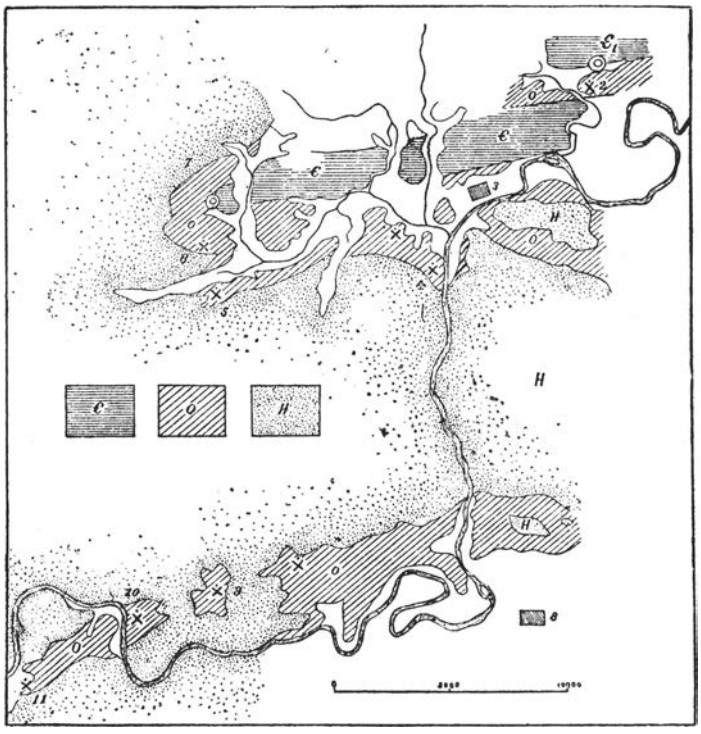
1) 平安南道德川郡甕上面下陶令里.

2) 平安南道德川郡日下面西倉.

3) Kawasaki, S. (1913), Mineral Resources of Chosen, Vol. II, (South Heian-do, Part I).

Tamura, E. (1917), Mineral Resources of Chosen, Vol. II, (South Heian-do, Part II.)

Figure 1. INDEX MAP SHOWING THE ORDOVICIAN FOSSIL LOCALITIES IN THE TOKUSEN AREA.



×	化石産地	Fossil Locality.
◎	大渦巻石灰岩	Limestone with Cryptozoon-like structure.
e	寒武利亞紀層	Cambrian Formation.
o	奥陶紀層	Ordovician Formation.
H	平安系	Heian System.
1	三湘洞	Samsangdong.
2	貞女洞	Chyongnyo-dong.
3	德川	Tokusen.
4	龍田里	Nongjon-ni.
5	方哥洞	Pang-ka-chi.
6	西倉	Sochan.
7	下洞	Hakol.
8	屠岩洞	Kulam-dong.
9	下陶令里	Hatoryong-ni.
10	鳳倉里	Hosori.

southern side of the river Seisen-ko an extensive distribution of the Great Limestone Series of Cambro-Ordovician age surrounding the Permo-Carboniferous coal-bearing series. When some years ago Messrs. K. Ichimura, R. Kodaira, and T. Shiraki[1] were engaged on a detailed survey of the coal-fields, they came across some Ordovician fossil localities.

The Heian, that is the above mentioned coal-bearing system, forms three structural basins of subelliptical outline, though the basinal areas are mountainous. The Ordovician formation is exposed between the basins, forming somewhat complicated domes or anticlinoria. The main axes of the basins and domes take an E.-W. trend—the "Liautung direction" of Professor B. Koto.[2]

The geological succession of the Ordovician formation of the area, in descending order, is as follows:—

Bed T_3. Dark gray or light blue coloured limestone, massive or thinly bedded, and sometimes cut by calcite veins in all directions.....Thickness about 300 m.

Bed T_2. Grayish white banded limestone.....Thickness about 50 m.

Bed T_1. Crystalline dolomitic limestone of dark gray colour which shows sometimes a *Cryptozoon* like structure, as well seen at the village of Samsang-dong.[3].....
.....Thickness about 50 m.

The Ordovician formation is disconformably overlain by the Koten Bed of the Heian System, and conformably overlies the slabby limestone, which intercalates layers of intraformational conglomerate, or "Wurmkalk," considered to be of Upper Cambrian age.

The following species of fossils were collected from the area in my journey last spring:

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1) Ichimura, K., R. Kodaira, and T. Shiraki (1927), Geological Map of the Northern Coal-Field of South Heian-do.

2) Koto, B. (1903), An Orographic Sketch of Korea. (Jour. Coll. Sci. Imp. Univ. Tokyo, Vol. XIX, Art. 1).

3) 平安南道德川郡豐德面三湘洞.

1) *Ormoceras tani* (Grabau) from Bed T_3 of Chyongnyo-dong, Hotoku-men, Tokusen-gun.[1)]
2) *Archaeocyathus* sp. from a block at Nongjon-ni, Tokusen-men, Tokusen-gun.[2)]
3) *Maclurea* cf. *tofangoense* Kobayashi from Bed T_3 at Nongjon-ni, Tokusen-men, Tokusen-gun.
4) *Actinoceras richthofeni* Frech, *Actinoceras* cf. *richthofeni* Frech, *Actinoceras submarginale* Grabau, *Actinoceras* cf. *submarginale* Grabau, *Ormoceras tani* (Grabau), *Ormoceras* cf. *tani* (Grabau), and *Actinoceras* sp. from Bed T_3 at Panggachi, Nikka-men, Tokusen-gun.[3)]
5) *Ormoceras suampanoides* (Grabau) from Bed T_3 at a point between Kulam-dong and Seikaku-ni, Sanjo-men, Tokusen-gun.
6) *Piloceras* sp. from a block at Hahtoryong-ni, Sanjo-men, Tokusen-gun.[5)]
7) *Actinoceras curvatum* Grabau from Bed T_3 at Hosori, Homei-men, Junsen-gun.[6)]

In Mr. T. Shiraki's collection I found *Ellesmereoceras* cf. *elongatum* Kobayashi, obtained from the dolomitic limestone of Bed T_1 at Hakol, Nikka-men, Tokusen-gun.[7)]

It is interesting to note (1) that Bed T_3, represented by a number of actinoceroids of various localities, is considered to be of the Toufangian age; (2) that the occurrences of *Piloceras* sp. and *Archaeocyathus* sp. suggest the existence of the Wolungian in the Tokusen area; and (3) that Bed T_1 is no doubt the Wanwanian, seeing that *Ellesmereoceras elongatum* Kobayashi is the characteristic member of the Wanwanian in

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1) 平安南道德川郡豐德面貞女洞.
2) 平安南道德川郡德川面龍田里.
3) 平安南道德川郡日下面方哥里.
4) 平安南道德川郡甕上面窟岩洞と棲鶴里の間.
5) 平安南道德川郡甕上面下陶令里.
6) 平安南道德川郡鳳鳴面鳳倉里.
7) 平安南道德川郡日下面下洞.

the Hualienchai and Niuhsintai areas, South Manchuria, where the base of the Wanwanian is well marked by the Wanwankou limestone of *Cryptozoon* like structure, as well seen at the base of Bed T_1 in this area. (See Plate IX).

ii) The Junsen area occupies the southern side of the Northern Coal-field of South Heian-do, which was surveyed by Mr. I. Tateiwa for the sheet map of Korea. The Great Limestone Series of this area is much disturbed, and its fossil contents extremely scanty. Mr. Tateiwa fourtunately found fragments of Brachiopod and Trilobite in shale at a point to the south of Are-sa-kol,[1] the former being an indeterminable Orthid, and the latter a cranidium of *Pliomera* (*Pliomerops ?*) *koseiensis* sp. nov. The shale is dark gray and weathers to a yellowish tint.

The shale is a characteristic layer in this area, lying above the dolomitic limestone and the banded limestone beds, and below the thick spotted limestone of the Toufangian type. From its stratigraphical position, as well as its lithological character, it is undoubtedly correlated to the Kosei Bed of the Bantatsu section, situated east of Heijo. The shale is not found in the Tokusen area. It may thin out toward the north.

Although the fossils just mentioned are unsatisfactory, being fragmentary, yet they are important as no fossil is found from the Kosei Bed of the Bantatsu section.

iii) The Kogen area lies on the northern side of Genzan or Wonsan, whence Mr. R. Kodaira, during his survey of the Kogen Coal-field,[2] procured a number of specimens from a block between Munange and Changtul, Sankoku-men, Kogen-gun,[3] which he kindly sent me. The specimens include many Ellesmereoceroids and corals, among which *Ellesmereoceras* cf. *elongatum* Kobayashi and *Archaeocyathus* (*Archæoscyphia*) *chihliense* Grabau have been identified. The whole collection is very interesting in that the former species is a characteristic member of the

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1) 平安南道順川郡密田面下史洞.

2) Kodaira, R. (1930), Kogen Anthracite Coal-field. (Report of the Korean Coal-field, Vol. V.)

3) 咸鏡南道高原郡山谷面門內浦と長坪の間.

Wanwanian fauna, and the latter of the Wolungian, so that the horizon to which the block belonged must be somewhat higher than the Wanwankou limestone of the Wanwanian, but lower than the Wolungian proper.

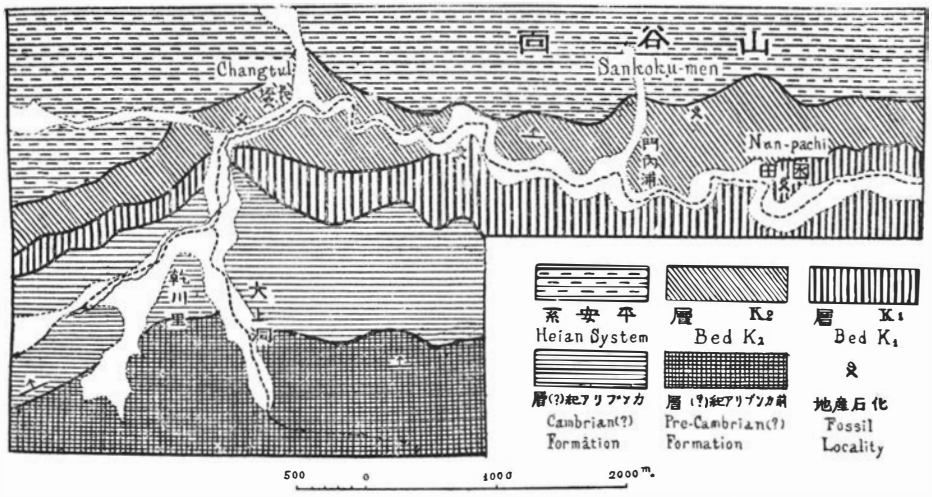

Figure 2. Geological Map of Changtul in the Kogen Area.

This spring I made a short trip to this area to determine the geological succession of the Ordovician formation. In Kokusan-men, Kogen-gun, South Kankyo-do, the following succession is observed, in descending order :—

A) The Heian System (The Koten Bed at the base.)

Unconformity

B) The Ordovician Formation.....Thickness about 350 m.

Bed K_2. Toufangian and Wolungian. Banded and spotted limestone of dark gray colour.

Bed K_1. Wanwanian. Gray crystalline dolomitic limestone.

Conformity

C) Cambrian (?) Formation.....Thickness about 800 m.

d) White finely bedded limestone.

c) Black spotted and banded limestone.

b) White massive limestone.

a) Black or gray slate.

Unconformity

A) Pre-Cambrian (?) Formation.

Phyllitic slates with intercalations of quartzite layers.

As no Cambrian fossil has been obtained, the age of the underlying formation is uncertain. The Ordovician formation is almost destitute of fossils, and what have been found are mostly ill preserved as the result of secondary deformation. The following species, however, have been determined : —

1) *Actinoceras* sp., collected from the upper part of Bed K_2, and *Piloceras* sp. from the lower part of the same bed at Changtul, Sankoku-men, Kogen-gun.

2) *Ellesmereoceras* sp., collected from the Upper part of Bed K_1 at Nun-pati, Sankoku-men.[1)]

From these collections the existence of the Wanwanian, Wolungian, and Toufangian has been made known. It is important that in the Kogen section, the Ordovician formation is comparatively thinner than the other sections so far known in Korea.

iv) The geological sections of the three areas are most probably correlated as shown in the following table :—

Locality / Geological Age	Kogen Area	Tokusen Area	Junsen Area
Toufangian.	Bed K_2 { Actinoceras Limestone.	Bed T_3 { Actinoceras Limestone.	Spotted Limestone.
Wolungian.	Bed K_2 { Piloceras Limestone.	Bed T_2 { Piloceras & Archaeocyathus Limestone.	Pliomera Shale.
Wanwanian.	Bed K_1 { Ellesmereoceras & Archaeocyathus Limestone.	Bed T_1 { Ellesmereoceras Limestone. Limestone with *Cryptozoon* like structure.	Dolomitic Limestone.

1) 咸鏡南道高原郡山谷面因田.

III) The Ordovician Formation of the Sosan, Kokai, and Kosho Areas

On the southern side of the river Oryokko or the Yalu, there are some patches of the Great Limestone Series. From this remote region came our knowledge of the Cambrian of Korea, as first made known by the writings of Dr. Carl Gottsche.[1] Afterward Professor S. Nakamura[2] surveyed the area, when he found an actinoceroid at Changsang-dong, Rinando, Gwaiki-men, Kokai-gun, North Heian-do,[3] belonging to the genus Tofangoceras, and already described in my previous paper.[4] It is the only Ordovician fossil recorded from these areas.

Last spring I made a geological trip to these districts with Mr. S. Kin to obtain more accurate knowledge of the Cambro-Ordovician formation. I shall refer here only to the Ordovician formation and its material, as I hope to describe in detail at no distant date the geology and palaeontology of the Cambrian formation.

A good succession of the Ordovician formation is observed near Kojo (or Kodang, Kojang) in the Sosan area. In descending order it is as follows:—

Overlying formation:—the Heian System.

Unconformity

The Ordovician formation.....About 500 m. in thickness.

S_5) Black spotted limestone frequently forming high cliffs..... ..... Toufangian.

S_4) Gray massive limestone.....Wolungian.

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1) Göttsche, C. (1886), Geologische Skizze von Korea, (Sitzungsberichte König. Preuss. Akad. d. Wiss. z. Berlin., XXXVI), p. 9.

2) Nakamura, S. and S. Shinowara (1913), Notes on the Mineral Resources of Kokai, Igen, Sosan and Hekido Prefectures, North Heian-do. (MS).

3) 平安北道江界郡外貴面吏南洞獐上洞.

4) Kobayashi, T. (1926–27), Op. cit., p. 190.

S_3) Dark gray dolomitic limestone.
S_2) Dark gray dolomitic limestone with *Cryptozoon* like structure.
S_1) White or light gray limestone with *Cryptozoon* like structure.
} Wanwanian.

Conformity

Underlying formation :—the Upper Cambrian.

Our collection from the Sosan area contains the following species :—

1) *Maclurea niuhsintaiense* Kobayashi, found in a block of spotted limestone at Sanno-dong, To-men, Sosan-gun.[1] Also *Archaeocyathus* sp., found in a light gray limestone from the same locality.
2) *Ormoceras harioi* (Kobayashi), collected from a spotted limestone at an eastern cliff of Changpyong-dong, Nan-men, Sosan-gun.[2]
3) *Stereoplasmoceras submarginale* Kobayashi, *Ormoceras tani* (Grabau), *Actinoceras* (*Ormoceras ?*) *nanum* Grabau, *Actinoceras manchurense* Kobayashi, and *Discoactinoceras multiplexum* Kobayashi, collected from the spotted limestone at a northern cliff of Changpyong-dong, Nan-men, Sosan-gun.
4) *Actinoceras* (?) sp., collected from the spotted limestone at Mansang-dong, Nan-men, Sosan-gun.[3]
5) *Cameroceras styliforme* Grabau, collected from a block of dark gray massive limestone at Fuchu-dong Nan-men, Sosan-gun ;[4] the exact locality of the block is not known with certainty.
6) *Ophileta plana* Grabau, collected from a block at the northern slope of Paekokae Pass, north of Kojo.[5]
7) *Ellesmereoceras amplum* Kobayashi, *Piloceras* (?) sp. and *Coreanoceras kemipoense* sp. nov., collected from massive limestone at

1) 平安北道楚山郡東面山路洞.
2) 平安北道楚山郡南面倉坪洞.
3) 平安北道楚山郡南面馬上洞.
4) 平安北道楚山郡南面厚秋洞.
5) 平安北道楚山郡古面古場.

a cliff between Yuyang-dong, and Pyongdang-dong in a village of Ryuto-do, near Kojo, Sosan-gun.[1]

In this collection the actinoceroids are most abundant. The occurrence of *Discoactinoceras multiplexum* Kobayashi is interesting, since it is known so far only from the Toufangian of the Niuhsintai Basin. The Wolungian fauna is represented by some species of Piloceras, Cameroceras, Coreanoceras, Ophileta, and Archaeocyathus.

ii) I spent a few days in the Kosho area, the general geology of which was once studied by Mr. F. Yamanari,[2] and collected Ordovician fossils at the following two localities.

1) *Maclurea niuhsintaiense* Kobayashi, *Stereoplasmoceras tofangoense* Kobayashi, and *Stereoplasmoceras* sp., obtained from a pisolitic limestone at the northern point of Chilpyong-ni, Shichihei-men, Kosho-gun.[3]
2) *Ormoceras harioi* (Kobayashi), collected from a black limestone at Sangdong, in Fukodo, Nanshin-men, Kosho-gun.[4]

The Toufangian of this area contains some pisolitic limestone and black limestone, which differ entirely from the Toufangian rocks of the other sections. It is an interesting fact that no dolomitic limestone with *Cryptozoon* like structure has yet been found in this area.

