A Monogragh of The Baculitidae from Japan

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A Monograph of The Baculitidae from Japan*

By

Tatsuro MATSUMOTO and Ikuwo OBATA

Contents

Preface

The family Baculitidae seems to be one of the most important groups of Ammonoidea in the Upper Cretaceous. In the Western Interior province of the U.S.A. COBBAN (1951, 1958b) has established an admirably fine zonation of the Upper Cretaceous; the zonal indices in the upper half of the sequence are mostly species of *Baculites*. Recently MATSUMOTO (1959b) described the Baculitidae from California and concluded (1960) that they are useful not only for local correlation in California but also for the interregional correlation of the Indo-Pacific region. MATSUMOTO (1959a, b) briefly mentioned the Japanese baculitids in connection with interregional correlation, but left them undescribed. In this paper descriptions of the Baculitidae from the Japanese Islands are given.

Specimens of the Baculitidae are known to occur in various areas in Japan, from Hokkaido to Kyushu. In preparing this paper we have studied about 1000 specimens from some 150 localities in Hokkaido and Honshu. The localities are grouped in the following areas of Cretaceous outcrops (Figs. 1 and 2). Baculitids have also been reported from other areas (marked with asterisks in the same list) and are briefly mentioned in this paper.

Hokkaido

(1) Kamisarufutsu area, Teshio Province*

* Received September 30, 1962.

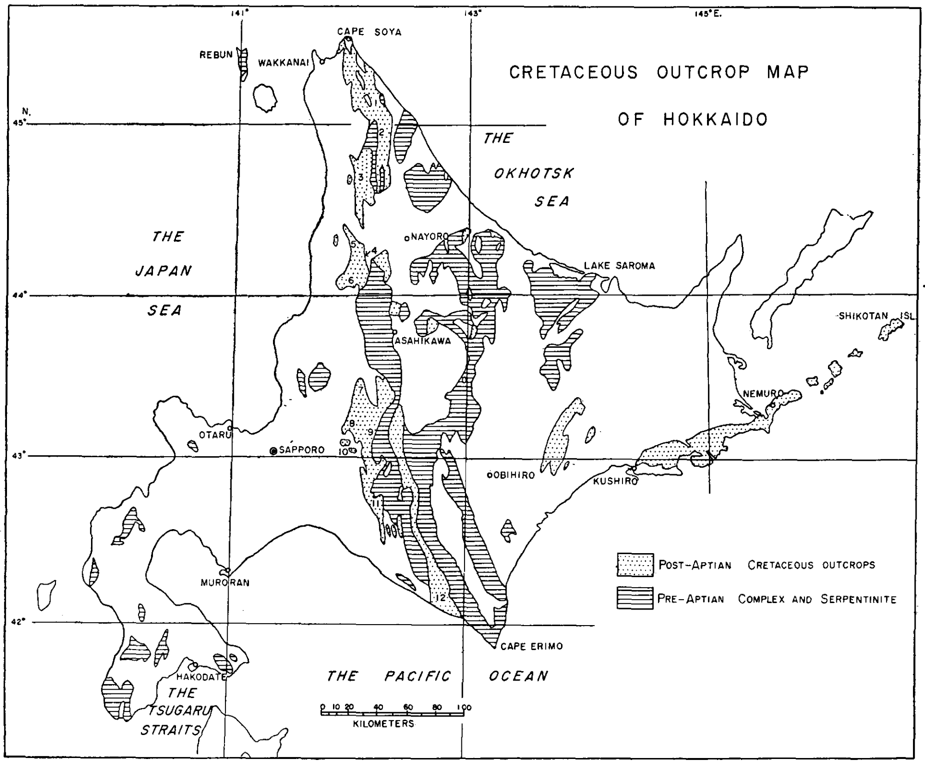

Fig. 2. Map of Hokkaido showing the Cretaceous outcrops and the localities from which baculitids are obtained. (Adapted from the map compiled by T. MATSUMOTO, 1954). 1. Kamisarufutsu area, 2. Tonbetsu [Tombets] Valley, 3. Abeshinai-Saku area, 4. Shumarinai area, 5. Chikubetsu—Haboro area, 6. Opirashibets Valley or Tappu-Horokanai area, 7. Ashibetsu-Bibai area, 8. Ikushumbets Valley, 9. Shuyubari Valley, 10. Hatonosu Hills near Yubari, 11. Hetonai [Tomiuchi] area, 12. Urakawa area.

(2) Tonbetsu [=Tombets] Valley, Kitami Province
(3) Abeshinai-Saku area, Teshio Province
(4) Shumarinai area, Ishikari Province*
(5) Chikubetsu-Haboro area, Teshio Province
(6) Opirashibets Valley or Tappu-Horokanai area, Teshio Province*
(7) Ashibetsu-Bibai area, Ishikari Province
(8) Ikushunbetsu [=Ikushumbets] Valley, Ishikari Province
(9) Shuyubari [=Shiyubari] Valley, Ishikari Province
(10) Hatonosu Hills near Yubari, Ishikari Province
(11) Hetonai area, Iburi Province
(12) Urakawa area, Hidaka Province

Honshu, Shikoku and Kyushu

(13) Futaba area, Fukushima Prefecture
(14) Nakaminato area, Ibaraki Prefecture*

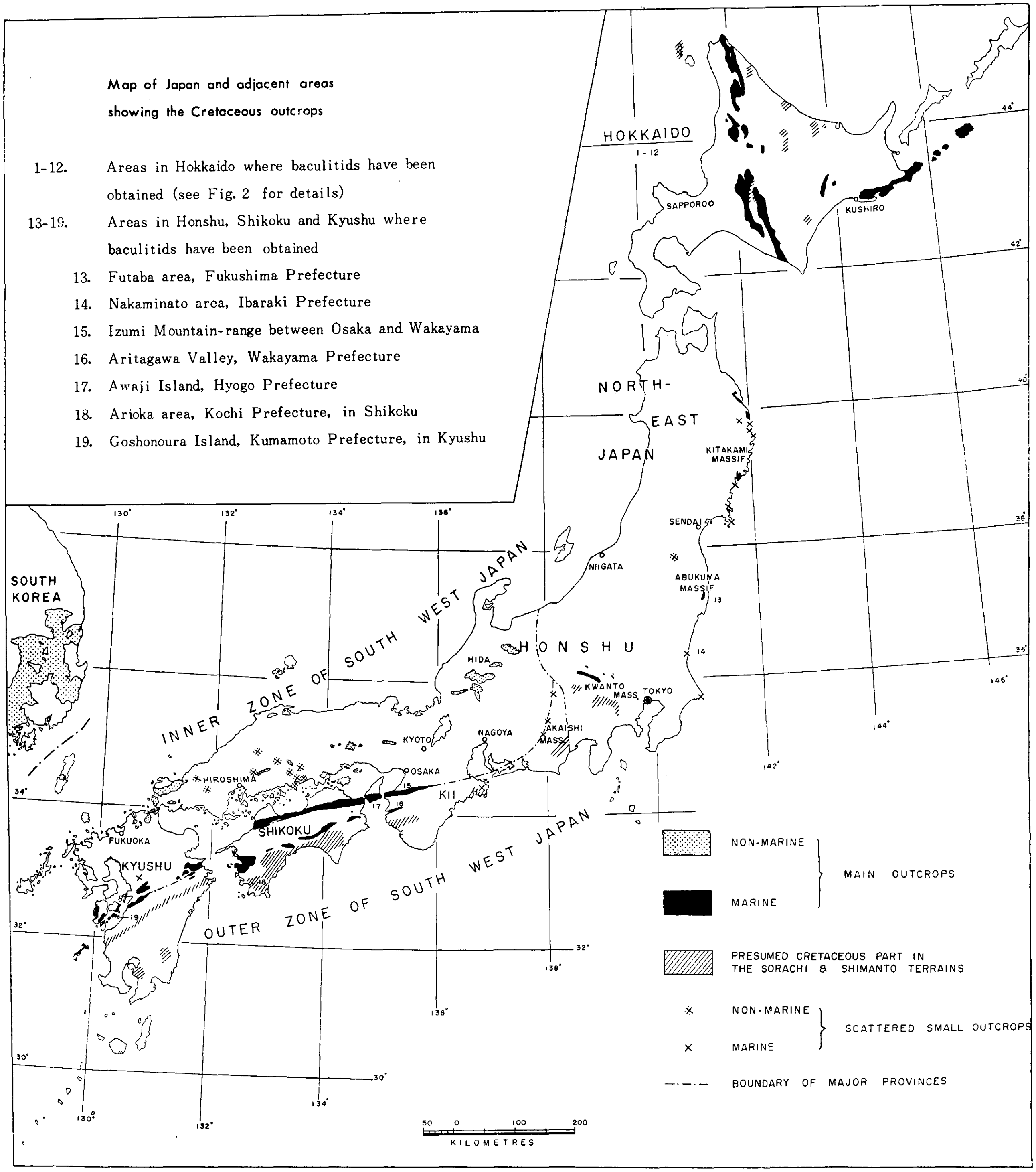

Fig. 1. Map of Japan and adjacent areas showing the Cretaceous outcrops and the localities where baculitids have been obtained (Adapted from the map compliled by T. MATSUMOTO, 1954).

(15) Izumi Mountain-range between Osaka and Wakayama
(16) Aritagawa Valley, Wakayama Prefecture
(17) Awaji Island, Hyogo Prefecture
(18) Arioka area, Kochi Prefecture*
(19) Goshonoura Island, Kumamoto Prefecture*

Historically the material goes back to YABE's listed specimens (1909), which were available for our study. Unfortunately TOKUNAGA and SHIMIZU's illustrated types (1926) were lost by a fire during World War II. We have examined the surviving specimens of YABE (1915, 1927), KOBAYASHI (1931), INOUYE (1933), SHIMIZU (1935), SASAI (1936) and MATSUMOTO (1942-1943), which were listed but not fully described.

Most of the material of this study lies, however, in the specimens collected in the last ten years, which are preserved in Kyushu University and other institutions. Some of them were briefly listed by TANAKA (1953, 56, 59, 60a), ICHIKAWA and MAEDA (1960), MATSUMOTO (1959a) and UEDA, MATSUMOTO and AKATSU (1962) without full descriptions.

Many persons have contributed to the above mentioned material. Their names are precisely recorded in the description of species. But we should like to mention here the following persons, whose collections are especially valuable in that they have reliable information of the geographic and stratigraphic positions, or contain enough well preserved specimens for studying intraspecific variations or interspecific relations or include new species.

One of us (T. M.), sometimes with his collaborators, has since 1938 accumulated a large number of specimens from the Abeshinai-Saku area, Ikushunbetsu Valley, Shuyubari Valley, Urakawa area and other localities. Tatsuo MURAMOTO has not only assisted MATSUMOTO's field work in Hokkaido since 1955 but also provided us his own collection from the Ikushumbets area. UEDA recently added a set of specimens from the Chikubetsu area. All of these are preserved in Kyushu University. The baculitid specimens collected by K. TANAKA and his collaborators on the occasion of their geological mapping in the Chikubetsu-Haboro, Ashibetsu, Aritagawa and Izumi areas were supplied for our study and are at present in Kyushu University. K. ICHIKAWA and his collaborators collected specimens of *Baculites*, among others, from the Izumi Range and Awaji Island. They are preserved partly in Kyushu University and partly in the Osaka City University.

The repositories of the described specimens are as follows, with symbols in parentheses.

Geological Institute, University of Tokyo (GT)
Division of Geoscience, Osaka City University (OCU)
Department of Geology, Kyushu University, Fukuoka (GK)

The description of the species in the following pages concerns primarily the Japanese material. In the course of this study, as in many other cases, we frequently met with difficulty in obtaining precise knowledge about the extent of variation of a species already established on a few oversea specimens. *Sciporo-*

ceras kossmati (NOWAK), for instance, was established on a single specimen from India. It is not easy for palaeontologists working in Japan to collect more specimens from the type locality in India to examine the extent of variation, while we know fairly clearly the extent of variation which is shown by our material. So far as the holotype is within this variation, the Japanese specimens are to be identified to *S. kossmati,* although the holotype may not be at the center of the variation. Again in the case of *Sciponoceras baculoides* (MANTELL), a better known species, we find some difference between the Japanese specimens with which we are dealing and the already described specimens from Europe. It is, however, rather difficult to decide whether that difference is a specific distinction or a variation within a species, since we are unable at the present moment to examine by ourselves the true extent of variation shown by the European specimens. Unpublished information may be obtained from the specialists in Europe. After long hesitation we have decided to identify the Japanese specimens with the European ones, the latter of which include the types of *S. baculoides.* In these circumstances we describe under each species the diagnostic features of the species which can be observed in our material and the extent of variation with remarks on overseas examples.

In this connection we have freely used specimens and plaster casts which were brought by one of us (T. M.) to Kyushu University from oversea areas. The abbreviations for the original repositories are

British Museum (Natural History), London (BM.)
United States National Museum, Washington, D.C. (USNM.)

The measurements, which are in millimeters in linear dimensions, are useful for presenting accurately the characters and extent of variation. The terms breadth and height are same as in the coiled ammonites. As regards the tapering or expansion of the shell, the angle is not always readily measured especially when the specimens are small. In the present study the tapering is estimated on the basis of the increase of heights in a given distance. The degree of tapering is indicated according to the following definition:

category	index $= \frac{\text{increased in heights}}{\text{distance}} \times 100$	approximate angle* $* = \tan^{-1}$ (index/100)
slow	<5	$<3°$
moderate	$5 \sim 10$	$3° \sim 6°$
rapid	>10	$>6°$

The terms "very slow" and "very rapid" may be used in some cases. The sutures have been drawn carefully under the microscope with a sectionized scale. This seems to bring us a better and more natural result than the technique of camera-lucida.

Acknowledgements.—We are much indebted to Mr. C. W. WRIGHT, London, who has kindly given us valuable information, including unpublished results of his own study, about the European specimens and good comments to our opinion and, furthermore, critically read the typescript of Part I.

Thanks are due to Professor Teiichi KOBAYASHI of the University of Tokyo and to Dr. Koichiro ICHIKAWA of the Osaka City University, who have provided their collections and other specimens kept in these Universities for the present description, also to Dr. Keisaku TANAKA and Dr. Yoshiro UEDA of the Geological Survey of Japan for the priviledge of describing their collections from the various localities, to Dr. Toshio SAITO of the Ibaraki University who has shown us his valuable collection, and to other persons whose names are indicated as collectors of baculitids in the list of material for the palaeontologic descriptions. Dr. W. A. COBBAN, U. S. Geological Survey, kindly showed to one of us (T. M.) his valuable collections and the type-localities in the Western Interior Province of the United States. Madam Suzanne FRENEIX, of Museum National d'Histoire Naturelle de Paris, kindly sent us some baculitid specimens from New-Caledonia. Finally our thanks are extended to Professor Ryuzo TORIYAMA, Dr. Kametoshi KANMERA and Dr. Tsugio SHUTO for their help in various ways. We are indebted to the Ministry of Education for the Grant in Aid for Scientific Researches which made this study possible. Miss Mitsue ISHIKAWA and Miss Chizuko OKAMURA assisted us in preparing the manuscript.

Part I

The Baculitidae from Hokkaido

(Studies of the Cretaceous Ammonites from
Hokkaido and Saghalien — XIII)

By

Tatsuro MATSUMOTO and Ikuwo OBATA

Part I

The Baculitidae from Hokkaido

(Studies of the Cretaceous Ammonites from Hokkaido and Saghalien — XIII)

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Abstracts

Twenty one species of the family Baculitidae are described from the Upper Cretaceous of Hokkaido. In our present knowledge, most of them are Indo-Pacific, some endemic and a few others cosmopolitan. Six new species and one new subspecies are established. A range chart of the baculitid species in the Upper Cretaceous of Hokkaido is presented.

Contents

Introductory Remarks

In this paper twenty one species, including one subspecies, belonging to *Sciponoceras* and *Baculites* from Hokkaido are systematically described and attention is paid to the beds in which they occur.

The following papers contain the stratigraphical descriptions of some of the formations from which the specmiens have been furnished, with some necessary maps and tables of localities:

"Fundamentals in the Cretaceous Stratigraphy of Japan" (T. MATSUMOTO, 1942-43)

"Explanatory Text of the Geological Map of Japan, Kamiashibetsu, Scale 1:50,000" (I. SHIMIZU, K. TANAKA & I. IMAI, 1953) [in Japanese with English abstract]

"The Cretaceous System in the Japanese Islands" (T. MATSUMOTO [Editor], 1954)

"Zonation of the Upper Cretaceous in Japan" (T. MATSUMOTO, 1959)

"The Cretaceous deposits in the Chikubetsu area, Hokkaido" (Y. UEDA, T. MATSUMOTO and K. AKATSU, 1962) [in Japanese with English abstract]

Systematic Descriptions

Family Baculitidae MEEK, 1876

In our present knowledge the family Baculitidae consists of the following six genera, with the type-species in brackets:

Lechites NOWAK, 1908 [*Baculites gaudini* PICTET and CAMPICHE, 1861]
Sciponoceras HYATT, 1894 [*Hamites baculoides* MANTELL, 1822]
Baculites LAMARCK, 1799 [*Baculites vertebralis* LAMARCK, 1801]
Eubaculites SPATH, 1926 [*Baculites ootacodensis* STOLICZKA, 1866]
Pseudobaculites COBBAN, 1952 [*Pseudobaculites nodosus* COBBAN, 1952]
Euhomaloceras SPATH, 1926 [*Baculites incurvatus* DUJARDIN, 1837]

The specimens from Hokkaido which we have studied are referred to *Sciponoceras* and *Baculites*. There is some evidence in Hokkaido to prove the close relationship between *Sciponoceras* and *Baculites* as described below.

There is an interesting specimen which resembles in some respects *Hamites* (?) *glaber* WHITEAVES (1884, p. 213, pl. 24, fig. 2, 2a-c) (KOSSMAT, 1895, p. 150, pl. 20, fig. 7a-b). This is, however, provisionally described in this paper under the heading of *Sciponoceras* (?) sp.

In the Upper Cretaceous of Hokkaido the existence of *Eubaculites* is not yet confirmed.

SHIMIZU listed *Euhomaloceras teshioense* (1935, p. 192, 197, 222), but this is a *nomen nudum* and is, therefore, invalid. There are no examples of *Euhomaloceras* in the available collections.

Genus *Sciponoceras* HYATT, 1894

Type-species.—Hamites baculoides MANTELL, 1894.

Synonymy.—Cyrtochilus MEEK, 1876 (*non* JAKOWLEW, 1875).

Diagnosis.—The genus was clearly defined by MATSUMOTO (1959b, p. 103).

Remarks.—Aside from a doubtful species mentioned above [*Sciponoceras* (?) sp.], there are four species of *Sciponoceras* in Hokkaido. The first of them is the well known *S. baculoides* (MANTELL), the extent of variation of which is examined from our material. The second is *S. kossmati* (NOWAK), which can be more clearly defined from our better preserved specimens. The third and the fourth are new, one from the Lower and Middle Turonian and the other from the Upper Turonian. The last new species was formerly described as *S.* aff. *bohemicum* by MATSUMOTO (1959b, p. 109) but has now proved to be distinct. It is an interesting species which has intermediate features between *Sciponoceras* and *Baculites*.

Sciponoceras baculoides (MANTELL)

Pl. 1, figs.-1-4; Pl. 2, figs. 1-3; Text-figs. 3, 26-32

Synonymy.—

1822. *Hamites baculoides* MANTELL, *Fossils of the South Downs,* p. 123, pl. 23, figs. 6, 7.

1959. *Sciponoceras baculoide,* MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.,* [D], vol. 8, no. 4, p. 104, pl. 31, fig. 1a-d; text-fig. 2a, b, containing a full list of synonymy.

Material.—The Japanese specimens before us are as follows: GK. H4275, a pebble from the Takanbetsno-sawa, Mikasa city, probably derived from the lower part of the Mikasa formation; GK. H5456a, b from a block above the flood-gate of Katsurazawa generating station, Ikushumbets Valley; GK. H5454a, b and GK. H5453 from the D-sawa, a tributary of the Ikushumbets Valley; GK. H5455 and GK. H5452 from loc. Ik1054 under the bridge of Ohashi, Ikushumbets Valley, *Mantelliceras* sp. subzone, lower part of Mikasa formation; all Ishikari Province. (Coll. T. MURAMOTO). In T. MATSUMOTO's collection, GK. H5458 and GK. H5459 from loc. Ik1054, subzone of M*antelliceras* n. sp., Ikushumbets Valley, Ishikari Province.

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
GK. H5456a	9.2	7.7	(0.84)	36.3
(on the internal mould)	8.1	7.0	(0.86)	
GK. H5456b	7.3	6.0	(0.82)	25.6
(on the internal mould)	6.8	5.6	(0.82)	
GK. H5454a				
(on the external shell)	7.2	7.1	(0.99)	
(on the internal mould)	6.2	6.2	(1.00)	37.7
	5.8	5.5	(0.95)	
GK. H5454b				
(on the internal mould)	8.0	6.6	(0.83)	

GK. H5453				
(on the internal mould)	11.2	10.2	(0.91)	
GK. H5455	6.5	6.0	(0.92)	29.4
(on the internal mould)	6.2	5.5	(0.89)	
GK. H5452	c.14.8	c.11.6	(c.0.78)	44.3
(on the external shell)	12.6	10.0	(0.79)	

Specimen	Longer diameter (=Height)	Distance between constrictions	Dis./Dia.
GK. H5453	11.2	26.1	(2.3)
(int. mould)	10.4	28.2	(2.7)
	10.2	28.0	(2.7)
GK. H5452	13.9	38.2	(2.7)
(ext. shell)	13.2	30.4	(2.3)
	11.3	21.7	(1.9)
	10.8	21.5	(2.0)
GK. H5454	7.2	27.4	(3.8)
(int. mould)	6.0	27.5	(4.6)
GK. H5455	6.2	35.1	(5.7)
(int. mould)			
GK. H5456	8.7	40.2	(4.6)
(int. mould)			

Description.—The shell is of moderate size, showing typically very slow tapering but sometimes less so. The section is subcircular to broadly elliptical in the early growth-stage, being slightly higher than broad in the late.

The surface of the shell is nearly smooth, but with faint prorsiradiate ribs and striae on the ventral half of the adult shell. The periodic constrictions are moderately frequent but may be less so in some young shells. They are prorsiradiate on the flank, projected on the ventral part, and nearly rectiradiate on the dorsum, although the curvature on the flank may vary by individuals and growth-stages. In the two young specimens, GK. H5454a and GK. H5455, the constrictions are oblique on the flank (about 45° to the long axis of the shell) as in a typical example of D'ORBIGNY (1842, p. 562, pl. 138, figs. 6, 7), but not so frequent as the latter, being about or more than 4 diameters apart. They are more frequent in the examples of later growth-stages, e.g. GK. H5453 and GK. H5452, being about 2 to 3 diameters apart. The curvature of the constrictions on the flanks in some adult shells (e.g. GK. H5453) are rather sigmoidal as in the figures of specimens from Tunisia (PERVINQUIÈRE, 1907, p. 92, pl. 4, figs. 7a, 8a, b) and Madagascar (COLLIGNON, 1929, p. 45[65], pl. 2[7], fig. 11, 11a). The constrictions are also variable in strength by individuals. The posterior part of the shell just behind the constriction is somewhat higher than the anterior one on the venter, thus forming a series of distant scale-like elevations.

The aperture is preserved in one example, GK. H4275 (Pl. 2, figs. 1, 3). Although the very apex is not completely preserved, the ventral rostrum is curved dorsally, while the dorsal rostrum is not developed; thus the aperture is facing dorsally. The apertural margin shows a very slight sinus to the dorsum in the lateral view, forming a moderate lappet near the very apex. A few dense ribs are distinct on the rostrum.

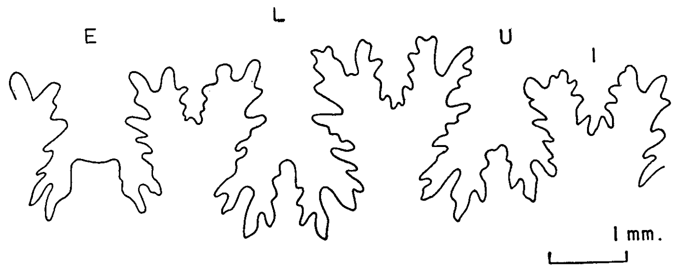


Fig. 3. *Sciponoceras baculoides* (MANTELL).
Suture, at height=6.2, breadth=5.5 mm., of GK. H5455, from loc. Ik1054 under the bridge of Ohashi, Ikushumbets Valley, Ishikari Province.

The suture is fairly deeply incised; its elements show rather intermediate form between trigonal to trapezoidal in general outline, being not so trigonal as the illustrated Californian specimen (MATSUMOTO, 1959, p. 105, text-fig. 2). The minor details of the lobes and the saddles vary to some extent, for example in the breadth of branches and basal stems and the depth of the lobules which divide the saddles.

Remarks.—Although no lectotype has been designated and the variation of English specimens is not fully described, *Sciponoceras baculoides* (MANTELL) seems to show some variation especially in the character of constrictions, cross-sections, and the details of suture. Several authors, such as FRITSCH and SCHLOENBACH (1872), SCHLÜTER (1876), PERVINQUIÈRE (1907), and MATSUMOTO (1959b), have already remarked some variability of this species. Our form, from the Lower Cenomanian of the Ikushumbets Valley, also shows similar variability.

In the lateral views Japanese specimens show a different outline from the described specimens from Europe. In almost every specimen from Hokkaido the posterior part of the shell behind the constriction is somewhat higher than the anterior one on the venter, forming a scale-like elevation. The aperture of the specimen GK. H.4275 is not perfectly preserved, but it seems to have some difference from those described by D'ORBIGNY (1842, p. 562, pl. 138, figs. 6, 8, 9), SCHLÜTER (1876, p. 139[19], pl. 39, fig. 15), CRICK (1896, p. 77, text-figs. A-E) or MATSUMOTO (1959b, p. 104, pl. 31, fig. 1a-d). Whether this character is particular to the Japanese form or otherwise cannot be decided from the literature alone. Replying to our inquiry, C. W. WRIGHT (a letter to MATSUMOTO dated Feb. 23, 1961) says as follows: "I have confirmed in *Scip. baculoides* the presence of a slight elevation behind the constrictions on the internal cast. On the English casts in chalk matrix the elevation seems to be a little less prominent than in your specimens, but I would regard yours as being within the range of variation of *S. baculoides* in this respect." Thus the Japanese form in question is best to be referred to the widespread Cenomanian species, *Sciponoceras baculoides.* Until more European specimens, including the types from England, are carefully examined, the specimens from Hokkaido are described under the heading *Sciponoceras baculoides* (MANTELL), although there remains a doubt that the Japanese form could be subspecifically separated from the typical European form of *S. baculoides*.

Affinity.—*Sciponoceras baculoides* is clearly distinguished from other species. *Sciponoceras kossmati* (NOWAK) and *S. orientale* n. sp., to be described in the following pages, may be descendants. The similarities and differences are given in those pages. There is an interesting specimen which seems to be intermediate between *S. baculoides* and *S. kossmati*. That is GK. H5456 (Pl. 1, fig. 1, Text-fig. 28), in which the cross section is broadly elliptical, the constrictions are gently sigmoidal and the saddles are shallowly subdivided. It thus approaches *S. kossmati*, but it can be included in the present species as an extreme variant. This specimen has another peculiar feature in that the dorsum is slightly narrower than the venter.

Occurrence.—Common at several localities, in the subzone of *Mantelliceras* n. sp., lower part (basal part of IIb) of Mikasa formation, Ikushumbets Valley, Hokkaido. This is the basal part of Lower Gyliakian (K4 α), approximately Lower Cenomanian.

Sciponoceras (?) sp.

Pl. 3, fig. 3; Text-figs. 4, 60

1942. *Baculites* sp., MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.*, [D], vol. 1, no. 3, p. 193, listed only.

Material.—GT. I-3158, a fragmentary specimen, from loc. T 596 (T. MATSUMOTO Coll.).