Mr. S. Kin collected a few specimens in the Kokai area.

1) *Actinoceras* sp. from a spotted limestone at Changsang-dong, Rinando, Gwaiki-men, Kokai-gun.[5]
2) *Cyrtoactinoceras* sp. from a light gray coloured limestone at the southern slope of a pass north of Memil-kol, Kokai-gun.[6]

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1) 平安北道楚山郡古面龍塘洞の柳良洞と萍塘洞との間.

2) Yamanari, F. (1919), Geology and Ore-deposits of Fuchang Mine in North Phyöngan-Do, Korea. (MS).—(1919) Report on Geology of Fuchang Copper Mine, (Chosen Kogyokwaishi Vol. II). Pt. I, p. 23.

3) 平安北道厚昌郡七坪面七坪里.

4) 平安北道厚昌郡南新面富興洞上洞.

5) 平安北道江界郡外貴面吏南洞獐上洞.

6) 平安北道江界郡從西面麥洞.

Based upon the foregoing evidences, the three areas may be correlated as follows:—

Region / Geological Age	Sosan Area	Kokai Area	Kosho Area
Toufangian.	Actinoceras bearing spotted limestone.	Actinoceras limestone.	Actinoceras limestone.
Wolungian.	Piloceras bearing massive limestone.		
Wanwanian.	Bed S_3. Bed S_2. Bed S_1. Limestone with *Cryptozoon* like structure.		

IV) The Kenjiho and Koshu Area

Some years ago, Mr. K. Ichimura,[1] when studying the Iron ore deposits near Kenjiho and Koshu, discovered new localities of Ordovician fossils; *Maclurea* sp., *Orthoceras* sp. Some fragments of Brachiopoda are recorded from Ordovician limestone, dark gray with greenish spots, at the Maruyama limestone-quarry,[2] in the northern part of Aphyonche[3] and Ryusen-ri (or Sonrin-ri)[4] near Kenjiho. Some Ordovician fossils are also found at Tanchyon near Koshu.[5] Lately, Mr. S. Shimamura[6] surveyed the area to prepare Sheet-Map No. 8 of Chosen, when

1) Ichimura, K. (1923), Origin of the Iron Ore Deposits of Kenjiho, Koshu Prefecture, Kokai-do, Chosen. (Chosen Kogyokwaishi, Vol. VI.); Ichimura, K. (1924), Limonite Deposits of Kokkyo-men and Tenchu-men, Koshu Prefecture, Kokai-do, Chosen. (Chosen Kogyokwaishi, Vol. VII.)

2) 黃海道黃州郡松林面丸山採石場.

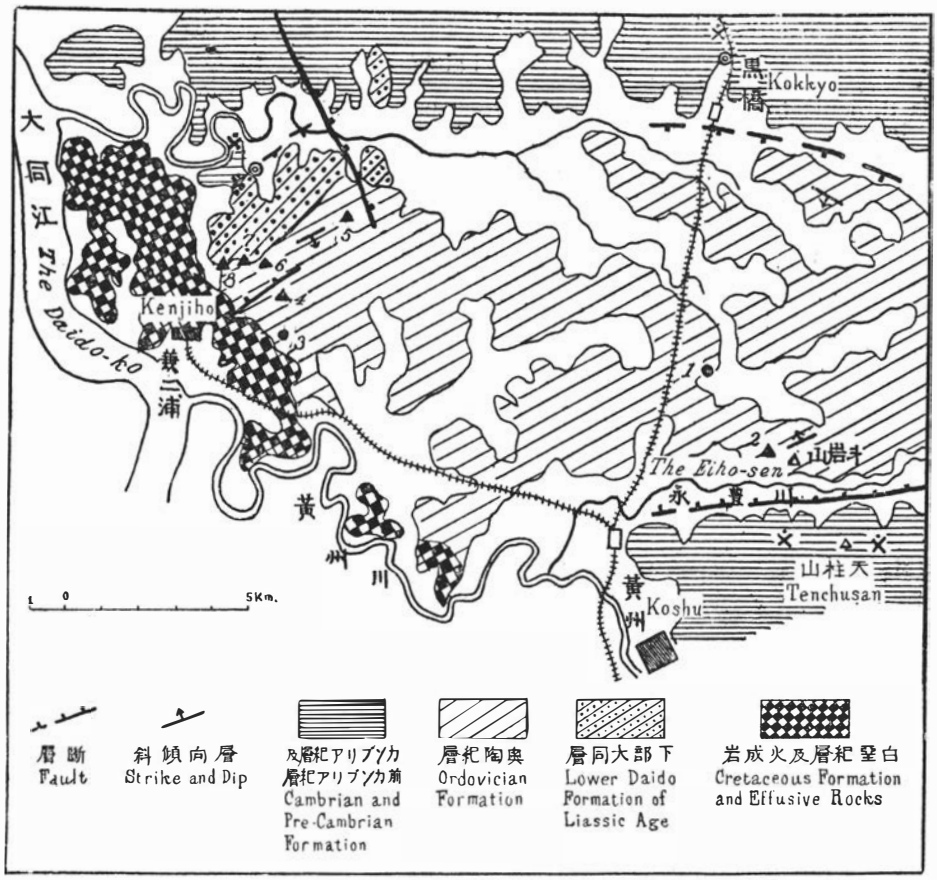
3) 黃海道黃州郡松林面前兄弟北方採堀場.

4) 黃海道黃州郡松林面龍川里 (或は松林里).

5) 黃海道黃州郡天柱面外下里堂中.

6) Shimamura, S. (1929), Geological Atlas of Chosen, No. 8.

he made a collection of the Ordovician fossils of these localities, among which I found some interesting forms of Piloceroids that are new to



× Cambrian Fossil Locality.

◎ *Girvanella manchurica* bearing Pisolitic Limestone, (Lower Cambrian).

▲ Wolungian Fossil Locality.

● Toufangian Fossil Locality.

1 Tangchon. *5* Chun-dang.

2 Toam-san. *6* Sapori.

3 Maruyama. *7* Shin-dong.

4 Aphyong-che. *8* Shorinri.

Figure 3. Geological Map of the Koshu Area.

science. They aroused my interest to such an extent that I visited the area and succeeded in making a large collection, which forms the material for this paper.

A low-land called the Koshu Peneplain[1] consists mainly of Ordovician formation, its geological structure being however of basin form; but it is difficult to thoroughly explain its geological structure, for the major part of the area is covered by later sediments and erosion products, such as "terra rosa," so that continuous exposures are difficult to find in such old-land topography. I came across only two reliable sections that could be verified by means of their fossils. One is a section of the western part of the Koshu peneplain and the other a section at a locality to the north of the Koshu railway station.

As shown in profile I, the Ordovician formation shows apparently a monoclinal structure, dipping generally S. S. E. with an angle of about 30 degrees. From its lithological characters it can be divided, in descending order, as follows:—

iii) Bantatsusan Bed. Alternation of massive limestone and dark gray banded limestone.....Thicknesss more than 150 m.

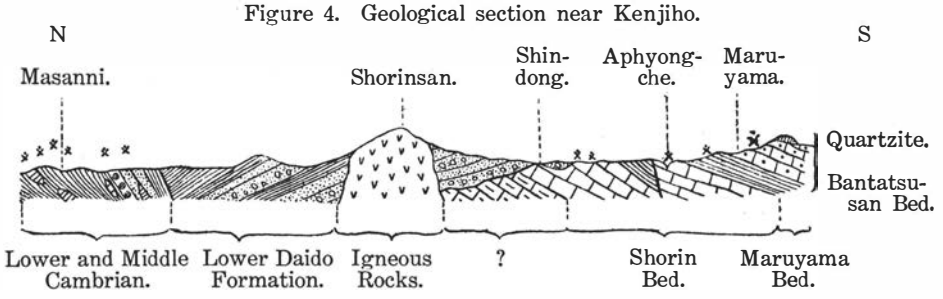
ii) Maruyama Bed. Alternation of bluish-gray compact limestone, and gray dolomitic limestone with some light gray slate bands that become yellowish on weathering....Thickness 70 to 100 m.

i) Shorin Bed. Alternation of dark gray limestone, and bluish-gray limestone with hard green fragments.....
.....Thickness more than 200 m.

The Shorin Bed containing the Piloceroid fauna is exposed in two

1) An extensive area is occupied by a marginal peneplain on the western side of the Korean Peninsula, with its western margin drowning into the sea of Tunghai. There is a plain typical of this character to the south of Heijo, which is about 25 meters above the sea level, and for which the name "Rakuroan Peneplain" is proposed by Professor S. Nakamura of the Kyoto Imperial University. Another plain of the same character is found near Koshu and Kenjiho, which is divided from the Rakuroan penelain by a range of monadnocks trending S. S. W.—N. N. E., and consisting mainly of Cambrian and older rocks.

Figure 4. Geological section near Kenjiho.



zones: one from Ryusen-ri to Chun-dang[1] through Shin-dong,[2] and the other from Soktap[3] to Aphyong-che. As shown in Fig. 4, the Shorin Bed, as well as the Maruyama Bed, are repeated in the section cut by a dislocation, though apparently monoclinal.

On the south-western side, Cretaceous effusive rocks cover the Ordovician formation, while on the northern side, the lower Daido formation of the Liassic age unconformably overlies the Ordovician formation, so that the base of the latter formation is concealed. A fault runs from E. N. E. to W. S. W. between the lower Daido formation and the middle and lower Cambrian formation.

Another section near Koshu lies on the other side of the structural basin. As shown in Fig. 5, the Ordovician formation has a strike E. N. E. to W. S. W., dipping N. N. W. some 20 to 30 degrees. A fault runs along the stream Eiho-sen,[4] which marks the boundary of the Ordovician basin from the Tenchu-san[5] range formed by an anticline of Middle Cambrian formation.

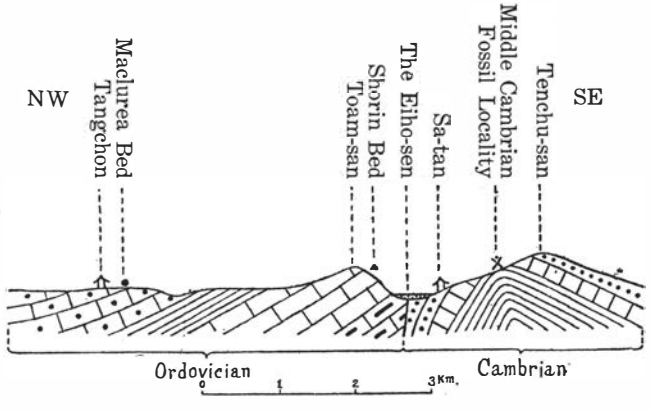


Figure 5. Geological section near Koshu.

Chinese characters: 1) 椿堂. 2) 新洞. 3) 石塔. 4) 永豐川. 5) 天柱山.

On a hill of Toam-san[1] I found *Raphistoma* cf. *ichimurai* sp. nov., *Coreanoceras kemipoense* sp. nov., and some others in the Shorin Bed. On this bed lie the Maruyama Bed and the Bantatsusan Bed in the order named, the latter containing *Maclurea* sp. at Tangchyon.

Of fossils collected from various localities in the Koshu area, the following species have been identified :—

i) From the Sonrin Bed at Shorinri, Keihori (or Sapo-ri),[2] Shin-dong, Chun-dang and Aphyong-che.

Syntrophia cf. *calcifera* (Billings).
Eoorthis (?) *coreanica* sp. nov.
Eoorthis (?) sp. undt.
Pterinea (?) *subasperula* sp. nov.
Liospira kawasakii Kobayashi.
Liospira lenticularis sp. nov.
Straparollus shirakii sp. nov.
Raphistoma ichimurai sp. nov.
Helicotoma kanekoi sp. nov.
Cyclonema (?) *sonrinense* sp. nov.
Holopea tateiwai sp. nov.
Clisospira shorinensis sp. nov.
Clisospira (?) *chundongensis* sp. nov.
Ellesmereoceras amplum Kobayashi.
Wolungoceras foerstei sp. nov.
Cameroceras curvatoformis sp. nov.
Cameroceras (*Proterocameroceras*) *mathieui* Grabau.
Coreanoceras kemipoense sp. nov.
Coreanoceras tenuicurvatum sp. nov.
Coreanoceras kokaiense sp. nov.
Coreanoceras kini sp. nov.

ii) Mr. Shimamura's collection from Maruyama, belongs most probably to the Maruyama Bed :—

Chinese character : 1) 斗岩山. 2) 系浦里.

Maruyamaceras shimamurai sp. nov.

Maruyamaceras watanabei sp. nov.

Maruyamaceras (?) sp.

Cameroceras sp.

iii) From Bantatsusan Bed of Maruyama limestone-quarry.

Ormoceras harioi (Kobayashi).

The Shorin fauna contains abundant brachiopods, gastropods, cephalopods, and others, among which the gastropods are quite different from those of the Toufangian, Lophospira being most common in the latter, while the cephalopods are well represented by numerous species and individuals of Coreanoceras.

Cameroceras (*Proterocameroceras*) *mathieui* Grabau is described from the Peilintze limestone at Shihmenchai, and from the western hills of Peking, Chihli Province, and the Wolung limestone in the Niuhsintai and Hualienchai areas, South Manchuria. *Ellesmereoceras amplum* Kobayashi is a characteristic species of the Wolung limestone in the Niuhsintai basin.

Syntrophia calcifera is described from the Calciferous formation of Quebec and the Mons formation of the Cordilleran area of Canada.

From these considerations the Shorin Bed is believed to be of Wolungian age, of which it probably represents the earlier period.

The collection from the Bantatsusan Bed contains *Ormoceras harioi* (Kobayashi), a characteristic member of the Toufangian fauna. The small members of the Maruyama Bed are represented by Maruyamaceras and Cameroceras, the former being common in the Wolungian, and the latter indicating the appearance of Actinoceroids. The age of the fauna is probably late Wolungian, rather than early Toufangian.

V) On the occurrence of Wolungian fauna in Shantung Province

Dr. G. R. Crick[1] described *Actinoceras* (*Ormoceras*) aff. *tenuifilum*

1) Crick, G. R. (1903), Note on some specimens of straight-shelled Nautiloidea collected by the Rev. Samuel Couling M. A. Ching-Chow-Fu, North China. (Geol. Mag., New Ser., Decade IV, Vol. X.)

Hall and *Gonioceras* sp. from the neighbourhood of Tsingchou-fu.[1] After that, Dr. Th. Lorenz[2] described *Maclurea logani* Salter, *Asaphus boehmi* Lorenz, and *Hyolites* sp. from Hoshan, and *Plectambonites sericeus* Sowerby from Santefan; while Dr. Stuart Weller[3] described *Orthoceras* sp. *Maclurea* ? or *Helicotoma* ? sp., *Lophospira* sp., *Asaphus* sp. and *Strophomena* sp. from various localities in Shantung Province. Some years ago, Dr. A. W. Grabau[4] described a number of Cephalopods of the Machiakou limestone in Shantung Province, as tabulated below.

Specific Names \ Localities	Ling-cheng.[5]	Ning-yang.[6]	Shen-tsun.[7]	Tai'an.[8]	Wen-nan.[9]
Stereoplasmoceras pseudoseptum Grabau. ...	×	×			
Stereoplasmoceras machiakouense Grabau. .	×				
Stereoplasmoceras actinoceriforme Grabau.					×
Actinoceras richthofeni Frech.	×		×		×
Actinoceras tani Grabau.....	×				
Actinoceras coulingi Grabau.....	×				
Actinoceras suampanoides Grabau.....	×	×	×	×	×
Actinoceras submarginale Grabau.					×
Actinoceras curvatum Grabau.	×				
Cyrtoactinoceras frechi Grabau.		×			×
Gonioceras shantungense Grabau.		×	×		

1) Chinese character: 青州府.

2) Lorenz, Th. (1906), Beiträge zur Geologie und Paläontologie von Ostasien und besonderer Berücksichtigung der Provinz Shantung in China, II, Paläontologische Teil. (Zeitsch. Deutsch. Geol. Gesell.) pp. 109–110.

3) Weller, Stuart (1913), A Report on Ordovician fossils collected in Eastern Asia in 1903–04. (Willis' Research in China, Vol. III.) pp. 279–280.

4) Grabau, A. W. (1922), Ordovician Fossils from North China. (Palaeontologia Sinica, Ser. B., Vol. 1, Fasc. 1.)

Chinese Characters: 5) 臨城. 6) 寧陽. 7) 沈村. 8) 泰安. 9) 汶南.

Through the writings of Dr. Grabau, the wide distribution of the Machiakou fauna of the Black River-Trenton age is now well known. Little, however, is known of the Wolungian fauna of Shantung. In a small collection obtained at Peshan by Mr. Kyukichi Watanabe, of the staff of the Geological Survey of Japan, I found the following interesting species :—

i) *Actinoceras coulingi* Grabau from a spotted limestone of Pei-chang-ho, Peshan-hsien.[1)]

ii) *Piloceras platyventrum* Grabau, *Stereoplasmoceras* cf. *manchiakouense* Grabau, and *Maruyamaceras peshanense* sp. nov. from a gray limestone of Tung-yüeh-yang, Peshan-hsien.[2)]

iii) *Ellesmereoceras amplum* Kobayashi from a dark gray limestone of Hsi-shih-ma, Peshan-hsien.[3)] The limestone contains many fragments of siliceous matter, as usually seen on the Wolungian limestone of South Manchuria, as well as on the Shorin limestone of North Korea.