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
GT. I-3158	20.2	18.2	(0.90)	36.0
〃	18.3	16.7	(0.91)	
(on the internal mould)				

Descriptive remarks.—The shell is fairly large with apparently rather moderate tapering. The cross section is subcircular, with slightly greater height than breadth. The partly preserved shell is relatively thick and has weak prorsi-

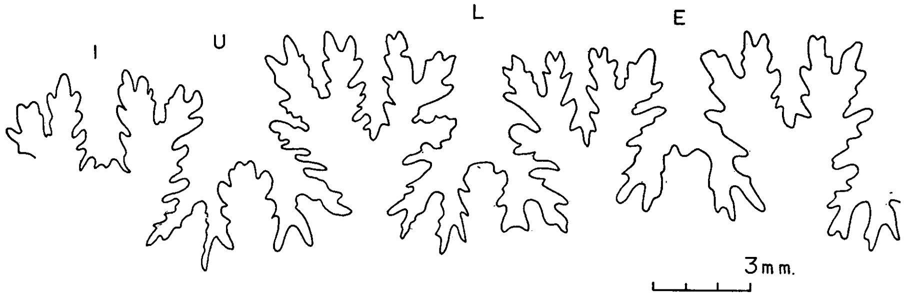


Fig. 4. *Sciponoceras* (?) sp.
Suture, at height=18.2, breadth=16.6 mm., of GT. I-3158, from loc. T596, uppermost part of bed IIa, the main course of the Abeshinai, Abeshinai-Saku area, Teshio Province.

radiate ribs. The surface of the internal mould is almost smooth. There is an obscure prorsiradiate protuberance which is accompanied posteriorly by a constriction-like depression. These features remind us such a species as *Hamites* (?) *glaber* WHITEAVES (1884, p. 213, pl. 24, fig. 2, 2a, 2b, 2c) (KOSSMAT, 1895, p. 150, pl. 20, fig. 7a, b), but the tight bend shown in WHITEAVES' fig. 2b is not confirmed in our specimen. The suture is deeply incised. The lobes and saddles are trigonal in general outline, with narrow basal stems and expanding branches. This pattern is very similar to that of *Sciponoceras baculoides* (MANTELL) (p. 11, Text-fig. 3) and *Sciponoceras orientale* sp. nov. (p. 21-22, Text-figs. 45-49), and also fairly similar to that of *Hamites* (?) *glaber* WHITEAVES (1884, pl. 24, fig. 2c).

There are three alternatives for the identification of this fragmentary specimen: it may represent an adult form of a species of *Sciponoceras*, e.g. *Sciponoceras baculoides* (MANTELL), may be a fragment of a species of *Lechites* or may represent an intermediate form between *Hamites* and *Lechites*. Although it is interesting, we need more and better preserved specimens for a clearer identification.

Occurrence.—Loc. T 596, uppermost part of bed IIa, along the main course of Abeshinai, Abeshinai-Saku Area, Teshio Province, Hokkaido. Stratigraphically it is assigned to the lower part of Lower Gyliakian, approximately upper part of Lower Cenomanian. The mudstone, partly silty, of loc. T-596 is rich in clacareous nodules, many of which are barren but some of which contain sparsely the immature shells of a phylloceratid, *Desmoceras, Marshallites* (?), *Anagaudryceras* and the group of *Inoceramus concentricus,* in addition to this *Sciponoceras* (?) sp.

Sciponoceras kossmati (NOWAK)

Pl. 3, fig. 2; Pl. 4, fig. 1; Pl. 5, figs. 1-3; Pl, 6, figs. 3-5; Text-figs. 5-25

Synonymy.—

1895. *Baculites* n. sp. aff. *bohemicus*, KOSSMAT (*non* FRITSCH), *Beitr. Geol. Pal. Oesterr.-Ung. Or.*, vol. 9, p. 154 [58], pl. 19 [5], fig. 18a-d.
1908. *Baculites kossmati* NOWAK, *Bull. Acad. Sci. Cracovie*, 1908, p. 348.
1942. *Baculites* cfr. *gaudini* PICTET & CAMPISCH, MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.*, [D], vol. 1, no. 3, p. 229, (*pro parte*) listed only.
1958. *Cyrtochilus stylus* ANDERSON, *Geol. Soc. Amer., Memoir* 71, p. 188, pl. 11, fig. 5, 5a.
1959. *Sciponoceras kossmati*, MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.*, [D], vol. 8, no. 4, p. 106, pl. 31, figs. 2a, b, 3; text-figs. 4a, b, 5a, b, 6a, b.

Material.—In T. MATSUMOTO's Collection, GK.H4335-GK.H4355 from loc. Ik987f; GK.H4300 and GK.H4301 from loc. Ik1038d; GK.H4302 from loc. Ik 1038f; GK.H5371-GK.H5373 from loc. Ik1038n; GK.H4303-GK.H4305 from loc. Ik1038; GK.H4308-GK.H4329 from loc. Ik1039c, GK.H4306, GK.H4307, GK.H4330-GK.H4334 from loc. Ik1039d; and other comparable fragments, GK.H4285-GK. H4287, GK.H4289-GK.H4294 from loc. Ik987c; GK.H4295, GK.H4296 from loc.

Ik987e. Another comparable fragments, GK.H4297-GK.H4299 from loc. Ik987d. A small specimen, GK.H1423 from loc. Y522a.

Measurements.—

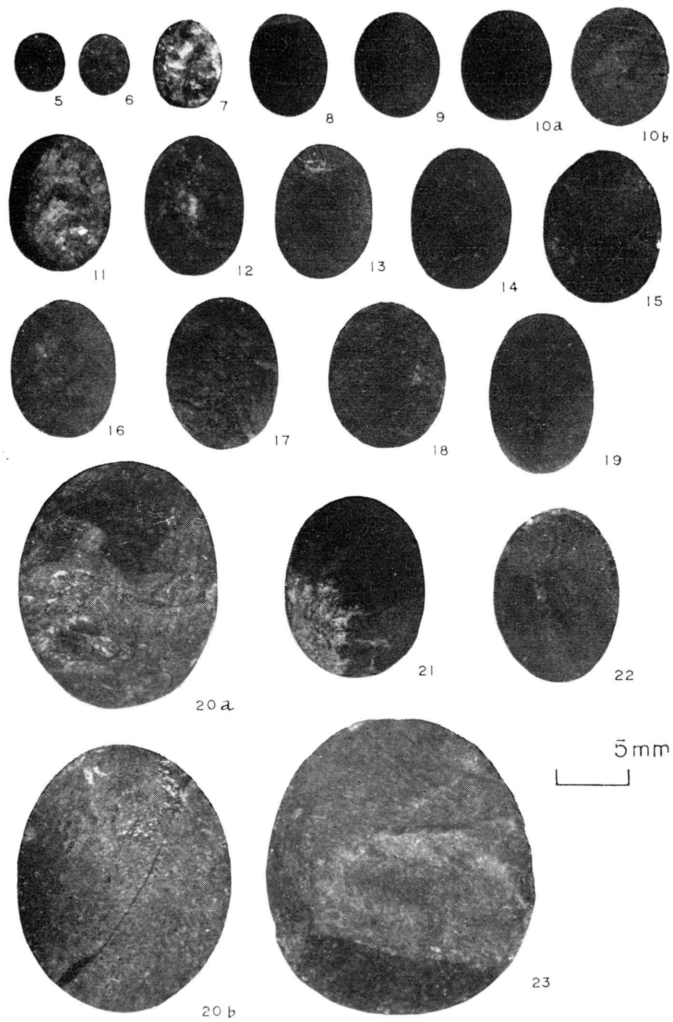
Specimen	Height	Breadth	(B/H)	Distance
GK. H1423	8.0	6.8	(0.85)	19.0
〃	7.6	6.3	(0.83)	20.0
〃	7.4	6.1	(0.82)	
GK. H4287	5.2	4.6	(0.88)	18.5
〃	4.2	3.6	(0.86)	
GK. H4300	8.6	6.8	(0.79)	21.4
〃	8.1	6.2	(0.77)	20.2
〃	7.6	6.0	(0.79)	
GK. H4308	7.1	5.1	(0.72)	22.4
〃	5.6	4.3	(0.77)	
GK. H4335	22.3	20.4	(0.91)	51.2
〃	21.2	17.2	(0.81)	53.4
〃	19.0	16.3	(0.86)	
GK. H4337	10.7	8.8	(0.82)	25.2
〃	10.3	8.3	(0.81)	24.5
〃	9.9	7.5	(0.76)	
GK. H4338	11.5	8.6	(0.75)	20.7
〃	10.6	8.0	(0.75)	
GK. H4342	20.7	18.2	(0.88)	57.9
〃	20.0	16.6	(0.83)	
Holotype, estimated from KOSSMAT's figure				
	9.8	7.5	(0.77)	

Specimen*	Longer diameter (=Height)	Distance between constrictions	Dis./Dia.
GK. H1423(i.)	7.5	23.7	3.2
GK. H4287(e.)	4.3	7.3	1.7
〃	4.7	5.6	1.2
〃	5.0	5.5	1.1
GK. H4300(i.)	8.6	17.6	2.0
〃	8.3	15.6	1.9
GK. H4305(e.)	7.3	5.9	0.81
〃	7.2	5.8	0.81
〃	6.7	6.2	0.93
GK. H4308(e.)	6.6	9.0	1.4
〃	5.7	12.6	2.2
GK. H4335(i.)	21.8	50.2(?)	2.3(?)
〃	20.5	51.9(?)	2.5
GK. H4337(e.)	10.5	24.0	2.3
〃	10.2	20.8	2.0

* i: on the internal mould; e: on the external shell.

Diagnosis.—The full-grown body chamber is of moderate size (over 20 mm. in dorsoventral diameter), with very slow to moderate tapering. The cross section is higher than broad and nearly elliptical, with a somewhat narrower venter than dorsum.

The constrictions are well marked on the internal mould, but obscure on the



Figs. 5-23. *Sciponoceras kossmati* (NOWAK), cross sections.
5: GK. H4353, 6: GK. H4289, 7: GK. H4307, 8: GK. H4305, 9: GK. H4345, 10a: GK. H1423(p.), 10b: GK. H1423(a.), 11: GK. H4300, 12: GK. H4320, 13: GK. H4303, 14: GK. H4331, 15: GK. H4324, 16: GK. H4286, 17: GK. H4337, 18: GK. H4344, 19: GK. H4321, 20a: GK. H4335(p.), 21: GK. H4338, 22: GK. H4332, 20b: GK. H4335(a.), 23: GK. H4342.
(a.): anterior and (p.): posterior parts of the same specimen.

outer shell. They are fairly frequent, especially so in the earlier stages in which they are about one to two diameters distant. In adult specimens the constrictions are prorsiradiate on the flanks. In immature specimens the constrictions are prorsiradiate on the outer half of the flanks and are typically nearly rectiradiate or very slightly prorsiradiate on the inner half of the flanks, thus forming a sigmoidal curvature. They are widened and shallowed towards the dorsum, sometimes fading away on the dorsum.

The ribs begin to develop at the relatively early stage of about 7 mm. in dorsoventral diameter. They are generally of moderate and regular intensity, separated by interspaces as narrow as the ribs themselves, about 4 in the distance of the dorsoventral diameter at 10 mm. diameter and 7 or 8 at 20 mm. diameter. They are about 95°-100° to the long axis of the shell on the dorsum, prorsiradiate on the flank, forming an angle of about 30°-35° on the dorsal half and that of about 60° on the ventral half with the long axis of the shell, and then cross the venter with a fairly gentle curvature. They are weakened and may be obsolete on the dorsum. Striae may sometimes be discernible running parallel with the ribs.

There is a collar along the apertural margin of the adult shell, although it is not perfectly preserved on the examined specimens (GK.H4335, GK.H4304). The striae show a broad forward curve on the dorsal part of the collar.

The test is relatively thinner than that of certain other species, e.g. *Sciponoceras baculoides* (MANTELL).

The suture is moderately incised. The lobes and saddles are trapezoidal to trigonal in general outline. L is relatively deeper than E; the saddle between E and L is slightly lower than that between L and U; U is somewhat oblique and asymmetrically subdivided; I is small.

Variation.—The tapering of the shell is generally very slow, but may be moderate in a young specimen (below 7 mm. in height) (e.g. GK.H4308). The proportion of breadth to height varies a little by individuals and growth stages

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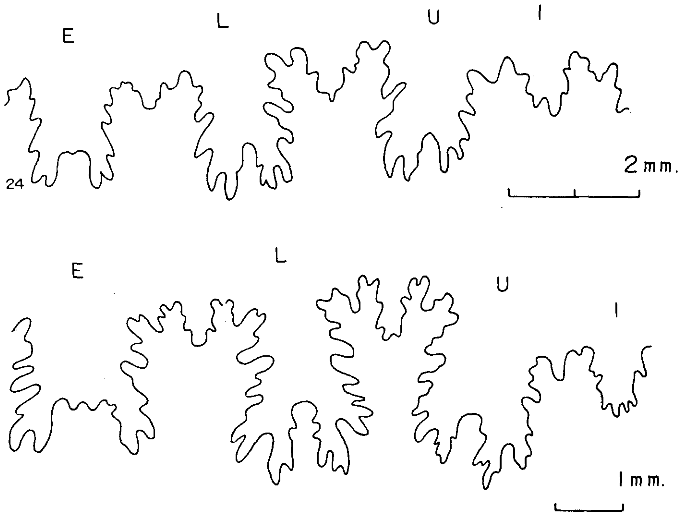

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Figs. 24, 25. *Sciponoceras kossmati* (NOWAK).

24. Suture, at height=7.4, breadth=6.1 mm., of GK. H1423, from loc. Y522a, Tengu-zawa, bed IIh, upper part of Middle Yezo group in the Shuyubari area, Ishikari Province.

25. Suture, at height=8.1, breadth=*c.* 6.5 mm., of GK. H4300, from loc. Ik1038d, uppermost part of bed IIc, Mikasa formation, Ikushumbets Valley, Ishikari Province.

(see measurements).

The constrictions are also variable. They are oblique on the full-grown body chamber (i.e. GK.H4335, Pl. 4, fig. 1; GK.H4342, Pl. 5, fig. 3), while the younger specimens from one and the same nodule exemplify a gently sigmoidal and less oblique constrictions than that of the mature one (e.g. GK.H4300, Pl. 5, figs. 2). Apparently oblique ribs are, however, observable in a few other small specimens (e.g. GK.H4308).

Considerable variation is also seen in the suture. The saddles and lobes are trapezoidal in general outline in some specimens (e.g. GK.H1423), but rather trigonal in others (e.g. GK.H4308 and GK.H4320) with narrower basal stems and expanding branches. The intermediate state in this respect is, of course, observable in many specimens (e.g. GK.H4300). The depth of incisions may vary from one to another. In some specimens the internal lobe may not be so distinctly trifid as in others.

Remarks.—Numerous specimens obtained from a limited thickness of strata in Hokkaido have given us a good picture of the diagnostic features and also extent of variation of the present species. The holotype, which is unfortunately a single, imperfectly preserved specimen from India (KOSSMAT, 1895, p. 154[58], pl. 19[5], fig. 18a-d), is within, but rather near the extreme end, of this variation. GK.H1423, among the specimens from Hokkaido, most closely resembles the holotype in various respects. The Californian specimens described by MATSUMOTO (1959b, p. 108, text-figs. 4-6, pl. 31, figs. 2, 3) are rather similar to these examples.

Affinity.—The present species is in many respects allied to *Sciponoceras baculoides* (MANTELL) (see above) of earlier geological age, but can be distinguished by its more distinct and more regular ribbing.

On the average *S. kossmati* is more clearly elliptical, i.e. less subcircular, in cross section than *S. baculoides*; typically the former has trapezoidal sutural elements but the latter trigonal ones; the constrictions are fairly frequent and more or less sigmoidal in the former but less frequent and rather simply oblique in the latter. There are, however, variations in these respects, as has been described above. Therefore the extreme variants of the two species approach each other in certain respects. Thus, for instance, several specimens of *S. kossmati* (e.g. GK.H4308 and GK.H4320) are almost indistinguishable from certain examples of *S. baculoides* as far as the suture is concerned. We have already mentioned the existence of an apparently intermediate form (e.g. GK.H5456) in respect to the constriction. On the basis of these and other facts, *S. kossmati* can be interpreted as a descendant of *S. baculoides.*

The distinction of *S. kossmati* from the contemporary *S. gracile* (SHUMARD) and later *S. bohemicum* (FRITSCH) has already been described by MATSUMOTO (1959b, p. 107).

Occurrence.—Loc. Y522a, Tengu-zawa, bed IIh (mudstone), upper part of Middle Yezo Group, Lower Gyliakian in the Shuyubari area, Ishikari Province in Hokkaido, approximately middle Cenomanian. Loc. Ik.1039c, d, and loc. Ik.

1038n, upper part of bed IIc (fine-sandy siltstone, partly with drifts), the upper part of Lower Gyliakian, approximately uppermost Cenomanian; locs. Ik.987c, d, e, f, Ik.1038d, f, uppermost part of bed IIc (fine-sandy siltstone), the basal part of Upper Gyliakian, approximately basal Turonian; all from the Mikasa formation, Ikushumbets Valley, Ishikari Province, Hokkaido. *Kanabiceras septemseriatum* (CRAGIN), *Gaudryceras denseplicatum* (JIMBO), *Otoscaphites puerculus* (JIMBO), *Allocrioceras* sp., and *Inoceramus* cf. *labiatus* (SCHLOTHEIM) were obtained from the same nodule which contained the body-chambers of *S. kossmati*. The associated species in the other nodules are as follows: loc. Ik1039c, *Damesites* cf. *laticarinatus* MATSUMOTO, fish scale, plant leaf; loc. Ik987c, *Allocrioceras* sp., *Borissjacoceras* (?) sp.; loc. Ik1038n, desmoceratid sp. young, simple coral; loc. Ik1038d, *Watinoceras* sp., *Inoceramus* cf. *labiatus* (SCHLOTHEIM). Thus, the species is found commonly in basal Turonian and uppermost Cenomanian in the Ikushumbets Valley, but rarely in middle Cenomanian in the Shuyubari area.

The locality of KOSSMAT's original specimen is recorded as Garudamungalum (Lumachellen), India, the Lower Trichinopoly group. The identical species from California is reported in the Lower Turonian.

Sciponoceras orientale sp. nov.

Pl. 3, fig. 1; Pl. 6, figs. 1, 2; Pl. 7, figs. 1-6;
Pl. 9, fig. 6; Text-figs. 33-49

Material.—Holotype, GT. I-3160a from loc. T610e, bed IIc (*a*), the upper part of Middle Yezo group, Abeshinai-Saku area, Teshio Province, Hokkaido (Coll. T. MATSUMOTO). Paratypes: GT. I-3160b-d from the same type locality; GT. I-3344a-d from loc. T726p; GK. H4738-GK. H4741, GK. H4989 from loc. T1022p7, GK. H4929-GK. H4934 from loc. T1022p8; GK. H1411a-g from loc. Y419, GK. H1412 from loc. Y134p; GK. H1413 and GK. H1417 from loc. Y138; GK. H 1414a-c from loc. Y415; GK. H1415a-g from loc. Y137; GK. H1421a-c from loc. Y205 and GK. H1422a-b from loc. Y455; GK. H4356 from loc. Y138E (all Coll. T. MATSUMOTO). KG. H4360-GK. H4368 from loc. P. 27 and GK. H4357-GK. H4359 from loc. P. 28 (Coll. K. TANAKA). A few possible but slightly doubtful specimens, which are deformed, of the present species: GT. I-3159a-e from loc. T912p (Coll. T. MATSUMOTO).

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
GT. I-3160a	11.2	9.9	(0.88)	
GT. I-3160d	8.5	7.7	(0.91)	
GK. H1411a	13.1	12.2	(0.93)	23.7
〃	11.5	10.2	(0.89)	
GK. H1411b	10.7	10.3	(0.96)	20.7
〃	10.5	9.6	(0.91)	
GK. H1411f	6.4	6.2	(0.97)	
GK. H4360	9.0	8.5	(0.94)	20.2
〃	7.8	7.2	(0.92)	
GK. H4361	5.7	5.3	(0.93)	

GK. H4366	4.6	4.3	(0.93)	
GK. H4741	8.1	8.0	(0.99)	22.1
〃	7.0	6.9	(0.99)	
GK. H4929	5.3	5.2	(0.98)	

Specimen	Longer diameter (Height)	Distance between constrictions	Dis. / Dia.
GT. I-3160b(i.)	6.3	10.2	1.6
〃	5.9	4.8	0.8
GT. I-3160c(i.)	5.0	7.0	1.4
〃	4.6	6.3	1.4
GK. H1412(i.)	9.4	17.6	1.9
GK. H4356(i.)	11.7	16.9	1.4
GK. H4360(i.)	8.4	18.6	2.2
GK. H4361(i.)	5.2	10.2	2.0
GK. H4366(i.)	5.1	9.5	1.9
GK. H4367(i.)	4.1	6.2	1.5
〃	3.7	5.3	1.4
〃	3.3	2.2	0.7

Diagnosis.—The shell is of moderate size, with diameters of about 20 mm. in a relatively larger example. The tapering is slow, except in the very early growth-stage. The cross section is nearly circular to broadly elliptical.

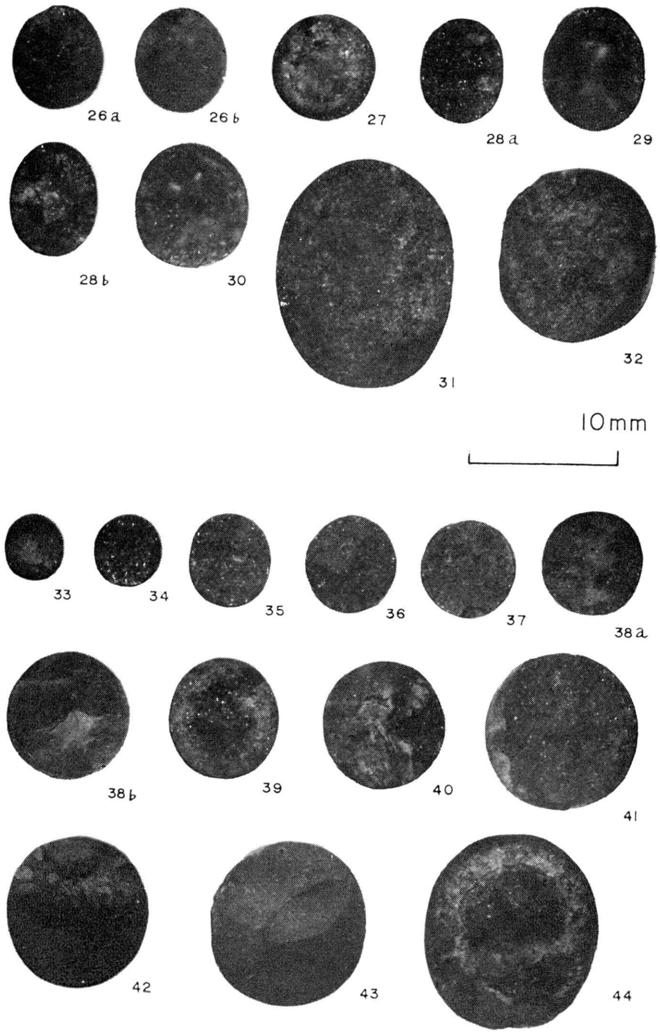
The constrictions are frequent, about one to two diameters apart, normally well marked on the internal mould and completely encircling it, of considerable breadth and depth on the internal mould but only slightly elevated on the external shell. They run almost parallel to the ribs.

The ribs are distinct, moderately distant, normally about 3 to 4 within the distance of a diameter. They are broadened and asymmetrically elevated to produce a gently projected scale-like ornament on the venter. They are prorsiradiate on the main part of the flank, forming an angle of 60° (±5°) with the long axis of the shell, becoming gradually fainter and bent at the dorsolateral margin. On the dorsum they are much weakened and nearly rectiradiate, showing a very gentle convexity.

In addition to the ribs numerous faint striae can be recognized on the well preserved shells (e.g. GK. H1414), which are oblique to the ribs on the flank, forming an angle of about 40° with the long axis of the shell, but are parallel to the ribs on the venter and also on the dorsum.

The suture is deeply incised; its elements are trigonal in general outline, with narrowed stems and expanding branches. The saddle between L and E is the highest.

The aperture, which is well preserved on one specimen, GK. H4739 (Pl. 7, fig. 3), is facing dorsally. The ventral rostrum has a trigonal outline, with a rather acute apex. It is extended in its basal part gradually from the venter of the main part of the body chamber with a very gentle bending towards the dorsum and then bent abruptly to form a small hood-like apical part which is almost at a right angle to the long axis of the shell. The dorsal rostrum is not well developed but the dorsal part of the body chamber is slightly bent dorsally



Figs. 26–32. *Sciponoceaas baculoides* (MANTELL), cross sections.
26a: GK. H5455(a.), 26b: GK. H5455(p.), 27: GK. H5454a, 28a: GK. H5456b (p.), 28b: GK.H5456b(a.), 29: GK. H5454b, 30: GK. H5456a, 31: GK. H5452, 32: GK. H5453.

Figs. 33–44. *Scipɔnoceras orientale* sp. nov., cross sections.
33: GT. I-3160c, 34: GK. H4361, 35: GK. H4359, 36: GK. H1411f, 37: GK. H4739, 38a: GK. H4741(p.), 38b: GK. H4741(a.), 39: GT. I-3160d, 40: GK. H4740, 41: GK. H4738, 42: GT. I-3160a, 43: GK. H1411b, 44: GK. H1411a.
(a.): anterior and (p.): posterior parts of the same specimen.

near the apertural margin, forming a collar-like part of moderate breadth. The scale-like ribs cover the ventral part up to the bending point, where the interspace is somewhat deeper and is bordered on both sides by sharper ribs than elsewhere on the shell. The triangular apical part has minor riblets on the surface and an elevated rim at the apical end.

Variation.—So far as the examined specimens are concerned, this species varies little. The proportion between breadth and height in cross section varies from 0.8 to 1.0, as is indicated by the measurements. The frequency of the constriction can be indicated by the distance between the constrictions in proportion to the height (i.e. longer diameter). This ranges, in the measurements, from 0.7 to 2.2, and is 1.5 or so on the average. The figure may change from place to place even in one and the same specimen.

The ribbing begins to appear at a height of 6 mm. but may be weak up to a height of 9 mm. These stages of development, as well as the strength of ribs, may vary to some extent by individuals. The density of the ribbing varies, too. This can be shown by the number of the ribs in a distance equal to a height. In the holotype it is 3 to 4. Many other specimens show the same figures, but a few (e.g. GK. H1412) have 5.

The diagnostic pattern of the suture is fairly constant. In the relatively young specimens the incisions are not so deep and the stems of the elements are not so narrowed as in the older ones and, accordingly, the general outline of the lobes and saddles may be called trapezoidal rather than trigonal.

Remarks.—The specific name, *Baculites orientalis*, has appeared in lists (MATSUMOTO, 1942, p. 195 and elsewhere) and may have been informably used by some Japanese geologists, but has been a *nomen nudum*. It is herein validated.

Affinity.—The present species most closely resembles *Sciponoceras baculoides* (MANTELL) (see above) in the slow tapering, the size of the shell, the subcircular to broadly elliptical cross section and the pattern of sutures. *S. orientale* is, however, distinguished from *S. baculoides* by its better marked, more frequent and on the average less oblique constrictions, and stronger and less oblique ribs. There is probably a difference in the character of the aperture.

It is interesting to note that the ribbing of the present species is similar to that of *Lechites gaudini* (PICTET and CAMPICHE) (see SPATH, 1941, p. 664, text-fig. 242a-f; pl. 72, fig. 10a, b) of the Albian stage. The well marked constriction, among other features, is however a good criterion to distinguish the present species from any species of *Lechites*.

S. orientale and *S. kossmati* (NOWAK) (described above) are nearly contemporary and were probably derived from the common ancestor, *S. baculoides*,

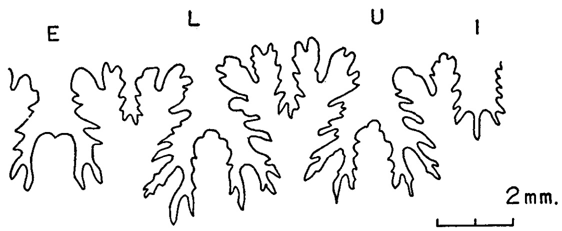
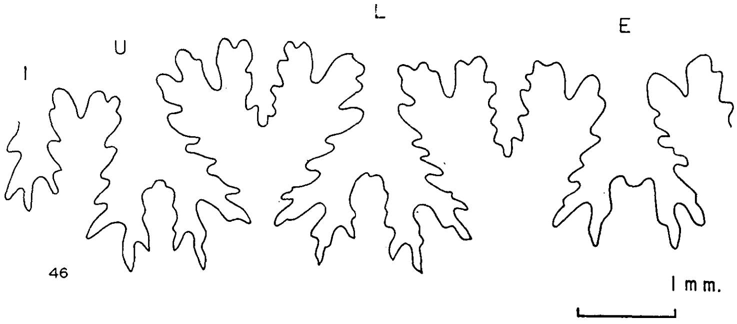


Fig. 45. *Sciponoceras orientale* sp. nov.
Suture of holotype, at height=11.2, breadth=9.9 mm., GT. I-3160a, from loc. T610e, bed IIc (α), the upper part of Middle Yezo group, Abeshinai-Saku area, Teshio Province.



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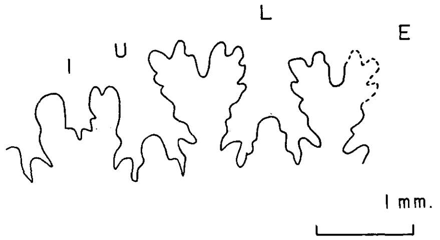

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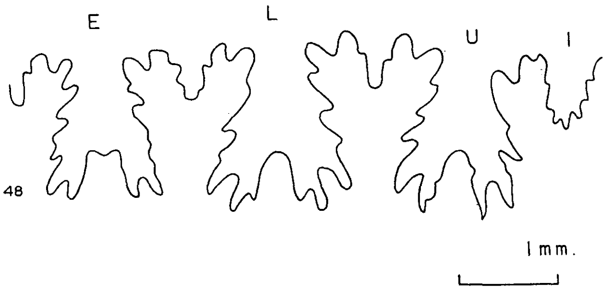

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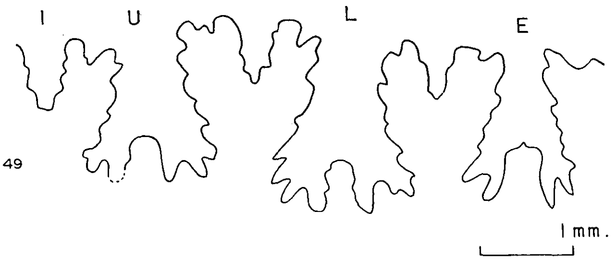

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Figs. 46–49. *Sciponoceras orientale* sp. nov.

46. A paratype, at height=6.3, breadth=5.7 mm., GT. I-3160b, from loc. T610e, the same locality as above.

47. A paratype, at height=3.3, breadth=3.3 mm., GK. H4364, from loc. P. 27, in the Porokoashibetsu, a tributary of the Ashibetsu, lower part of bed Ue4 in the lower part of the Upper Yezo group in Ishikari Province.

48. A paratype, at height=4.6, breadth=4.3 mm., GK. H4366, from loc. P. 27, the same locality as above.

49. A paratype, at height=5.1, breadth=4.5 mm., GK. H1415d, from loc. Y415, bed IIn, lower part of the Saku formation, Shuyubari area, Ishikari Province.

but were on different lines of evolution. While *S. orientale* keeps the same features as *S. baculoides* in the cross section and the suture, *S. kossmati* has acquired a more compressed shell and the less deeply incised suture with a trapezoidal outline of the elements. The constrictions have become more frequent and the ribs more distinct in both *S. orientale* and *S. kossmati* than in *S. baculoides,* but their curvatures or orientations are dissimilar between the two species. On the average the ribbing is somewhat coarser and more distant in *S. orientale* than in *S. kossmati,* although there is little difference in this respect between the extreme variants of the two species.

Sciponoceras gracile (SHUMARD) (1860, p. 596), from the Lower Turonian of the Gulf Coast and Western Interior of North America and also southeast England, seems to be much apart from *S. orientale* in its shallower incisions and subrectangular outline of the sutural elements, more compressed cross section, less distinct constrictions and denser and generally weaker ribs, which however become very coarse on the body chamber. There is probably a distinction in the aperture. There is, however, no reliable description of the extent of variation and the mean characters of that species. Nobody designated the lectotype. The above comparison is based preliminarily on actual specimens, preserved in Kyushu University, from the Eagle Ford clay and the Greenhorn limestone, and the description by STANTON (1894, p. 166, pl. 36, figs. 1-3), ADKINS (1928, p. 206, pl. 24, fig. 3), COBBAN (1955, p. 202, pl. 2, fig. 3) and MATSUMOTO (1959, p. 107, text-fig. 3) and also the information kindly given by W. A. COBBAN and C. W. WRIGHT.

Occurrence.—The type locality, T610e in bed IIc (α), mudstone unit below the Saku formation, lower part of Upper Gyliakian and also nodules of more or less fine-sandy calcareous mudstone obtained at locs. T726p, T1022p7, and T1022p8, all from the zone of *Inoceramus hobetsensis-Collignoniceras teshioensis* in bed IId, lower part of the Saku formation, middle part of Upper Gyliakian in the Saku-Abeshinai area, Teshio Province, northern Hokkaido. Locs. P. 27 and P. 28, in the Porokoashibetsu, a tributary of the Ashibetsu, lower part of bed Ue4 (of TANAKA), fine sandy siltstone and mudstone, in the lower part of the Upper Yezo group, zone of *Inoceramus hobetsensis,* in Ishikari province, central Hokkaido. Locs. Y137, Y138, Y138E, Y205, Y415, Y419 and Y455, all in bed IIn, and also loc. Y134p derived from beds IIq-IIn, lower part of the Saku formation, lower part of the Upper Gyliakian, in the southern part of Ishikari Province, central Hokkaido.

The present species is, thus, common in the lower and middle part of Upper Gyliakian, approximately Lower and Middle Turonian.

Although I have not examined the specimens, TANAKA (*in* TSUSHIMA *et al.,* 1958, p. 14 and IGI *et al.,* 1958, p. 33) recorded the occurrence of this species from his unit Mi and Mj of the Middle Yezo group in the Tappu-Horokanai area, i.e. the Opirashibetsu Valley, Teshio province. This is in harmony with the above conclusion.

The range of the present species may extend down to the upper part of

Lower Gyliakian, approximately Upper Cenomanian, because some comparable specimens occured in a rolled nodule, T912p, derived probably from bed IIc (δ) in the southern part of the Abeshinai area, Teshio province.

Sciponoceras intermedium sp. nov.

Pl. 8, figs. 1-3, 6; Pl. 11, fig. 6; Pl. 12, figs. 4, 5; Text-figs. 50-59, 61

Synonymy.—

1959. *Sciponoceras* aff. *S. bohemicum*, MATSUMOTO (*non* FRITSCH), *Mem. Fac. Sci., Kyushu Univ.*, [D], vol. 8, no. 4, p. 109, pl. 30, figs. 2a-c, 3a, b; pl. 31, fig. 4 (?); text-figs. 7a, b, 8-11.

Material.—Holotype: GK. H5386, from loc. Ik2014e, bed IIIa, near the basal part of the Upper Yezo group exposed along the Pombets, a tributary of the Ikushumbets, Ishikari Province, Hokkaido (Coll. T. MATSUMOTO, 1961).

Paratypes: GK. H5375-H5385, H5387 and H5388, from the same nodule as the holotype; GK. H4369-H4371 and GK. H4374-H4379 from loc. Ik2014d (Coll. T. MATSUMOTO); GK. H4372 from loc. Ik2014d (Coll. T. OMORI); GK. H4426-H4444 from loc. Ik940, GK. H4445 from loc. Ik968b, GK. H4446-H4447 from loc. Ik967, and GK. H5374 from loc. Ik939 (all Coll. T. MATSUMOTO).

Measurements.—

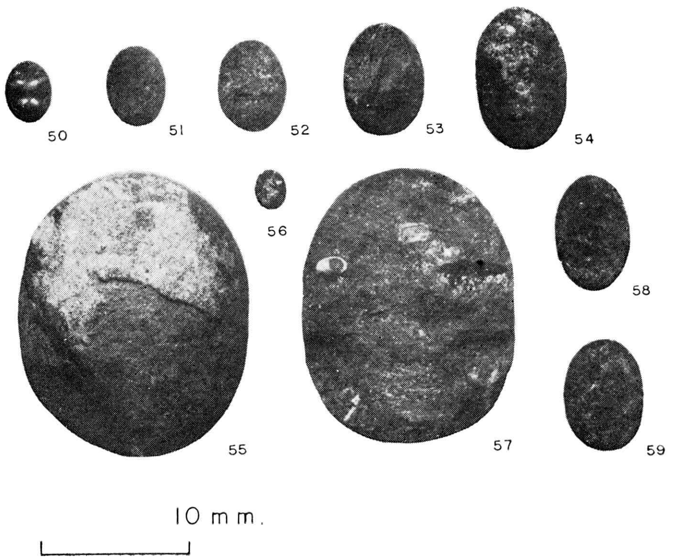
Specimen	Height	Breadth	(B/H)	Distance
GK. H5386	8.2	6.6	(0.80)	31.0
〃	6.7	5.0	(0.75)	
GH. H4370	17.3	14.0	(0.81)	
GK. H4732	20.3	17.0	(0.84)	50.1
〃	19.3	15.6	(0.81)	
GK. H4426	9.2	6.1	(0.66)	22.1
〃	7.5	5.1	(0.68)	
GK. H5375	14.2	11.0	(0.77)	26.6
〃	13.1	9.5	(0.73)	
GK. H5376	8.0	6.3	(0.79)	21.2
〃	7.1	5.0	(0.70)	
GK. H5381	4.6	3.5	(0.76)	18.1
〃	3.3	2.8	(0.85)	
GK. H5382	5.3	4.1	(0.77)	15.1
〃	4.2	3.0	(0.71)	
GK. H5387	7.5	5.5	(0.73)	22.5
〃	5.7	4.3	(0.75)	
GK. H5388	6.1	4.7	(0.77)	17.0
〃	5.2	4.0	(0.77)	

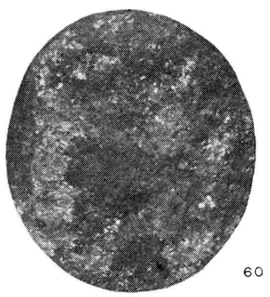
Diagnosis.—The shell increases slowly in height and breadth in the main part, but moderately in the early growth-stage. It is rather small; the largest example of the body chamber is about 20 mm. in height and 17 mm. in breadth. The cross section is distinctly higher than broad and elliptical in every growth-stage.

The constrictions occur at irregular intervals, being impressed very weakly and shallowly on the internal mould, and run nearly parallel to the ribs. On the shell the elevation of the constrictions is slightly stronger than the normal ribs.

The ribs are weak, narrow, numerous, closely spaced and often branching or inserted in the ventral part. They are very faint on the dorsum, run backward on the inner third of the side, forming an angle of about 110° to the long axis of the shell, then curve forward to run obliquely forward at about 40°-35° to the long axis on another third of the flank, and then gradually pass to a broad forward curve on the venter. Periodic, faint, crescentic bullae may be occasionally developed at the dorsolateral bending point.

The aperture, which is well preserved in the holotype and incompletely so





Figs. 50-59. *Sciponoceras intermedium* sp. nov., cross sections.
50: GK. H4376, 51: GK. H4375, 52: GK. H4330, 53: GK. H4374, 54: GK. H4426, 55: GK. H4372, 56: GK. H4442, 57: GK. H4370, 58: GK. H4438, 59: GK. H4437.

Fig. 60. *Sciponoceras* (?) sp., cross section of GT. I-3158.

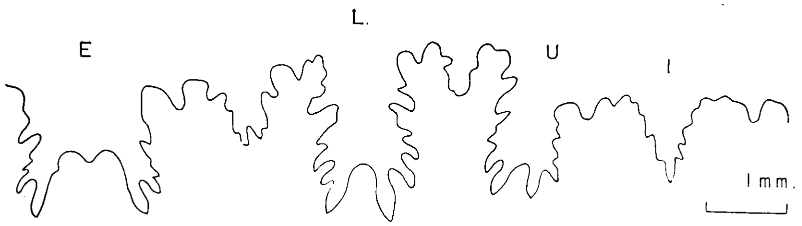


Fig. 61. *Sciponoceras intermedium* sp. nov.
Suture, at height=7.2, breadth=5.5 mm., of a paratype, GK. H5387, from loc. Ik2014e, bed IIIa, near the basal part of the Upper Yezo group exposed along the Pombets, a tributary of the Ikushumbets, Ishikari Province.

in two other specimens (GK. H4372 and GK. H5375), is oblique, facing dorsally. The ventral rostrum is gently curved to the dorsum near it narrowing apex. In the lateral view the apertural margin is shallowly biconcave to the anterior, with a slight convexity near the middle of the flank, if not forming a lappet. The dorsal rostrum is very short and shows an arch which is more distinctly rounded than the curvature of the ribs on the dorsum. No prominent collar is developed along the margin, except for an insignificant low one around the dorsum and near the apex of the ventral rostrum.

The suture, which is perfectly preserved in the paratypes, GK. H4374, H5376, H5387, H5388, etc. and imperfectly seen in the holotype and other specimens, is relatively simple. Its elements are bifid, less deeply incised, and have a roughly rectangular or slightly trapezoidal outline. The first lateral saddle is as high as but nearly one and a half times as broad as the second. Both are subsymmetrically bifid. The dorsal saddle is nearly as narrow as, or slightly narrower, but much lower than the second lateral saddle. The external lobe [E] is of moderate breadth. The first lobe [L] is as deep as but somewhat narrower than E, and irregularly bifid at the bottom. The second lateral lobe [U] is oblique, nearly as narrow as and slightly shallower than I. The internal lobe [I] is shallow and small.

Variation.—The proportion between height and breadth varies from 0.66 to 0.85, but mostly between 0.7 to 0.8. The ribs show a certain extent of variation

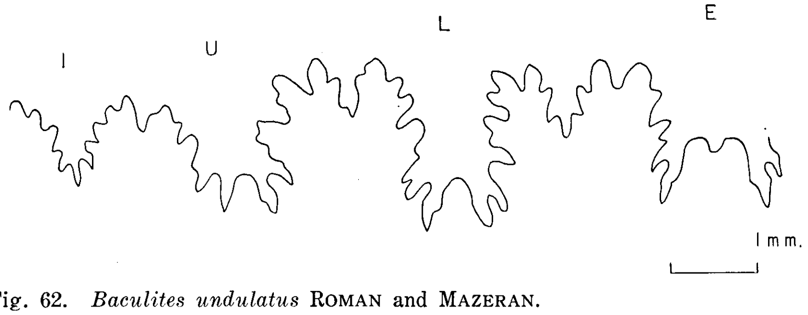


Fig. 62. *Baculites undulatus* ROMAN and MAZERAN.
Suture, at height=7.3, breadth=5.4 mm., of GK. H4407, from loc. Ik1181, upper part of unit IIIa, lower part of the Upper Yezo group in the Ikushumbets Valley, Ishikari Province.

in the intensity and also in the density, but in some cases the feature is affected by the mode of preservation.

Remarks.—The specimens, from California, which MATSUMOTO (1959b, p. 109, pl. 30, figs. 2a-c, 3a, b; pl. 31, fig. 4(?); text-figs. 7a, b, 8-11) called temporarily *Sciponoceras* aff. *S. bohemicum* are good examples of the present species.

Affinity.—The present species is most closely allied to *Sciponoceras bohemicum* (FRITSCH) (*in* FRITSCH and SCHLOENBACH, 1872, p. 49, pl. 13, figs. 23-25, 29, 30), from the Upper Turonian of Europe, in many respects, but is distinguished from that species by much weaker, more numerous, on the average slightly more oblique ribs and weaker constrictions. Probably there may be some, if not great, distinction in the aperture between the two species (compare the holotype of the present species with an example of *S. bohemicum,* from Germany, illustrated by SCHLÜTER [1876, pl. 39, fig. 1]).

Since the extent of variation was not accurately known, MATSUMOTO (1959) did not establish a new species when he dealt with the Californian specimens under the heading of *S.* aff. *bohemicum.* Owing much to C. W. WRIGHT's prescript of the description of *S. bohemicum,* we are inclined to regard the present species as separable from *S. bohemicum,* although the variations of the two species seem to approach closely to each other. Presumably the two species may have a common undescribed ancestor in the Lower Turonian.

On the other hand the present species is very close to *Baculites yokoyamai* TOKUNAGA and SHIMIZU of the succeeding age. Comparisons with that species and also with *Baculites undulatus* ROMAN and MAZERAN are given below. Anyhow the present species represents an intermediate stage from the later species of *Sciponoceras* to the earlier species of *Baculites.*

Occurrence.—Loc. Ik2014d (the locality) and loc. Ik2014e, dark colored fine-sandy siltstone of bed IIIa, nearly basal part of the Upper Yezo group in the section along the Pombets, a tributary of the Ikushumbets, Ishikari Province, Hokkaido. In addition to the holotype and paratypes many comparable specimens of poorer preservation occur here. Among the associated ammonites *Subprionocyclus neptuni* (GEINITZ) is found. Locs. Ik939, Ik940, Ik967 and Ik968b, bed IIIa, dark colored fine-sandy siltstone belonging to the subzone of *Reesidites minimus* (HAYASAKA and FUKADA), exposed along the main course of the Ikushumbets, Ishikari Province, Hokkaido.

Summarizing the above, the stratigraphic position of *Sciponoceras intermedium* n. sp. is upper part of Upper Gyliakian in the type sections of the Ikushumbets area, Hokkaido. This is approximately Upper Turonian.

Genus *Baculites* LAMARCK, 1799

Type-species.—*Baculites vertebralis* LAMARCK, 1801 (designated by MEEK, 1876).

Diagnosis.—WRIGHT (*in* MOORE [Editor], 1957, p. L218) recently described concisely the diagnosis of the genus and MATSUMOTO (1959b, p. 111) amended a point about the suture.

Remarks.—Several new species are introduced from the Japanese material as described in the following pages, but there is no need to split this genus. Transitional features from *Sciponoceras* to *Baculites* can be observed in the three species from the Upper Turonian and Coniacian of Japan: *Sciponoceras intermedium* n. sp. (described above), *Baculites undulatus* ROMAN and MAZERAN and *Baculites yokoyamai* TOKUNAGA and SHIMIZU (to be described below).

Baculites undulatus ROMAN and MAZERAN (ex D'ORBIGNY)

Pl. 8, fig. 4; Pl. 9, figs. 1-5; Pl. 11, figs. 2, 3; Text-figs. 62-71

Synonymy.—

1847. *Baculites undulatus* D'ORBIGNY, *Prodrome paléont. stratigr. universelle*, vol. 2, 19 and 21, no. 21.

1913. *Baculites undulatus* ROMAN and MAZERAN, *Arch. Mus. hist. nat. Lyon*, vol. 2, mem. 2, p. 11, pl. 4, figs. 6-8.

Type.—D'ORBIGNY's specimen in the collection of the Muséum d'Histoire Naturelle, Paris, as indicated by ROMAN and MAZERAN (1913, p. 11, pl. 4, fig. 6).

Material.—GK. H4380-GK. H4424, GK. H4491-GK. H4502 from loc. Ik1181; GK. H4693-4701, GK. H4714-GK. H4729, GK. H4990-GK. H4997, GK. H5000, GK. H5219-GK. H5222, GK. H5226-GK. H5231 from loc. T1002r; GK. H5223-GK. H5225 from loc. T1002 (Coll. T. MATSUMOTO). GK. H4742-GK. H4752 from loc. Yb87p and a comparable fragment from loc. Yb84p (Coll. M. HARADA).

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
GK. H4381	5.0	3.7	(0.74)	20.7
〃	3.7	2.9	(0.78)	
GK. H4404	8.7	6.2	(0.71)	
GK. H4405	6.5	5.1	(0.78)	20.4
〃	5.8	4.1	(0.71)	
GK. H4407	8.0	6.2	(0.78)	20.5
〃	7.1	5.0	(0.70)	
GK. H4742	7.4	5.9	(0.80)	16.1
〃	6.9	5.0	(0.72)	17.4
〃	5.6	4.3	(0.77)	
GK. H4750	3.3	2.6	(0.79)	12.2
〃	2.4	2.0	(0.83)	
GK. H5221	3.6	3.0	(0.83)	15.4
〃	2.6	2.3	(0.88)	
GK. H5222	3.3	2.5	(0.76)	16.2
〃	2.3	1.8	(0.79)	
GK. H5226	5.7	4.6	(0.81)	22.6
〃	4.4	3.3	(0.75)	

Description.—There are fairly numerous specimens, but unfortunately they are all small pieces below 10 mm. in heights. They show slow tapering except for the very early stage. The cross section is almost elliptical, sometimes very slightly narrower on the venter than on the dorsum. The ribs are low and rounded, typically simple and well developed all over the flanks and on the venter, but are very faint or hardly discernible on the dorsum. They are rather moderately prorsiradiate on the flank (forming an angle of 47° or so with the long axis), projected on the venter, and broadly curved forward on the dorsum, showing a shallow sinus on the dorso-lateral part (rursiradiate dorsally at about 30°). They are, more or less, closely spaced and are separated by interspaces which are nearly as wide as the ribs. When the test is preserved the growth lines are discernible which are slightly more projected than the ribs and are as projected as the fine ribs of *Sciponoceras intermedium* and *Baculites yokoyamai.*

There is some individual variation in the coarseness, density and strength of the ribs. For instance, GK. H4389 has relatively coarser and more distant ribs than the normal one (e.g. GK. H 4407). Many of the specimens before us have simple ribs, but a few, larger examples (e.g. GK. H4404) show branching of the ribs and the dorsolateral bullae on the last preserved part (e.g. at the longer diameter of the cross section=9 mm.).

The aperture is well preserved on a few specimens (i.e. GK. H4389, GK. H4415). The ventral rostrum is curved dorsally, and forms a narrow tongue-like extension of the ventral area. Its inner margin shows a gentle biconcave curvature to the front, being convex near the midst of the flank. The dorsal rostrum is not well developed, but broadly curved forward. Thus the aperture is rather facing dorsally, and not quite of *Baculites* type. The associated subcostae on the apertural area are narrower, finer, more closely spaced and more strongly projected on the venter than other ordinary ribs.

The suture, which is well preserved on several specimens (e.g. GK. H4715, GK. H4407), is simple. The saddles are subrectangular in general outline. The lateral saddles are much broader than the lateral lobes (L). L and the saddles on both sides of it are subsymmetrically divided. The first lateral saddle is the largest, and the second lateral one is as high as but less broad than the first, being nearly two thirds of the first in breadth. The dorsal saddle is slightly less broader than, or as broad as, the second lateral saddle, but is much lower than the latter. E is nearly as deep as and slightly broader than L, U is oblique, and I is shallow and small.

In GK. H4392, an unusual example, the suture is not quite symmetric between the two sides in the detailed features, such as the width of the first lateral saddle and the position of E.

Remarks.—For the identification of the present species we depend much on C. W. WRIGHT's kind information about the British and other European examples as well as on the description and illustration of ROMAN and MAZERAN (1913).

Affinity.—*Baculites undulatus* and *Sciponoceras intermedium* (described in the preceding pages) are closely allied to each other in the slow tapering, the elliptical cross section and the same type of aperture and suture, but are distinguished by the constriction and the ribbing. They occur in the Upper Turonian of Hokkaido, but their localities are separated. Constrictions are absent in *B.*

undulatus but feebly developed in *S. intermedium*. The ribs are on the average coarser, less closely spaced, less strongly prorsiradiate (forming an angle of 47° with the long axis as compared with 35°) and less projected on the venter in the former than in the latter.

Baculites yokoyamai TOKUNAGA and SHIMIZU, from the Coniacian, is another resembling species. The comparison is to be given in the description of that species.

Occurrence.—Loc. Ik1181, the glauconitic, calcareous, silty fine to medium-grained sandstone in the upper part of unit IIIa, lower part of the Upper Yezo group in the Ikushumbets Valley, Ishikari Province; loc. T1002, including T1002r, calcareous nodules from the mudstone with interbeds of sandstone, upper part of unit IId, the Saku formation, in the Abeshinai-Saku area, Teshio Province; locs. Yb84p and Yb87p, derived from the fine-grained sandstone of the upper part of unit Mk4, the upper part of the Mikasa formation in the Hatonosu Hills, Yubari City. All belong to the zone of *Inoceramus teshioensis*, in which *Subprionocyclus* cf. *normalis* sometimes occurs among others, the upper part of the Upper Gyliakian.

In Europe *B. undulatus* is known from the Upper Turonian.

Baculites yokoyamai TOKUNAGA and SHIMIZU

Pl. 8, fig. 5; Pl. 10, figs. 1-6; Pl. 11, figs. 1, 4, 5; Pl. 12, fig. 3; Pl. 14, fig. 4; Text-figs. 72-87

Synonymy.—

1909. *Baculites teres*, YABE (*non* FORBES), *Zeitschr. deutsch. geol. Ges.*, vol. 61, p. 439, listed only.
1926. *Baculites* (*Lechites*) *yokoyamai* TOKUNAGA and SHIMIZU, *Jour. Fac. Sci., Imp. Univ. Tokyo*, sec. 2, vol. 1, p. 195, pl. 22, fig. 5a, b, pl. 26, fig. 11.
?1931. *Baculites besairiei* COLLIGNON, *Ann. Géol. Sérv. Mines, Madagascar*, fasc. 1, p. 37, pl. 5, figs. 6, 6a, 7, 7a, 8, 8a, 9.
1959. *Baculites* cf. *B. yokoyamai*, MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.*, Ser. D, vol. 8, no. 4, p. 118, text-fig. 26.

Type.—Holotype, by monotypy, was a fragmentary specimen described by TOKUNAGA and SHIMIZU (1926, p. 195, pl. 22, fig. 5a, b; pl. 26, fig. 11). It was preserved at Waseda University in Tokyo but was lost by a fire during World War II. The original locality is in the Lower Futaba beds in the upper reaches of Sakurazawa in Oriki, Hirono-mura, Fukushima Prefecture (northeast Honshu). We visited there frequently but sought in vain well preserved specimens. Only a few poorly preserved fragments of *Baculites* were obtained there.

The Lower Futaba beds belongs to the zone of *Inoceramus uwajimensis* and in the same zone in Hokkaido a large number of specimens are obtained. Many of them show the same feature in essential points as the illustration of TOKUNAGA and SHIMIZU*. One of them, GK. H4580 (Pl. 10, fig. 5) collected by MATSUMOTO

* The too long internal lobe in the illustration of TOKUNAGA and SHIMIZU (1926, pl. 22, fig. 5b) is probable due to bad retouching.

Figs. 63–71. *Baculites undulatus* ROMAN and MAZERAN, cross sections.
63: GK. 4400, 64: GK. H4387, 65: GK. H4742, 66: GK. H4407, 67: GK. H4386, 68: GK. H4417, 69: GK. H4695, 70: GK. H4409, 71: GK. H4404.

Figs. 72–86. *Baculites yokoyamai* TOKUNAGA and SHIMIZU, cross sections.
72: GK. H4567, 73: GK. H4574, 74: GK. H4568, 75: GK. H4576, 76: GK. H5415, 77: GK. H4580, 78a: GT. I-325a(p.), 78b: GT. I-325a(a.), 79: GK. H4566, 80: GK. H4578, 81: GK. H4552, 82: GK. H4546, 83: GT. I-325b, 84: GK. H4534, 85: GK. H4562, 86: GK. H4594.
(a.): anterior and (p.): posterior parts of the same specimen.

at loc. Ik1111a, along the Bannosawa, from the zone of *Inoceramus uwajimensis* is to be selected as a neotype. We intend to publish this in the *Bulletin of the Zoological Nomenclature* to validate the neotype.