The geological succession of the Ordovician formation of the Peshan area has not been thoroughly studied, although the horizon of the first locality belongs undoubtedly to the Machiakou limestone, judging from the presence of *Actinoceras coulingi* Grabau. Maruyamaceras is a characteristic genus in the Maruyama fauna of the Upper Wolungian, and *Piloceras platyventrum* Grabau is, according to Grabau, more common in the Liangchiashan limestone than in the Peilintze limestone, so that the horizon of the second locality represents the upper part of the Wolungian. The appearance of Stereoplasmoceras at this period is, as remarked on page 24, very interesting from the phylogenic point of view. The third locality is considered to be Lower Wolungian from the *Ellesmereoceras amplum* Kobayashi described from the Wolung limestone in the Niuhsintai Basin,

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1) 山東省博山縣白楊河.

2) 山東省博山縣東岳陽.

3) 山東省博山縣西石馬，淄河沿岸.

South Manchuria, and from the Shorin Bed of the Kenjiho-Koshu area in North Korea.

The provisional correlation of the Ordovician formation of Shantung with that of Korea is shown in the following table.

Region / Geological Age	Shantung	North Korea
Toufangian.	Machiakou limestone.	Bantatsu Beds.
Wolungian.	Maruyamaceras limestone. *Ellesmereoceras amplum* limestone.	Maruyama Bed. Shorin Bed.
Wanwanian.	Orthoceras Zone of Sun.[1]	Beds T_1 and K_1.

VII) Conclusion

i) Correlation and Distribution of the Ordovician formation in Shantung, Chihli, North Korea, and South Manchuria.

In the foregoing pages I have described the Ordovician formation of various regions of North Korea. The chronological relation between these geological successions in North Korea, North China and South Manchuria is shown in table on page 23.

As stated in my previous paper[2] on the Cambro-Ordovician Stratigraphy of South Manchuria, the Ordovician formation of the Niuhsintai and Hualienchai areas is divisible into three series ; namely, the Toufangian, Wolungian, and Wanwanian, all of which are well characterized by their distinct fauna and by the intraformational conglomerates or "Wurmkalk," so frequently observed at the base of these series. Judging from the abrupt change of fauna and the presence of the intraformational con-

1) Sun, Y. C. (1924), Contribution to the Cambrian fauna of North China. (Palaeontologia Sinica, Ser. B., Vol. 1, Fasc. 4.) p. 9.

2) Kobayashi, T. (1931), Op. cit. p. 152.

Locality / Geological Age	Taizuho Area, in South Manchuria	Sosan, Kokai, and Kosho, Areas	Tokusen, Junsen, and Kogen, Areas	Bantatsu Area	Koshu and Kenjiho Areas	Shantung	Chihli
Toufangian.	Toufangkou Limestone.	Actinoceras Limestone.	Actinoceras Limestone.	Nanso Beds. Unkaku Bed. Bantatsusan Bed.	Bantatsu Beds.	Machiakou Limestone.	Machiakou Limestone.
Wolungian.	Wolung Limestone.	Piloceras Limestone.	Pliomera Shale. Piloceras Limestone.	Kosei Bed.	Maruyama Bed. Shorin Bed.	Maruyama-ceras Lime-stone. Ellesmereo-ceras Lime-stone.	Liangchia-shan for-mation. Peilintze Limestone. Yehli Lime-stone.
Wanwanian.	Chiushukou Shale. Wanwankou Limestone.	Cryptozoon Dolomite. Cryptozoon Limestone.	Ellesmereo-ceras and Archaeo-cyathus Limestone. Ellesmereo-ceras Lime-stone. Cryptozoon Limestone.			Orthoceras Zone.	Shakutun Limestone.

glomarate, a regression of the sea to some extent may be supposed to have occurred between every two series, though the sequence represents no marked unconformity.

In marked contrast to the stratigraphic breaks in the Manchurian section, a more complete succession of the Ordovician sediments seems to exist in North Korea, where the fauna of the three series shows a gradual transition, the one to the other, some faunules representing a somewhat intermediate character between the two series. An example is the upper Wanwanian fauna of Bed K_1 of the Kogen area, in which *Ellesmereoceras elongatum* Kobayashi occurs in association with *Archaeocyathus* (*Archœocyphia*) cf. *chihliense* Grabau, the latter being very common in the Wolungian of North China and South Manchuria, but absent in the Wanwanian, so far as our present knowledge goes. Another example is the Maruyama fauna of North Korea and Shantung, which consists of Cameroceras and Pilocéras on the one hand and Stereoplasmoceras and Maruyamaceras on the other, the two latter genera indicating the appearance of Actinoceroids in late Wolungian.

Though some forerunners of the succeeding fauna appear in the later stage of the preceeding series, the fauna of all these three series is, broadly speaking, well characterized by their typical elements; that is to say, the Wanwanian, Wolungian, and Toufangian may be called the age of the Ellesmereoceroids, Piloceroids, and Actinoceroids respectively. These fauna are rather ubiquitous in North China, South Manchuria, and North Korea. It is especially so in the Toufangian, but the early Wolungian fauna seems to be somewhat localized, the Chihlioceras fauna being restricted to Chihli Province, and the Coreanoceras fauna to North Korea, so far as we know at present. The Piloceras fauna, however, has a very wide distribution. It occurs not only in North China, North Korea, and South Manchuria, but also in the Arctic and North American regions.

As to the distribution of the Ordovician formation in North Korea and South Manchuria, it is restricted to the west of a line from Gensan

to Kirin and to the south of the river Hun-ho, although some doubtful Ordovician patches have been reported from near Ssupingkai.[1]

The lateral change of the geological succession is recognized northwardly as well as eastwardly. As mentioned in the preceeding pages, the Ordovician formation along the river Taitzu-ho shows frequent regressions of the sea, as proved by the abrupt change of the faunas and the frequency of the intraformational conglomerates. The conglomerates are supposed, according to the intratidal theory, to be a deposition product near the strand line.

In North Korea, the lateral difference is most striking on the thickness of the formation. In the northern and eastern sections, such as those of the Kokai, Kosho, and Kogen areas, the thickness is much smaller than those of the southwestern sections, such as those of the Bantatsu area and the Koshu-Kenjiho area.

In considering these lateral changes of the Ordovician formation, the Hun-ho line and the Gensan-Kirin line are very important from the Palaeogeographical point of view.

ii) Ordovician Cephalopod evolution in the Arcto-American Chinese region.

Since Dr. G. R. Crick described *Actinoceras* (*Ormoceras*) aff. *tenuifilum* Hall from Shantung, both Dr. Rudolff Rüdemann[2] and Dr. Olaf Holtedahl[3] have noticed the faunal resemblance between the North Chinese and the Arcto-American Ordovician formations. Recently Dr. A. W. Grabau described the Canadian fauna from Chihli Province, and drew attention to the intimate relation between these two regions, not only in the Middle Ordovician, but also in the Canadian period. In the Manchurian Ordovician formation, I found a rich fauna of Ozarkian age in addition to those of the Lower and Middle Ordovician.

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1) 四平街.

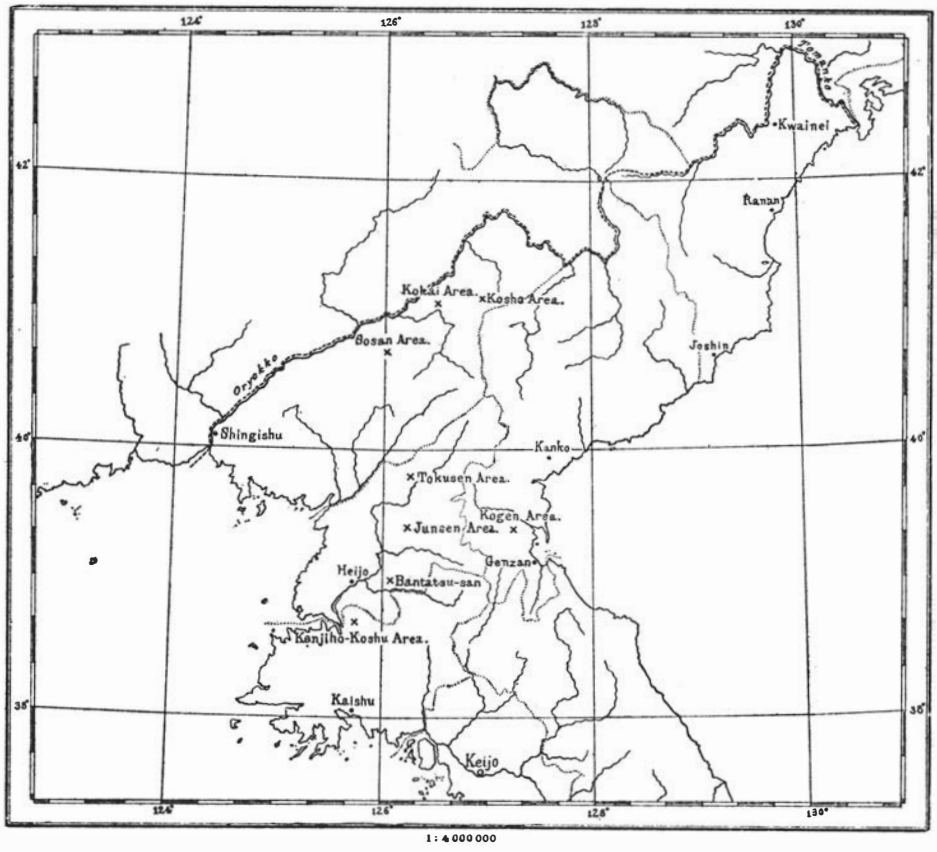
2) Rüdemann, Rudolf (1906), Cephalopoda of the Champlain Basin, (N. Y. State Mus. 90), pp. 516–517.

3) Holtedahl, Olaf (1918), Notes on the Ordovician Fossils from Bear Island. (Norsk Geologisk Tidskrift, Bd. V.)

After studying the stratigraphy and palaeontology of all the Ordovician material, I came to the conclusion that the Ordovician formation of South Manchuria is naturally divisible into three series, the Wanwanian, the Wolungian, and the Toufangian. Evidences show that the division into three series finds support in the Ordovician formation of North Korea and North China.

The vertical and horizontal distributions of the Ordovician cephalopod genera in North China, South Manchuria, and North Korea, as well as their distribution in the Arctic and North American regions, are shown in the subjoined table on the page 27 :—

INDEX MAP OF THE ORDOVICIAN LOCALITIES IN NORTH KOREA.



Geological Age / Region / Cephalopod Genera	Wan-wanian		Wolungian			Toufangian			Ozar-kian		Cana-dian		Cham-plainian	
	South Manchuria	North Korea	Shantung Chihli	South Manchuria	North Korea	Shantung Chihli	South Manchuria	North Korea	North America	Arctic Region	North America	Arctic Region	North America	Arctic Region
Ellesmereoceras	×	×		×	×				×	×		(×)		
Clarkoceras	×								×	×				
Ermoceras	×										×	×		
Wolungoceras				×	×									
Suecoceras			×	×							×			
Cameroceras			×	×	×						×		×	
Vaginoceras				×		×	×	×					×	×
Piloceras			×	×	×						×	×		
Coreanoceras					×									
Manchuroceras				×										
Chihlioceras			×											
Orthoceras							×						×	×
Cycloceras						×	×	×					×	×
Maruyamaceras			×		×									
Stereoplasmoceras			×			×	×	×						
Tofangoceras							×	×						
Ormoceras						×	×	×					×	
Acinoceras						×	×	×					×	×
Crytoactinoceras						×	×	×					×	
Discoactinoceras							×	×						
Gonioceras						×							×	×

From this table, the parallelism of the faunal evolution of the Far East with that of the Arcto-American region is self-evident. The three periods, namely the Wanwanian, the Wolungian, and the Toufangian, generally speaking, correspond to the Ozarkian, the Canadian, and the Middle Ordovician of North America and the Arctic regions, respectively. The Ellesmereoceroids, Piloceroids, and Actinoceroids appeared, flourished, and declined in these regions one after the other.

It is worth noting that the Upper Ordovician or Richmondian transgression, so wide-spread in North America and the Arctic regions, covered there an area scarcely equalling the combined area of North China, North Korea, and South Manchuria. On the other hand the Gotlandian and Devonian are utterly absent from these last-mentioned areas.

The Cambro-Ordovician boundary ought to be taken at the base of the Wanwankou limestone, as discussed in my previous paper.[1)]

The Ordovician being a marked formational unit in Eastern Asia, well characterized by its cephalopods that range from the Ozarkian to the Middle Ordovician, and spread over South Manchuria, North Korea, and North China, I wish to give it the name *Tsinan System* after the classical 'Tsinan Limestone' of Drs. Willis and Blackwelder. The area occupied by the *Tsinan System* will hereafter collectively be called the *Tsinan Basin*, which, it may be added, is marked off by the *Tsinling-Keijo Line*[2)] from the ancient seas that are now occupied by South China and South Korea, the fauna of which is closely related to the European.

I wish now to take the opportunity of recording my sincere thanks to Professor T. Kato of the Tokyo Imperial University for his kind en-

1) Kobayashi, T. (1931), Op. cit. p. 149.

2) Kobayashi, Teiichi (1931), The Cambrian and Ordovician Faunas of South Korea and the Bearing of the Tsinling-Keijo Line on Ordovician Palaeogeography. (Proceedings of the Imperial Academy, Vol. VI, No. 10) p. 426.

couragement in the preparation of this paper; to Professor S. Tokunaga, also of the Tokyo Imperial University, Professor H. Yabe of the Tohoku Imperial University, and to Professor S. Nakamura of the Kyoto Imperial University, for their valuable suggesions on the palaeontological and stratigraphical studies; and to Dr. S. Kawasaki, director of the Korean Geological Survey, for numerous facilities accorded me in the prosecution of this research.

Although most of the fossil material utilized in this paper was collected by me, yet I am under no small obligation to the gentlemen who kindly loaned me their specimens, chief among who are Mr. K. Watanabe of the staff of the Japanese Geological Survey; Messrs. I. Tateiwa and S. Shimamura of the staff of the Korean Geological Survey; Messrs. T. Shiraki and R. Kodaira of the Korean Fuel Investigation Office; and Mr. S. Kin, a student of Tokyo Imperial University, to all of whom I offer my grateful thanks.

DESCRIPTION OF FOSSILS.

A description of *Pliomera* (*Pliomerops* ?) sp. undt. from the Wuhutsui Basin at the neck of Liautung Peninsula is added to the descriptions of fossils of North Korea and Shantung.

BRACHIOPODA.

Genus **SYNTROPHIA** Hall and Clark.

Syntrophia cf. ***calcifera*** (Billings).

Plate I, figs. 3–5.

1912. cf. *Syntrophia calcifera* Walcott, Cambrian Brachiopoda, p. 800, pl. CIV, figs. 1a–i.

1924. *Syntrophia* cf. *calcifera* Walcott, Cambrian Geol. & Paleont., IV, p. 516.

Three specimens of ventral valves.

General form transversely ovate, wider than high, obtusely angular at the beak; width of mesial sinus nearly one-third the breadth of the shell; on both sides of the sinus the shell is gradually elevated and then curves down to the lateral margin; hinge-line not long; area narrow and divided by a relatively large triangular deltyrium; surface marked very faintly by concentric lines of growth.

Nothing is known of the dorsal valve and the interior of the ventral valve of the Korean specimen.

Syntrophia calcifera (Billings) is described from the Calciferous formation of Quebec and the Mons formation of the Cordilleran area of Canada. In comparing with the figures of this species quoted above, the present specimens are closely allied to the holotype described by Billings, except the lines of growth which are not so distinct as those of the holotype.

Locality and Horizon:—Shorin Bed at Shorinri, near Kenjiho, Koshu-gun, Kokai-do.

Genus EOORTHIS Walcott.

Eoorthis (?) *coreanica* sp. nov.

Plate II, figures 1 and 2.

Shell convex, roundly trapezoidal, higher than broad; the maximum breadth being at one-third from the frontal margin; umbo broadly angular; hinge-line straight; cardinal extremities obtusely angular; surface ornamented with numerous radiating ribs which are increased by interpolation of new riblets and interrupted by concentric lines of growth.

This species is represented by many incomplete specimens. Its true generic position is obscure, as it is not possible to examine the cardinal area and the internal structure.

Locality and Horizon:—Shorin Bed at Shorinri and Shindong, Koshu-gun, Kokai-do.

Eoorthis (?) sp. undt.

Plate I, figure 2.

A single specimen of a ventral valve which is convex, nearly pentagonal, wider than high; mesial sinus narrow and relatively deep; cardinal area high, hinge-line long, showing the maximum breadth of the shell; its extremities are not acuminated; surface is marked by numerous radiating ribs.

It has a length of 5.3 mm. and a breadth of 8 mm.

This species differs from the preceding by the outline and the mode of the mesial sinus.

Locality and Horizon:—Shorin Bed at Shorinri, near Kenjiho, Koshu-gun, Kokai-do.

LAMELLIBRANCHIATA.

Genus PTERINEA Goldf.

Pterinea (?) *subasperula* sp. nov.

Plate I, figures 1, 1a.

A solitery specimen of a left valve collected from the Shorin Bed near Kenjiho is the only bivalve known from the Korean Ordovician.

Left valve strongly convex, elongately ovate, scarcely oblique; anterior margin straight, less than the maximum breadth of the shell; latter being about two-thirds the height; anterior wing not preserved; posterior wing sub-triangular, not so large and somewhat sinuated behind; surface marked by strong and numerous radial ribs of acute roof-shape which are crossed by fine lines in a concentric manner.

The specimen is 18 mm. high, 7 mm. thick and more than 10 mm. broad.

As nothing is known of the ligament and teeth, it cannot be ascertained whether it belongs to Pterinea or to Pteria. Both genera have commonly oblique outlines, whereas the present specimen has a sub-equilateral outline.

Avicula securiformis Hall[1] from the American Silurian, which belongs, according to Bassler's Index,[2] to the genus Pterinea, is somewhat allied to this species in its long subrhomboid-ovate, slightly oblique outline; the surface-markings and the convexity, however, are different. *Actinopteria asperula* McCoy var. *croydonensis* Chapman,[3] from the Silurian of Victoria, is more or less allied to this species, but the former has a broader shell, a more prominent beak, a large posterior wing, and

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1) Hall, J. (1859), Paleontology of New York, Vol. III, p. 290, pl. 53, figs. 13 and 14.