Material.—The better preserved examples of the present species from Hokkaido other than the proposed neotype are: GK. H4540 and GK. H4542 from loc. Ik966d, GK. H4335, GK. H4536, GK. H4545, and GK. H4546 from loc. Ik964a;

GK. H4573, GK. H4574, GK. H4576, GK. H4577, and GK. H4579 from loc. Ik 1108p; GK. H4563, GK. H4598, GK. H4603, and GK. H4604 from loc. Ik1159p1 (all Coll. T. MATSUMOTO). GK. H4534, a body chamber with a well preserved aperture, from loc. Mu2415 (Coll. T. MURAMOTO). GT. I-325 (=MM7603) a, b, labeled and listed as "*Baculites teres* FORBES" by YABE (1909, p. 439), without a precise record of locality.

There are many other less completely preserved ones which are referable to the present species (i.e. GK. H4511-H4513 from loc. Ik2120; GK. H4514 from loc. Ik1137; GK. H4538, H4541, H4543, H4544, GK. H4605-GK. H4650 from loc. Ik966d; GK. H4651-GK. H4655 from loc. Ik964b; GK. H4537, GK. H4547-GK. H4555, GK. H4656-GK. H4664 from loc. Ik964a, GK. H4665 and GK. H4666 from loc. Ik966b; GK. H4667-GK. H4669, GK. H4539, GK. H4671-GK. H4675 from loc. Ik965b; GK. H4670 from loc. Ik965; GK. H4676-GK. H4679 from loc. Ik1166; GK. H4680-GK. H4685 from loc. Ik1117p2; GK. H4686 from loc. Ik1108; GK. H4575-H4578, H4687 from loc. Ik1108p; GK. H4688-GK. H4692 from loc. Ik1102p; GK. H4556-H4562, H4564-H4572, H4581-H4596, from loc. Ik1111a; GK. H4599-H4602 from loc. Ik1159p1; H5389 from loc. Ik2106p2, all in T. MATSUMOTO's Coll.; GK. H5390-H5392 from locs. Yb33p2, Yb64p1, Yb64p2 in M. HARADA's Coll.

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
GT. I-325a	10.5	7.5	(0.71)	24.4
〃	9.5	6.5	(0.68)	
GK. H4534	12.6	9.1	(0.72)	32.2
〃	12.2	8.9	(0.73)	
GK. H4547	7.7	5.7	(0.74)	19.2
〃	6.6	5.1	(0.77)	
GK. H4574	7.5	5.2	(0.69)	
〃	5.3	3.7	(0.70)	
GK. H4576	7.0	4.9	(0.70)	23.2
〃	6.0	4.2	(0.70)	
GK. H4577	7.5	5.6	(0.75)	26.0
〃	5.7	4.2	(0.74)	
GK. H4580	9.0	6.5	(0.72)	17.4
〃	8.2	6.0	(0.73)	
GK. H4582	5.2	4.1	(0.79)	
GK. H4603	6.2	4.4	(0.71)	24.1
〃	4.5	3.6	(0.80)	
GK. H4604	8.9	6.3	(0.71)	24.8
〃	7.2	5.2	(0.72)	28.3
〃	5.2	3.8	(0.73)	

Diagnosis.—The shell is relatively small. The largest shell (GK. H4563) among the examined specimens is about 15 mm. in height and 10 mm. in breadth. The body chamber is about 80 mm. long in an example (GK. H4534). The tapering is typically very slow beyond the early stage. The cross section is nearly elliptical and compressed, with the proportion between breadth and height from 0.7 to 0.8 in most specimens.

The subcostae on the surface of the shell are very fine, closely spaced, prorsiradiate on the flank, forming an angle of about 25° to 35° with the long axis, and projected prominently on the venter. They are so faint that they are not always impressed on the internal mould. In many specimens they are so much weakened on the dorsum that the shell is apparently semicostate. The lirae show a broad and less pronounced forward curve on the dorsum and a sinus on the dorsolateral part.

The apertural margin, as seen on a well preserved specimen (GK. H4534), is not quite of the *Baculites* type. The ventral rostrum is gently curved to the dorsum at its anterior end. Its inner margin is nearly parallel to the subcostae or lirae but shows a slight biconcavity by the presence of a weak sinuosity at the mid-flank. The dorsal margin shows a broad forward curve, with a collar.

The suture is simple. The saddles are subquadrate to subrectangular in general outline. The first lateral saddle is broad and subsymmetrically divided. The asymmetrically divided second lateral saddle is nearly as high as or slightly higher than and is about two thirds as broad as the first. L is normally the deepest among the lobes, nearly as narrow as or slightly narrower than the second lateral saddle and subsymmetric to asymmetric. E is wide and moderately deep. U is oblique, as narrow as or slightly narrower than L. I is evidently smaller and shallower than other lobes.

Variation.—Among a large number of specimens from one and the same formation there are some which deviate in certain characters from normal examples. The tapering, for example, is generally very slow in the main growth stages and is somewhat rapid in the early stage. In a few specimens (e.g. GK. H4604), however, the rapid tapering is retained up to a later stage. The cross section is elliptical in most specimens but rather oval in some specimens (e.g. GT. I-325, Text-figs. 78, 83) in which the venter is more narrowly rounded than the dorsum.

There is a variation in the breadth, density and intensity of the subcostae. On the shell of GK. H4535, for example, the subcostae are still finer and more closely spaced than those of the normal ones (e.g. GK. H4546, Pl. 11, fig. 6) which are obtained from the same nodule. GT. I-325 [=MM7603] (Pl. 11, fig. 4) is illustrated as another example of the fine ornament. Because of the weakness

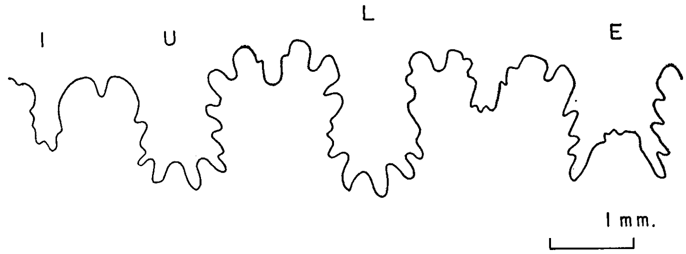


Fig. 87. *Baculites yokoyamai* TOKUNAGA and SHIMIZU.
Suture, at height=7.0, breadth=4.9 mm., of GK. H4576, from loc. Ik1108p, along the Bannosawa, a tributary of the Ikushumbets, bed IIIb in the Upper Yezo group, Ishikari Province.

of the subcostae the internal mould is almost smooth in some specimens, but in some other specimens (e.g. GK. H4577) riblets are observable faintly on the venter and the adjacent part even on the internal mould.

Although the present species is normally free from tubercles, two peculiar specimens (GK. H4538 and GK. H4539) have faint crescentic dorsolateral tubercles of *B. schencki* type on one side of the shell. They are otherwise quite identical with the numerous normal examples of *B. yokoyamai* from the same locality. Therefore we are inclined to regard this peculiar form as an extreme variant of *B. yokoyamai.*

The present species shows a variation in the details of the suture, such as the breadth and height of the saddles and the degree of asymmetry of the bifurcated lateral saddles.

Remarks.—Baculites besairiei COLLIGNON was established on specimens from the Lower Senonian of Madagascar when *B. yokoyamai* was not clearly defined. But now it can be concluded that all the described characters of *Baculites besairiei* COLLIGNON are the same as those of *B. yokoyamai* here redefined. Therefore, as has already been mentioned by MATSUMOTO (1959, p. 117), *B. besairiei* COLLIGNON, 1931 is very probably synonymous with *B. yokoyamai* TOKUNAGA and SHIMIZU, 1926.

Affinity.—Baculites yokoyamai, from the zone of *Inoceramus uwajimensis,* is very closely allied to *Sciponoceras intermedium* n. sp. (see p. 24), from the zone of *Inoceramus teshioensis,* in the small size, slow tapering, almost elliptical section, numerous, weak, fine subcostae which show a slightly forward curve on the dorsum and a considerable projection on the venter, similar pattern of suture and the same type of aperture. The distinction is the absence of the constriction in *B. yokoyamai.* On the average *B. yokoyamai* has weaker subcostae and more flattened flanks than *S. intermedium,* although in these respects the extremes of the two species may overlap. *S. intermedium* is, thus, very probably the direct ancestor of *B. yokoyamai* and the two species exemplify a gradual change from *Sciponoceras* to *Baculites.* In several specimens of *B. yokoyamai,* e.g. GK. H4540, GK. H4542, GK. H4573, GK. H4669 and GK. H4686, some of the subcostae are periodically slightly stronger than others and accompanied with better marked striae. This may be either a feature reminiscent of the weak constrictions in ancestral *S. intermedium* or a mere irregularity in the ornament.

Baculites yokoyamai is also similar to *B. undulatus* ROMAN and MAZERAN, described above, in the slow tapering, elliptical section, simple suture and type of aperture, but is distinguished by the ornament. In *B. yokoyamai* the subcostae are much finer, weaker, more oblique on the flank and more strongly projected on the venter than in *B. undulatus.* The growth-lines of *B. undulatus* are somewhat oblique to the subcostae, being as prorsiradiate as the subcostae of *B. yokoyamai.* The dorsolateral bullae are developed on the adult shell of *B. undulatus* but not on that of *B. yokoyamai,* except on the peculiar variant mentioned above.

Remarks on the intimate relation between *B. yokoyamai* and *B. schencki* have already been given by MATSUMOTO (1959, p. 117) (see also below under *B. schencki*).

Baculites mariasensis COBBAN (1951, p. 818, pl. 118, figs. 10-12; text-figs. 4-7), from the Coniacian of the Western Interior region of North America, resembles *B. yokoyamai* in the slow tapering, smoothish surface and simple sutures but is distinguished by an ovate cross section with narrow venter in its later growth stages and the second lateral saddle not so narrow as in *B. yokoyamai.*

Baculites bailyi WOODS (1906, p. 341, pl. 44, fig. 5) [=*Baculites sulcatus* BAILY, 1855, p. 4557 (*partim*), pl. 11, fig. 5a, b (*non* fig. 5c)], from the Santonian of South Africa, is somewhat allied to *B. yokoyamai,* as seen in the slow tapering and the same curvature of the lirae, but has more deeply incised sutures.

Occurrence.—Locs. Ik964a, b; Ik965a, b and Ik966b, d along the main stream of the Ikushumbets; locs. Ik1102p, Ik1108, Ik1108p, Ik1111a, Ik1117p2, Ik1137, Ik1159p1 and Ik1166 along the Bannosawa, a tributary of the Ikushumbets; locs. Mu. 2415, Ik2106p2 and Ik2120, along the Gonosawa, Pombets, a tributary of the Ikushumbets; all of these are from unit IIIb, the Lower Urakawan (Coniacian), zone of *Inoceramus uwajimensis* in the Upper Yezo group, Ishikari Province, Hokkaido. At loc Ik966d the shells are embedded in the green sandstone nearly in parallel with the plane of bedding. At other localities they are preserved, orientated at random, in calcareous concretions of the fine-sandy siltstone.

TANAKA (1953, 57) listed this species from the zone of *I. uwajimensis* in the Bibai area of Ishikari Province and the Tappu-Obirashibets area of Teshio Province. Numerous fragmentary specimens which can be called *B.* cf. *yokoyamai* were furnished for us by M. HARADA from the glauconitic, sandy, calcareous siltstone at locs. Yb33p2, Yb64p1 and Yb64p2, basal part (bed U1) of the Upper Yezo group in the Hatonosu Hills, Yubari City, Ishikari Province.

TOKUNAGA and SHIMIZU's type locality of *B. yokoyamai* in the Futaba area, Northeast Honshu, also belongs to the zone of *I. uwajimensis.*

Outside Japan *B.* cf. *yokoyamai* is known from the probable Coniacian of California (MATSUMOTO, 1959) and *B. besairiei* COLLIGNON, which is probably synonymous with *B. yokoyamai,* from the Lower Senonian of Madagascar.

Baculites bailyi WOODS

Pl. 20, figs. 1, 2; Pl. 21, fig. 5; Text-figs. 88, 89, 116-120, 140-142

Synonymy.—

1855. *Baculites sulcatus* BAILY, *Quart. Jour. Geol. Soc. London,* vol. 11, p. 457 (*partim*), pl. 11, fig. 5a, b (*non* 5c).
1906. *Baculites bailyi* WOODS, *Ann. South African Museum,* vol. 4, part 7, no. 12, p. 341, pl. 44, fig. 5.
1921. *Baculites bailyi,* v. HOEPEN, *Ann. Transvaal Museum,* vol. 8, part 1, p. 18, pl. 3, figs. 9, 10.
1921. *Baculites bailyi,* SPATH, *Ann. South African Museum,* vol. 12, part 7, p. 261.

Type.—WOODS (1906, p. 342) remarked, when he established this species, that "the specimen figured by BAILY may be taken as the type of the species." He illustrated the suture of a specimen in GRIESBACH's collection (WOODS, 1906, pl. 44, fig. 5) and not of BAILY's specimen. WOODS' sentence can be taken as a proper designation as holotype of the specimen of BAILY (1855, pl. 11, fig. 5a, b only), BM. No. 11372.

Material.—The specimens from Hokkaido which are referable to the present species are GK. H4515, GK. H4517, GK. H4518, GK. H4527, and GK. H4528 from loc. Y441 (Coll. S. YAMAGUCHI); smaller examples, GK. H4519-GK. H4526, from loc. 073004, and GK. H4516, from loc. 080101 (Coll. Y. KINO); and a somewhat unusual example, GK. H4810, from loc. CK61 (Coll. Y. UEDA).

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
GK. H4515	7.2	5.4	(0.75)	23.8
〃	7.2	4.4	(0.69)	
GK. H4517	6.2	4.6	(0.74)	
GK. H4519	7.0	5.2	(0.74)	
GK. H4520	6.0	4.6	(0.77)	
GK. H4521	5.6	4.2	(0.75)	
GK. H4522	5.5	4.2	(0.76)	
GK. H4523	5.0	4.0	(0.80)	
GK. H4527	5.6	4.1	(0.73)	
GK. H4528	5.7	4.2	(0.74)	
GK. H4810	9.8	7.6	(0.78)	27.3
〃	7.9	6.0	(0.76)	

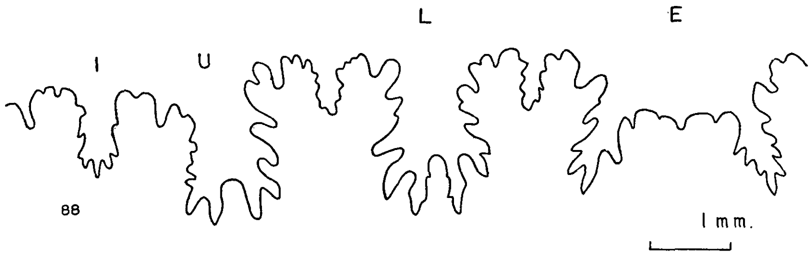
Description.—The shell is small. GK. H4515, in which the last two sutures are approximated, is only 7.2 mm. in height and 5.4 mm. in breadth at the last suture. The tapering is moderate in the very early growth-stage (e.g. GK. H4523) and very slow in later ages (e.g. GK. H4515 etc.). The cross section is subelliptical to suboval, higher than broad, narrower on the venter than on the dorsum and thickest at a point below the mid-flank near the dorsolateral part. The outline of the section in the Japanese specimens shows a narrower venter and a more rounded dorsum than the illustrated section of BAILY (1855, text-fig. 5b).

The surface of the shell is nearly smooth, having only numerous, sinuous lirae, which form a gentle forward arch on the dorsum and a moderately deep sinus on the dorsolateral part, are remarkably prorsiradiate on the main two thirds of the flank and strongly projected on the venter. As seen on the well preserved shells (e.g. GK. H4517, GK. H4520, etc.) at irregular intervals some of the lirae are distinct enough to be called riblets. The same feature was illustrated by BAILY (1855, pl. 11, fig. 5a). The ornament may be very faintly impressed on the internal mould.

The suture, which can be clearly seen on GK. H4515 and others, is moderately incised. The lateral saddles and the first lateral lobe (L) are subtrapezoidal in general outline and nearly symmetrically divided. L is somewhat narrower than the lateral saddles. The median foliole at the bottom of L is somewhat larger than the adjacent folioles. The second lateral saddle is slightly broader than the first. The dorsal saddle is nearly as high as or lower than the two laterals. The internal lobe (I) is small and narrow. The observed sutures in the Japanese specimens are, thus, similar to the illustrated suture of *B. bailyi* from South Africa (WOODS, 1906, pl. 44, fig. 5), but the latter shows the lateral saddles as narrow as L and slender elements. In this respect the suture of a specimen from Hokkaido, GK. H4810, closely resembles WOODS' figure, but the lateral saddles of the former are not so symmetrically bifid as those of the latter.

Remarks.—There are minor differences in the outline of the cross section and the details of the suture between the specimens from South Africa and Japan as mentioned above. They do not seem, however, to be significant enough for specific distinction, nor, without examining more specimens from the two regions, we can justify subspecific separation.

Affinity—*Baculites bailyi* WOODS, from the Santonian, is closely allied to *Baculites yokoyamai* TOKUNAGA and SHIMIZU (emended above), from the Coniacian, in the small size, slow tapering in the main growth-stages, subelliptical cross section, nearly smooth surface and curvature of the lirae. The former has, on the average, a still finer and weaker ornament than the latter. The pattern of the suture is generally similar between the two species, but the incision is deeper and the lateral saddles and lobes are narrower in the former than in the latter. The general outline of the sutural elements in the late growth-stage is nearly trapezoidal in *B. bailyi* but subquadrate in *B. yokoyamai*. It is highly



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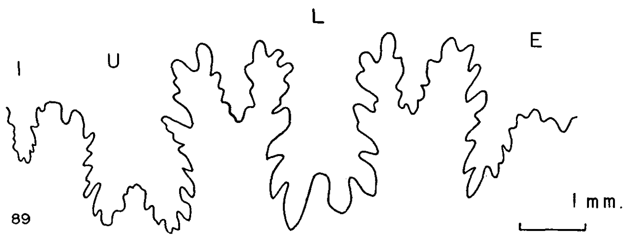

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Figs. 88, 89. *Baculites bailyi* WOODS.
88. Suture, at height=7.4, breadth=5.6 mm., of GK. H4515, from loc. Y441, upper part of member U3, Upper Yezo group, the Sakasa river, a tributary of the Haboro, Sankei quadrangle (Chikubetsu-Haboro area), Teshio Province.
89. Suture, at height=8.2, breadth=6.1 mm., of GK. H4810, from loc. CK61, Detofutamata river, member B1, zone of *Inoceramus amakusensis*, Chikubetsu-Haboro area, Teshio Province.

probable that *B. bailyi* was derived directly from *B. yokoyamai*.

Relations with an almost contemporary species, *B. uedae* sp. nov. (described in p. 40), are mentioned in the description of that species.

Occurrence.—According to TANAKA, who supplied us with the specimens and stratigraphic information, the locality records are as follows: loc. Y441, upper part of member U3 in the Upper Yezo group, upper part of Upper Urakawan [K5 β], the Sakasa river, a tributary of the Haboro, Sankei quadrangle, Teshio Province; loc. 073004 along a branch of the Chikubetsu near the Chikubetsu coal mine, and loc. 080101 along the main stream of the Chikubetsu near the same coal mine, both in the extension of the same member as above, K5 β in age, Chikubetsu coal mine quadrangle, Teshio Province, northwest Hokkaido. An unusual example, H4810, came from loc. CK61, Detofutamata river, member B1 of UEDA *et al.* (1962), zone of *Inoceramus amakusensis*, Lower part of K5 β, in the same Chikubetsu area.

Baculites schencki MATSUMOTO

Pl. 12, figs. 1, 2; Pl. 14, fig. 1; Text-figs. 90, 131-133

1959. *Baculites schencki* MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.* [D], vol. 8, no. 4, p. 113, pl. 32, figs. 1a-c, 2a-c, 3a, b, 4a, b, 5a-c, 6a-c; text-figs. 12a, b, 13a-c, 14a, b, 15-21, 22a, b, 23a-c, 24, 25.

Material.—Japanese examples of this species are as follows: GK. H4277 from loc. Mu. 1959 and GK. H4276 from loc. Mu. 6322 (Coll. T. MURAMOTO). Several other fragmentary specimens, GK. H4680 from loc. Ik1117p2, (Coll. T. MATSUMOTO); GK. H4278-GK. H4284 from loc. "Yb. 64p2"; and GK. H4914, a comparable example, from loc. "Yb. 33p2" (Coll. M. HARADA).

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance	Interval between tubercles
GK. H4277	8.3	6.0	(0.72)	21.7	1.8/2.0/2.2/2.7
〃	7.1	5.5	(0.77)		3.6/2.8/3.3/3.6/3.1
GK. H4276	6.6	5.1	(0.77)		5.0/4.6/5.7/5.6
GK. H4278	7.5	5.6	(0.75)	28.2	4.0/4.1/3.7
〃	5.5	4.0	(0.73)		
GK. H4279	5.5	4.1	(0.75)		5.9/4.6/4.7
GK. H4281	7.0	5.1	(0.73)		
GK. H4282	5.6	4.7	(0.84)		
GK. H4284	4.7	3.6	(0.77)		
GK. H4478	7.7	5.4	(0.70)	18.3	
〃	6.6	4.3	(0.65)		
GK. H4680	8.9	7.2	(0.81)		
GK. H4914	*c.*13.0	—	—		5.0/6.3/5.3

Description.—The specimens listed above are well identified as *Baculites schencki* by the small size, moderate tapering, egg-shaped cross section, normally weak, short, crescentic, dorsolateral nodes developed in the middle growth stage, weak riblets or lirae and simple sutures.

MATSUMOTO (1959) recognized a considerable extent of variation in this

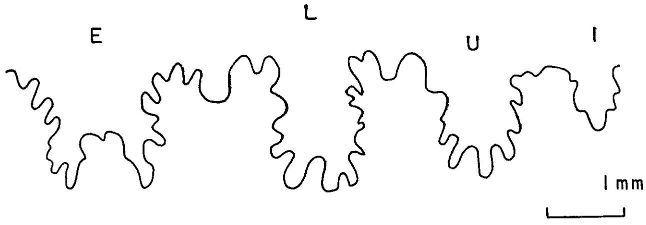


Fig. 90. *Baculites schencki* MATSUMOTO.
Suture, at height=6.3, breadth=4.8 mm., of GK. H4276, from loc. Mu. 6322, Gonosawa, Pombets, a tributary of the Ikushumbets, bed IIIb of the Upper Yezo group, Ishikari Province.

species when he established it on the Californian material. The Japanese specimens before us show a similar variation. The short, crescentic, dorsolateral node, for instance, appears in the immature stage at about 6 mm. in height in some specimens (e.g. GK. H4276 and GK. H4277) but at a height of 7.6 mm. in some others (e.g. GK. H3278). The nodes are feeble and more crowded in GK. H4277 (17 nodes in the distance of 40 mm.) but coarser and more separated in GK. H4276 (see measurements); Other specimens are intermediate.

With regard to the suture the first lateral saddle is slightly lower than the second lateral saddle in GK. H4277 but as high as the latter in GK. H4276; the dorsal saddle is distinctly lower than the lateral saddles in GK. H4276 but nearly as high as the latter in GK. H4277. There may be minor variations in other details of the suture.

Remarks.—The original description of *Baculites schencki* by MATSUMOTO (1959b, p. 113, pl. 32, figs. 1-6; text-figs. 12-25) is almost sufficiently clear. From the Japanese material, however, a question has arisen whether the smoothish specimens could be included within this species as a variant or should be removed to another species (see. *B. uedae* described in p. 40 for further discussion).

Affinity.—*Baculites schencki* is related to the nearly contemporary *Baculites yokoyamai,* redefined above, but is distinguished by its rapid tapering, oval section and short, crescentic, dorsolateral nodes. The relation of the two species in the northern Pacific region is parallel to that of smoothish *B. mariasensis* COBBAN (1951, p. 818, pl. 118, figs. 10-12; text-figs. 4-7) and ornate *B. sweetgrassensis* COBBAN (1951, p. 820, pl. 118, figs. 6-9; text-figs. 1-3) in the Coniacian of the Western Interior province of North America. *B. schencki* shows a stronger tapering and has much shorter and more closely spaced nodes than *B. sweetgrassensis*. *B. schencki* sometimes occurs from the same bed as *B. yokoyamai* but is an uncommon species in Japan. It is more common in the Coniacian of California, where *B. yokoyamai* is rare.

B. schencki is closely allied to the Lower Senonian *B. boulei* COLLIGNON (to be described below) and *B. brevicosta* SCHLÜTER (1876, p. 141 [21], pl. 39, figs. 9-10), as has already been mentioned by MATSUMOTO (1959, p. 117). The affinity with a Santonian new species (*B. uedae* n. sp.) from Hokkaido is to be described in p. 43.

Occurrence.—Loc. Mu. 6322, Gonosawa, Pombets, a tributary of the Ikushumbets; a boulder at loc. Mu. 1959 along the Pombets; loc. Ik1117p2, the main stream of the Ikushumbets; these three are in bed IIIb, more or less glauconitic, fine-sandy siltstone in the Upper Yezo group and belong to the zone of *Inoceramus uwajimensis*. Also locs. Yb33p2 and Yb64p2, glauconitic sandy calcareous siltstone derived from the basal part of the Upper Yezo group in the Hatonosu Hills, Yubari City. This species is rather rare in the Lower Urakawan [K5 α] of Hokkaido.

In California *B. schencki* is common in the Coniacian (MATSUMOTO, 1959b, p. 118).

Baculites uedae sp. nov.

Pl. 20, figs. 5-7; Pl. 21, figs. 1, 3, 6; Text-figs. 91, 92, 121-129

Material.—Holotype GK. H4794 from loc. CK64, the main stream of Detofutamata river, Chikubetsu area, Teshio Province, Hokkaido (Coll. Y. UEDA*).

Paratypes: GK. H4825, GK. H 4795-GK. H4802, GK. H4826-GK. H4833, from loc. CK64; GK. H4793 and GK. H4790-GK. H4792 from loc. CK75; GK. H5251 from loc. CK46; GK. H5232-GK. H5238 from loc. CK12 (all Coll. Y. UEDA*). GT. I-3584 from loc. T311; GK. H4705-GK. H4708 from loc. T1187p2 (Coll. T. MATSUMOTO). GK. H4479-GK. H4489 from loc. Y531 (Coll. S. YAMAGUCHI). Beside the above type specimens of the present species, the following specimens are comparable with it: GK. H4811-GK. H4824 from loc. CK61, GK. H5241-GK. H5247 from loc. CK65 (Coll. Y. UEDA); A fragment from loc. Yb. 31p2 (Coll. M. HARADA).

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
GK. H4794	11.7	8.9	(0.76)	29.5
〃	9.6	7.3	(0.76)	33.5
〃	6.6	5.0	(0.76)	
GT. I-3584	9.2	7.2	(0.78)	19.0
〃	8.1	6.2	(0.77)	23.0
〃	6.0	4.6	(0.77)	
GK. H4479	7.1	5.2	(0.73)	16.6
〃	5.8	4.2	(0.72)	17.6
〃	4.3	3.4	(0.79)	
GK. H4705	8.2	6.5	(0.79)	19.1
〃	7.0	5.6	(0.80)	
GK. H4790	7.5	5.6	(0.75)	
GK. H4793	5.5	4.2	(0.76)	24.2
〃	2.7	2.3	(0.85)	
GK. H4798	8.1	6.1	(0.75)	25.3
〃	6.0	4.3	(0.72)	

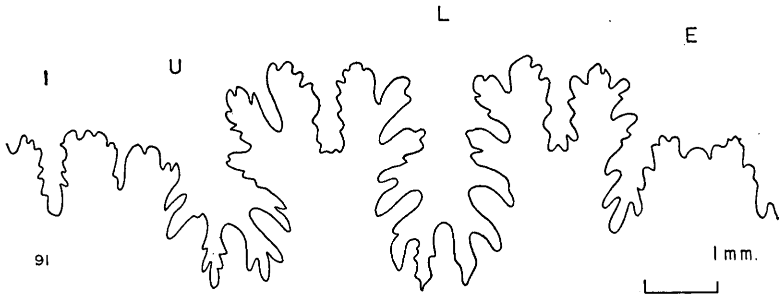
* The species is dedicated to Dr. Yoshiro UEDA, who collected the valuable specimens.

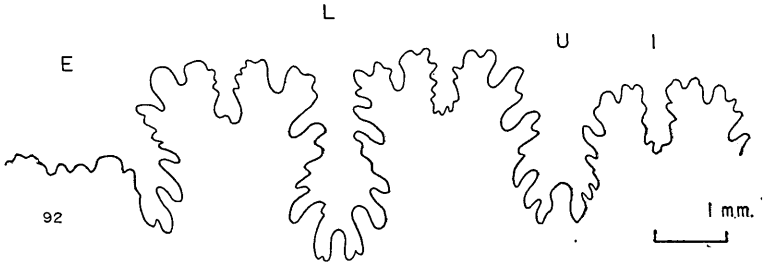
GK. H4799	6.2	5.2	(0.84)	35.1
〃	4.2	3.3	(0.79)	
GK. H4825	11.0	8.0	(0.73)	33.7
〃	8.5	6.1	(0.72)	
GK. H4826	9.1	6.7	(0.74)	

Diagnosis.—The shell is comparatively small and tapers rapidly or moderately. The cross section is oval, higher than broad, thickest near the mid-flank, and distinctly narrower and more convergent on the venter than on the dorsum.

The surface of the shell is nearly smooth and has lirae, which form a gentle arch on the dorsum and a sinus of asymmetric curvature on the dorsolateral part and are remarkably prorsiradiate on the main part of the flank, forming an angle of about 35° with the long axis of the shell, and strongly projected on the venter. Very faint, dorsolateral, crescentic bullae may be occasionally discernible.

The suture is moderately incised. The first lateral lobe [L] and the saddle on both sides of it are subrectangular to rather trapezoidal in general outline and subsymmetrically bifid. The first and the second lateral saddles are nearly of equal size but sometimes the former is slightly smaller than the latter. L is distinctly narrower than the lateral saddles. The median foliole at its bottom is as small as and overhang by the adjacent lateral folioles. The second lateral lobe [U] is asymmetric and nearly as deep as L in later growth-stages. The





Figs. 91, 92. *Baculites uedae* sp. nov.

91. Suture, at height=8.9, breadth=6.6 mm., of holotype, GK. H4794, from loc. CK64, the main stream of Detofutamata river, Chikubetsu-Haboro area, Teshio Province.

92. Suture, at height=8.2, breadth=5.9 mm., of a paratype, GT. I-3584, from loc. T311, the Wakkawembets river, bed IIId, Abeshinai Valley, Teshio Province.

external lobe [E] is the broadest but shallower than L. The internal lobe [I] is narrow and shallow. The saddle between I and U is much lower than the lateral saddle.

Variation.—As is shown by the holotype and other examples, the tapering is generally rapid even in the body chamber but in a few specimens (e.g. GK. H4826) it is slowed in the body chamber. The flanks are gently inflated in the typical specimens but are flattened in other more compressed specimens (e.g. GK. H5251). Normally the flanks are gradually convergent to the narrowly arched venter, but in a few specimens (e.g. GK. H4833) there are obscure ventrolateral shoulders.

In the holotype the surface of the shell is eroded. When the test is well preserved, as in GT. I-3584 and GK. H5251, the lirae are fairly well marked and on the venter slightly elevated to form the extremely weak riblets. On the internal mould the faint impression of the very fine ventral corrugation may be discernible under oblique lighting. Dorsolateral crescentic bullae are absent in many specimens but very feebly developed at a moderate interval in some specimens (e.g. GK. H4825 and GK. H5241). The bullate examples occur in the same nodule as the normal ones.

There is a variation in the minor details of the suture, too, such as the breadth and the general outline of the saddles and lobes, degree of asymmetry of the elements and depth of incisions. In the holotype and some other specimens the general outline of the lateral saddle is rather trapezoidal, but in some others (e.g. GK. H4479 and GT. I-3584) it is subrectangular.

Affinity.—*Baculites uedae* is related to *B. yokoyamai* TOKUNAGA and SHIMIZU (emended above) and also to *B. bailyi* WOODS (see the preceding description) in the small size, oval cross section, smooth surface with a similar curvature of the lirae and generally similar pattern of suture, but is distinguished from the latter two species by its rapid tapering, narrower venter, occasional weak, dorsolateral crescentic bullae and differences in the details of the suture. The suture of *B. uedae* is distinctly more deeply incised and has narrower stems of the elements than that of *B. yokoyamai*. In *B. uedae* the lateral saddles are subsymmetrically bifid and much broader than L, but in *B. bailyi* they are more symmetrically bifid and nearly as narrow as or slightly broader than L. In a specimen of *B. bailyi*, GK. H4810, mentioned already, the lateral saddles are as narrow as L, as in WOODS' illustration (1906, pl. 44, fig. 5), but are somewhat asymmetrically bipartite as in *B. uedae*.

In *B. uedae* the median foliole at the bottom of L is as small as and overhang by the lateral folioles. Accordingly its pattern of suture resembles that of the young specimens of *B. rex* ANDERSON (see MATSUMOTO, 1959b, p. 139, text-figs. 48, 49) and related species of later geological ages. This is another distinction of *B. uedae* from *B. bailyi*, in the latter of which the median foliole is distinctly larger than the lateral ones. In this point and in the rapid tapering, oval section and nearly smooth surface *B. uedae* is similar to *B. hochstetteri* LIEBUS (1902,

p. 119, pl. 6, figs. 4-6; text-fig. 2), from the Carpathians, and *B. rex* ANDERSON from California and Hokkaido (see the description in p. 64). In the latter two species the shell is on the average more compresed and the suture is much more deeply incised.

In the rapid tapering, ovoid cross section with a narrow venter and the appearance of weak dorsolateral bullae *B. uedae* is very similar to *B. schencki* MATSUMOTO (see the preceding description). The distinction is in that *B. schencki* has less incised and lower sutural elements and on the average more frequently developed dorsolateral nodes than *B. uedae.* In this respect some of the varieties in *B. schencki* as described by MATSUMOTO (1959, p. 114-116) are apparently very close to *B. uedae,* but there are still some differences. For instance, GK. H7006 from the Lower Marlife formation in California (MATSUMOTO, 1959, text-fig. 23a-c), which has a smooth surface and comparatively high sutural elements, is distinguishable from any specimens of *B. uedae* by its subtrigonal section and the median foliole which is not overhung by the lateral folioles in the lower part of L. Examples of *B. uedae,* however, could well be expected to occur in the Upper Cretaceous of California.

B. uedae is also apparently similar to *B. mariasensis* COBBAN, 1951 in its ovate section and smoothish surface, but has a stronger tapering and more deeply incised and narrower suture.

From the available evidence we are inclined to presume as a possible interpretation that *B. uedae* may be derived from *B. yokoyamai* in a similar direction to *B. schencki* almost simultaneously with *B. bailyi* and that it may be an ancestor of such species as *B. hochstetteri* and *B. rex.*

Occurrence.—Loc. CK64, type-locality, and CK75 along the main stream of the Detofutamata river, from the calcareous nodules of fine-sandy mudstone in member B_1; loc. CK12, Panke-zawa, calcareous nodules of medium-grained sandstone of member C (upper part); loc. CK46, Sankebetsu river, calcareous nodule of sandy mudstone in member A; comparable specimens from locs. CK61 and CK-65, Detofutamata river, member B_1, all in the Chikubetsu area, Teshio Province. Also loc. T311, the Wakkawembets river, bed IIId (fine-sandy mudstone), and loc. T1187p2, Saku-gakko-zawa, from the same bed IIId in the Abeshinai Valley, Teshio Province; loc. Y531′, middle part of unit U3 (sandy mudstone), Kotan-zawa, Haboro Valley, Teshio Province.

Thus the species is fairly common in the Upper Urakawan [K5 β] of the Teshio Province, northwest Hokkaido, where comparatively near shore facies of the Upper Yezo group is developed. The nodules contain frequently the drifted woods and other plant flakes along with the marine shells.

Although *B. uedae* is nearly contemporary with *B. bailyi,* the specimens of the two species were obtained at different localities, except in one case (loc. CK61) where an unusual specimen of *B. bailyi* occurred with *B. uedae.*

Baculites boulei COLLIGNON

Pl. 13, figs. 3, 5; Pl. 15, fig. 6; Text-figs. 93, 152-155

Synonymy.—

1907. *Baculites vagina*, BOULE, LEMOINE & THEVENIN (*non* FORBES), *Ann. Pal.*, vol. 2, p. 65, pl. 15, g. 3, 3a.

1931. *Baculites boulei* COLLIGNON, *Ann. Géol. Serv. Mines, Madagascar*, fasc. 1, p. 35, pl. 5, fig. 2, 2a; pl. 9, fig. 14.

1959. *Baculites boulei*, MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.*, [D], vol. 8, no. 4, p. 118, pl. 32, fig. 7a-c; pl. 33, figs. 4a-c, 5a, b, 6a-d; text-figs. 27a, b, 28-32.

Type.—The lectotype was designated by MATSUMOTO (1959, p. 118) as the illustrated one of the nine syntypes of COLLIGNON (1931, pl. 5, fig. 2, 2a; pl. 9, fig. 14), from Mahagaga, Madagascar.

Material.—The examples from Hokkaido which we refer to this species are: GK. H4254-GK. H4258, from loc. Sk69 [=Y558] (Coll. K. TANAKA & S. YAMAGUCHI), GK. H4259-GK. H4274, from loc. Y443 (Coll. S. YAMAGUCHI); GK. H4478, from loc. Ik1277p1, and GK. H4597 from loc. Ik1111a (Coll. T. MATSUMOTO). GK. H4923, a probable but somewhat doubtful example from loc. Yb32p2 (Coll. M. HARADA).

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance	Interval between tubercles ant.← →post.
GK. H4254	16.6	13.4	(0.81)	15.3	8.5/8.5/5.8/9.1
〃	14.9	11.8	(0.79)		
GK. H4256	18.0	12.5	(0.69)	36.4	9.2/12.0
〃	16.1	11.7	(0.73)		
GK. H4258	5.1	3.9	(0.76)		
GK. H4259	7.2	5.6	(0.78)		3.4
GK. H4261	5.0	3.6	(0.72)	19.8	
〃	3.2	2.3	(0.72)		
GK. H4270	8.1	6.2	(0.77)	23.1	4.2/3.6/6.3/5.2/3.3
〃	6.5	5.1	(0.78)	23.1	
〃	4.3	3.2	(0.74)		
GK. H4271	8.1	6.1	(0.75)		
GK. H4272	6.6	4.9	(0.74)		
GK. H4597	*c.*10.0	—	—		8.1
GK. H4923	—	*c.*15.0	—		7.1/7.1/7.6/10.2

Remarks.—The diagnosis of *Baculites boulei* is well understood from the descriptions by COLLIGNON (1931, p. 35) and MATSUMOTO (1959b, p. 118).

Description.—The Japanese specimens listed above are identified with the present species by the moderate tapering in the main part, oval cross section which is broadest in the dorsolateral part, venter more narrowly rounded than the dorsum, more or less strong dorsolateral crescentic nodes in the later growth-stages, weak and fine riblets and lirae which are strongly projected on the venter and comparatively simple suture, with low and broad, subquadrate, subequally bifid lateral saddles.

MATSUMOTO (1959b) described the variability of the species in California. Similarly the specimens from Hokkaido exemplifies the variation. The tapering is normally slow but a few specimens (e.g. GK. H4270) taper moderately in the

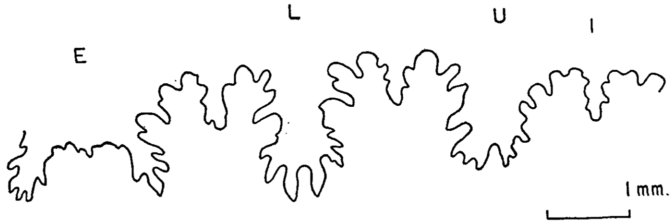


Fig. 93. *Baculites boulei* COLLIGNON.
Suture, at height=6.1, breadth=4.5 mm., of GK. H4270, from loc. Y443, the Sakasa, a branch of the Haboro, member U3, Upper Yezo group, Sankei quadrangle (Chikubetsu-Haboro area), Teshio Province.

earlier growth-stages.

The intensity of the dorsolateral crescent nodes varies considerably. For example they are extremely weak in GK. H4256, a body chamber, which came from the same nodule as the normal ones (GK H4254, etc.). The interval between the nodes is normally moderate, but may vary irregularly as can be understood from the figures of the measurements.

So far as the observed examples (GK. H4270, GK. H4272 and GK. H4478) are concerned, the sutures are essentially similar to those of the already described specimens (COLLIGNON, 1931, pl. 9, fig. 14; pl. 5, fig. 2, 2a; MATSUMOTO, 1959b, text-fig. 27b), although there may be minor differences.

Affinity.—As has already been remarked by MATSUMOTO (1959b, p. 120), *B. boulei* is intimately related to *B. yokoyamai* TOKUNAGA and SHIMIZU (emended above) (with which *B. besairiei* COLLIGNON is probably synonymous), *B. schencki* MATSUMOTO and *B. capensis* WOODS. This is confirmed by the study of the Japanese material, too.

Occurrence.—Loc. Ik1111a, Bannosawa, unit IIIb (glauconitic fine-sandy mudstone) of the Upper Yezo group in the Ikushumbets Valley, Ishikari Province, zone of *Inoceramus uwajimensis*, Lower Urakawan [K5 α]. At this locality the species is associated with more abundant *B. yokoyamai.*

Loc. Ik1277pl, Kikumezawa, unit IIId (mudstone) of the Upper Yezo group in the Ikushumbets Valley, Upper Urakawan [K5 β]; loc. Sk69 [=Y558] along the main stream of the Haboro and loc. Y443 along the Sakasa, a branch of the Haboro, both from the middle part of TANAKA's member U3 (fine sandy or

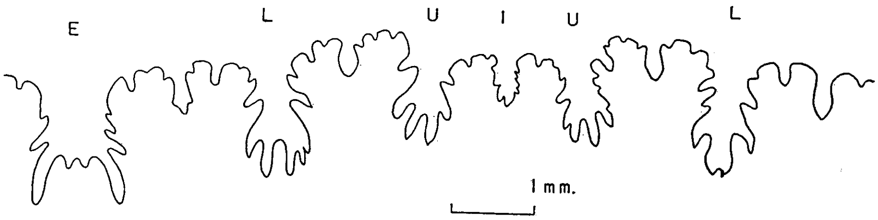


Fig. 94. *Baculites* sp. nov. (?) aff. *B. sulcatus* BAILY.
Suture, at height=5.2, breadth=4.2 mm., of GK. H4702, from loc. T1020pl, a pebble in Saku-gakko-zawa, Abeshinai-Saku area, Teshio Province.

silty mudstone) of the Upper Yezo group, Sankei quadrangle, Teshio Province, K5 β; loc. Yb32p2, bed U2 (mudstone) of HARADA and MATSUMOTO in the Hatonosu Hills near Yubari, Ishikari Province.

B. boulei is known from the Lower Senonian in Madagascar and California.

Baculites n. sp. (?) aff. *B. sulcatus* BAILY

Pl. 12, fig. 6; Text-figs. 94, 130

Compare.—

1855. *Baculites sulcatus* BAILY, *Quart. Jour. Geol. Soc. London*, vol. 11, p. 457 (*partim*), pl. 11, fig. 5c (only).
1906. *Baculites sulcatus*, WOODS, *Ann. South African Museum*, vol. 7, part 7, no. 12, p. 341, pl. 44, fig. 4.
1921. *Baculites* cf. *sulcatus*, SPATH, *Ann. South African Museum*, vol. 12, part 6, no. 16, p. 260.
1921. *Baculites sulcatus*, VAN HOEPEN, *Ann. Transvaal Museum*, vol. 8, part 1, p. 18, pl. 3, figs. 7, 8.
1931. *Baculites sulcatus*, COLLIGNON, *Ann. Géol. Serv. Mines Madagascar*, fasc. 1, p. 36, pl. 5, fig. 3, 3a, 4, 4a, 5, 5a, 13; pl. 9, fig. 15.

Type of B. sulcatus.—WOODS (1906, p. 341) did not clearly designated the lectotype but handled "the types in the Museum of the Geological Society of London", when he redefined *B. sulcatus*. One of the figured specimens of BAILY (1855, pl. 11, fig. 5c) which was indicated by WOODS as an example of his redefined *B. sulcatus* is here designated as the lectotype.

Material.—A small, but well preserved specimen, GK. H4702, and associated smaller fragments, from loc. T1020pl (Coll. T. MATSUMOTO).

Measurements.—

	Height	Breadth	(B/H)	Distance
GK. H4702 (body chamber)	5.8	4.6	(0.79)	23.7
〃 (septate part)	5.1	4.2	(0.82)	

Description.—The shell is small and tapers very slowly. Its cross section is subelliptical, slightly broader in the dorsal part than in the ventral part, and the flanks are gently inflated.

The surface is ornamented with numerous, close-set subcostae and the dorsolateral bullae. The subcostae show a gentle forward curvature on the dorsum and a moderate sinus on the dorsolateral part, are remarkably prorsiradiate on the flank, forming an angle of about 37° with the long axis of the shell and strongly projected on the venter. The dorsolateral bullae are irregularly weak and developed at each second or third subcosta, with bifurcated or inserted riblets.

The suture is comparatively simple, resembling that of *B. boulei*. On one side L is unusually narrowed but on the other side it is normal. The dorsal elements are relatively more ascending than in *B. boulei*.

Affinity.—In the characteristic ornament as well as the shell-form this species is similar to *Baculites sulcatus* BAILY (see above list) and also to *B. undulatus*

ROMAN and MAZERAN (described in p. 28), but the ornament is not so coarse as in *B. sulcatus* and the riblets are still finer and more prorsiradiate than in *B. undulatus*. In this respects, as well as in the shell-form and the suture, the present species is closer to *B. yokoyamai* TOKUNAGA and SHIMIZU, *B. boulei* COLLIGNON and *B. capensis* WOODS, but *B. yokoyamai* has still finer subcostae and usually no dorsolateral bullae, *B. boulei* more distant and stronger tubercles and *B. capensis* stronger and still more distant tubercles and much finer lirae. The dorsolateral bullae appear earlier in the present species than in *B. boulei* and *B. capensis*.

The ascending tendency of the suture in the dorsal part is similar to that in *B. latelobatus* COLLIGNON (1931, p. 38, pl. 5, figs. 11-12; pl. 9, fig. 8), but that species has no dorsolateral bullae.

In short the specimens here described probably represent a new species which is related to *B. yokoyamai, B. boulei,* etc. and presumably descended from *B. yokoyamai* itself or the common ancestor in parallel with the line of *B. undulatus—B. sulcatus*. The establishment of the new species is, however, suspended until more specimens are obtained.

Occurrence.—Loc. T1020pl, a pebble of a calcareous mudstone nodule in Saku-gakko-sawa, Abeshinai-Saku area, Teshio Province, Hokkaido. From the associated species the rock is probably referred to the Urakawan part of the Upper Yezo group.

Baculites capensis WOODS

Pl. 14, fig. 2; Pl. 15, figs. 3-5; Pl. 19, fig. 2; Text-figs. 95, 96, 147-151

Synonymy.—

1906. *Baculites capensis* WOODS, *Ann. South African Museum,* vol. 4, pt. 7, no. 12, p. 342, pl. 44, figs. 6a, b, 7a, b.
?1907. *Baculites vagina,* BOULE, LEMOINE & THEVENIN (*non* FORBES), *Ann. Paléont.,* vol. 2, p. 65, pl. 15, fig. 3.
1909. *Baculites* cf. *asper,* YABE, *Zeitsch. deutsch. geol. Ges.,* p. 439, listed only.
1921. *Baculites capensis,* SPATH, *Ann. South African Museum,* vol. 12, pt. 7, no. 16, p. 257, pl. 24, figs. 6, 7.
?1931. *Baculites* aff. *capensis,* COLLIGNON, *Ann. Géol. Serv. Mines, Madagascar,* fasc. 1, p. 22, pl. 3, fig. 6.
1936. *Baculites capensis,* VENZO, *Pal. Italica,* vol. 36, p. 116 [58].
1936. *Baculites capensis* var. *umsinensis* VENZO, *Pal. Italica,* vol. 36, p. 116 [58], pl. 10 [6], fig. 13a, b.
1958. *Baculites buttensis* ANDERSON, *Geol. Soc. Amer., Memoir* 71, p. 191, pl. 49, fig. 6, 6a, 6b.
1958. *Baculites* aff. *capensis,* ANDERSON, *Geol. Soc. Amer., Memoir* 71, p. 192, pl. 48, fig. 8, 8a.
1959. *Baculites capensis,* MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.,* [D], vol. 8, no. 4, p. 121, pl. 33, figs. 1a-d, 2a-c, 3a, b; pl. 45, figs. 1a-d, 2a-d, 3a-d, 4a-d; text-figs. 33a, b, 34a, b.

Types.—One of us (MATSUMOTO, 1959b, p. 121) considered it desirable that anyone who was accessible to WOODS' syntypes should select the lectotype, but nobody has done so. Therefore one of the illustrated syntypes of WOODS (1906, pl. 44, fig. 6 a, b) is here designated as the lectotype.

Material.—The following specimens from Hokkaido are identified as *Baculites capensis*: GT. I-326 (=MM7604) in YABE's collection. GK. H4707-GK. H4713, GK. H4937-GK. H4945, GK. H4951-GK. H4953 from loc. T1187p2 (Coll. T. MATSUMOTO). GK. H4730-GK. H4735 from loc. T1164p4 (Coll. T. MATSUMOTO). GK. H4736. GK. H4935, GK. H4936 from loc. T1151p (Coll. T. MATSUMOTO). GK. H4702, a comparable specimen, from loc. T1020p (Coll. T. MATSUMOTO).

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance	Interval between tubercles ant.← →post.
GT. I-326	14.6	10.7	(0.73)	18.6	18.9/9.2/10.3
〃	13.2	9.6	(0.73)		
GK. H4709	6.1	4.3	(0.70)		5.3/6.0/?/7/3/5.3
GK. H4730	11.5	8.0	(0.70)	48.2	13.1
〃	7.8	6.1	(0.78)		
GK. H4731	5.6	4.3	(0.77)	18.5	7.7
〃	4.0	3.2	(0.80)		
GK. H4732	5.1	4.1	(0.80)		
GK. H4733	4.2	3.3	(0.79)		
GK. H4734	4.0	3.2	(0.80)	13.5	
〃	2.7	2.4	(0.89)		
GK. H4736	7.0	5.0	(0.71)	18.6	7.2/6.2/5.1
〃	5.8	4.2	(0.72)		
GK. H4942	*c.*8.9	—	—		8.1/8.1/8.3
GK. H4943	*c.*5.7	—	—		5.3/3.3/3.0/3.0

Description.—The characters observed in the Japanese specimens are written below, in comparison with the hitherto described ones.

One of our specimens, GT. I-326, is similar in size to the lectotype (WOODS, 1906, pl. 44, fig. 6a, b). Others are smaller than that.

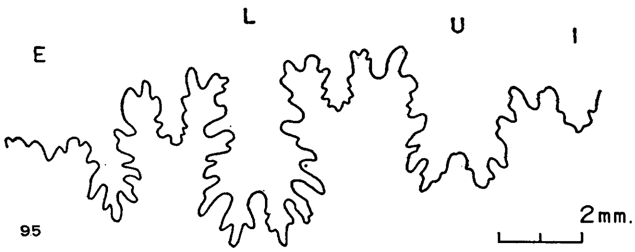
The tapering is moderate and many of our examples are not so extremely parallel sided as in the figured specimens from South Africa and California. The cross section is subelliptical, with nearly flattened flanks, higher than broad and broadest somewhat below the mid-flank. The venter is moderately rounded and is narrower than the broadly rounded dorsum. This difference between the venter and dorsum in many of the Japanese examples is somewhat larger than in one of the figured specimens from South Africa (WOODS, 1906, pl. 44, fig. 7c) and some of the Californian examples (MATSUMOTO, 1959, text-figs. 33, 34) but nearly as large as that shown by the lectotype and some other Californian examples (e.g. the specimen described as *Baculites buttensis* ANDERSON, 1958, pl. 49, fig. 6b).

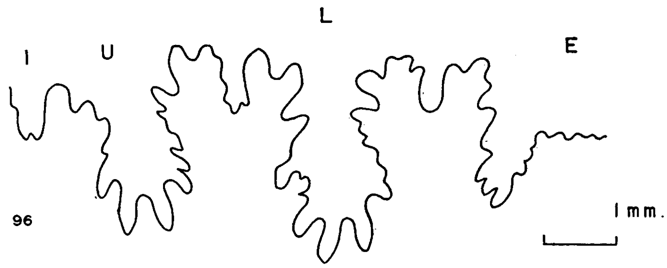
The widely separated, prominent tubercles in a row at a short distance from the dorsolateral shoulder is characteristic of the present species. As has already been pointed out by MATSUMOTO (1959, p. 124), the longitudinal elongation of the tubercles is inconstant in the Hokkaido examples. The crescentic tubercles are more frequently observed in the small, probably young, shells from Hokkaido and the longitudinally elongated ones are so in the probably adult shells, but this is by no means constant. Obliquely elongated tubercles and rounded ones also occur. The interval between the tubercles is also variable to some extent between individuals and even in an individual (see the measurements). In GT. I-326 (Pl. 14, fig. 2), for instance, the second of the three preserved tubercles is much apart from the first, showing the longer distance than the height of the cross section, but the third is not so apart from the second, being as distant as the breadth of the section.

The well preserved surface of the shell shows closely spaced, very weak riblets, lirae and striae. Their curvature is similar to that in *B. yokoyamai.* Some of them may be faintly impressed on the ventral part of the internal mould.

The apertural margin, which is preserved in a small specimen (GK. H4733), is almost parallel to the lirae on the surface of the shell. The dorsal margin shows a gently forward curvature, followed by an asymmetric sinus in the dorso-lateral part, and then by an almost straightly oblique margin in the main part of the flank, which passes gradually to the ventral projection. The ventral part of the shell close to the projected apex is very slightly bent towards the dorsum, but can be described as nearly (if not strictly) straight.

The suture is simple, showing comparatively shallow minor incisions. The lobes and saddles are subrectangular in general outline. The first and the second lateral lobes are bifid and almost equally broad and equally high, as typically





Figs. 95, 96. *Baculites capensis* WOODS.

95. Suture, at height=12.4, breadth=9.0 mm., of GT. I-326 (=MM7604), from "the Shisanushibe", a tributary the Popets [=Hobets], "*Parapachydiscus* beds", i.e. the zone of *Anapachydiscus* spp., Iburi Province.

96. Suture, at height=7.6, breadth=6.0 mm., of GK. H4730, from loc. T1164 p4, in the upper reaches of the Saku-gakko-zawa, derived from bed IIId, Upper Yezo group, Abeshinai-Saku area, Teshio Province.

shown by GK. H4730. In some specimens (e.g. GK. H4736) the former is slightly broader and lower than the latter; in others (e.g. GT. I-326) the former is narrower and lower than the latter. The first lateral lobe (L) is the deepest. It is about two thirds as narrow as the lateral saddle, but may vary. In an unusual example (i.e. GT. I-326) it is almost as broad as the first lateral saddle, the latter of which is unusually narrowed.

Remarks.—As can be judged from the above description, the minor differences which may be observed between some of the already described specimens (from South Africa and California) and ours can be regarded as within the range of species variation. Whether subspecies can be distinguished or not should be determined by further systematic study of more specimens from various regions.

Affinity.—Baculites capensis is closely related to *B. yokoyamai* and *B. boulei,* as has already been pointed out by MATSUMOTO (1959, p. 124). Whether *B. capensis* was derived directly from *B. yokoyamai* in parallel with *B. boulei,* or derived from the same species by way of *B. boulei,* or the three species were sprung simultaneously from a common ancestor, such as *Sciponoceras intermedium,* is not easily determined from the available evidence. From the stratigraphic occurrence the last interpretation seems to be probable. Morphologically there is a more or less abrupt change in each of the three lines. In many of the immature shells of *B. capensis* from Hokkaido, for instance, the dorsolateral tubercles are more frequently crescentic and widely spaced than in the typical examples and, accordingly, they are fairly close to *B. boulei.* In its subelliptical cross section *B. capensis* is closer to *B. yokoyamai* and *S. intermedium*; the latter two are generally free from tubercles, except in an exceptional case in *B. yokoyamai* and in a very feeble and infrequent appearance of the bullae in *S. intermedium.*

B. capensis seems, on the other hand, to be very intimately related to a new species of the succeeding age (see the description of *B. tanakae* in page 51 for further remarks).