2) Bassler, R. S. (1915), Bibliographic Index of American Ordovician and Silurian Fossils. (Bull. U. S. National Mus. 92.)

3) Chapman, Frederick (1908), A Monograph of the Silurian Bivalved Mollusca of Victoria, p. 47, pl. V, fig. 71.

fewer radial ribs. The relationship of this species to the Pterinea cannot be decided without further material.

Loalitcy and Horizon:—Shorin Bed of Shorinri, near Kenjiho, Koshu-gun, Kokai-do.

GASTROPODA.

Genus LIOSPIRA Urlich and Scofield.

Liospira kawasakii Kobayashi.

Plate I, figures 9a–c, 10a–b.

1930. *Liospira kawasakii* Kobayashi, On the Bantatsu Bed of the Ordovician Age, pp. 92–93, pl. IX, figs. 10a–b.

A description of this species is given in my work above quoted. In comparing them with the holotype, the present specimens have slightly narrower apical angles and less sharp peripheries.

In one specimen (Plate I, figures 9a–c), the shell is 12 mm. high and 18 mm. wide, its apical angle being about 120 degrees. The umbilical cavity, which cannot be examined in the holotype specimen, is well seen in this one. It is narrow, less than one-third the breadth of the shell.

Locality and Horizon:—Shorin Bed at Shorinri, near Kenjiho, Koshu-gun, Kokai-do.

Liospira lenticularis sp. nov.

Plate I, fig. 11; Pl. II, figs. 5a–b, 7a–b.

Discoidal shell of medium size; spire low, consisting of five to six gradually enlarging whorls; whorl subrhombic in cross-section; periphery sharply angular; upper face nearly flat with a band along the outer margin, which is well defined by a line; lower side of the whorl a little convex; width of umbilical cavity half the diameter of the shell, and deep, its edge being rather angular; lines of growth bent back from the suture and directed forward from the periphery, forming an acute angle between.

In the holotype specimen (Pl. II, figs. 5a–b) the shell is 28 mm.

wide and 12 mm. high, its apical angle being 150 degrees. In a large specimen (Pl. I, fig. 11) the shell is 34 mm. across.

This species is easily distinguished from the preceding by the lower spire, the narrower umbilicus, and the course of the growth lines.

Locality and Horizon:—Shorin Bed at Shorinri, near Kenjiho, Koshu-gun, Kokai-do.

Genus STRAPAROLLUS Montf.

Straparollus shirakii sp. nov.

Plate II, figure 6.

Shell depressedly conical, with apical angle of about 130 degrees; spire consisting of about four volutions; body whorl roundly subquadrate in section with a deep suture; umbilicus wide, not very deep; surface smooth.

In the single specimen in hand the apical part is missing. The shell measures 8 mm. across and 3 mm. high.

In general outline, this species somewhat resembles *Liospira kawasakii* Kobayashi, but the latter is distinguished by its acute peripheral carina and its suture, which is not so deep as in this species. *Straparollus hippolyta* Billings[1] is closely allied to this species, but the Canadian species has a higher spire and more rounded whorls.

Locality and Horizon:—Shorin Bed of Keihori, near Kenjiho, Koshu-gun, Kokai-do.

Genus RAPHISTOMA Koken.

Raphistoma ichimurai sp. nov.

Plate II, figures 4a–c.

Medium sized shell of about six volutions; spire flat, enlarging gradually; whorl obliquely subquadrate in cross-section, flattened above and rounded below; upper face slightly convex with a narrow and shallow

1) Billings, E. G. (1865), Paleozoic Fossils, Vol. I, (Geological Survey of Canada.) p. 160, fig. 144.

band just within the periphery; outer edge sharp, rather elevated; lower side of the whorl regularly rounded; the umbilicus wide; fine lines of growth turning back, when crossing the angle of the periphery.

Holotype specimen measures 31 mm. wide and 10 mm. high.

This species resembles *Raphistoma varginata* Koken[1] from B_3 of the Ordovician in Estland, but the whorl of the latter is triangular in cross-section. *Raphistoma sinensis* Frech[2] of South China, considered by Grabau[3] to belong to the genus Eccyliopterus, is more or less allied to this species, but its spire is depressed instead of being flattened.

Locality and Horizon:—Shorin Bed of Shorinri, near Kenjiho, Koshu-gun, Kokai-do.

Genus HELICOTOMA Salter.

Helicotoma kanekoi sp. nov.

Plate I, figs. 8a–c; Pl. II, figs. 3a–c.

Shell small, discoidal; spire consisting of about five volutions; the earlier ones elevating from the plane of the last whorl and the middle depressing from the plane; section of the whorl roundly quadrate; upper face flat with a narrow concave band in the middle; lines of growth bent back at the band; umbilical cavity wide.

Holotype specimen (Pl. II, figs. 3a–c) measures 4 mm. in height and 10 mm. in breadth. *Helicotoma yabei*[4] and *Helicotoma tamurai*[5] are described from the Unkaku Bed at Shokori, from which the present

1) Koken-Perner (1925), Die Gastropoden des Baltischen Untersilurs. (Mém. de l'Akad. des Sci. de Russie, VIII Sér., Vol. XXXVII, No. 1.) p. 85, pl. XII, fig. 7.

2) Frech, F. (1895), Ueber Palaeozoische Faunen aus Asien und Nordamerika (Neues Jarhb. für Min. Geol. u. Pal. Bd. II.) p. 3, figs. 1a–b.

Yabe, H. and I. Hayasaka (1920), Palaeontology of South China, p. 46, pl. XVI, fig. 7; pl. XXVIII, fig. 11.

3) Grabau, A. W. (1922), Ordovician Fossils from North China, p. 23, pl. II, figs. 8a–d.

4) Kobayashi, Teiichi (1930), On the Bantatsu Bed of the Ordovician Age, p. 95, pl. XI, figs. 4a–b; 5a–c.

5) Kobayashi, T. (1930), Op. cit., p. 95, pl. XI, fig. 4a–b.

species is quite distinct in its outline and in the strong middle band of the upper side of the whorl.

Locality and Horizon:—Shorin Bed of Shorinri and Chundong, near Kenjiho, Koshu-gun, Kokai-do.

Genus CYCLONEMA Hall.

Cyclonema (?) *sonrinensis* sp. nov.

Plate II, figure 9.

Small sinistral shell; four volutions preserved, which are round and ventricose; apical angle about 55 degrees; surface marked by numerous ridges crossing the whorls obliquely from suture downward and backward, and by fine faint lines crossing the ridges and running obliquely forward from the suture.

Two incomplete specimens are in hand. In one of them, the shell preserved is 5 mm. high and 4 mm. wide. As the body whorl is not preserved, it is not certain if it really belongs to this genus.

Cyclonema perversum Lindström[1] from the Silurian formation of Gotland resembles this species, but the former shell is more elongated and is ornamented by strong longitudinal ridges.

Locality and Horizon:—Shorin Bed at Shorinri, near Kenjiho, Koshu-gun, Kokai-do.

Genus HOLOPEA Hall.

Holopea tateiwai sp. nov.

Plate II, figure 8.

Small trochiform shell; spire consisting of about four or five volutions, with an apical angle of about 60 degrees; whorl round, ventricose; upper and lower sides gently convex with a round periphery; umbilicus narrow; surface apparently smooth.

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1) Lindström, G. (1884), On the Silurian Gastropoda and Pteropoda of Gotland, p. 180, pl. XXI, figs. 55–56.

Holotype specimen measures 7.3 mm. wide and 7.3 mm. high, in which the apical part is not preserved. This species belongs obviously to the genus Holopea by the presence of a small umbilicus, though the general form is more allied to the genera Cyclonema and Strophostlyus.

Locality and Horizon:—Shorin Bed at Shorinri, near Kenjiho, Koshu-gun, Kokai-do.

Genus CLISOSPIRA Billings.

Clisospira shorinensis sp. nov..

Plate II, figures 10a–c.

Small, conical shell, sub-elliptical in outline; spire consisting of four or five volutions, excentric, sinistrally coiled, expanding gradually; face of the whorl moderately convex, ornamented by lines directed obliquely backward, which are crossed by another system of irregular lines.

Holotype specimen, the apical part of which is broken off, measures 7 mm. high, and 13 mm. and 11.5 mm. in major and minor diameters.

This species is well characterized by its excentric spire with sub-elliptical base and irregular reticulation on the surface. *Clisospira curiosa* Billings[1] from the Canadian near St. Antonie, above Quebec, Canada, is allied to this species, but the former has a taller spire and regularly reticulated ornamentation.

Locality and Horizon: Shorin Bed at Shorinri, near Kenjiho, Koshu-gun, Kokai-do.

Clisospira (?) *chundongensis* sp. nov.

Plate I, figures 12a–c.

Shell conical with sub-ovate base, its apical angle being 70 degrees, spire with a central apex consisting of about four volutions; suture

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1) Billings, E. G. (1865), Paleozoic Fossils, Vol. I, p. 186, fig. 167; p. 420, App. fig. 401a–b.

Miller, S. A. (1889), North American Geol. & Paleont., p. 400, fig. 661.

obscure; surface of the whorl slightly convex, marked by numerous lines which are very fine and directed forward and downward from the sutures.

A minute specimen with apex partly broken is in hand, measuring about 5 mm. across and 4 mm. high.

As the specimen is not complete, its true generic position cannot be determined; but it is distinguished from the preceding species by its non-reticulated ornamentation on the less convex surface of the whorl.

Locality and Horizon:—Shorin Bed of Chundong, near Kenjiho, Koshu-gun, Kokai-do.

CEPHALOPODA.

Genus ELLESMEREOCERAS Foerste.

Ellesmereoceras amplum Kobayashi.

Plate V, figures 3a–c, 5; Pl. VI, figs. 3a–c.

1931. *Ellesmereoceras amplum* Kobayashi, Studies on the Stratigraphy and Palaeontology of the Cambro-Ordovician Formation of Hualienchai and Niuhsintai, South Manchuria, p. 162, pl. XVII, figs. 1a–c.

The specimen, obtained from the Shorin Bed, is a fragment 50 mm. long, shell cylindrical, very gradually enlarging, nearly circular with a marginal siphuncle in cross-section; diameter of the siphuncle corresponding to about one-third that of the shell; septa numerous, about 2 mm. apart which curve abruptly forward near the shell-wall, the remaining parts straight, horizontal; septal necks roundly rectangular; funnel reaching to the middle point of the preceding one; foreign matrix filling the space of the siphuncle and camerae.

A small specimen, obtained from the Sosan area, is a straight, cylindrical conch 14 mm. long, on which six camerae are counted; in cross-section the shell and siphuncle circular, 11 mm. and 3.5 mm. in diameter, respectively; siphuncle marginal, directly in contact with the shell on the ventral side, so that the septal sutures are discontinuous on

the ventral side and broadly sinuated on the other side; siphuncle and camerae filled with foreign matrix.

Another specimen, collected by Mr. K. Watanabe, geologist in the Geological Survey of Japan, from limestone from a cliff along the river Tzu-ho, near Hsi-shih-ma, Peshan-hsien, Province Shantung.[1] The limestone contains many fragments of siliceous matter, as usually seen on the Wolungian limestone of South Manchuria. The specimen is a cylindrical fragment about 60 mm. long, with a circular cross-section of 27 mm. diameter at the broader end; septal sutures transversal except at the siphonal side, where they are broadly sinuated. They are nearly equidistant; five septal sutures and four intervals having been counted in a length of 11 mm. at the broader part.

As the internal characters of the specimen cannot be well examined, it is not certain whether it is a conch or a siphuncle. If it is a siphuncle, externally it is not unlike that of *Cameroceras* (*Proterocameroceras*) *mathieui* Grabau, but it is distinguished from it by its circular cross-section and internal filling of the siphuncle, which consists only of foreign matrix. It resembles more closely the conch of this species, though the character of the siphuncle and camerae are not known.

The holotype specimen above quoted is described from the Wolungian limestone of the Niuhsintai Basin, South Manchuria. In comparison with it, the first specimen has a little broader siphuncle; but in the second specimen the ratio of the diameters of the siphuncle and shell almost equals that of the holotype.

Locality and Horizon:--This species is one of the characteristics of the Wolungian fauna. The holotype specimen was collected from the Wolungian limestone of the Chiushukou valley, Niuhsintai basin, South Manchuria. The first specimen above described was obtained from the Shorin Bed of Shorinri, near Kenjiho, Koshu-gun, Kokai-do, Korea; the second from a dark gray limestone of a cliff between Yuyang-dong and Pyongdang-dong in the village of Ryutodo, near Kojo, Sosan-gun, North

1) Chinese characters: 博山縣西石馬溜河沿岸.

Heian-do; and the third from a Wolungian limestone near Hsi-shih-ma, Peshan-hsien, Province Shantung, China.

Genus WOLUNGOCERAS Kobayashi.

Wolungoceras minor sp. nov.

Plate VI, figures 1a–b, 2, 4a–b; Pl. VIII, fig. 6.

Shell long, teretely conical, tapering at the rate of about 1 in 12 mm.; in cross-section the shell is elliptical without endocone, excentric, submarginal, occupying midway from margin to center; septa numerous, nearly equidistant, separated about 1 mm. or less from one another; their convexities nearly equal to one septal distance; surface smooth; siphuncle and camerae filled to a certain extent with calcareous deposits.

In one specimen 40 mm. long, (Pl. VI, fig. 1), the shell-diameter, major and minor, are 5 mm. and 3.5 mm., respectively, at the narrower end, while the minor diameter is 7.5 mm. at the broader end. In another specimen 32 mm. long, (Pl. VI, fig. 2), the shell tapers so gently that its ratio is 1 to 13. In the third specimen of 22 mm. length (Pl. VIII, fig. 6), fourteen camerae are counted in a space of 16.5 mm.

Though the structure of the siphuncle is concealed, this species may be an Ellesmereoceroid, based on the following features: (1) the elongately conical conch with elliptical section; (2) the narrow siphuncle and the absence of the endocone; and (3) the numerous equidistant septa. Ellesmereoceras s. str. has a marginal siphuncle. The siphuncular position of this species suggests that it belongs most probably to the genus Wolungoceras,[1] which has been established for forms having submarginal or central siphuncle.

Locality and Horizon:—Shorin Bed of Shorinri, near Kenjiho, Koshu-gun, Kokai-do.

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1) Kobayashi, Teiichi (1931), Studies on the Stratigraphy and Paleontology of the Cambro-Ordovician Formation of Hualienchai and Niuhsintai, South Manchuria, p. 158.

Genus CAMEROCERAS Conrad.

Cameroceras curvatoformis sp. nov.

Plate VI, figures 5a–b, 6; Pl. IX, fig. 3.

Medium sized cyrtoceracone, gradually enlarging at the rate of 1 in about 6 mm.; cross section circular with a ventral siphuncle; diameter of the siphuncle attaining to about two-fifths of the shell diameter; endosiphocone and endosiphosheathes conical and long; camerae shallow and numerous; septa slightly convex, septal distance being equal to one-third of the siphuncular diameter; septa slightly convex, slowly rising on approaching the dorsal wall of the shell forming an obtuse angle at the septal neck; funnel extending farther beyond the preceding neck, surface unknown, but apparently smooth.

Rudolf Rüdemann described *Cameroceras curvatum*[1] from the dove-coloured Chazy limestone of Isle La Mont, which resembles this species in the gently curving conch with circular cross-section and the shallow and narrow camerae, but the Korean species is distinguished from the American by its greater curvature of the conch and the marginal siphuncle.

Holotype specimen measures 37 mm. long and 9 mm. and 15 mm. broad at the narrower and broader part, where its siphuncle is 3 mm. and 6 mm. broad, respectively (Pl. VI, fig. 5).

The siphuncle, shown in figure 6 on Plate VI, is a fragment of 31 mm. length, its later part of 12 mm. partly broken. The breadth of the siphuncle enlarges from 3 mm. to 4.5 mm. in a length of 19 mm., and on which fourteen septal sutures and thirteen intervals are counted.

Locality and Horizon:—The Shorin Bed of Shorinri and Shin-dong near Kenjiho, Koshu-gun, Kokai-do.

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1) Rüdemann, Rudolf (1906), Cephalopoda of the Champlain Basin. (Bull. N. Y. State Mus. 90.), p. 411, fig. 2, pl. II, figs. 6 and 7.

Cameroceras styliforme Grabau.

Plate V, fig. 2.

1922. *Cameroceras styliforme* Grabau, Ordovician Fossils from North China, p. 39, pl. IV, figs. 4–6.

1931. *Cameroceras* cf. *styliforme* Kobayashi, Studies on the Stratigraphy and Palaeontology of the Cambro-Ordovician Formation, etc., p. 167, pl. XVII, figs. 4a–b; text-figure.

The specimen of a siphuncle is a terete cone 85 mm. long, tapering at the rate of 1 in 11 mm.; cross-section of the siphuncle and endosiphuncle circular, 18.5 mm. and 12 mm. in diameter at the broad end, respectively; nine septal sutures and ten intervals counted in the later part of 27.5 mm.; the endosiphuncle tapering rapidly in that portion, so that it does not appear in the longitudinal section of the front part; siphuncle is filled with crystalline calcite; the parallel vertical lines are, however, believed to indicate traces of the endosiphosheathes; the endosipholining of Rüdemann thick.

This specimen is most closely allied to the third specimen from the Liangchiashan limestone and the specimen from the Wolung limestone.

Locality and Horizon :—Specimen obtained from a block of dark gray massive limestone at Fuchu-dong, Nan-men, Sosan-gun, North Heian-do. There is some uncertainty regarding its true locality.