The similarity and distinction between *B. capensis* and *B. asper* MORTON (see REESIDE, 1927) were mentioned by MATSUMOTO (1959, p. 125). GT. I-326, from Hokkaido, which was once labelled as *B.* cf. *asper,* is undoubtedly to be referred to *B. capensis.*

Occurrence.—The locality of GT. I-326 is recorded as "the Shisanushibe, a tributary of Popets [=Hobetsu], Iburi Province, "*Parapachydiscus* beds", i.e. the zone of *Anapachydiscus* spp. in the recent definition, Urakawan. Locs. T1151p, T1164p4, T1187p2, all the upper reaches of the Saku-gakko-sawa, calcareous concretions derived from bed IIId (fine-sandy mudstone) of the Upper Yezo group in the Abeshinai-Saku area, Teshio Province, Upper Urakawan [K5 β].

Outside Hokkaido *B. capensis* is known from the Lower Senonian of southeast Africa, Madagascar and California.

Baculites tanakae sp. nov.

Pl. 13, fig. 4; Pl. 16, figs. 1-5; Pl. 17, figs. 1-5; Pl. 18, figs. 1, 3, 4;
Pl. 19, figs. 1, 4; Text-figs. 97-113, 115

Material.—Holotype: GK. H4288, from loc. Sk60, along the main stream of the Haboro, the uppermost part of the Upper Yezo group, Sankei quadrangle (Chikubetsu area), Teshio Province (Coll. K. TANAKA*).

Paratypes: GK. H4229-GK. H4233 and GK. H4241-GK. H4245, from the same nodule as the holotype (loc. Sk60); GK. H4234, GK. H4237-GK. H4240 and GK. H4246-GK. H4253, from loc. Sk46 (all Coll. K. TANAKA*). GK. H4753-GK. H4789, GK. H4946, GK. H4948-GK. H4950, GK. H4954-GK. H4977, from loc. T1186p1 (Coll. T. MATSUMOTO). GK. H4978-GK. H4988 from a nodule obtained in the Saku area (without precise locality records). GK. H5115a-n from one and the same nodule (Hokkaido, without precise locality records), purchased from S. NAGAOKA.

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance	Interval between tubercles ant.← →post.
GK. H4288	10.2	7.4	(0.73)	18.2	15.6/12.8/10.9
〃	9.1	6.5	(0.71)		
GK. H4229	14.2	10.6	(0.75)	25.7	20.3/17.6
〃	12.7	9.2	(0.72)		
GK. H4230	9.3	7.1	(0.76)	19.8	9.6
〃	8.2	6.0	(0.73)		
GK. H4234	10.3	8.0	(0.78)	28.4	10.1/9.4/9.4
〃	8.9	6.6	(0.74)		
GK. H4236	7.1	5.5	(0.77)	26.4	
〃	5.0	4.1	(0.82)		
GK. H4238	10.6	8.0	(0.75)	40.7	11.7/9.3
〃	8.0	6.1	(0.76)		
GK. H4759	5.3	4.2	(0.79)	18.5	4.0/3.2/3.5/3.4
〃	3.7	3.1	(0.84)		
GK. H4773	9.0	7.2	(0.80)		9.2
GK. H4776	5.7	4.7	(0.82)	31.1	6.2
〃	3.1	2.5	(0.81)		
GK. H4954	7.0	5.2	(0.74)	17.9	4.6/6.7/5.4
〃	5.9	4.6	(0.78)	17.6	
〃	4.3	3.4	(0.79)		

Diagnosis.—The shell is rather small, expanding moderately or rapidly in the early growth-stage but slowly in the late. The cross section is higher than broad; the dorsum is broadly rounded; the flanks are slightly convex and nearly parallel; the ventrolateral shoulders are bluntly developed and the venter is approximately fastigate.

The shell is ornamented with a dorsolateral row of tubercles, which are typically, but not always, strong, widely spaced and asymmetrically crescent or

* The species is dedicated to Dr. Keisaku TANAKA, who generously supplied us with his valuable specimens and also necessary locality records.

elongated obliquely or parallel to the long axis of the shell. Weak riblets may be extended from the tubercles. Very faint and fine subcostae and lirae are also discernible on the interspaces, when the preservation is favourable. They are remarkably prorsiradiate on the flank, forming an angle of about 25° to 30° with the long axis and strongly projected on the venter, with minutely corrugated chevrons on crossing.

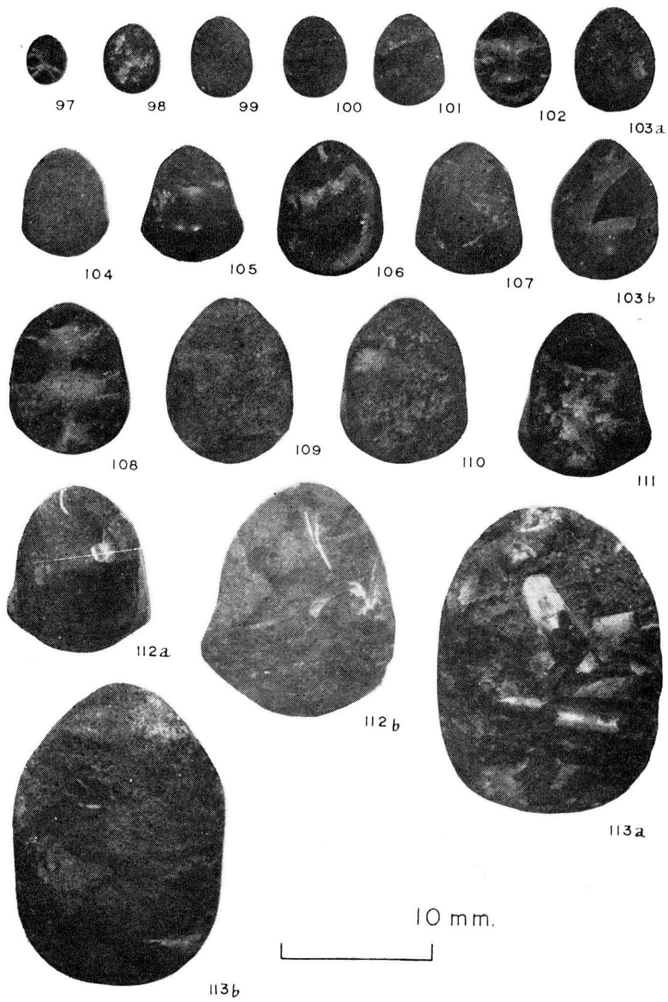
The suture is rather simple, with comparatively shallow minor incisions. The ventral lobe [E] is wide, being nearly as broad as or somewhat broader than the saddles. The first and the second lateral saddles are subrectangular to inversed-subtrapezoidal in general outline and subsymmetrically bifid. The former is slightly lower and slightly narrower than, but sometimes nearly as broad as, the latter. The first lateral lobe (L) is deep and narrower than the lateral saddles, being more or less narrowed at its stem. The second lateral lobe (U) is somewhat shallower or nearly as deep as the first. It is not so narrowed as L at its stem but is sometimes as narrow as L in a general outline. The dorsal lobe (I) is very small. The saddle between I and U is much narrower and variably lower than the lateral saddles.

The apertural margin, which is preserved in a small specimen (GK. H4772) and very incompletely so in the holotype, is almost parallel to the lirae on the surface of the shell. It is quite similar to that of *Baculites capensis* described in page 49.

Variation.—There seems to be some variation in the size of the shell. The holotype is regarded as an adult shell, because the last septa are approximated. Its body-chamber, which is nearly complete, is about 45 mm. long along the antisiphonal line. Its height (in section) is 12 mm. at the anterior end. Many other specimens of a probably adult stage show similar, if not identical, sizes, but another specimen, GK. H4252, of a fragmentary body chamber, is 20 mm. high and 15 mm. broad.

The roof-shaped venter is characteristic of the present species, but the sharpness of the ventral periphery and the ventrolateral shoulder varies between individuals and growth-stages. GK. H4253 is an example with rather more rounded peripheries. The flanks are nearly parallel and flattened or only gently inflated in many specimens, but may be convergent (e.g. GK. H4773) or slightly divergent (e.g. GK. H4236) in a few specimens. In the young shells the cross section is comparatively more rounded than in the shells of later growth-stages.

The interval between tubercles is usually greater, sometimes nearly as great as, but occasionally slightly shorter than the height (i.e. longer diameter) of the cross section, as can be seen from the figures of the measurements. Tubercles begin to appear at the height from 4 mm. in some specimens (e.g. GK. H4756) to over 7 mm. in others. The intensity of the tubercles may be dissimilar between individuals and may vary from place to place even in one specimen. Typically the tubercles are fairly strong, but weakly tuberculate examples (e.g. GK. H5115a) may occasionally occur along with the normal ones. The shape of the tubercles varies from asymmetrically crescentic or obliquely elongated to longi-



Figs. 97-113. *Baculites tanakae* sp. nov., cross sections.
97: GK. H5115n, 98: GK. H4772, 99: GK. H4759, 100: GK. H4757, 101: GK. H4776, 102: GK. H4236, 103a: GK. H5115a(p.), 103b: GK. H5115a(a.), 104: GK. H5115h, 105: GK. H4773, 106: GK. H4288, 107: GK. H4754, 108: GK. H4239, 109: GK. H4238, 110: GK. H4234, 111: GK. H4231, 112a: GK. H4229 (p.), 112b: GK. H4229(a.), 113a: GK. H4252(a.), 113b: GK. H4252(p.).
(a.): anterior and (p.): posterior parts of the same specimen.

tudinally elongated, as in *Baculites capensis.*

In the present species the suture is considerably variable in its details. The minor incisions are shallower and less numerous in GK. H5115a than in other specimens of a similar size. There is variation in the comparative proportion of breadth between saddles and lobes as well as in their shape. In GK. H4238, for example, the lateral lobes (L and U) are not so narrow as in others, being only slightly narrower than the lateral saddles. In this and some other specimens the sutural elements are subrectangular in general outline. In the holotype

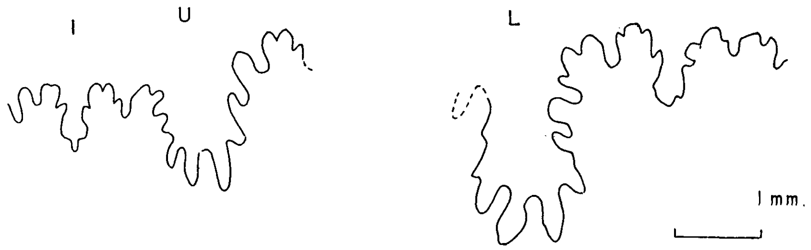


Fig. 114. *Baculites* cf. *kirki* MATSUMOTO.
Suture, at height=*c.* 9.3, breadth=*c.* 7.2 mm., of GK. H5394, from loc. Kd. 905p, Matsuishi-zawa, a western branch in the upper reaches of the Porokeshomap, a tributary of the Sharu, unit B, Upper Yezo group, Hidaka Province.

(GK. H4288) and a few other specimens L is much narrowed at its stem and, accordingly the general outline of the elements is inversed subtrapezoidal. In many other specimens intermediate features are observable. As far as the suture is concerned, the mean is represented by GK. H4230 (see the illustration). The suture of GK. H4288 is unusual in that the median foliole at the bottom of L is somewhat larger than the adjacent lateral folioles. The difference is sometimes seen in the minor details of the suture between the two sides of one and the same specimen.

Affinity.—The present species is closely allied to *Baculites capensis* WOODS (see the preceding description), from the Lower Senonian of the Indo-Pacific region, but is distinguished by its approximately fastigate, instead of rounded, venter. In the Japanese succession *B. tanakae* occurs just above the bed of *B. capensis* in the same area. In some specimens of *B. capensis* the venter is narrower than in others and in an extreme case, as represented by the specimens (GK. H4730-H4735) from loc. T1164p4, it is intermediate between *B. capensis* and *B. tanakae*. Thus, *B. tanakae* is very probably derived directly from *B. capensis*.

The present species is considerably similar to *Baculites taylorensis* ADKINS

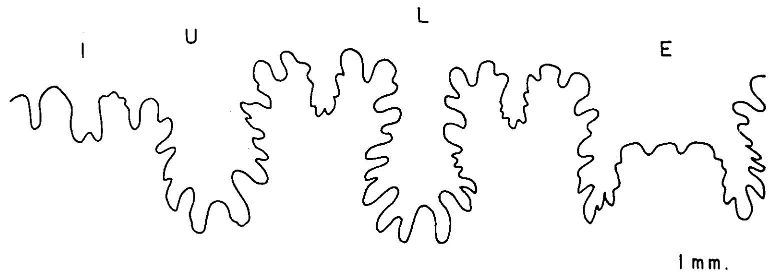


Fig. 115. *Baculites tanakae* sp. nov.
Suture, at height=8.2, breadth=6.0 mm., of a paratype, GK. H4230, from loc. SK60, the main stream of the Haboro, the uppermost part of the Upper Yezo group, Sankei quadrangle, Chikubetsu-Haboro area, Teshio Province.

(1929, p. 204, pl. 5, figs. 9-11), from the Campanian Taylor marl of Texas, but in that species the distant nodes are transversally elongated and the venter is fairly narrowly rounded but not fastigate. *B. taylorensis* is probably derived from *B. asper* MORTON. Thus there is parallelism between the lines of *B. capensis* —*B. tanakae* of the Indo-Pacific region and *B. asper*—*B. taylorensis* of the Gulf-Atlantic province.

It is interesting to note that some of the immature specimens of *B. tanakae*, as represented by GK. H4948, are fairly close to *B. lomaensis* ANDERSON (1958, p. 191, pl. 48, figs. 5, 5a, 6; MATSUMOTO, 1959, p. 126, pl. 34, figs. 1, 2; text-figs. 35-41), from the Lower Maestrichtian or Uppermost Campanian of California. *B. lomaensis* has a more rounded dorsum, denser and more crescentic tubercles and more numerous frills of the suture than *B. tanakae*. The latter has ventro-lateral shoulders and parallel flanks but the former has simply convergent flanks.

Some specimens, especially the internal moulds, of *Baculites kirki* MATSUMOTO 1959, p. 143, pl. 43, figs. 1-3; text-figs. 53-58), from the Santonian of California and Hokkaido (see p. 65), are somewhat similar to the present species in cross section, but that species has a rounded keel and no tubercles.

Occurrence.—Loc. Sk60 [=Y339], the type locality, along the main stream of the Haboro, and loc. Sk46, Haborogoe of the Kotanbetsu, both from member U6 (fine sandy-siltstone), uppermost part of the Upper Yezo group in the Sankei-Chikubetsu area, Teshio Province, northwest Hokkaido. Member U6 contains, accordng to TANAKA, *Inoceramus* cf. *schmidti* MICHAEL, *I.* cf. *orientalis orientalis* SOKOLOW, *I.* cf. *orientalis nagaoi* MATSUMOTO and UEDA and *I.* cf. *balticus* BOEHM, among others, and is, K5γ-K6α in age, approximately Campanian. Also loc. T1186p1, a calcareous nodule of mudstone, in the upper reaches of Saku-gakko-sawa, probably derived from bed IIId-e (with *Inoc. orientalis* and *I.* cf. *balticus* among the associated species), in the Abeshinai-Saku area, Teshio Province, northwest Hokkaido.

Baculites princeps sp. nov.

Pl. 13, figs. 1, 2; Pl. 15, figs. 1, 2; Text-fig. 134-139

Material.—Holotype, GK. H4454, an internal mould, from loc. Y420, Kotodo-no-sawa, Haboro Valley, TANAKA's member U3 of the Sankei quadrangle, Teshio Province, Hokkaido (Coll. S. YAMAGUCHI). Paratypes, GK. H4453, and GK. H4455-GK. H4460 from the same nodule as the holotype (Coll. S. YAMAGUCHI); GK. H5248-GK. H5250 from loc. CK94 (Coll. Y. UEDA); GK. 4461, GK. H4463, GK. H4465, GK. H4469, GK. H4470 and GK. H4473-GK. H4477, from loc. Ik. 1264p2 (Coll. T. MATSUMOTO).

There are many, poorly preserved specimens which are referable to the present species: GK. H4916-GK. H4921, from loc. Yb. 65p (Coll. M. HARADA); GK. H4924-GK. H4928, from loc. Yb. 30 (Coll. M. HARADA); GK. H4449-GK. H4452, from loc. Ik1264p1 (Coll. T. MATSUMOTO); GK. H4462, GK. H4464, GK. H4466-GK. H4468, GK. H4471 and GK. H4472 from loc. Ik1264p2 (Coll. T. MATSUMOTO); GK. H4947, from loc. T1187p2 (Coll. T. MATSUMOTO).

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance	Interval between tubercles
GK. H4454	7.5	5.5	(0.73)		
〃	6.2	4.8	(0.77)		
GK. H4453	10.5	8.3	(0.79)		10.4
GK. H4457	6.1	4.5	(0.74)		
GK. H4469	—	*c*.9.5	—		5.8/5.3/6.1
GK. H4470	9.4	7.5	(0.80)	21.6	
〃	8.3	6.3	(0.76)		
GK. H4477	5.3	4.2	(0.79)	17.8	
〃	4.1	3.1	(0.76)		
GK. H5248	13.3	10.0	(0.75)		15.3
GK. H4916	16.7	10.8	(0.65)		12.9
GK. H4924	—	—	—		10.3/10.2
GK. H4947	9.9	7.9	(0.80)		8.1

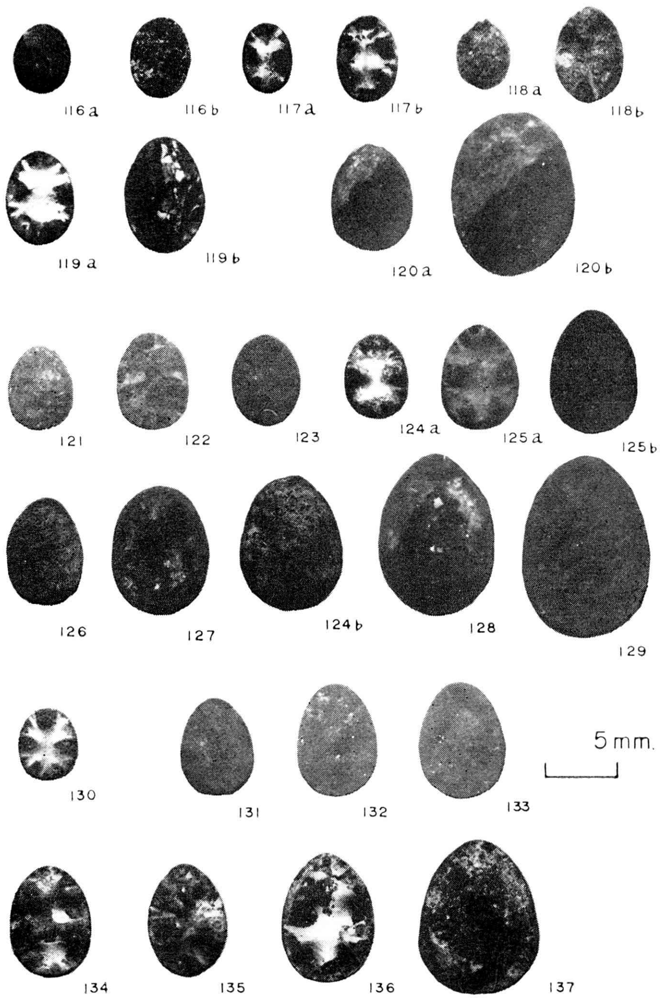
Diagnosis.—The shell is small, with moderate tapering. The section is compressed, with the proportion between breadth and height ranging from 0.65 to 0.80, and rounded subtrigonal, with a narrow, more or less acute venter and a rounded dorsum. It is broadest at a point slightly dorsad of the midflank.

The surface of the shell is nearly smooth in the early growth-stage but is ornamented with dorsolateral, crescentic, weak tubercles or bullae at moderate to wide intervals in more or less late growth-stage. In addition to the tubercles lirae are observable on the well preserved shell, which are prorsiradiate on the main part of the flank, strongly projected on the venter and gently curved forward on the dorsum.

The suture is moderately incised. The lateral saddles are subsymmetrically bifid, subrectangular to inversed trapezoidal in general outline, their stems being normally somewhat narrowed by the incision of the lobules. The first lateral saddle is as high as or slightly lower than the second. The former is nearly as broad as, but sometimes slightly narrower or broader than, the latter. The first lateral lobe [L] is nearly subrectangular to slightly subtrapezoidal in general outline, deep and subequally bifid. The median foliole at the bottom of L is nearly as small as the adjacent lateral folioles. The top of the former is nearly as high as or slightly lower than that of the latter. The second lateral lobe [U] is as broad as, but shallower than L. The ventral lobe [E] is broadest, but smaller than L. The dorsal lobe [I] is shallow and small. The saddle between I and U is much lower than the lateral saddles.

Variation.—The tendency to the *anceps* type shell-form, with a convergent ventral part, is characteristic of the present species, but the acuteness of the venter varies considerably ranging from the typically acute form to narrowly rounded.

The development of the weak, dorsolateral, crescentic bullae or tubercles is another diagnostic character of the present species, but the bullae or tubercles vary considerably in intensity, distance, and the stage of the first appearance. The holotype, for instance, which is an internal mould, is nearly smooth, but



Figs. 116–120. *Baculites bailyi* WOODS, cross sections.
116a: GK. H4521(p.), 116b: GK. H4521(a.), 117a: GK. H4527(p.), 117b: GK. H4527(a.), 118a: GK. H4520(p.), 118b: GK. H4520(a.), 119a: GK. H4515(p.), 119b: GK. H4515(a.), 120a: GK. H4810(p.), 120b: GK. H4810(a).

Figs. 121–129. *Baculites uedae* sp. nov., cross sections.
121: GK. H4793, 122: GK. H4799, 123: GK. H4706, 124: GT. I-3584(p.), 125a: GK. H4790(p.), 125b: GK. H4790(a.), 126: GK. 4479, 127: GK. H4826, 124b: GT. I-3584(a.), 128: GK. H4833, 129: GK. H4794.

Fig. 130. *Baculites* sp. nov. (?) aff. *sulcatus* BAILY, cross section of GK. H4702.

Figs. 131–133. *Baculites schenki* MATSUMOTO, cross sections.
131: GK. H4276, 132: GK. H4277, 133: GK. H4278.

Figs. 134–137. *Baculites princeps* sp. nov., cross sections.
134: GK. H4454, 135: GK. 4456, 136: GK. H4458, 137: GK. H4453.
(a.): anterior and (p.): posterior parts of the same specimen.

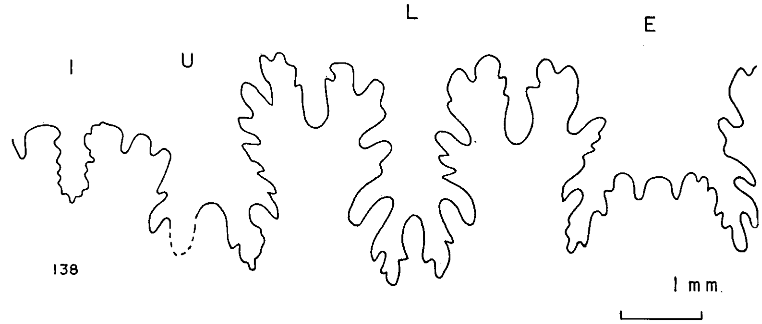
a few dorsolateral bullae are discernible under oblique lighting in a part with heights of 6-7 mm. A fragmentary body chamber, GK. H4453, which was found in the same nodule as the holotype, has weak but more distinct, crescentic bullae at an interval nearly equal to the height (i.e. longer diameter in cross section). Another body chamber, GK. H5248, has crescentic tubercles at a greater interval than the height. In some others, which may be septate or not, the interval is somewhat shorter than the height (see measurements).

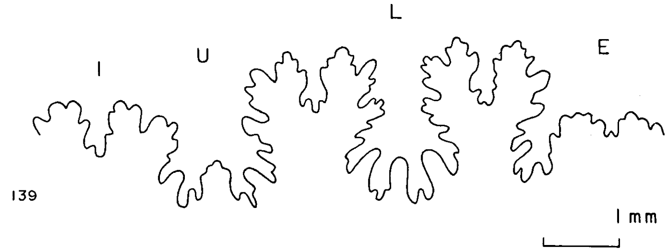
Variability is seen also in the details of the suture. In the holotype, on which sutures are well exposed, the lateral saddles and lobes are taller and deeper than in some others (e.g. GK. H4456 and GK. H4458 from the same nodule). Similarly there are minor differences in the degree of asymmetry or symmetry of the division of the lateral saddles and in that of narrowing of the stems of the lateral saddles from specimen to specimen.

Affinity.—The present species is fairly similar to *Baculites boulei* COLLIGNON (see the description in p. 44) but is distinguished by its narrower and more acute venter, on the average weaker tubercles, taller saddles, deeper lobes, and better developed folioles and lobules at the bottom of L than in *B. boulei.*

B. princeps is fairly similar to *B. anceps* LAMARCK (to be described below) in its more or less acute venter and other features, but *B. anceps* has more regularly arcuate ribs and a more rectangular outline of the sutural elements.

Occurrence.—The type locality is at loc. Y420, Kotodono-sawa, a tributary of the Haboro, a calcareous nodule in fine-sandy mudstone of the upper part of member U3 of K. TANAKA in the Sankei quadrangle, Teshio Province, north-





Figs. 138, 139. *Baculites princeps* sp. nov.

138. Suture, at height 7.3, breadth=5.3 mm., of holotype, GK. H4454, from loc. Y420, Kotodono-sawa, Haboro Valley, member U3, Sankei quadrangle, Chikubetsu-Haboro area, Teshio Province.

139. Suture, at height=6.8, breadth=5.1 mm., of a paratype, GK. H4456, from the same nodule as above.

western Hokkaido, Loc. Ck94, Ainu-sawa, another tributary of the Haboro, a calcareous siltstone nodule from member C of Upper Yezo group in the Chikubetsu area (UEDA, MATSUMOTO and AKATSU, 1962), Teshio Province, northwestern Hokkaido; loc. Ik1264p2, Kikumezawa, a nodule from bed IIId (mudstone) of Upper Yezo group in the Ikushumbets Valley, Ishikari Province, Hokkaido.

Localities where comparable specimens were obtained are Ik1264p1 and Ik 1264p2, Kikumezawa, nodules from bed IIId (mudstone) of Upper Yezo group in the Ikushumbets Valley, Ishikari Province, Hokkaido; T1187p2, Saku-gakko-sawa, a calcareous nodule derived from bed IIId of Upper Yezo group in the Abeshinai-Saku area, Teshio Province, north-west Hokkaido; locs. Yb30 and Yb65p, along the Ponhorokabetsu, member U2 (mudstone) of Upper Yezo group in the Hatonosu Hills, Yubari, Ishikari Province, central Hokkaido.

In brief *B. princeps* occurs in the mudstone to fine-sandy mudstone of the upper part of Upper Yezo group in Hokkaido, Upper Urakawan [K5 β].

Baculites anceps LAMARCK

Synonymy.—

1822. *Baculites anceps* LAMARCK, *Hist. anim. sans vertéb.*, vol. 7, p. 648.
1842. *Baculites anceps*, D'ORBIGNY, *Paléont. franç., Terr. crét.*, vol. 1, p. 564, pl. 139, figs. 1-7.
1861. *Baculites anceps*, BINKHORST, *Monogr. gastérop. et céphalop. craie supér. Limbourg*, p. 42, pl. 5d, fig. 3a-d.
1876. *Baculites anceps*, SCHLÜTER, *Palaeontographica*, vol. 24, p. 145, pl. 40, fig. 2.
1889. *Baculites anceps*, GRIEPENKERL, *Palaeont. Abh.*, vol. 4, p. 106, pl. 11 [44], fig. 2.
?1891. *Baculites valognensis* BÖHM, *Palaeontographica*, vol. 38, p. 50, pl. 1, fig. 13a, b.
1908. *Baculites anceps* var. *valognensis*, NOWAK, *Bull. Acad. Sci., Cracovie*, 1908, p. 335, text-figs. 1-4; 6a, 7a, 7b, 9, 12.
1951. *Baculites anceps*, WRIGHT and WRIGHT, *Palaeontogr. Soc.*, 1950, p. 16.