Subgenus PROTEROCAMEROCERAS Rüdemann.

Cameroceras (*Proterocameroceras*) *mathieui* Grabau.

Plate VI, figures 7, 8a–c; Pl. IX, fig. 4.

1922. *Proterocameroceras mathieui* Grabau, Ordovician Fossils from North China, p. 36, pl. IV, figs. 1–3.

1931. *Cameroceras* (*Proterocameroceras*) *mathieui* Kobayashi, Studies on the Stratigraphy and Palaeontology of the Cambro-Ordovician Formation, etc., p. 168, pl. XVII, figs. 5a–b; pl. XVIII, figs. 5a–c; pl. XIX, fig. 10.

This species is not uncommon in the Shorin Bed near Kenjiho, Chosen.

The specimen (Pl. VI, fig. 7), has a length of 55 mm., the free siphuncle of which is 10.6 mm. long. The conch tapers at the rate of 1 in about 4 mm. In cross-section the shell is nearly circular with a marginal, rather elliptical, siphuncle. Transverse and dorso-ventral diameters of the shell are 10 mm. and 11 mm. at the middle point of the shell where the diameters of the siphuncle are 6 mm. and 7 mm. respectively. Preseptal cone is gradually and regularly tapering toward the apex.

The second specimen (Pl. VI, fig. 8), is 77 mm. siphuncle marginal. depressedly ovate in cross-section with a flattened venter; endosiphocone subcentral, conical, alters to a narrow endosiphotube. In the later part of the siphuncle no endosipholining is present.

The third specimen (Pl. IX, fig. 4), is a fragment 45 mm. long, in which the camerate part is well preserved. Septa about 1.8 mm. apart, straight and obliquely ascending from the siphuncle to the shell wall; septal neck obtusely angular, funnel extending beyond the preceding neck.

The first specimen differs slightly from the holotype in the shape of the cross-section, but in other respects it is closely allied to the type. The Korean specimens are interesting and important, since the preseptal cone and the later part of the conch in them are visible.

Locality and Horizon:—Shorin Bed of Shorinri and Chundong, near Kenjiho, Koshu-gun, Kokai-do.

Genus PILOCERAS Salter.

Piloceras platyventrum Grabau.

Plate V, figures 4a–c.

1922. *Piloceras platyventrum* Grabau, Ordovician Fossils from North China, p. 42, pl. IV, figs. 11a–c, 12a–c; text-figs. 1a–e.

Specimens of a siphuncle, 80 mm. long and 16 mm. across at the narrow end; in cross-section the dorsal wall of the endosiphocone flattened and not curving inwardly; endosiphuncle tapering abruptly and

continuous to the endosiphotube, which occupies a point one-third from ventral to dorsal margin.

In the space between the endosiphuncle and siphuncular wall, there are numerous endosheathes which alter partly to crystalline calcite; camerate part not preserved, but a septum is found beside the siphuncle.

Locality and Horizon:—Only a single specimen was collected from gray limestone at Tung-yüeh-yang, Peshan-hsien, Province Shantung.

Piloceras sp. undt.

Plate V, figures 1a–d.

Three specimens of Piloceras collected in Chosen.

The one from Tokusen is a siphuncle more than 110 mm. long. There is a mammilary elevation at the apex, which is 6 mm. long and 5 mm. broad. Above the elevation, the siphuncle enlarges rapidly at first and then gradually. In cross-section the siphuncle is depressedly ovate with an excentric ovate endosiphuncle. The endosiphuncle of this specimen is near the ventral wall and not on the dorsal side, as seen in *Piloceras wolungense*.[1)]

The second specimen, collected from Kogen, is a siphuncle 110 mm. long, strongly deformed by lateral compression, so that the original form cannot be ascertained. So far as the present specimen is concerned, the siphuncle is a terete cone with ovate cross-section; endosiphuncle central and ovate.

The third specimen from Kojo, is a slightly curving siphuncle 44 mm. long; in cross-section it is ovate with an endosiphuncle near the center.

These three specimens belong most probably to the genus Piloceras, but the specific determination is a matter of difficulty.

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1) Kobayashi, Teiichi (1931), Op. cit., p. 170, pl. XVII, figs. 2, 3a–b, 6; pl. XVIII, figs. 12a–b; pl. XIX, fig. 1.

Locality and Horizon:—The first specimen was collected from a block in the southern cliff of Hatoryong-ni, Sanjo-men, Tokusen-gun, South Heian-do; the second specimen from the lower part of Bed K_1 at Changtur, Sankoku-men, Kogen-gun, South Kankyo-do; the third from a cliff between Yuyang-dong and Pyondang-dong in the village of Ryutodo, near Kojo, Sosan-gun, North Heian-do.

Genus COREANOCERAS gen. nov.

1931. *Coreanoceras* Kobayashi, Studies on the Stratigraphy and Palaeontology of the Cambro-Ordovician Formation, etc. p. 169.

Straight or slightly curved longicone with a large holochoanitic siphuncle, latter being marginal, in contact with the shell on the flattened ventral side; siphuncular cavity, or endosiphocone of Rüdemann, large, sub-conical except the ventral side which is incurved by the elevation of a ventral cone and altering into a narrow tube dorso-ventrally compressed, the endosiphotube of Rüdemann. On the ventral side of the siphuncular wall, there is a ventral cone which is cylindrical along the endosiphotube, sub-circular in cross-section, and tapering conically along the endosiphocone at the same time, its cross-section being triangular or ovate. Preseptal cone or nepionic bulb of Hyatt, narrow and relatively long; camerae numerous, narrow; surface apparently smooth; aperture unknown.

Genotype *Coreanoceras kemipoense* gen. et sp. nov.

This genus is allied to the other Piloceroids, such as Piloceras Salter, Chilioceras Grabau, and Manchuroceras Ozaki; but the existence of the ventral cone in the siphuncular wall, by which it is easily identified, is characteristic of this genius.

Piloceras wolungense Kobayashi from the Wolungian limestone in the Niuhsintai basin closely resembles this species, even to the extent that the former has a ventral elevation on the siphuncular wall like that of

this genus. The elevation in *Piloceras wolungense* is not due to the ventral cone, but to a cylindrical part in the ventral side of the siphuncular wall which is not surrounded by any special wall as seen in Coreanoceras and circular in cross-section, consisting of crystalline calcite radially deposited. The preseptal cone is longer in Coreanoceras than in Piloceras. If homologous, the ventral cone and the preseptal cone are much degenerated in Piloceras.

Rudolf Rüdemann[1] is of opinion that the scars on the wall of the endosiphocone might have served for the muscular attachment. If so, such a prominent elevation of the ventral wall might have served a far better purposes than that of mere attachment. At all events, the presence or otherwise of the ventral process should necessitate corresponding modification in the organization. For this reason, the presence of the ventral cone is sufficient to justify the establishment of a new genus.

Chihlioceras, taking *Chihlioceras nathani* for its genotype, was established by Grabau for a breviconic orthoceracone with a large stout siphuncle, which has two lateral alveoli besides a median alveolus; Manchuroceras established by Ozaki has only one, instead of two, lateral alveolus which is filled by stereoplasm. Coreanoceras is quite distinct from these genera by the absence of any lateral alveolus.

Referring to their geological ages and phylogenetical relations, Chihlioceras is restricted to the Peilintze limestone, Manchuroceras to the Wolung limestone, and Coreanoceras to the Shorin limestone. Piloceras has a wide range in the Far East, from the Peilintze limestone to the Liangchiashan limestone through Wolung limestone. From these geological evidences and their taxonomic characters, their phylogenetical relations are believed to be as under.

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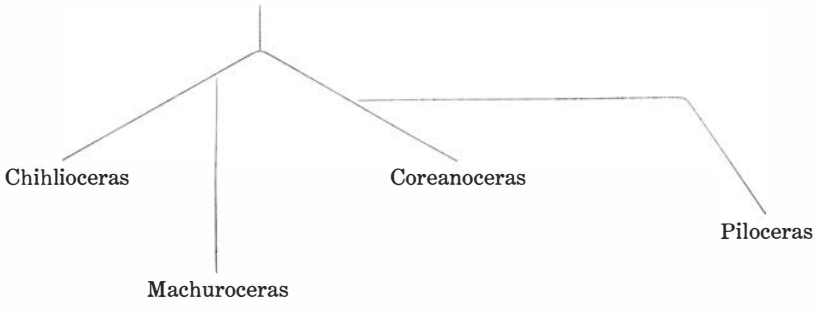
1) Rüdemann, Rudolf (1904), Structure to some Primitive Cephalopods. (Rep. N. S. State Paleontoligists.) p. 330.



Coreanoceras kemipoense sp. nov.

Plate VII, figs. 1–4; Pl. VIII, fig. 1; Pl. IX, fig. 2.

Orthoceracone of medium size; in cross-section the shell and siphuncle subcircular with flattened venters where the two are in contact with each other; siphuncle gradually enlarging at the rate of 1 in 8.5 mm. to 10 mm.; endosiphocone large, slightly excentric, dorsal, conical except ventral elevation; the apex of the endosiphocone, which is acutely angular, is connected to a narrow, dorso-ventrally compressed endosiphotube; siphuncular wall thick, filled with calcareous matter; in the ventral wall along the siphuncular cavity there is a cone well defined by a thin sheath-like wall which is roundly triangular to ovate in cross-section. It transforms into a circular cylinder on the ventral side of the endosiphotube, where the diameter of the ventral cone corresponds to more than two-thirds the siphuncular diameter; preseptal cone narrow, cylindrical, straight on the ventral side and swelling at the middle of the dorsal side.

Septa numerous, about 2 mm. apart where the siphuncle is about 10 mm. in the dorso-ventral diameter; septa gradually ascending from siphuncle to shell-margin; septal suture sloping down from ventral side to dorsal; no suture on the ventral flattening; septal neck obtusely angular; funnel reaching beyond the preceding neck.

The holotype specimen (Pl. VII, fig. 2), is a siphuncle 33 mm. long and 10 mm. and 12 mm. across at the narrow and broad ends, respectively. The second specimen (Pl. VII, fig. 1), is 97 mm. long

and 32 mm. across at the broad end. Five camerae are counted in a length of 9 mm. at the middle part where the shell and siphuncle are about 21 mm. and 10 mm. across, respectively. The third specimen (Pl. VII, fig. 4), is a siphuncle 60 mm. long and 19 mm. across at the broad end; at the other end the siphuncle and ventral cone are 12.5 mm. and 7.8 mm., respectively; as shown on the longitudinal section the apical angle of the endocone is 30 degrees. The fourth specimen (Pl. VII, fig. 3), is a siphuncle 82 mm. long, which shows a nepionic bulb at the apical end.

Locality and Horizon:—Very common in the Shorin Bed of Shorinri, Shindong, near Kenjiho and Toam-san near Koshu, Kokai-do; a specimen collected associated with *Ellesmereoceras amplum* Kobayashi from dark gray limestone in a cliff between Yuyang-dong and Pyondang-dong, in the village of Ryuto-do, near Kojo, Sosan-gun, North Heian-do.

Coreanoceras kokaiense sp. nov.

Plate VIII, figures 3–5, 7.

This species is closely allied to the preceding except in the prominence of the ventral elevation and certain other characters.

Siphuncle teretely conical, compressed in the dorso-ventral direction, and elliptical; siphuncular cavity with an acute ventral process which is large and roundly triangular; sometines subordinate ridges produced on the face of the large ventral prominence; the siphuncular cavity changing in the apical part into a narrow tube, semi-elliptical in cross-section; at the same point the ventral cone cylindrical, its cross-section being elliptical, laterally compressed; septal sutures oblique, about 2 to 2.5 mm. apart, descending toward the dorsal side and fading off on the ventral side.

Locality and Horizon: —Shorin Bed of Shorinri, near Kenjiho, Koshu-gun, Kokai-do.

Coreanoceras tenuicurvatum sp. nov.

Plate VIII, figure 8; Pl. IX, fig. 2.

This species differs from *Coreanoceras kemipoense* in the gentle curve of its siphuncle.

Siphuncle gently curving and teretely tapering with a sub-circular cross-section, dorso-ventrally compressed; siphuncular cavity tapering abruptly, altering into a narrow endosiphotube; ventral cone excentric, elliptical, laterally compressed; septa numerous, their sutures obliquely ascending toward the ventral flattening where there are no sutures; siphuncle ending in a flat top without nepionic bulb.

Locality and Horizon:—Shorin Bed of Shorinri, near Kenjiho, Koshu-gun, Kokai-do.

Coreanoceras kini sp. nov.

Plate VIII, figure 2.

Siphuncle slowly tapering at the rate of 1 in about 8 mm.; its cross-section sub-elliptical, laterally compressed, the ratio of the diameters, major and minor, being 7 : 6; ventral cone large, subcentral; in the apical part the siphuncle abruptly diminishing its magnitude, altering into the preseptal cone which occupies the ventral side; septal sutures nearly transversal, descending laterally on the dorsal side and forming sinuate curvatures on the ventral and dorsal sides; septal suture separated by a distance less than 2 mm. from the preceding; camerate part unknown.

Holotype specimen is 56 mm. long; its major diameter measures 12 mm. where that of the shell is 15.5 mm.

This species is characterized by the lateral compression of the siphuncle, sub-central position of the ventral cone, the sinuous curvature of the septal suture, and abrupt tapering of the preseptal cone.

From the presence of the septal suture on the ventral side it is

presumable that the siphuncle might not directly attach to the wall of the shell on that side.

Locality and Horizon:—Shorin Bed of Aphyong-che, near Kenjiho, Koshu-gun, Kokai-do.

Genus STEREOPLASMOCERAS Grabau.

(Genotype *Stereoplasmoceras pseudoseptum* Grabau.)

The Stereoplasmoceras was established by Grabau as being closely related to Loxoceras McCoy, with which it agrees in the character of the siphuncle. "Its distinct character however is seen in the development of the compound septa, or septa and pseudosepta, with stereoplasmic deposit between. In these respects the genus is related to Actinoceras. Indeed the genus may be considered as intermediate between Loxoceras and Actinoceras, partaking of some characters peculiar to the one and of others characteristic of the others."[1)]

From the standpoint of the much narrower and fewer nummuloidal segments of siphuncle, Stereoplasmoceras is more closely related to Ormoceras than Actinoceras s. str. Loxoceras and Sactoceras are considered to be cogeneric by Hyatt,[2)] whereas Foerste[3)] treated Sactoceras as a distinct genus, separating it from Loxoceras of the Carboniferous age. In the circumstances, the taxonomic position of Stereoplasmoceras had best be called intermediate between Ormoceras and Sactoceras.

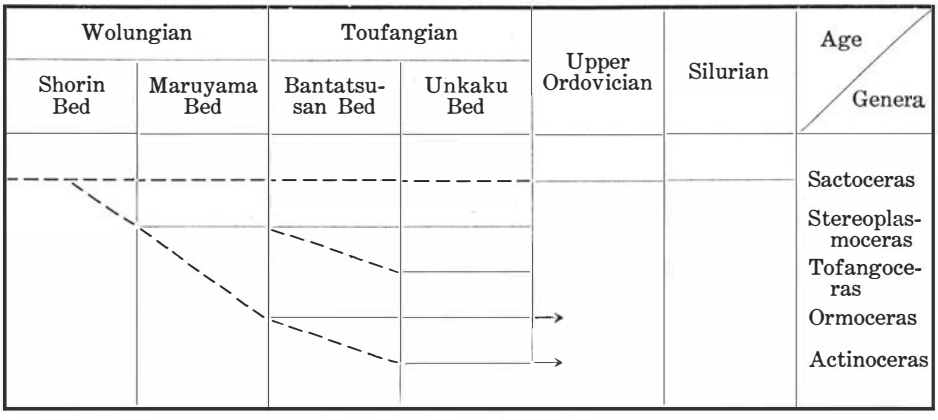
Stereoplasmoceras appeared earlier than Ormoceras and Actinoceras. *Stereoplasmoceras* sp. is reported from the Bantatsusan bed of the Bantatsu area. *Ormoceras tani* (Grabau) is found in the corresponding bed of the Kenjiho area, *Stereoplasmoceras* cf. *machiakouense* Grabau is collected from a limestone of Peshan, associated there with *Piloceras platyventrum* Grabau in the same block. The horizon of the limestone

1) Grabau (1922), Op. cit., p. 66.

2) Hyatt in Zittel-Eastman's Text-Book of Palaeontology, p. 608.

3) Foerste (1921), Notes on American Paleozoic Cephalopods, p. 227.

may correspond to the Maruyama Bed. From these evidences, the phylogenetical relation of Stereoplasmoceras, Ormoceras, Actinoceras Sactoceras, and Tofangoceras are tabulated as follows:—



Key to the species of Stereoplasmoceras.

Stereoplasmoceras pseudoseptum, *Stereoplasmoceras machiakouense*, and *Stereoplasmoceras actinoceriformis* are described by Grabau from the Machiakou limestone of Shantung and Chihli; *Stereoplasmoceras submarginale*, *S. subcentrale*, *S. uedai*, and *S. tofangoense* by me from the Toufangkou limestone of South Manchuria. These seven species are distinguished by the following criteria:

i) Rather tubular siphuncle filled with crystalline calcite to a small extent.

a) Shell circular in cross-section with a flattened venter; siphuncle excentric; pseudosepta present on both sides of the septa..... .....*Stereoplasmoceras pseudoseptum* Grabau.

b) Cross-section of the conch subovate, siphuncle subcentral; pseudosepta confined to the superior side of the septa. ....*Stereoplasmoceras machiakouense* Grabau.

c) Cross-section of the conch subcircular, siphuncle subcentral; septa more widely separated from one another than in any other species. .....*Stereoplasmoceras tofangoense* Kobayashi.

d) Cross-section of the conch subcircular, siphuncle excentric; septa

more closely crowded than in any other species. .....
....*Stereoplasmoceras uedai* Kobayashi.

ii) Siphuncle more nummuloidal than in the preceding group, in which there is crystalline calcite filling to a large extent.

e) Subovate cross-section of the conch, siphuncle subcentral. .....
.....*Stereoplasmoceras actinoceriformis* Grabau.

f) Subelliptical section of the conch, siphuncle subcentral. .....
.....*Stereroplasmoceras subcentrale* Kobayashi.

g) Subelliptical cross-section of the conch, siphuncle submarginal....
.....*Stereoplasmoceras submarginale* Kobayashi.

The species of the second group are more closely allied to the genus Ormoceras than those of the first.

Stereoplasmoceras tofangoense Kobayashi.

Plate V, figures 4a–d.

1930. *Stereoplasmoceras tofangoense* Kobayashi, Studies on the Stratigraphy and Palaeontology of Hualienchai and Niuhshintai, South Manchuria, p. 172, pl. XIX, figs. 7a–c.

This species is described for material collected from the Toufangkou limestone of Toufangkou, near Hualienchai Station, South Manchuria. A specimen obtained from Kosho resembles this one so closely that the two are identifiable with each other.

The specimen from Kosho is about 35 mm. long. The conch is teretely conocal, enlarging at the rate of 1 in 10 mm. In cross-section it is sub-circular with a slightly excentric siphuncle, which swells moderately within the camerae. Camerae are 5 mm. high where the shell is 17 mm. across. Septa compound. Stereoplasm fills the camerae and not the space of the siphuncle.

This species is well characterized by its high camerae, and by which it is easily distinguished from allied species, such as,—*Stereoplasmoceras pseudoseptum* and *Stereoplasmoceras subcentrale.*

Locality and Horizon :—Pisolitic limestone at the northern end of Changpyong-ni, Koshu-gun, North Heian-do.

Stereoplasmoceras cf. *machiakouense* Grabau.

Plate IV, figures 3a–b.

1922. cf. *Stereoplasmoceras machiakouense* Grabau, Ordovician Fossils from North China, p. 68, pl. IV, fig. 8.

A single specimen 94 mm. long, straight, teretely conical, tapering at the rate of 1 in 6.5 mm. ; twelve septa and thirteen camerae counted in that length ; cross-section of the conch ovate with a sub-central siphuncle which is narrow and expanding within the camerae ; septa widely separated, 8 mm. apart from one another where the conch is 29 mm. across ; septal depth corresponding to about one camera ; pseudo-septa present on both sides of the septa ; foreign matrix filling the space of the siphuncle and camerae ; surface of the shell smooth.

This specimen is closely allied to *Stereoplasmoceras machiakouense* in respect of the cross-section of the conch and the position of the siphuncle, but differing in the stereoplasmic deposits which are confined to the upper side of the septa in the latter species. Otherwise this specimen belongs undoubtedly to *Stereoplasmoceras machiakouense* Grabau.

Locality and Horizon :—A specimen collected in association with *Piloceras platyventrum* Grabau from a gray limestone of Tung-yüeh-yang, Peshan-hsien, Province Shantung. The horizon of the limestone is believed to correspond to the Maruyama bed near Kenjiho, Koshu-gun, Kokai-do.

Genus MARUYAMACERAS gen. nov.

Siphuncle abruptly enlarging, filled with vertical lamellae of calcareous matter, its surface being marked by frequent annulations and constrictions ; septal neck curving, and in longitudinal section describing a semi-circle ; body chamber and camerate part unknown.

Genotype *Maruyamaceras shimamurai* gen. et sp. nov.

Genus Calhaounoceras has been established by Troedsson for forms from the Cape Calhoun series of Northern Greenland, which is allied to this species in the manner of the siphuncular deposits. That genus[1] however has a teretely conical siphuncle with broad constrictions, instead of a rapidly tapering one with frequent constrictions.

Maruyamaceras shimamurai sp. nov.

Plate III, figures 1a–d.

Siphuncle large, conical, abruptly enlarging, sub-circular in cross-section; annulations on the siphuncular surface tranversal, frequent, counted as many as five annulations in a length of 24 mm., which are regularly separated from one another by deep constrictions; septal neck curving along the constriction and ending inside of the preceding annulations; divarticula opening its perforation at the end of the septal neck; siphuncular deposits consist of a number of fine vertical plates which are arranged radially from center to margin.

Holotype specimen is 45 mm. long and 27 mm. across at the annulation of the broader end. Eight annulations and ten constrictions are counted in that length.

Locality and Horizon :—A single specimen of this interesting species was collected by Mr. Shimbei Shimamura from the Maruyama bed of Maruyama, near Kenjiho, Koshu-gun, Kokai-do.

Maruyamaceras watanabei sp. nov.

Plate III, figures 2a–c.

Siphuncle large, straight on one side and slightly curved on the other, enlarging gradually in the apical part and narrowing again at

1) Troedsson, Gustaf T. (1926), On the Middle and Upper Ordovician Faunas of North Greenland, p. 77.

the opposite end; siphuncular surface marked by numerous narrow annulations of nummuli; calcareous deposits filling up the siphuncular space except the central cavity.

Holotype specimen measures 80 mm. long and 27 mm. wide at the siphuncular annulation. Five annulations are counted in a length of 21 mm. at the broader part.

The divarticula of this species ascends abruptly from the opening of the camera to the central cavity. The shape of the annulation is quite distinct from that of Actinoceras s. str. This species is different from the preceding in its mode of tapering and gentle curving of the siphuncle, and the frequent and narrow annulations of nummuli.

Locality and Horizon:—Maruyama Bed of Maruyama, near Kenjiho, Koshu-gun, Kokai-do.

Maruyamaceras peshanensis sp. nov.

Plate IV, figures 2a–b.

Siphuncle straight, conical; cross-section ovate with an excentric endosiphuncle; annulations on the siphuncular wall separated by deep but narrow constrictions; septum running along the inferior side of the annulation and forming a minute semi-circle at the bottom of the constriction; a number of vertical plates radiating in all directions from the endosiphuncle.

Holotype specimen is 80 mm. long on which eighteen annulations are counted.

This species differs from the preceding two species in the gradual tapering of the siphuncle, its narrow constrictions, and the excentric endosiphuncle in the ovate cross-section.

Locality and Horizon:—A specimen from gray limestone at Tung-yüeh-yang, Peshan-hsien, Province Shantung. *Stereoplasmoceras* cf. *machiakouense* Grabau and *Piloceras platyventrum* Grabau were collected from the same locality. The limestone corresponds to the Maruyama Bed of the Kenjiho area, Korea.

Maruyamaceras (?) sp.

Plate III, figure 3.

A fragment of a siphuncle 60 mm. long and 34 mm. broad at the middle point which is filled with crystalline calcite; septal neck forming a semi-circle and a divarticula opening its perforation at the end of the septal neck; annulation is broader than the constriction and is semi-circular, covered by a very thin connecting sheath.

As the specimen is incomplete, we cannot tell whether it is a Actinoceras or a Maruyamaceras.

Locality and Horizon:—Maruyama Bed of Maruyama, near Kenjiho, Koshu-gun, Kokai-do.

Genus DISCOACTINOCERAS Kobayashi.

Discoactinoceras multiplexum Kobayashi.

Plate IV, figures 1a–b.

1926. *Discoactinoceras multiplexum* Kobayashi, Ordovician Fossils form Corea and South Manchuria, p. 202, pl. XXII, figs. 7a–d.

For this interesting specimen, collected in the Niuhsintai basin, the genus Discoactinoceras is established, naming it *Discoactinoceras multiplexum* for the genotype. A specimen of straight siphuncle collected from the Sosan area is 70 mm. long, its diameter gradually enlarging from 13 mm. to 16 mm. A tubular sheath of about 1 mm. thick is in the siphuncle, its diameter being less than one-third that of the siphuncle. In the type specimen, the diameter of the tubular sheath is one-third of the siphuncular diameter at the narrow end, which enlarges rather rapidly to a breadth of more than half the siphuncular diameter at the broad end.

From the slender and gradual enlargement of the sheath, the present specimen is presumed to represent the apical part rather than the

specimen of Niuhsintai. Divarticula branch off from a narrow endosiphuncle. Camerate part invisible.

Locality and Horizon:—From spotted limestone at the northern cliff of Changpyong-dong, Nam-men, Sosan-gun, North Heian-do.

TRILOBITA.

Genus PLIOMERA Angelin.

Subgenus PLIOMEROPS Raymond.

Pliomera (*Pliomerops* ?) *koseiensis* sp. nov.

Plate I, figure 6.

A fragment of a subtriangular cranidium; glabella cylindrical, its axial furrows being sub-parallel to each other; three lateral furrows discontinuous, directed obliquely to the axis of the glabella; occipital furrow transversal; eye and palpebral lobe of moderate size occupying the middle of the cheek.

The glabella has a height of 4 mm. and a breadth of 3 mm. It is not expanding in front as in that of the Pliomera. In comparing it with the genotype, *Pliomerops canadensis* (Billings),[1] this species is distinguished by its marked first furrow. This species is not unlike the genus Eccoptochile.[2] As it is an incomplete cranidium, taxonomic questions have to remain unsettled.

Locality and Horizon:—Kosei shale of Aresakol, in the Junsen area, South Heian-do.

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1) Raymond, P. E. (1905), Notes on the Names of Amphion, Harina and Platymetops. (Am. Jour. Sci. 19.), p. 377.

Raymond, P. E. (1909–1910), Trilobites of the Chazy of the Champlain Valley. (Rep. of Vermont State Geol.), p. 238.

Raymond, P. E. (1910), Notes on Ordovician Trilobites, IV, New and Old species from the Chazy, pp. 75–76, pl. XVIII, fig. 14; Text-figs.

2) Barton, Donald, C. (1915), Revision of the Cheirurinae with notes of their Evolution. (Washington University Studies, p. 104.)

Pliomera (?) sp. undt.

Plate I, figure 7.

Pygidium convex, roundly triangular, length about two-thirds of the breadth ; axis conical, less than one-third the breadth of the pygidium, divided into five segments and ending in a caudal segment, five pleural segments directed postero-laterally, their terminals being spines and curving abruptly downward.

The length of the pygidium.....	2.0 mm.
The breadth of the pygidiun	3.5 mm.
The length of the axis without the caudal spine	1.2 mm.
The breadth of the axis	1.6 mm.

Two species of Pliomera, *Pliomera insigensis*,[3] and *Pliomera marthelli*[4] are known from the Ordovician of Burma and Yunnan. In comparing their pygidia with that of our specimen, the latter possess caudal segments. For like reason, it is different from *Pliomerops canadensis* (Billings).

Locality and Horizon :—A specimen collected from the western cliff of Luo-tuo-shan in the Wu-hu-tsui Basin, at the neck of the Liautung Peninsula.

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3) Reed, Cowper (1906), The Lower Palaeozoic Fossils of the Northern Shan States, Burma, p. 74, pl. V, figs. 15–19.

Reed, Cowper (1915), Supplementary Memoir on the New Ordovician and Silurian Fossils from the Northern Shan States, p. 50, pl. VIII, figs. 15–21.

Reed, Cowper (1919), Ordovician and Silurian Fossils from Yunnan, p. 55, pl. VIII, figs. 15–16.

List of Described Genera and Species.

PLATE I.

Plate I.

Ordovician Brachiopods, Bivalves, Gastropods, and Trilobites.

Figure 1 and 1a. *Pterinea* (?) *subasperula* sp. nov.....p. 32
Slightly magnified. Shorin Bed of Shorinri.

Figure 2. *Eoorthis* (?) sp. undt. .....p. 31
Twice magnifined. Shorin Bed of Shorinri.

Figures 3–5. *Syntrophia* cf. *calcifera* (Billings). .....p. 30
Ventral valves. All twice magnified. Shorin Bed of Shorinri.

Figure 6. *Pliomera* (*Pliomerops* ?) *koseiense* sp. nov. .....p. 57
Twice magnified. Kosei Bed of Aresakol.

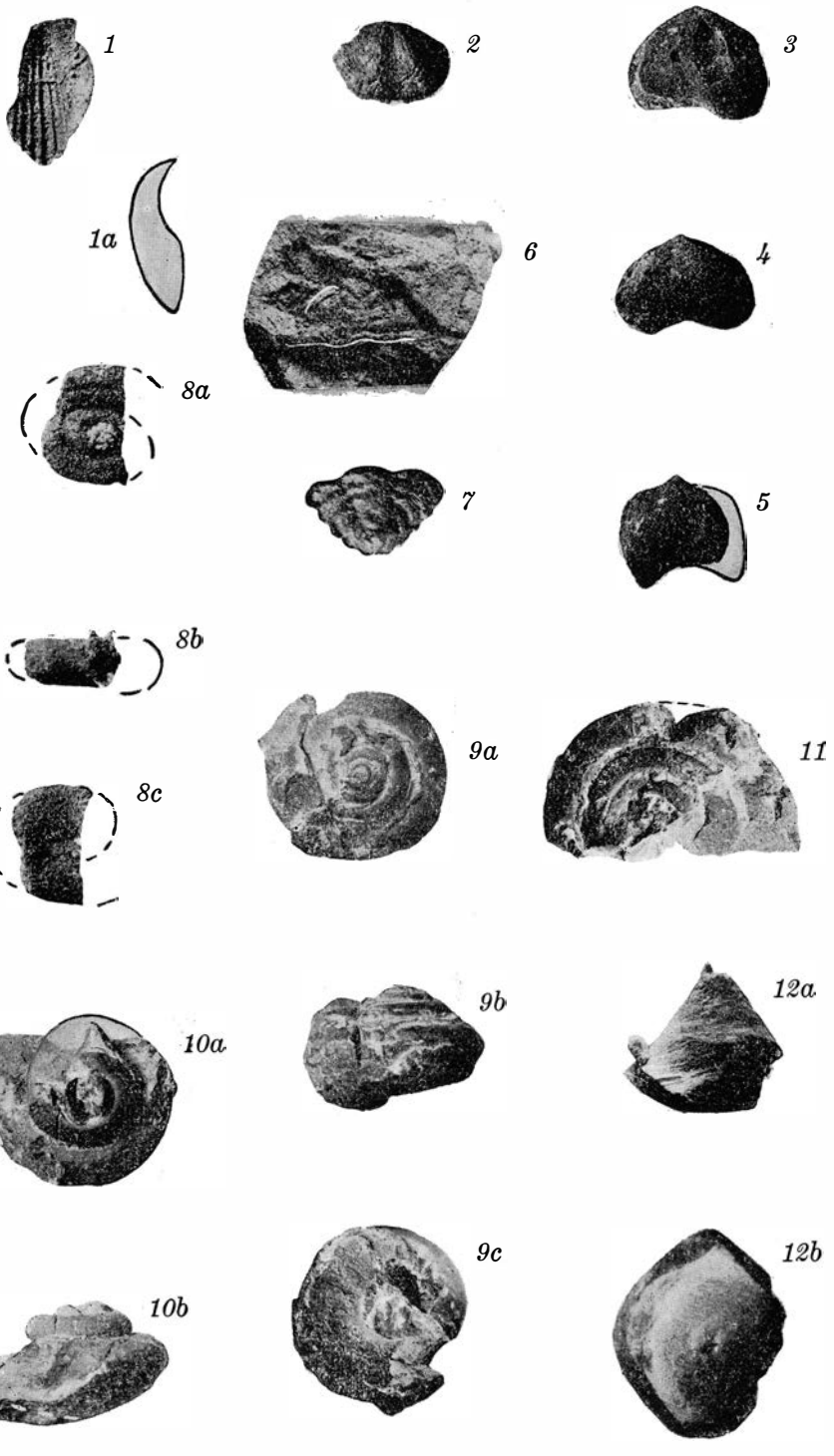
Figure 7. *Pliomera* (?) sp. undt. .....p. 58
About five times magnified. Wuhutsui Basin.

Figures 8a–c. *Helicotoma kanekoi* sp. nov.....p. 35
$\times 3\frac{1}{3}$. Shorin Bed of Shorinri.

Figures 9a–c, 10a–b. *Liospira kawasakii* Kobayashi. .....p. 33
All one and half times magnified. Shorin Bed of Shorinri.

Figure 11. *Liospira lenticularis* sp. nov. .....p. 33
Natural size. Shorin Bed of Shorinri.

Figure 12a–b. *Clisospira* (?) *chundongensis* sp. nov.....p. 37
Five times magnifined. Shorin Bed of Chundong.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10b

PLATE II.

Plate II.

Brachiopods and Gastropods of the Shorin Bed.

Figures 1–2. *Eoorthis* (?) *coreanica* sp. nov. .....p. 31
About three times magnified. Shorin Bed of Shorinri.

Figure 3a–c. *Helicotoma kanekoi* sp. nov. .....p. 35
Twice magnified. Shorin Bed of Chundong.

Figures 4a–c. *Raphistoma ichimurai* sp. nov. .....p. 34
Natural size. Shorin Bed of Shorinri.

Figure 5a–b. *Liospira lenticularis* sp. nov. .....p. 33
Natural size. Shorin Bed of Shorinri.

Figure 6a–b. *Straparollus shirakii* sp. nov. .....p. 34
Twice magnified. Shorin Bed of Shorinri.

Figure 7. *Liospira lenticularis* sp. nov. .....p. 33
7a) apical view ; 7b) side view. All natural size. Shorin Bed of Shorinri.

Figure 8. *Holopea tateiwai* sp. nov.....p. 36
Twice magnified. Shorin Bed of Shorinri.

Figure 9. *Cyclonema* (?) *sonrinese* sp. nov.....p. 36
Twice and half times magnified. Shorin Bed of Shorinri.

Figure 10. *Clisospira shorinensis* sp. nov. .....p. 37
a–b) apical and side views ; one and one-third times magnified.
c) Figure showing the surface ornamentation ; strongly magnified.
Shorin Bed of Shorinri.