Remarks.—As was mentioned by MATSUMOTO (1959b), the situation regarding the types of *Baculites anceps* is unsettled. Until the necessary procedure is taken by someone who is well acquainted with the European material, the specimens of D'ORBIGNY (1842, p. 564, pl. 139, figs. 1-7) and others as listed above are regarded as typical examples of *B. anceps*.

The specimens from Japan described in this paper and those from California (MATSUMOTO, 1959, p. 130) constitute a subgroup which is subspecifically separable from the typical subgroup from Europe, *Baculites anceps anceps*, and thus a new subspecies is proposed as follows:

Baculites anceps pacificus subsp. nov.

Pl. 20, fig. 3; Text-figs. 145, 146, 156

Synonymy.—

?1902. *Baculites fairbanksi* ANDERSON (*pro parte*), *Proc. Calif. Acad. Sci.*, ser. 3, vol. 2, no. 1, p. 92, pl. 7, figs. 152, 153 (*non* pl. 10, fig. 194).

1915. *Baculites chicoensis,* WARING (*non* TRASK), *Calif. Min. Bureau Bull.*, 69 (1914), map, fig. 6.

?1932. *Baculites* n. sp. (?), NOMLAND and SCHENCK, *Univ. Calif. Publ. Geol. Sci.*, vol. 21, no. 4, p. 46, fig. 4.

?1958. *Baculites fairbanksi,* ANDERSON, *Geol. Soc. Amer., Memoir* 71, p. 190, pl. 48, fig. 4, 4a; pl. 49, fig. 4, 4a.

1959. *Baculites* aff. *B. anceps,* MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.* [D], vol. 8, no. 4, p. 130, pl. 34, fig. 3a-d; pl. 35, fig. 1a-d; text-figs. 42a, b, 43.

Material.—LSJU. 8561, one of the specimens (Coll. J. P. SMITH) from California illustrated by MATSUMOTO (1959, pl. 34, fig. 3a-d), is designated here as the holotype of this subspecies.

Other specimens from California, which were described by MATSUMOTO (1959, p. 130, with a list of the specimens in p. 131) under the heading of *Baculites* aff. *B. anceps* LAMARCK, and the following specimens from Hokkaido are paratypes: GK. H3555, from loc. U238 (Col.l T. MATSUMOTO) and GK. H3553, from loc. U47b (Coll. T. MATSUMOTO).

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
GK. H3555	9.9	7.7	(0.78)	
GK. H3553*	8.9	5.9	(0.69)	23.1
//	7.3	4.8	(0.66)	

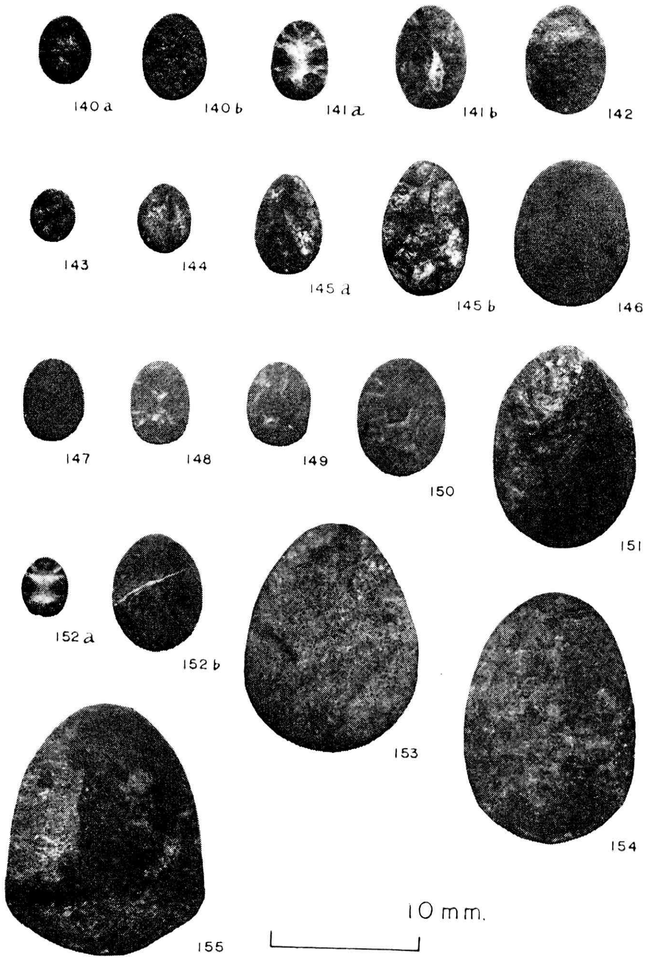
* secondarily compressed (?)

Diognosis.—The shell is of moderate size, growing rather slowly but sometimes moderately. The cross section is normally oval and much higher than broad, with the siphonal area more narrowly rounded than the antisiphonal.

The flank is ornamented with arcuate ribs of moderate intensity and density. Some intercalatory riblets and lirae run obliquely forward on the ventral two thirds of the flank and are strongly projected on the venter, where a weak corrugation is formed on crossing.

The suture is moderately incised. The first lateral lobe [L] and the lateral saddles are subrectangular in general outline and subsymmetrically bifid. The first lateral saddle is somewhat lower than the second. The ventral lobe [E] is the broadest and L is the deepest. L is somewhat narrower or nearly as broad as the lateral saddle. The median foliole at the bottom of L is slightly larger than the adjacent lateral folioles. The top of the former is nearly as high as those of the latter, but the relative height may vary to some extent. The second lateral lobe [U] is shallower than L, oblique and asymmetric. The dorsal lobe [I] is of moderate depth, but is smaller than other lobes.

Affinity.—*Baculites anceps pacificus* is closely allied to *B. a. anceps* but can be distinguished in that its venter is not so acute as in the latter, that the ventral prolongation of the ribs and lirae in the latter is farther forward than in the former, that the ribs cross the siphonal area with a weak corrugation in the



Figs. 140–142. *Baculites bailyi* WOODS, cross sections.
140a: GK. H4521(p.), 140b: GK. H4521(a.), 141a: GK. H4517(p.), 141b: GK. H4517(a.), 142: GK. H4519.

Figs. 143, 144. *Baculites* sp. nov. (?) aff. *hochstetteri* LIEBUS, cross sections.
143: GK. H3554, 144: GK. H5396.

Figs. 145, 146. *Baculites anceps pacificus* subsp. nov., cross sections.
145a: GK. H3553(p.), 145b: GK. H3553(a.), 146: GK. H3555.

Figs. 147–151. *Baculites capensis* WOODS, cross sections.
147: GK. H4731, 148: GK. H4736, 149: GK. H4709, 150: GK. H4730, 151: GT. I-326 (MM7604).

Figs. 152–155. *Baculites boulei* COLLIGNON, cross sections.
152a: GK. H4270(p.), 152b: GK. H4270(a.), 153: GK. 4256, 154: GK. H4255, 155: GK. H4254.
(a.): anterior and (p.): posterior parts of the same specimen.

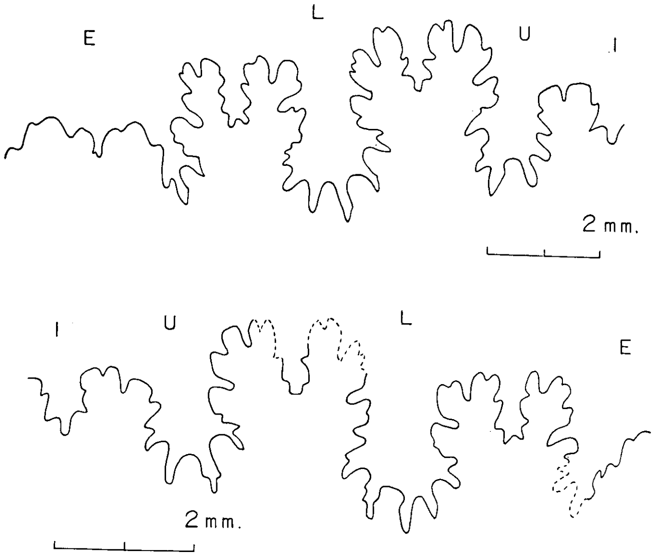


Fig. 156. *Baculites anceps pacificus* subsp. nov.
Two parts of the same suture, at height=8.9, breadth=5.9 mm., of a paratype, GK. H3553, from loc. U47b, upper reaches of the Urakawa Valley, bed Ur4β, zone of *Inoceramus schmidti*, Hidaka Province.

former but no ribs cross there in the latter and that the former has on the average more slender (high rectangular) saddles of the sture as compared with the more massive (broadly subquadrate) ones in the latter.

B. anceps pacificus is not only morphologically distinguished from *B. anceps anceps** but also separated geographically between Europe and the Pacific region. Geologically the former is slightly younger than the latter, although their ranges may overlap. Thus the subspecific separation is justified.

The similarity and distinction between *B. anceps* and *B. princeps,* of earlier age, has already been mentioned (see the description of *B. princeps*). *B. anceps* does not seem to be directly related with *B. princeps,* because no serial change is recognized between them in the suture and the ornament. As MATSUMOTO (1959b, p. 135) has already suggested, a possible origin of *B. anceps pacificus* is rather in such species as *B. bailyi* WOODS.

Occurrence.—The type locality of *B. anceps pacificus* is loc. LSJU. 1840, Arroyo del Valle, Jordan ranch, 8 miles southeast of Livermore, Tesla quadrangle, Alameda County, California. Other localities in California were listed by MATSUMOTO (1959, 1960). They are referred to Upper Campanian and *Metaplacenticeras pacificum* often occurs with *B. anceps pacificus.*

In Hokkaido only two localities are known: Loc. U238, Nishihorobetsu, a calcareous fine-sandy mudstone nodule in bed Ur5 β and loc. U47b, upper reaches of the Urakawa valley, a calcareous fine-sandy mudstone nodule in bed Ur4 β,

* The variations of the two subspecies overlap, as is exemplified by a few exceptional specimens (see MATSUMOTO, 1959b, p. 133).

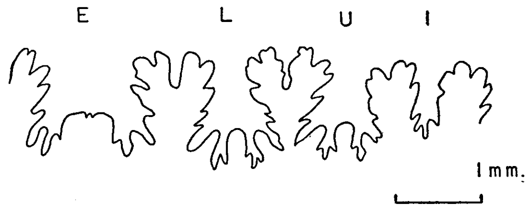


Fig. 157. *Baculites* sp. nov. (?) aff. *hochstetteri* LIEBUS.
Suture, at height=4.0, breadth=3.4 mm., GK. H3554, from loc. U47, upper reaches of Urakawa Valley, bed Ur4β, Hidaka Province.

both belonging to the zone of *Inoceramus schmidti*, Lower Hetonaian [K6 α], in the Urakawa area, Hidaka Province, southern part of the meridional belt of Hokkaido.

Baculites sp. nov. (?) aff. *B. hochstetteri* LIEBUS
Pl. 20, fig. 4; Text-figs. 143, 144, 157

Compare.—

1902. *Baculites hochstetteri* LIEBUS, *Beitr. Palaeont. Geol. Oesterr.-Ungarns u.d. Orients*, vol. 14, p. 119, pl. 6, figs. 4-6; text-fig. 2.

Types.—Of LIEBUS' three figured syntypes the original of (LIEBUS, 1902) pl. 6, fig. 5a, 6; text-fig. 2b is here designated as the lectotype of *Baculites hochstetteri.*

Material.—The specimens from Hokkaido which are described under the above heading are GK. H3554, from loc. U47, GK. H5396, from loc. U47b, and GK. H5397, from loc. U238 (all Coll. T. MATSUMOTO).

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
GK. H3554	4.1	3.6	(0.88)	
GK. H5396	4.5	3.7	(0.82)	16.6
〃	3.5	3.2	(0.91)	
GK. H5397	6.7	5.7	(0.85)	23.4
〃	6.4	5.5	(0.86)	

Descriptive remarks.—The three fragmentary small specimens from Hokkaido are closely allied to but not quite identical with *B. hochstetteri* LIEBUS from the Upper Cretaceous of the Carpathians.

The tapering is moderate (GK. H3553 and GK. H5396) to slow (GK. H5397) as in the syntypes. The section is oval or elliptical, with the narrower venter than the dorsum. It is not so compressed as the illustrated sections of LIEBUS.

The surface is nearly smooth as in the lectotype.

The suture, which is best exposed on GK. H3554 and observable also on other two specimens, is very similar to that of *B. hochstetteri* in the complex pattern with deep incisions, a reversed trigonal general outline of the elements, with much narrowed stems of the lateral saddles, subsymmetric division of the lobes and saddles and comparatively deep dorsal lobe. A minor but significant difference is that in our specimen the median foliole at the bottom of L is slightly larger and higher than or nearly as high as the adjacent lateral folioles but in LIEBUS' types the former is nearly as small as and slightly lower than the latter.

Occurrence.—Locs. U47 and U47b, upper reaches of the Urakawa river, calcareous nodules of fine-sandy siltstone from bed Ur4 β, and loc. U238, Nishi-horobetsu, a similar nodule from bed Ur5 β, zone of *Inoceramus schmidti*, Lower Hetonaian [K6 α], Middle (?) to Upper Campanian, in the Urakawa area, Hidaka Province, southern part of the meridional belt of Hokkaido.

Baculites rex ANDERSON

Pl. 19, fig. 3; Text-figs. 158, 165

Synonymy.—

1958. *Baculites rex* ANDERSON, *Geol. Soc. Amer., Memoir* 71, p. 191, pl. 49, fig. 2.
1959. *Baculites rex*, MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.*, [D], vol. 8, no. 4, p. 136, pl. 31, fig. 5; pl. 34, fig. 5; pl. 39, figs. 1-3; pl. 40, fig. 1; text-figs. 45-52.

Material.—A single, septate specimen, GK. H4737, from loc. IA-165 (Coll. A. INOMA).

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
GK. H4737	10.7	7.9	(0.74)	33.3
〃	6.8	5.1	(0.75)	

Descriptive remarks.—This specimen shows rapid tapering and is gently arcuate, being convex on the ventral area, as in some examples of *B. rex* from California (see MATSUMOTO, 1959, p. 139, pl. 39, fig. 2). The section is much compressed, egg-shaped, and broadest a little below the mid-flank, with the venter more narrowly rounded than the dorsum and the gently inflated flanks.

The surface of the shell is almost smooth, but with very weak lirae, which show a broad convexity on the dorsum and an asymmetric sinus on the dorso-lateral part, run obliquely forward on the main part of the flank and cross the venter with a pronounced projection.

The suture is complex and deeply incised. The first lateral saddle is nearly symmetrically bifid and its stem is narrowed by the deep incisions of the lobules. The second lateral saddle is slightly larger than the first and is asymmetrically bifid, with the smaller branch closer to L. The first lateral lobe [L] is deep, nearly symmetric, narrowed at its stem but the lateral lobules are streched obliquely downward; the median foliole at its bottom tends to be overhung by the lateral folioles. The second lateral lobe [U] is broader and a little shallower than L; its branches are expanded. The dorsal lobe [I] is comparatively larger than in other species, being nearly as deep as the saddles on both sides of it.

From these characters the described specimen from Hokkaido is certainly to be referred to *Baculites rex* ANDERSON, which was well defined by MATSUMOTO (1959, p. 136).

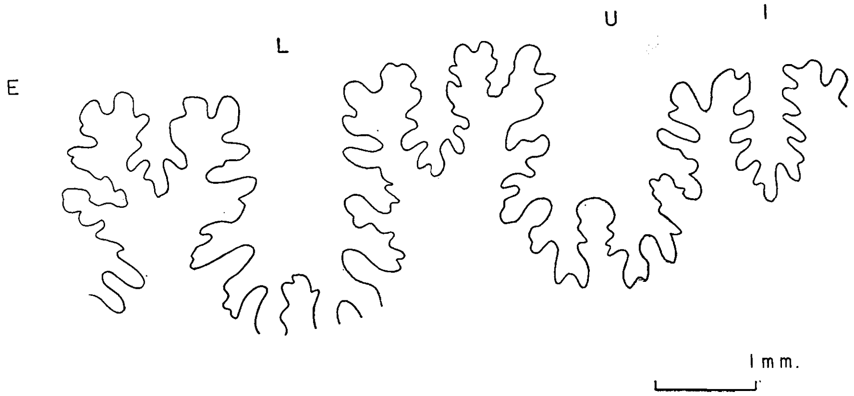


Fig. 158. *Baculites rex* ANDERSON.
Suture, at height=8.2, breadth=6.2 mm., of GK. H4737, from loc. IA-165, a small branch of the Heitaro-zawa, Nakatombets, Kitami Province.

As a possibility we are now inclined to consider that the line of descent was *Baculites uedae*—*B. hochstetteri*—*B. rex*, rather than *B. bailyi*—*B. anceps pacificus*—*B. rex* (see MATSUMOTO, 1959, pp. 141-142), but the evidence is yet insufficient.

Occurrence.—This single specimen was in a limy nodule at loc. IA-165, a small branch of the Heitaro-zawa, Nakatombets, Kitami Province, northern Hokkaido. No other fossils are associated with it. Stratigraphically it is interpreted to have come either from the lowest part of unit H2b or from the upper part of unit Hlb, probably the lowest part of K6 β or the upper part of K6 α. This may correspond to the lower part of the range of *B. rex* in California, from upper Upper Campanian to the top of the Maestrichtian (Marca shale).

Baculites cf. *kirki* MATSUMOTO

Pl. 18, fig. 2; Text-fig. 114

Compare.—

1959. *Baculites kirki* MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.*, [D], vol. 8, no. 4, p. 143, pl. 43, figs. 1-3; text-figs. 53-58.

Material.—Three, fragmentary specimens, GK. H5393-GK. H5395, from loc. Kd. 905p (Coll. H. KIDO).

Measurements.—

Specimen	Height	Breadth	(B/H)
GK. H5393	16.2	13.6	(0.84)

Descriptive remarks.—MATSUMOTO (1959) clearly described the characters and the extent of variation of *Baculites kirki*. Probable examples of this species from Hokkaido are imperfectly preserved, but show the diagnostic features.

The largest of the three, GK. H5393, is a fragmentary body chamber which is larger and thicker than any of the Californian examples of *B. kirki*. Its dorsum is broadly rounded, flanks are only gently inflated and rather flattened, and the ventral keel is blunt. The shell form is, thus, similar to that of *B. kirki* rather than that of *B. chicoensis*. The two smaller specimens are deformed.

The surface of the shell is nearly smooth, but with very weak riblets or striae, which are similar to those on the shell of *B. kirki*.

The suture, which is exposed on GK. H5394, is simple, having shallow, minor incisions and roundish terminals of the subdivisions. The lateral saddles are broad and subrectangular in general outline, the first lateral lobe is narrower than the lateral saddles and high-subrectangular in general outline. Thus the observed suture is very similar to that of *B. kirki* and well distinguished from that of *B. chicoensis*.

Occurrence.—Loc. Kd905p, Matsuishi-zawa, a western branch in the upper reaches of the Porokeshomap, a tributary of the Sharu, about 4 km. northwest of Furenai, a limy nodule, containing many species, derived from unit B (mudstone) of the Upper Yezo group, Upper Urakawan (Santonian).

In California *B. kirki* occurs in member V of POPENOE in the Redding area, Santonian (see MATSUMOTO, 1959, p. 145).

Baculites chicoensis TRASK

Pl. 21, figs. 2, 4; Text-figs. 159, 163, 164

*Synonymy**.—

1856. *Baculites chicoensis* TRASK, *Calif. Acad. Nat. Sci., Proc.*, vol. 1, p. 92, pl. 2, fig. 2, 2a.

1959. *Baculites chicoensis*, MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.*, [D], vol. 8, no. 4, p. 145, pl. 36, fig. 2; pl. 37, fig. 1; text-figs. 59-63.

Material.—Two small specimens, GK. H4703 and GK. H4704, from loc. S-164 (Coll. NAGASAKA).

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
GK. H4703	7.7	5.9	(0.77)	26.2
〃	6.4	4.6	(0.72)	
GK. H4704	9.4	6.9	(0.73)	16.7
〃	9.2	6.5	(0.71)	

Descriptive remarks.—MATSUMOTO (1959, p. 145) described precisely the characters and the variation of *B. chicoensis*. The two specimens from Hokkaido are referred to this species, although there are minor features which may be particular to the individuals.

In GK. H4704, which is about 40 mm. long, the posterior one fourth is septate and the rest is the body-chamber. Since the last suture is fairly approximated, this specimen may represent an adult shell in spite of its small size. Another more fragmentary specimen, GK. H4704, has the last suture at the height of 9.4 mm. The tapering is slowed in the two specimens, as in the larger adult shell from California. The specimens from California which are as large as the Hokkaido examples generally show more rapid tapering, because they are

* For a full list of synonymy for *B. chicoensis*, see MATSUMOTO, 1959, p. 145.

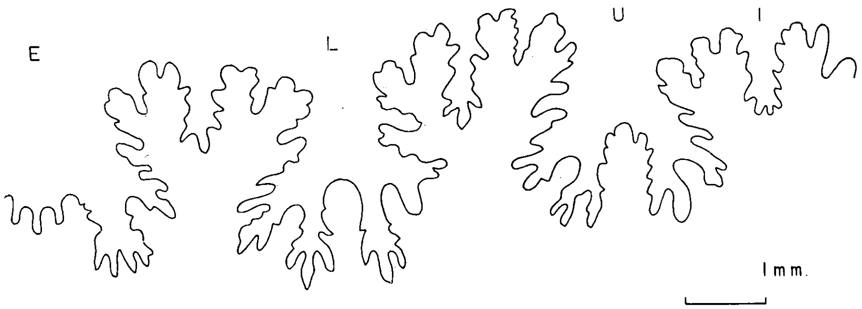


Fig. 159. *Baculites chicoensis* TRASK.
Suture, at height=9.1, breadth=6.4 mm., of GK. H4704, from loc. S164, Itaya, Kyowa quadrangle, upper reaches of the Abeshinai, Teshio Province.

immature. The Hokkaido cxamples may be dwarfs or there may be a considerable variation in the size of the animal.

In many of the immature specimens from California as large as the Hokkaido specimens the keel has not yet appeared. In GK. H4703 the venter is narrowed and an indistinct keel like elevation is discernible on the anterior half of the body-chamber. In GK. H4704 an acuter ventral keel is developed. In regard to the keel the specimens from Hokkaido are rather similar to the larger adult ones from California. Thus, the above interpretation of the size variation seems to be warrantable from the character of the keel, too.

In other features, such as the generally oval cross section, the nearly smooth surface, the curvature of the faint striae and the pattern of the suture, the specimens from Hokkaido closely resemble those from California.

From the above description the specimens under consideration can be specifically identified as *Baculites chicoensis*. In connection with the size variation mentioned above the difference of the facies between the Californian and Hokkaido examples should be taken into consideration. The sandy, Chico formation, in which the Californian specimens occur, is evidently of shallower environment and nearer to the sea shore than the muddy, upper part of the Upper Yezo group. Whether or not subspecific separation had taken place in this species between the different environments or provinces should be examined by the study of more specimens from more localities. Even in California the species is extremely rare outside the area of the type Chico formation.

Occurrence.—Loc. S-164, Itaya, Kyowa quadrangle, in the upper reaches of the Abeshinai, Teshio Province, northwest Hokkaido. This belongs probably to bed IIId-e (fine-sandy mudstone) of the Upper Yezo group and is referable to H5 γ (Lower Campanian), because *Canadoceras yokoyamai* (JIMBO), *Tetragonites popetensis* YABE, *Gaudryceras* cf. *tenuiliratum* YABE and *Ryugasella* cf. *ryugasensis* WRIGHT and MATSUMOTO occurred at the same locality and *Inoceramus orientalis* SOKOLOW in the overlying bed at loc. S-170.

In California *B. chicoensis* occurs abundantly in the upper part of the Chico formation (*s.s.*), often associated with *Submortoniceras chicoense* (TRASK).

Baculites pseudobaculus sp. nov.

Pl. 14, fig. 3; Text-figs. 160-162, 166, 167

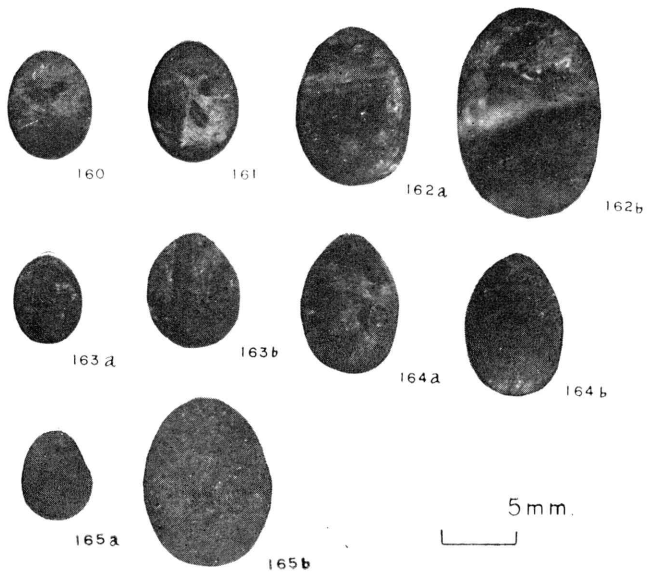
Material.—Holotype, GK. H4803, from loc. CK54 (Coll. Y. UEDA). Paratypes, GK. H4804, GK. H4809, GK. H5239 and GK. H5240, from the same nodule as the holotype.

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
GK. H4803	13.1	9.6	(0.73)	45.2
〃	10.9	8.3	(0.76)	
GK. H4804	7.9	6.0	(0.76)	
GK. H4809	7.3	5.8	(0.79)	
GK. H5239	10.3	7.6	(0.74)	29.0
〃	8.3	6.4	(0.77)	
GK. H5240	9.3	7.0	(0.75)	

Diagnosis.—The shell is small and grows slowly or moderately. It is compressed and subelliptical in section, with a slightly more narrowly rounded venter than the dorsum and rather flattened or very gently inflated flanks.

The surface of the shell is almost smooth, but with faint lirae and striae, which show a broad, dorsal arch, an asymmetric dorsolateral sinus, a straightly



Figs. 160–162. *Baculites pseudobaculus* sp. nov., cross sections.
160: GK. H4809, 161: GK. H4804, 162a: GK. H4803(p.), 162b: GK. H4803(a.).

Figs. 163, 164. *Baculites chicoensis* TRASK, cross sections.
163a: GK. H4703(p.), 163b: GK. H4703(a.), 164a: GK. H4704(p.), 164b: GK. H4704(a.).

Figs. 165a, b. *Baculites rex* ANDERSON, cross sections.
165a: GK. H4737(p.), 165b: GK. H4737(a.).
(p.): posterior and (a.): anterior parts of the same specimen.

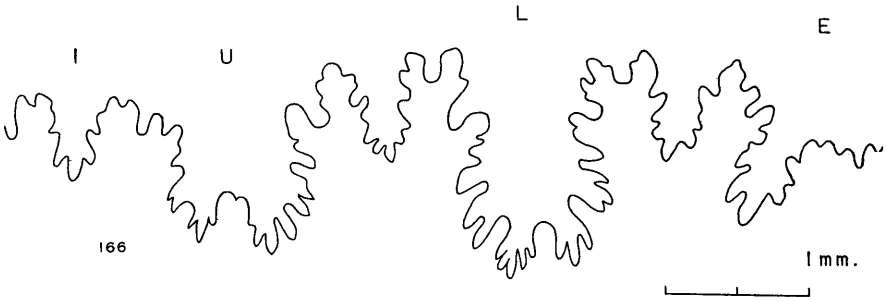
oblique forward line on the main part of the flank and a strong, ventral projection.

The suture is incised with moderate depth. The first and the second lateral saddles are nearly equally broad and asymmetrically bifid, with the larger branches on both sides of the first lateral lobe [L]. L is the deepest, subrectangular in general outline and about two thirds as broad as or nearly as broad as the lateral saddle. The median foliole at the bottom of L is nearly as small as the adjacent lateral folioles. The second lateral lobe [U] is as broad as and shallower than L. It is asymmetric. The ventral lobe [E] is shollow but the broadest. The dorsal lobe [I] is small and divided into five lobules.