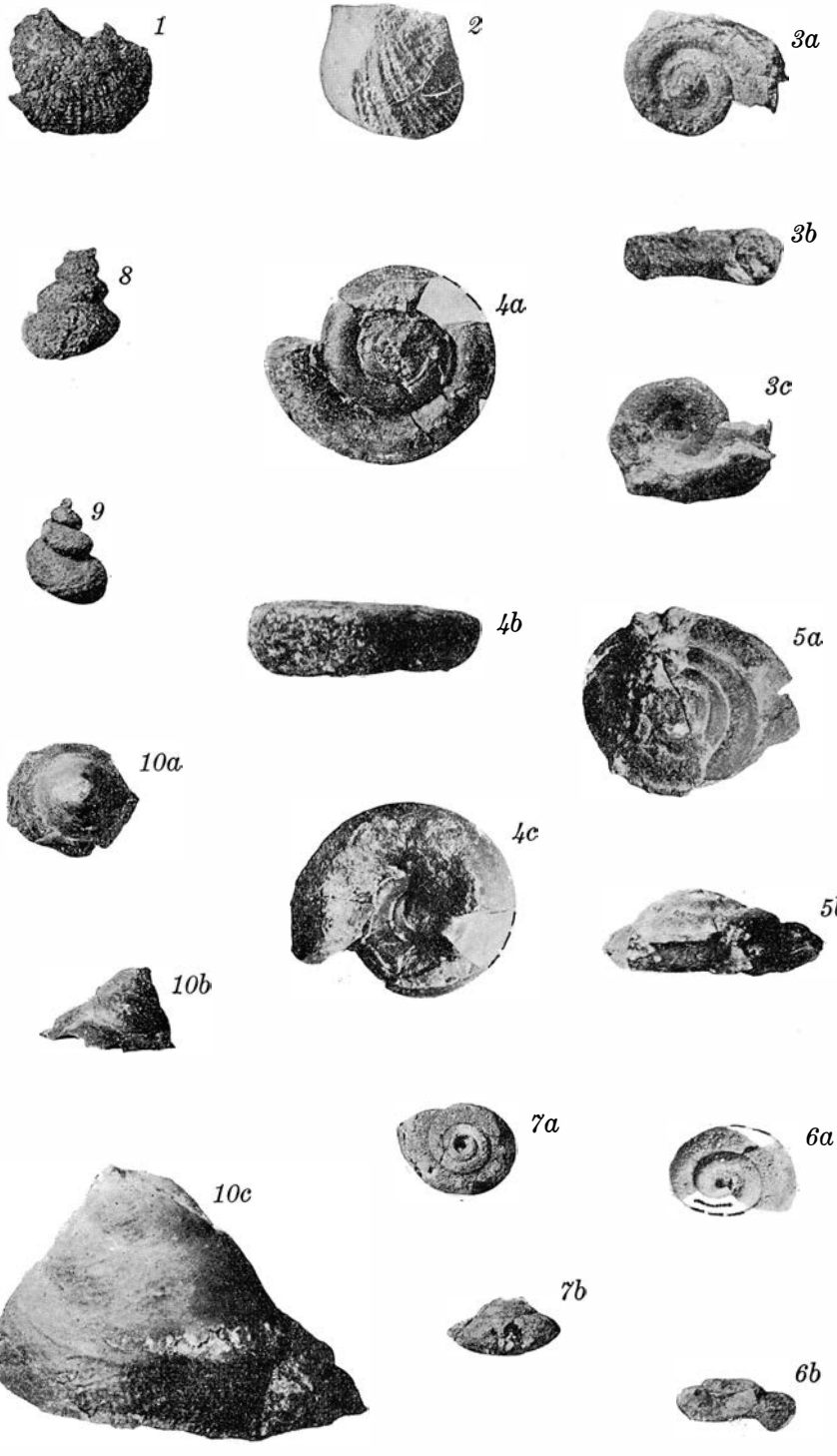
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PLATE III.

Plate III.

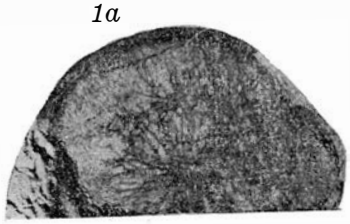
Figure 1. *Maruyamaceras shimamurai* sp. nov. .....p. 54
1a) Cross-section; 1b) Longitudinal section. Both one and one third times magnified. 1c) Lateral view. Natural size. 1d) Diagrammatic section showing the septal neck and divarticula strongly magnified. Maruyama Bed of Maruyama, near Kenjiho.

Figure 2. *Maruyamaceras watanabei* sp. nov. .....p. 54
2a) Longitudinal section; 2b) Diagrammatic cross-section. All natural size. 2c) Diagrammatic section showing the septal neck and divarticula. Strongly magnified. Maruyama Bed of Maruyama.

Figure 3. *Maruyamaceras* (?) sp. .....p. 59
Longitudinal section somewhat oblique to the axis of the siphuncle. Natural size. Maruyama Bed of Maruyama.

1d

1a



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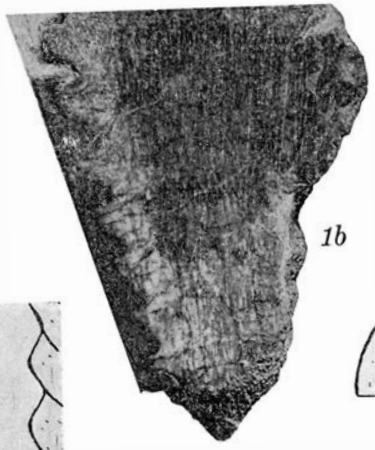

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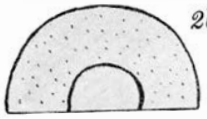
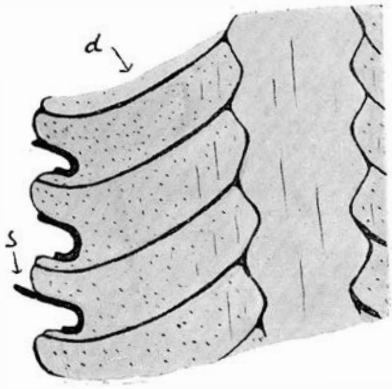


2b



2c

2a

3

PLATE IV.

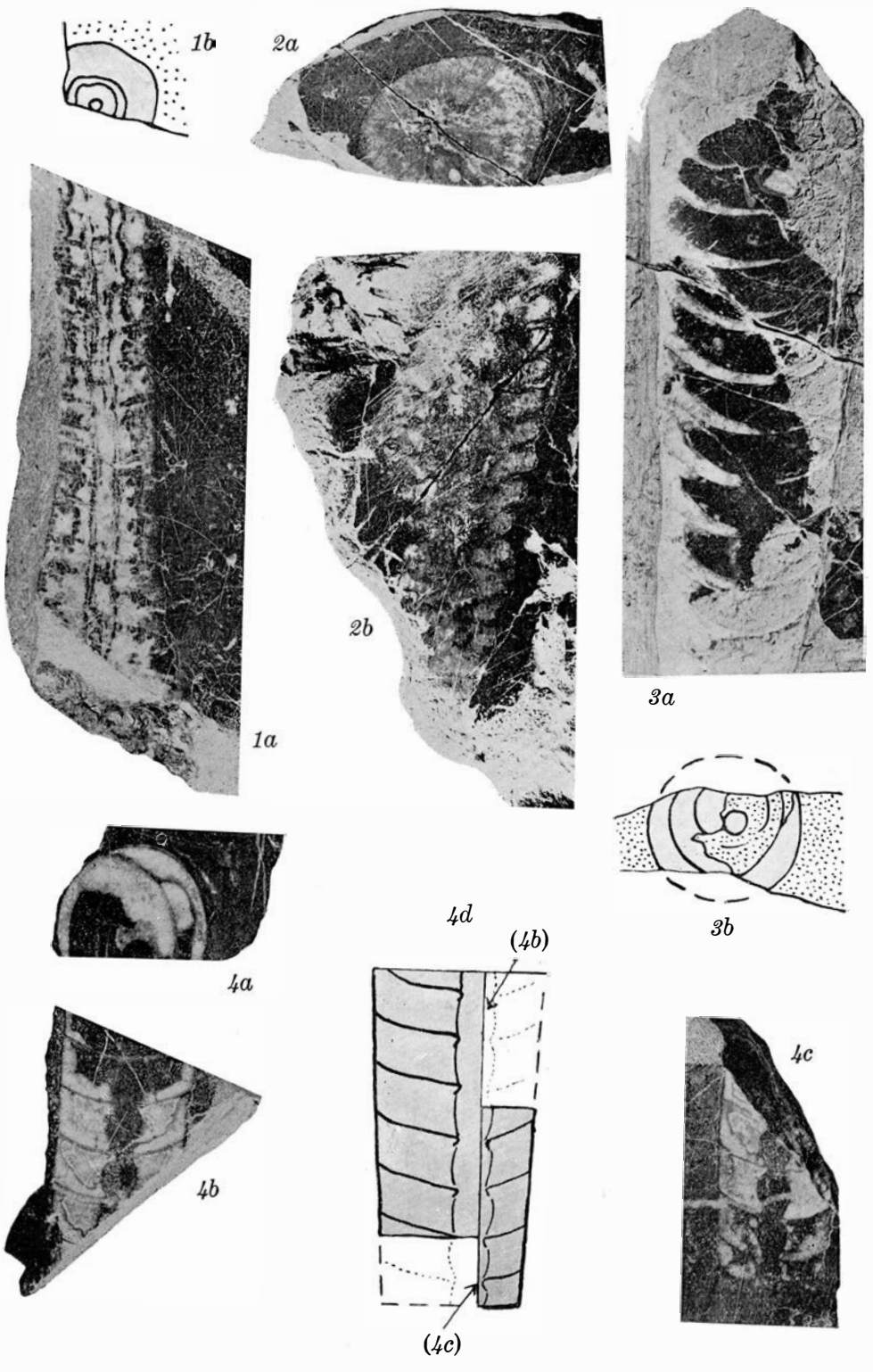
Plate IV.

Figure 1. *Discoactionoceras multiplexum* Kobayashi. .....p. 56
1a) Longitudinal section ; 1b) Cross-section. All natural size. Toufangian limestone of Changpong-dong, Sosan-gun, N. Heian-do.

Figure 2. *Maruyamaceras peshanense* sp. nov. .....p. 55
2a) Cross-section ; 2b) Longitudinal section. All natural size. Maruyama Bed of Tung-yüeh-yang, Peshan-hsien, Province Shantung.

Figure 3. *Stereoplasmoceras* cf. *machiakouense* Grabau. .....p. 53
3a) Longitudinal section ; 3b) Cross-section. All natural size. Maruyama Bed of Tung-yüeh-hsien, Peshan-hsien, Province Shantung.

Figure 4. *Stereoplasmoceras tofangoense* Kobayashi.....p. 52
4a) Cross-section ; 4b–c) Longitudinal sections ; 4d) Diagrammatic section showing the relation of the sections shown on figures (4b) and (4c). One and half times magnified. Changpyong-ni, Kosho-gun, N. Heian-do.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(4b)
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(4c)

PLATE V.

Plate V.

Wolungian Fossils.

Figure 1. *Piloceras* sp. .....p. 44
1a) Cross-section ; 1b) Longitudinal section ; 1c–d) Diagrammatic longitudinal and cross-sections. All natural size. Hatoryong-ni, Tokusen-gun, S. Heian-do.

Figure 2. *Cameroceras styliforme* Grabau. .....p. 42
2a) Cross-section of the broader end ; 2b) Side view and longitudinal section ; 2c) Cross section of the narrower end. All natural size. Fuchu-dong, Sosan-gun, N. Heian-do.

Figure 3. *Ellesmereoceras amplum* Kobayashi. .....p. 38
3a) Lateral view ; 3b) Cross-section ; all one and half times magnified. Ryutodo, near Kojo, Sosan-gun, N. Heian-do.

Figure 4. *Piloceras platyventrum* Grabau. .....p. 43
4a) Longitudinal section ; 4b–c) Diagrammatic longitudinal and transverse sections. All natural size. Tung-yüeh-yang, Peshan-hsien, Province Shantung.

Figure 5. *Ellesmereoceras amplum* Kobayashi. .....p. 38
Natural size. Shihshima, Peshan-hsien, Province Shantung.

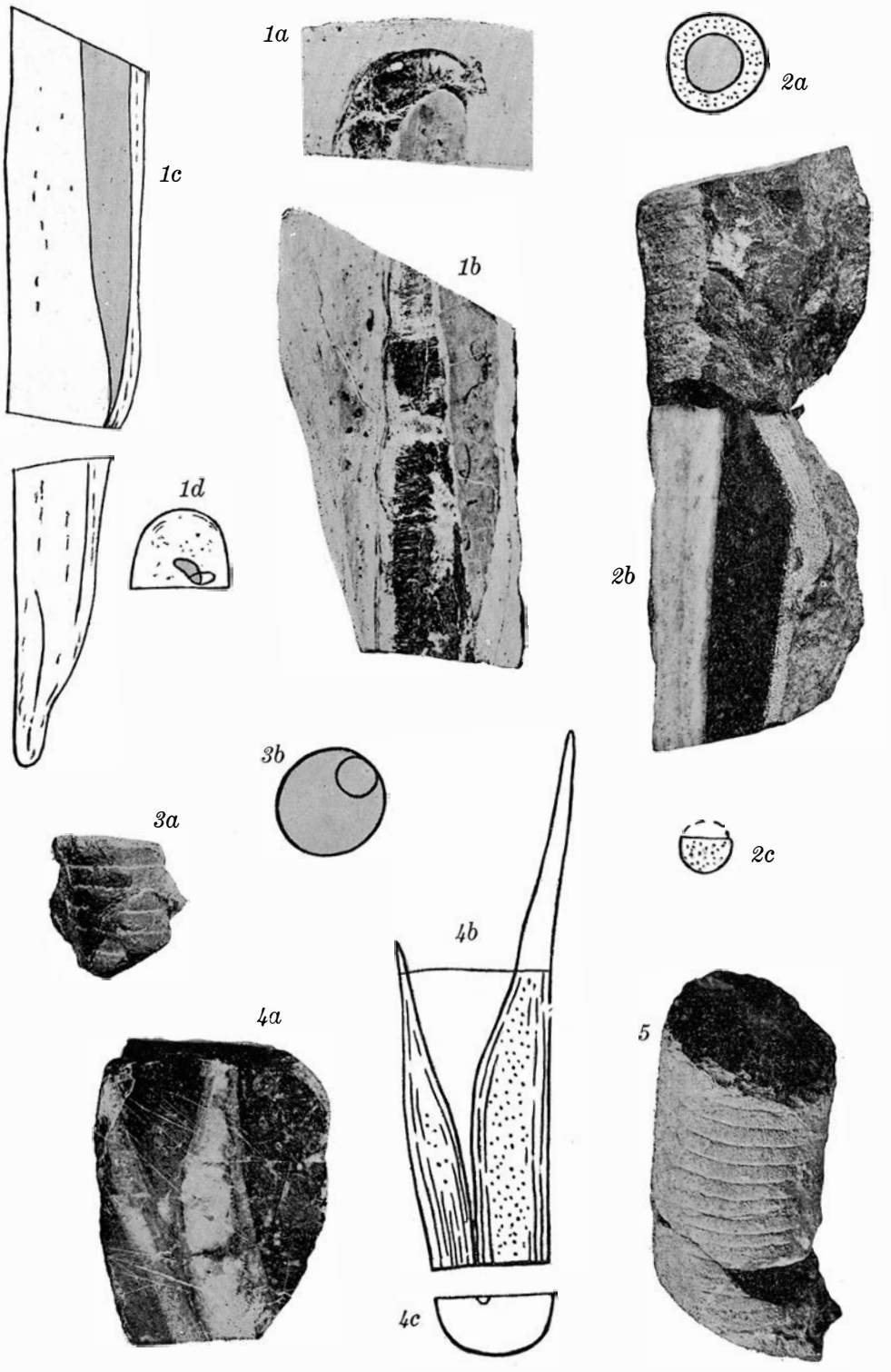
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PLATE VI.

Plate VI.

Cephalopods of the Shorin Bed.

Figure 1. *Wolungoceras minor* sp. nov. .....p. 40
1a) Weathered surface. 1b) Cross-section; Natural size. Shorin Bed of Shorinri.

Figure 2. *Wolungoceras minor* sp. nov. .....p. 40
Weathered surface. One and half times magnified. Shorinri.

Figure 3. *Ellesmereoceras amplum* Kobayashi. .....p. 38
3a) Side view. 3b) Cross-section. 3c) Longitudinal section. All natural size. Shorinri.

Figure 4. Diagrammatic section of *Wolungoceras minor* sp. nov....p. 40
4a) Cross-section; 4b) Longitudinal section.

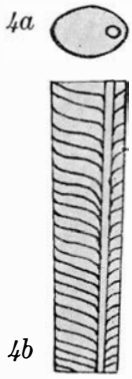
Figure 5. *Cameroceras curvatoformis* sp. nov. .....p. 41
5a–b) Longitudinal sections. 5a) One and one-third times magnified. Shorinri.

Figure 6. *Cameroceras curvatoformis* sp. nov. .....p. 41
Weathered surface of a siphuncle. One and one-third times magnified. Shorinri.

Figure 7. *Cameroceras* (*Proterocameroceras*) *mathieui* Grabau.....p. 42
Weathered surface. Natural size. Shorinri.

Figure 8. *Cameroceras* (*Proterocameroceras*) *mathieui* Grabau.....p. 42
8a) Longitudinal section. One and one-third times magnified. 8b) Longitudinal section; 8c) Cross-section. Both natural size. Shorinri.


2


4a

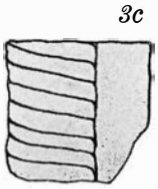
4b

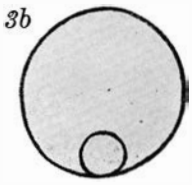

1a

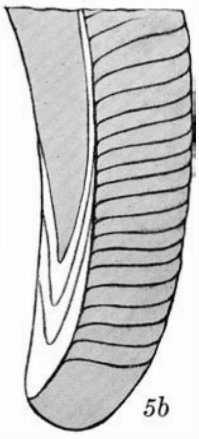

3a


1b


7


3c

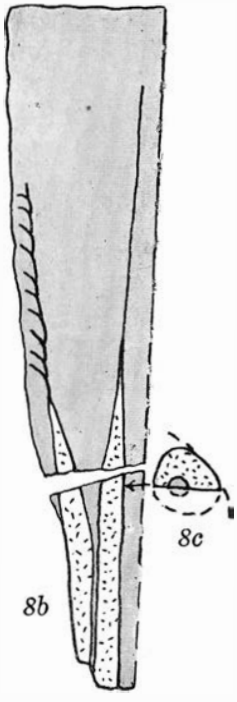

3b


5b


5a


6


8a


8c

8b

PLATE VII.

Plate VII.

Coreanoceras kempipoense gen. et sp. nov.

Figure 1. Weathered surface showing a siphuncle and camerae. Natural size. Shorinri.

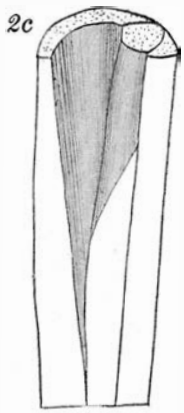
Figure 2. Cross-section (2a); Longitudinal section (2b). Both one and one-third times magnified. Diagrammatic sections (2c–d). Shorinri.

Figure 3. Ventral view (3a) and Lateral view (3b) of a siphuncle and a preseptal cone. All natural size. Shorinri.

Figure 4. Longitudinal section (4a); Cross-section of a narrow end (4b). 4c–d) Diagrammatic transverse and longitudinal sections. All natural size. Shorinri.


2a


2b

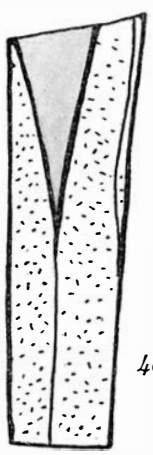

2c
2d


3a


3b


1


4d


4c


4a

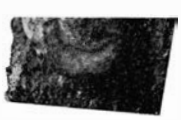

4b

PLATE VIII.

Plate VIII.

Cephalopods of the Shorin Bed of Shorinri.

Figure 1. *Coreanoceras kemipoense* sp. nov. .....p. 47
Weathered surface. Natural size.

Figure 2. *Coreanoceras kini* sp. nov. .....p. 49
2a) Cross-section ; 2b) Side view. All natural size.

Figure 3. *Coreanoceras kokaiense* sp. nov. .....p. 48
3a) Cross-section. 3b) Weathered surface.

Figure 4. *Coreanoceras kokaiense* sp. nov. .....p. 48
4a) Cross-section. 4b) Weathered surface.

Figure 5. *Coreanoceras kokaiense* sp. nov. .....p. 48
5a) Weathered surface. 5b) Cross section.

Figure 6. *Wolungoceras minor* sp. nov. .....p. 40
Weathered surface.

Figure 7. *Coreanoceras kokaiense* sp. nov. .....p. 48
7a) Dorsal view of two siphuncles. 7b) Cross-section of a broad end. 7c) Cross-section of a narrow end. 7d) Longitudinal section of a smaller siphuncle. All natural size.

Figure 8. *Coreanoceras tenuicurvatum* sp. nov.....p. 49
8a) Weathered surface and a longitudinal section. 8b) Cross-section of a broad end. 8c) Cross-section of a narrow end. All natural size.

Ordovician Fossils of North Korea.

Plate VIII.

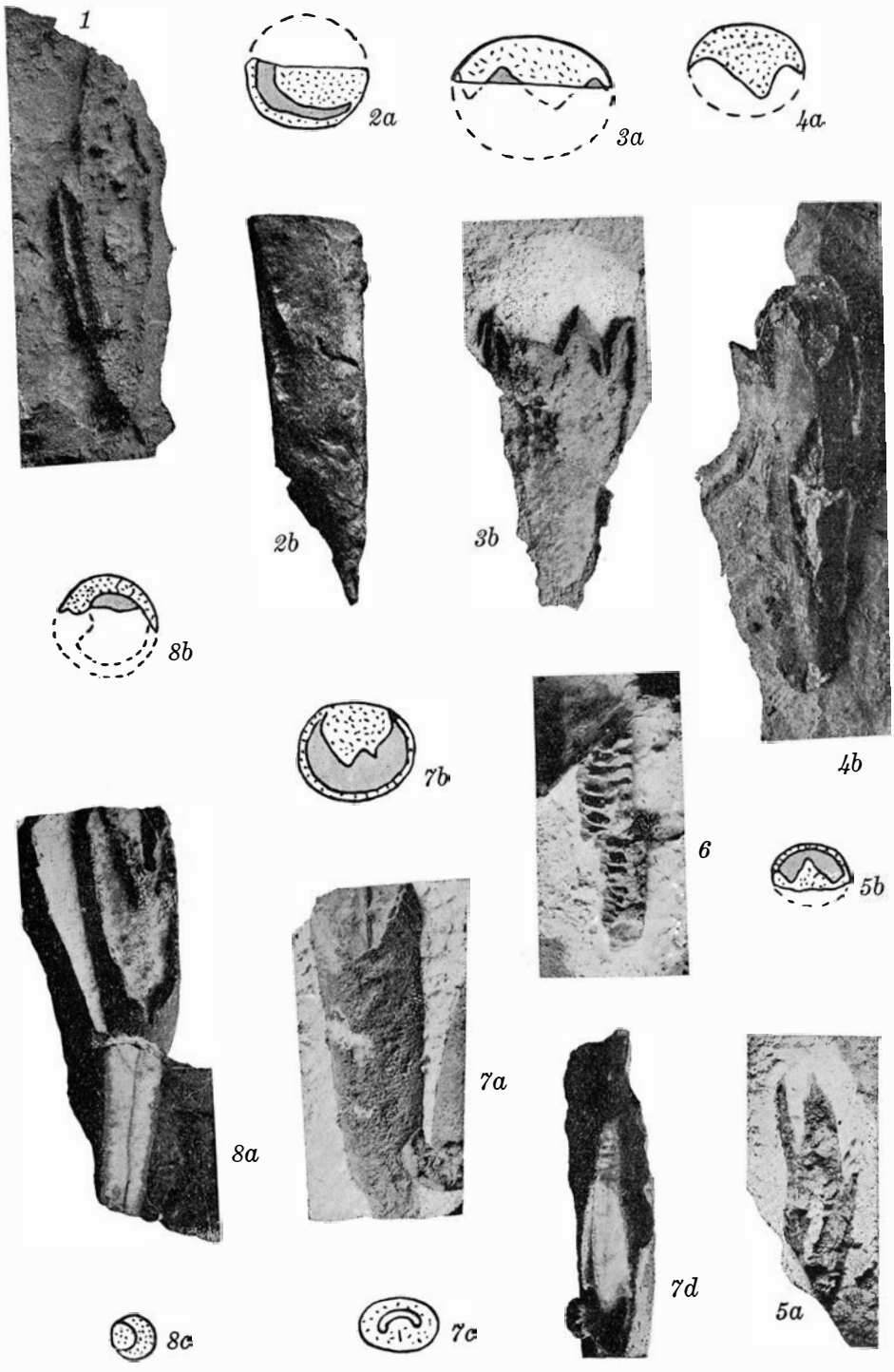


PLATE IX.

Plate IX.

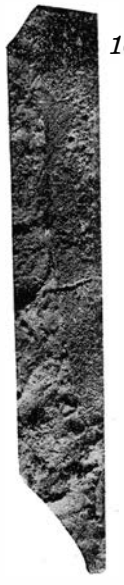
Figure 1. *Coreanoceras tenuicurvatum* sp. nov.....p. 49
1a) Side view of a siphuncle; 1b) Longitudinal section; 1c) Cross-section. All natural size. Shorin Bed of Shorinri.

Figure 2. *Coreanoceras kemipoense* sp. nov. .....p. 47
2a) Weathered surface; 2b) Cross-section. Natural size. Shorin Bed of Shorinri.

Figure 3. *Cameroceras curvatoformis* sp. nov. .....p. 41
Weathered surface of a siphuncle. Natural size. Shorin Bed of Shorinri.

Figure 4. *Cameroceras* (*Proterocameroceras*) *mathieui* Grabau.....p. 42
Longitudinal section. One and one-third times magnified. Shorin Bed of Shorinri.

Figure 5. Basal limestone of the Ordovician formation showing the *Cryptozoon* like structure. Photographed at the village of Samsan-dong, Tokusen-gun, South Heian-do, Korea.



1a

2b

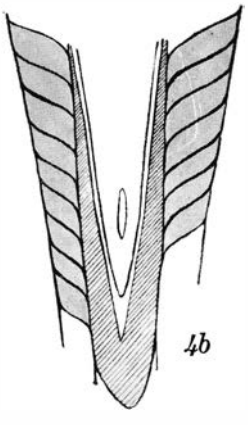
2a

3

1b

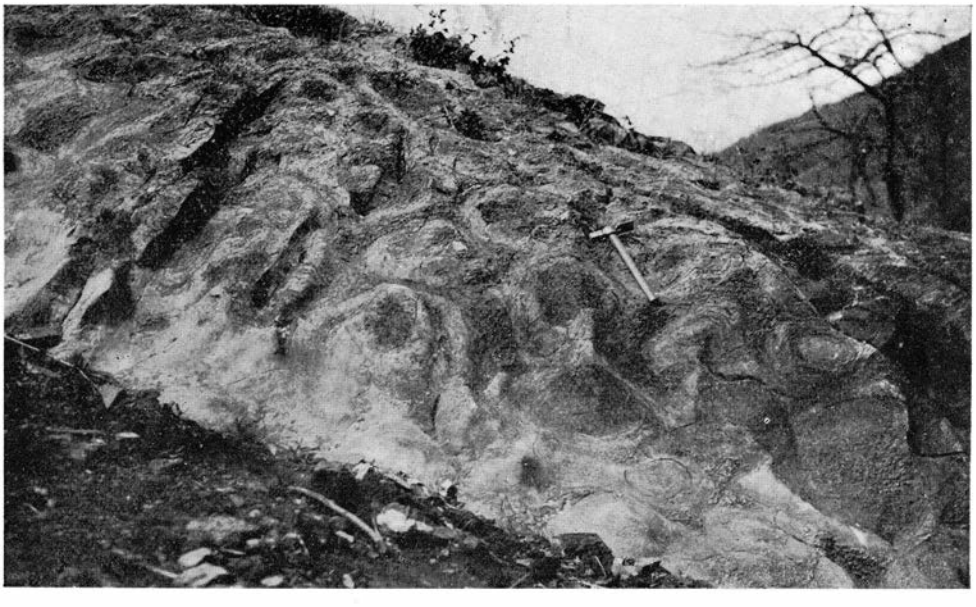
1c

4a



4b

5



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晩達層　斑狀黝灰色石灰岩

松林層ハこれあのせらすヲ初メ種々ノ頭足類巻介二枚介腕足介等ヲ多産シ、臥龍統下部ニ當リ、丸山層ハまるやませらすヲ産出シ、臥龍統上部ヲ示ス。晩達層下部ノ石灰岩ハ製鐵用熔解劑ニ利用サル。

以上北朝鮮諸地方ノ奥陶紀層ハ下表ノ如ク對比サル。

地名／岩層	豆房統	臥龍統	灣灣統
黄州兼二浦	晩達山層	丸山層 松林層	
晩達山	南壯層 雲鶴層 晩達山層	廣井層	
德川順川高原	あくちのせらす層	ぷりおめら層 ぴろせらす層	れすめれおせらす層 大渦巻石灰岩
楚山江界厚昌	あくちのせらす層	ぴろせらす層	泥灰岩薄層 大渦巻石灰岩

三、楚山、江界、厚昌地方。

楚山地方ノ奥陶紀層ハ下方ハ上部寒武利亞紀層ヲ被覆シ、上方ハ平安系ニ依ッテ被覆セラル。奥陶紀岩層ハ下位ヨリ左ノ如ク區分スルコトヲ得。

一、大渦卷石灰岩及ビ白雲岩……
二、板狀泥灰岩薄層……　灣灘統
三、白雲岩……

四、塊狀石灰岩……臥龍統

五、斑狀石灰岩……豆房統

斑狀石灰岩ハ豆房フォーナヲ、塊狀石灰岩ハ臥龍フォーナヲ產出スルコトニヨリ其ノ時代ヲ確定サル。

右岩層區分ハ大體ニ於テ江界、厚昌ノ兩地方ニモ適用サルト雖モ、之等兩地方ニ於テハ、大渦卷石灰岩ト臥龍統ノ發達スルヤ否ヤ未ダ明カナラズ。

五、兼二浦、黃州地方。

此ノ地方ノ奥陶紀層ニハ鐵鑛胚胎ス。大體ニ於テ楕圓形ノ構造盆地ヲナスト雖モ周邊ニハ斷層發達シ、寒武利亞紀層トノ連續關係不明ナリ。此ノ地方ノ奥陶紀層ハ下位ヨリ左ノ如ク區分スルコトヲ得。

松林層　暗灰色斑狀石灰岩ト雲形ノ珪質物ヲ有スル青灰色石灰岩ノ累層……厚サ二百米

丸山層　灰白色板狀石灰岩……厚サ七十乃至百米

南壯層　黝灰色石灰岩……厚サ約六十米

南壯層ハ平安系ノ紅店統ニ依ッテ不整合ニ被覆セラル。雲鶴層ハ主要ナル含化石層ニシテ、あくちのせらす其他ノ頭足類、ろふすぴら其他ノ巻介ヲ初メ種々ナル化石ヲ産出シ、南滿洲ノ豆房溝石灰岩、山東直隷ノ馬家溝石灰岩ト共ニ北米北極兩地方ノぷらっくりばー、とれんとん階頃ニ相當ス。晩達山層モ亦稀ニ化石ヲ産出スルコトアリ。本層ハ良質ノセメント原料ナリ。以上ノ三層ヲ一括シテ晩達層ト呼ブ。

二、德川、順川、高原地方。

德川地方ノ奥陶紀層ハ上部寒武利亞紀(?)ノ蠕虫狀石灰岩ヲ夾有スル板狀石灰岩累層ヲ被覆シ、約五十米ノ厚サヲ有スル結晶質苦土質石灰岩ニ始マル。平安南道德川郡豐德面三湘洞ニ於テハ第九版第五圖ニ示スガ如キ標式的ノ大渦卷石灰岩アリ、又平安南道德川郡日下面下洞ニ於テハ灣灣統特有ノ化石ヲ産出ス。

右岩層上ニハ厚サ約五十米ノ灰白色石灰岩、次イデ約二百米ノ厚サヲ有スル黝灰色乃至青白色ノ石灰岩相重ナリ、遂ヒニ平安系ノ紅店統ニ依ッテ被覆セラル。黝灰色乃至青白色石灰岩層ヨリハ、ぴろせらすフォーナト　あくちのせらすフォーナノ化石ヲ産出スルコトニヨリ豆房統ヨリ臥龍統ニ及ベルモノナルヲ知ル。

順川地方ニ於テモ亦之トホボ同樣ノ岩層發達スレドモ一般ニ化石ニ乏シ。苦土質石灰岩上ニ廣井層ニ相當スルト考ヘラル、岩層アリ。平安南道順川郡密田面下史洞ノ南方ニ於テハ此ノ岩層ヨリ三葉虫ぷりおめらヲ産ス。

高原地方ニ於テモ亦奥陶紀層下部ニ苦土質石灰岩アリ、えれすめれおせらす及ビあーけをしあたすヲ産出シ、上部ニハ板狀石灰岩及ビ斑狀石灰岩ノ累層アリ、臥龍統及ビ豆房統ノ頭足類化石ヲ産出ス。

朝鮮地質調査要報　第十一卷ノ一

北朝鮮ニ於ケル奥陶紀層序及古生物ノ研究

朝鮮總督府囑託　小林貞一

緒言

朝鮮ニ奥陶紀層ノ實在スル事ハ矢部長克博士ノ平安南道無烟炭調査當時、平安南道江東郡貨泉洞ヨリあくちのせらす、りひとほーふぇにヲ發見セシコトニ依ツテ實證セラレタリト雖モ、本岩層ノ調査未ダ極メテ不充分ナリ。依テ著者ハ先ヅ北朝鮮ニ發達スル奥陶紀層ノ層位ヲ鮮明ナラシメン爲數回ノ野外踏査ヲ試ミ、一方中村新太郎、立岩巖、島村新兵衛、素木卓二、小平亮二、今野圓藏、金鐘遠ノ諸氏及ビ著者自身ノ採集ニカヽル化石標本ヲ研究セリ。

一、平安南道晩達山地方。

晩達山附近ニ發達スル奥陶紀層ヲ下位ヨリ左ノ如ク區分スルコトヲ得。

廣井層	灰白色泥灰岩ト青色（風化スレバ黄綠色）結晶質石灰岩ノ互層	
晩達山層	暗灰色團塊狀石灰岩ト青灰色板狀石灰岩ノ互層……	厚サ約二百米
雲鶴層	暗灰色斑狀石灰岩……	厚サ約六十米

朝鮮地質調査要報　第十一卷ノ一　（昭和六年）

北朝鮮ニ於ケル奥陶紀層序及古生物ノ研究

附　山東及遼東ノ奥陶紀化石

朝鮮總督府地質調査所