The body-chamber in the holotype is at least 47 mm. long but the apertural margin is not preserved.

Variation.—As the specimens are not numerous, the extent of variation is not precisely known. The sutures of the holotype are approximated and probably indicate the last stage in the ontogenetic growth. They have, however, broader elements and apparently shallower incisions than those of the smaller specimens (i.e. GK. H4804 and GK. H4809). In the latter two the saddles are considerably narrowed. The essential feature of the suture as described in the diagnosis is, however, recognized in all three specimens.

Affinity.—*Baculites pseudobaculus* closely resembles *B. yokoyamai* TOKUNAGA and SHIMIZU (see p. 30), of the preceding age, in the small size, slow tapering, compressed subelliptical section and nearly smooth surface, but is distinguished



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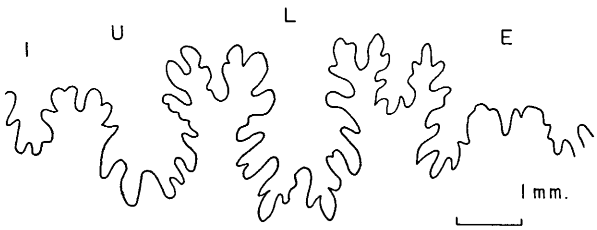

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Figs. 166, 167. *Baculites pseudobaculus* sp. nov.

166. Suture, at height=10.8, breadth=8.2 mm., of holotype, GK. H4803, from loc. CK54, Sankebetsu, a branch of the Chikubetsu, member B2, Upper Yezo group, Chikubetsu area, Teshio Province.

167. Suture, at height=7.7, breadth=5.9 mm., of a paratype, GK. H4804, from the same nodule as above.

by its deeper incision of the suture and its asymmetrically bipartite lateral saddles, with larger branches on both sides of L.

In these characters of the suture this species is similar to *Pseudobaculites wyomingensis* COBBAN (1952, pl. 110, figs. 11-16, 19-21), from the Niobrara stage of the Western Interior province of North America, but the latter has more complicated sutures, greater tapering, a more compressed section and ventral broad undulations which are absent in *B. pseudobaculus.*

B. pseudobaculus resembles *B. bailyi* WOODS (see p. 35), of nearly contemporaneous age, in the slight tapering, subelliptical section, nearly smooth surface and the general outline and comparative breadth of the saddles and lobes, but *B. bailyi* has nearly symmetrically bipartite lateral saddles and its median foliole at the bottom of L is distinctly larger than the adjacent lateral folioles.

In short *B. pseudobaculus* is probably derived straight from *B. yokoyamai,* showing the tendency to acquire the sutural pattern of *Pseudobaculites.* It is still referred to *Baculites* rather than to *Pseudobaculites.*

Occurrence.—Loc. CK54, the type locality, along the Sankebetsu, a branch of the Chikubetsu, in member B_2 (siltstone and fine-grained mudstone in frequent alternation) of the Upper Yezo group on the western wing of the Chikubetsu anticline, Chikubetsu area, Teshio Province, northwest Hokkaido. *Texanites kawasakii* (KAWADA) is identified, among others, from the same locality. According to UEDA *et al.* (1962), member B_2 is referred to the zone of *Inoceramus amakusensis,* lower part of K5 β, approximately Lower Santonian.

Summary of Results

The species of Baculitidae from Hokkaido which are described in this paper are listed below. The stratigraphic position of each species is indicated in parentheses. The species with asterisk is represented in Hokkaido by numerous specimens from various areas. Six new species are established, of which two belong to *Sciponoceras* and four to *Baculites.* For each of the new species the closest affinity is shown in square brackets. In addition a new subspecies is introduced.

(1) *Sciponoceras baculoides* (MANTELL) (lower part of bed IIb, Ikushumbets) (lower K4 α)

(2) *Sciponoceras* (?) sp. (uppermost part of bed IIa, Abeshinai) (lower K4 α)

(3) *Sciponoceras kossmati* (NOWAK) (bed IIh, Shuyubari; upper part of bed IIc, including its top horizon, Ikushumbets) (middle to upper K4 α and basal K4 β)*

(4) *Sciponoceras orientale* sp. nov. [descendant of *S. baculoides*] (beds IIcα, δ

In addition to the above listed species there is *Sciponcoeras* sp. in an interesting faunule in the Infragyliakian [K3γ] of the Shumarinai area, Teshio Province, which is being studied by W. HASHIMOTO, A. INOMA and T. MATSUMOTO.

and IId, Abeshinai-Saku; bed IIn, Shuyubari; lower part of Ue4, Ashibetsu) (lower to middle K4 β; probably also upper K4 α)*

(5) *Sciponoceras intermedium* sp. nov. [closely allied to *S. bohemicum* (FRITSCH) and ancestor of *B. yokoyamai*] (bed IIIa, Ikushumbets) (upper K4 β)

(6) *Baculites undulatus* ROMAN and MAZERAN (upper part of bed IIIa, Ikushumbets; upper part of IId, Abeshinai-Saku; upper part of Mk4, Yubari) (upper K4 β)*

(7) *Baculites yokoyamai* TOKUNAGA and SHIMIZU (bed IIIb, Ikushumbets; bed U1, Yubari) (K5 α)*

(8) *Baculites bailyi* WOODS (member U3, Haboro; member B1, Chikubetsu) (K5 β)

(9) *Baculites schencki* MATSUMOTO (bed IIIb, Ikushumbets; bed U1, Yubari) (K5 α)

(10) *Baculites uedae* sp. nov. [probable derivative of *B. yokoyamai* and ancestor of *B. hochstetteri* LIEBUS] (members A, B1, and C, Chikubetsu; member U3, Haboro; bed IIId, Abeshinai-Saku; bed U2, Yubari) (K5 β)*

(11) *Baculites boulei* COLLIGNON (member U3, Haboro; beds IIIb and IIId, Ikushumbets; bed U2, Yubari) (K5 α and K5 β)

(12) *Baculites* sp. nov. (?) [aff. *B. sulcatus* BAILY] (somewhere in bed IIIa-d, Abeshinai-Saku) (K5)

(13) *Baculites capensis* WOODS (bed IIId, Abeshinai-Saku; unit III, Hobetsu) (K5 β, possibly also K5 α)

(14) *Baculites tanakae* sp. nov. [descendant of *B. capensis*] (member U6, Haboro; bed IIId-e, Abeshinai-Saku) (K5 γ)*

(15) *Baculites princeps* sp. nov. [related to *B. boulei* and similar to *B. anceps*] (member U3, Haboro; member C, Chikubetsu, bed IIId, Ikushumbets; bed U2, Yubari; bed IIId, Abeshinai-Saku) (K5 β)*

(16) *Baculites anceps pacificus* subsp. nov. (beds Ur4 β and Ur5 β, Urakawa) (K6 α)

(17) *Baculites* sp. nov. (?) [aff. *B. hochstetteri* LIEBUS] (bed Ur4 β, Urakawa) (K6 α)

(18) *Baculites rex* ANDERSON (basal part of H2b or upper part of H1b, Nakatombets) (uppermost K6 α or lower K6 β)

(19) *Baculites* cf. *kirki* MATSUMOTO (unit B, Sharu, south of Hetonai) (K5 β).

(20) *Baculites chicoensis* TRASK (bed IIId-e, Abeshinai) (K5 γ)

(21) *Baculites pseudobaculus* sp. nov. [probable derivative of *B. yokoyamai*, with similarity to *Pseudobaculites wyomingensis* COBBAN] (member B1, Chikubetsu) (lower K5 β)

The above results are not only a good addition to our knowledge of the ammonoid fauna in the Upper Cretaceous of Hokkaido, but also give more systematic knowledge of the Baculitidae generally. The latter problem is to be discussed comprehensively in Part III.

Among the twenty-one species from Hokkaido, *Sciponoceras baculoides* is cosmopolitan. *Baculites undulatus* is known, in our present knowledge, from Europe and Japan, and *B. anceps* from Europe, Japan and California. In *B. anceps,* however, subspecific separation is recognized between Europe and the North Pacific region. The 17th species in the above list is closely allied to, but not quite identical with *B. hochstetteri* from the Carpathians.

Sciponoceras kossmati, Baculites yokoyamai [=? *B. besairiei*], *B. bailyi, B. boulei* and *B. capensis* are good examples of Indo-Pacific elements. The 12th species, which is represented only by a single specimen from Hokkaido, is similar to, but not identical with *B. sulcatus* from southeast Africa.

Baculites schencki, B. kirki, B. chicoensis and *B. rex* occur abundantly or commonly in California and are regarded as almost endemic to California, but they have now proved to occur also in Hokkaido. They are, however, very rare in Japan and may be immigrants. In addition to them, *Sciponoceras intermedium, Baculites anceps pacificus* and four of the above mentioned Indo-Pacific elements are common between Hokkaido and California. Accordingly the intimate relationship of the Upper Cretaceous ammonite fauna between Japan and California, as pointed out by MATSUMOTO (1960, p. 172), is confirmed from the study of Baculitidae. Also the importance of the Japanese material for the interregional problem can be stressed.

As far as the available material is concerned, *Sciponoceras orientale, Baculites uedae, B. tanakae, B. princeps* and *B. pseudobaculus* are new sepcies which are apparently particular to Japan. Whether they are truly restricted to the Japanese province or have wider distribution needs to be examined by further study of other regions.

B. pseudobaculus is interesting in that it shows a tendency to acquire the diagnostic characters of *Pseudobaculites,* which is represented by two species from the Western Interior region of North America. The parallel relationship between the Indo-Pacific and the Gulf-Atlantic-Western Interior regions is exemplified by the similarity of *Sciponoceras orientale* to *S. gracile, Baculites yokoyamai—B. boulei* or *B. schencki* to *B. mariasensis—B. sweetgrassensis,* and *B. capensis—B. tanakae* to *B. asper—B. taylorensis.*

The stratigraphic distribution of the baculitid species in the Upper Cretaceous of Hokkaido is summarized in a chart of Fig. 168. In this chart the abundance in a given stage is indicated according to the following definition of the categories:

Category	Number of area	Number of localities	Total number of specimens
Abundant	$\geqq 5$	>10	>50
Common	2–4	5–10	>30
Less common	1–2	4–6	>10
Rare	1	1–2	<5

The estimation of the abundance is done on the basis of the described records, which are, of course, far from ideal data for statistical treatment. The results shown in the range chart are, accordingly, tentative and approximate.

The stratigraphic ranges of the baculitid species in the Upper Cretaceous sequence in Hokkaido are comparatively short. Their succession is generally in harmony with that in California, India, Madagascar, southeast Africa and Europe. Thus the species of Baculitidae are important for the international as well as for the domestic correlation.

The intimate relation seems to exist between the facies of the Cretaceous deposits in Hokkaido and the occurrence of the fossil baculitids. This is to be discussed more concretely in Part III.

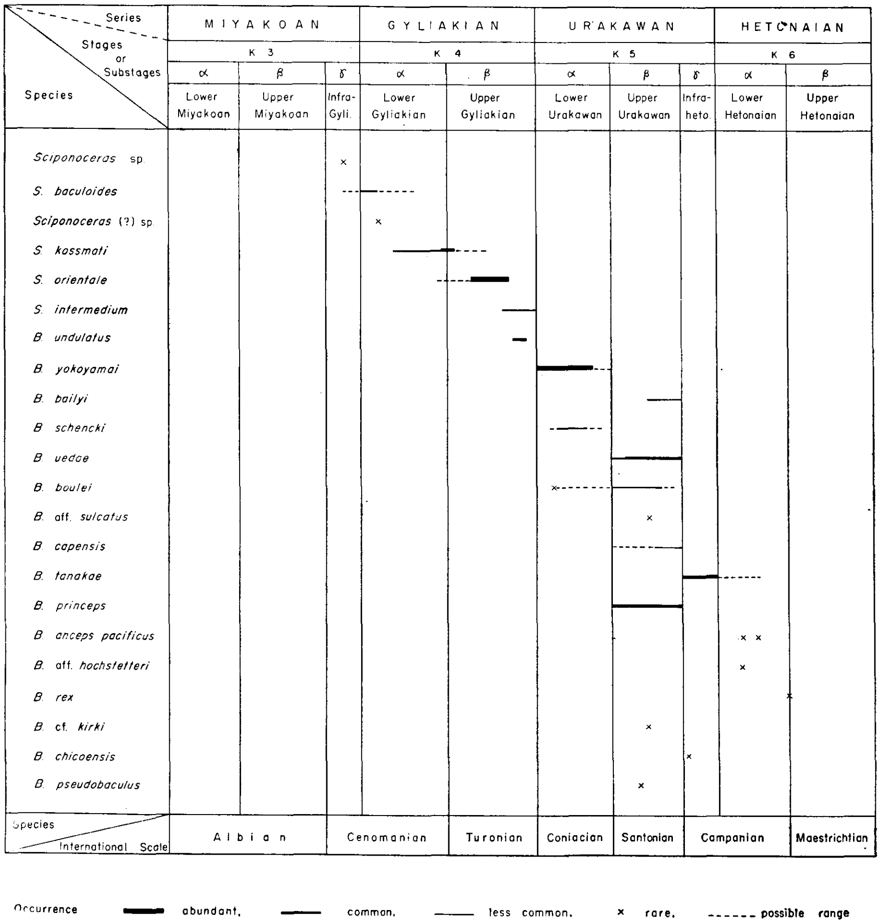


Fig. 168. Geological ranges of the species belonging to the Baculitidae in Hokkaido.

Part II

Some Baculitids from Honshu

By

Ikuwo OBATA and Tatsuro MATSUMOTO

Part II

Some Baculitids from Honshu

By

Ikuwo OBATA and Tatsuro MATSUMOTO

Abstract

Five species of *Baculites* from Honshu are described. They are *B. yokoyamai*, a widespread Coniacian species in the Indo-Pacific region, *B. princeps*, a species occurring from the Santonian of Hokkaido and Honshu, and three Campanian species, *B. inornatus*, *B. occidentalis* and a new species, which are common between Japan and the west coast of North America.

Contents

Introductory Remarks

Since YABE (1915) described *Baculites* sp. from the Toyajo formation of Kii Peninsula, the existence of baculitids in the Upper Cretaceous in Honshu (i.e. the main island of Japan) has been known by many stratigraphers. Certain specific names of *Baculites* were listed by previous authors in connection with the Cretaceous stratigraphy of the Japanese Islands (i.e. YABE, 1927; SHIMIZU, 1935; MATSUMOTO, 1954). In Northeast Japan TOKUNAGA (1923) collected and listed some specimens of *Baculites* from the lower Futaba formation [=Ashizawa formation]. Subsequently TOKUNAGA and SHIMIZU (1926) established *Baculites yokoyamai* on a specimen in TOKUNAGA's collection. In the Awaji Island two species of *Baculites* were reported by SASAI (1936) occurring in the Shichi shale member and the Kitaama sandstone member. From the Azenotani shale member of the Izumi group in the Izumi Mountain-range KOBAYASHI (1931) and also ICHIKAWA and MAEDA (1960) collected and listed certain *Baculites*. In the Kii Peninsula, INOUYE (1933), MATSUMOTO (1947), and TANAKA (1956) collected baculitids from the Toyajo formation and the last author collected those from the Futakawa formation. Other authors who investigated these fields often quoted the specific names, including the baculitids, from the above authors' lists.

Unfortunately the holotype of *Baculites yokoyamai* TOKUNAGA and SHIMIZU was lost by a fire during World War II and a few others of the above collections are missing, but many others are available for the study.

As has been mentioned in the *Preface* of this monograph, the specimens from the following areas in Honshu (with the heading numbers corresponding to that indicated in the map of Fig. 1) are dealt with in the present study:

(13) Futaba area, Fukushima Prefecture
(15) Izumi Mountain-range between Osaka and Wakayama
(16) Futakawa and Toyajo areas in the Aritagawa valley, Wakayama Prefecture
(17) Awaji Island, Hyogo Prefecture

Recently one of us (I.O.) did field work there to see the stratigraphic sequences and to collect the fossils. We have studied the specimens in the collections of the previous authors as well as our own to sort them more systematically and to get the clearer knowledge about the geological distribution of the baculitid species.

The stratigraphic units from which the described baculitid specimens came are the Lower Futaba beds in the Futaba area, the Azenotani shale member in the lower part of the Izumi group in the Izumi Mountain-range, the Futakawa and Toyajo formations in the Aritagawa valley, the Minato shale and the Shichi shale members of the lower and the lower middle part of the Izumi group in the island of Awaji. For the local stratigraphy of these areas a reader may refer to TOKUNAGA and SHIMIZU (1926) (for 13), KOBAYASHI (1931) (for 15), MATSUMOTO (1947) and TANAKA *in* HIRAYAMA and TANAKA (1956) (for 16) and SASAI (1936) (for 17). The up-to-date correlation was discussed by MATSUMOTO (1954, 1959) and ICHIKAWA and MAEDA (1956).

Descriptions of Species

Family Baculitidae MEEK, 1876
Genus *Baculites* LAMARCK, 1799

Type-species.—*Baculites vertebralis* LAMARCK, 1801 (designated by MEEK, 1876, p. 391).

Diagnosis and remarks.—see p. 27 in Part I of this paper.

Baculites cf. *yokoyamai* TOKUNAGA and SHIMIZU
Pl. 27, fig. 11

*Compare.**—

1926. *Baculites* (*Lechites*) *yokoyamai* TOKUNAGA and SHIMIZU, *Jour. Fac. Sci.*,

* see p. 30

Imp. Univ. Tokyo, ser. 2, vol. 1, part 6, p. 195, pl. 22, fig. 5a, b, pl. 26, fig. 11.

Type.—The holotype, by monotypy, is a fragmentary specimen described by TOKUNAGA and SHIMIZU (1926, p. 195, pl. 22, fig. 5a, b; pl. 26, fig. 11), from "the upper reaches of Sakurazawa in Oriki, Hirono-mura", Fukushima Prefecture. It had been preserved at Waseda University, Tokyo, but was unfortunately lost by a fire during World War II. Recently one of us (I.O.) visited the type locality for several times and found several fragmentary specimens, but failed to obtain a better specimen which is competent for the designation of the neotype of *B. yokoyamai.*

Material.—GK. H5271 from the Lower Futaba beds of TOKUNAGA and SHIMIZU [i.e. Ashizawa formation by some authors], at the lower reaches of Nagasonezawa in Oriki, Hirono-mura, Fukushima Prefecture (Coll. I. OBATA). Besides the specimens from the type locality, there is a large number of examples in the collection from the zone of *Inoceramus uwajimensis* in Hokkaido. It is described in detail in Part I.

Descriptive remarks.—The illustrated specimen is a deformed one but is referable to *Baculites yokoyamai* TOKUNAGA and SHIMIZU. Its cross section is much compressed, about 10 mm. in height and about 4 mm. in breadth, but this is obviously due to the secondary deformation. Anyhow the cross section is higher than broad and nearly elliptical. The shell grows very slowly.

The surface of the internal mould is nearly smooth. No traces of riblets or striae are observed on this specimen. The simple sutures are partly and obscurely preserved.

The holotype of *B. yokoyamai* TOKUNAGA and SHIMIZU (1926, p. 195, pl. 22, fig. 5a, b; pl. 26, fig. 11) and three other fragments of *Baculites* sp. (p. 195, pl. 26, figs. 12, 13, 14) from the type locality in Futaba seem to be more or less deformed. This type locality belongs to the zone of *Inoceramus uwajimensis.* Although the holotype was lost, the original illustration of the cross section (TOKUNAGA *et al.*, pl. 22, fig. 5a) seems to show a deformed outline. .

The specimens of *Baculites yokoyamai* from the zone of *Inoceramus uwajimensis* in Hokkaido are great in number and better preserved. Most of their cross sections are not so much compressed as that original figure, while some crushed sections of a similar size from the muddy sandstone in Hokkaido are as strongly compressed as the latter.

Occurrence.—GK. H5271 from the sandy siltstone of the Lower Futaba beds in Nagasonezawa is associated with *Otoscaphites* sp., *Inoceramus uwajimensis* YEHARA, *Apiotrigonia minor* (YABE and NAGAO), and other pelecypods in one and the same nodule. One of us (I.O.) collected *Inoceramus uwajimensis* YEHARA, *Didymotis akamatsui* (YEHARA), *Steinmanella* (*Yeharella*) *kimurai* (TOKUNAGA and SHIMIZU), *Apiotrigonia minor* (YABE and NAGAO), *Bostrychoceras indicum* (STOLICZKA), *Yabeiceras* sp. and others from the conglomerates of the Lower Futaba beds in the upper reaches of Sakurazawa in Oriki, Hirono-mura, Fukushima Prefecture. Accordingly the age of the present species in the Lower

Futaba beds, including the type locality, is undoubtedly the Lower Urakawan, approximately Coniacian. The present species occurs abundantly in the zone of *Inoceramus uwajimensis* in Hokkaido.

In California *Baculites* cf. *yokoyamai* occurs in the probable Coniacian (MATSUMOTO, 1959), although it is rare. In Madagascar, *Baculites besairiei* COLLIGNON, a probable synonym of *B. yokoyamai*, occurs abundantly in the Lower Senonian (COLLIGNON, 1931).

Baculites inornatus MEEK
Pl. 22, fig. 1; Pl. 24, fig. 6; Pl. 26, figs. 4-6;
Text-figs. 169, 170, 187-190

*Synonymy.**—

1862. *Baculites inornatus* MEEK, *Proc. Acad. Nat. Sci., Philadelphia*, vol. 13, p. 316.
1936. *Baculites* cf. *anceps*, SASAI, *Jour. Geol. Soc. Japan*, vol. 43, no. 515, p. 599, listed only.
1959. *Baculites inornatus*, MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.*, [D], vol. 8, no. 4, p. 155, pl. 38, fig. 1a-c; pl. 43, fig. 5a-c; text-figs. 72-79.

Types.—Three of MEEK's original specimens with numbers USNM. 1257, 1258 and 1259 in the U. S. National Museum were reexamined by MATSUMOTO (1959), who designated USNM. 1259 as the lectotype (p. 155, pl. 43, fig. 5a-c; text-fig. 72a, b). The plaster casts of them are preserved in Kyushu University (GK. H 9188 for USNM. 1257, GK. H9189 for USNM. 1258, GK. H9190 for USNM. 1259).

Material.—In H. SASAI's Collection, GT. I-654 [=MM. 7471] a-d from Shichi shale member. The specimens were labeled and listed by SASAI (1936, p. 599) as *Baculites* cf. *anceps* LAMARCK. Another set of fragmentary specimens (i.e. GK. H5361-GK. H5370) from loc. 610507-4, the upper part of Shichi [=Siti] shale member is also referred to the present species (Coll. K. ICHIKAWA and Y. MAEDA). Many poorly preserved fragments from the same loc. 610507-4 and two others, OCU. MM764 and MM765, from the Minato shale member of loc. IM73 are probably comparable to the present species (Coll. K. ICHIKAWA and Y. MAEDA).

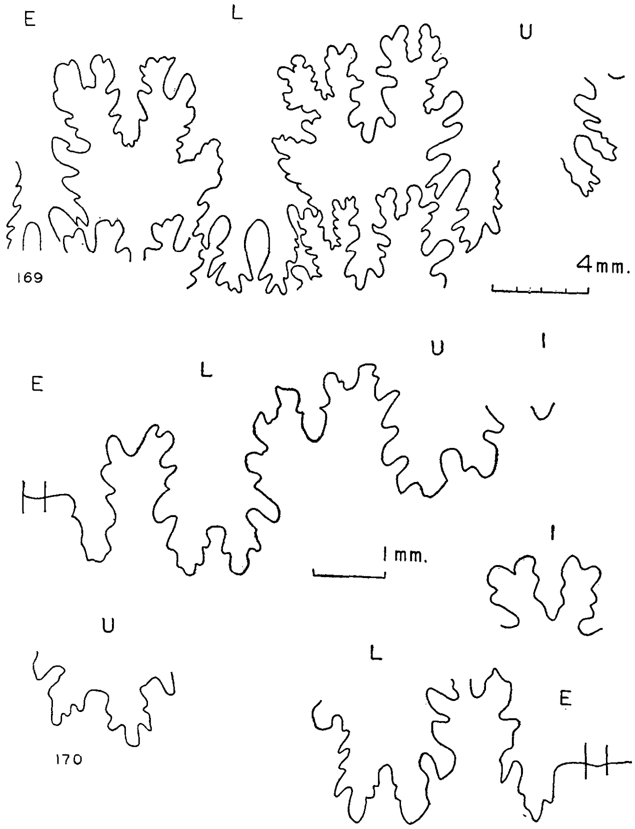
Measurements.—

Specimen	Height	Breadth	(B/H)
GT. I-654a	*c.*22.3	*c.*18.0	(0.81)
〃 b	18.2	13.2	(0.73)
〃 c	7.3	6.2	(0.85)
〃 d	5.3	4.4	(0.83)
GK. H5361	10.8	8.8	(0.81)
GK. H5362	11.6	9.0	(0.78)
GK. H5364	5.6	4.9	(0.88)
GK. H5366	7.6	6.5	(0.86)
GK. H5367	5.3	4.4	(0.83)
OCU. MM765	8.1	7.2	(0.89)

* For full list of synonymy see MATSUMOTO, 1959b, p. 155.

Descriptive remarks.—In many specimens tapering is very slow but may be moderate in some younger shells. The section is higher than broad. That of GT. I-654a is nearly elliptical and is slightly more narrowly rounded on the venter than on the dorsum. GT. I-654b has an oval cross section with a more narrowly rounded venter than normal examples from North America (see MATSUMOTO, 1959b, p. 158). The section is broadest at a point a little below the midst of the flanks. Some of the younger specimens also show a variation from elliptical to ovate cross section.

The surface of the shell, which is partly preserved on GT. I-654a, is almost smooth, but on the siphonal area very weak corrugation is discernible just as on the venter of the lectotype of *B. inornatus* (i.e. USNM. 1259). The ventral corrugation shows a moderate projection. The surface of the internal mould is almost smooth. The apertural margin is partly preserved on GT. I-654b and GK. H5363. The apertural part of the dorsum is somewhat higher than other



Figs. 169, 170. *Baculites inornatus* MEEK.

169. Suture, at height=22.3, breadth=20.0 mm., of GT. I-654a, from Tokuhara, Hirota-mura, Mihara-gun, Awaji Island, Shichi shale member of the Izumi group, Hyogo Prefecture.

170. Sutures, at height=7.3, breadth=6.2 mm., of GT. I-654c, from the same nodule as above.

part, showing a broad projection of the margin. The ventral rostrum is slightly curved inward.

The sutures of the adult stage are preserved on GT. I-654a and GK. H5361. The saddles, especially the second lateral saddle, are broad, squarish, and massive. The subsymmetrically bifid first lateral saddle is slightly narrower and lower than the subsymmetrically bifid second lateral. The lateral lobe (L) is the deepest, but is slightly narrower than the saddles. The three folioles at the bottom of L are nearly equally small, the top of the median one being slightly lower than the top of the lateral folioles. The lobules are more finely incised than the folioles, the latter of which show a phylloid terminal. The dorsal lobe (I) is small and narrowly trigonal in general outline. The saddle between I and U is lower than the lateral saddles. Young sutures are preserved on GT. I-654c, GK. H5364, GK. H5367, etc. The minor incisions are shallow. The lateral elements are subrectangular and massive. The first lateral saddle is more or less narrower and slightly lower than the second. E is the widest. U is shallower, but is broader than L. I is shallow. Summarizing the above, the observed sutures are of the same type as those of *B. inornatus* from America, although there is minor variation between individuals.

Occurrence.—GT. I-654 [=MM7471] a-d are contained in one and the same nodule of calcareous mudstone from Shichi shale member of the Izumi group. Its locality is Tokuhara, Hirota-mura, Mihara-gun, Awaji Island, Hyogo Prefecture. From the same member, previous authors (SASAI, 1936; MATSUMOTO, 1954; ICHIKAWA and MAEDA, 1960) listed *Inoceramus balticus toyajoanus* NAGAO and MATSUMOTO, *Gaudryceras* sp., *Pachydiscus* sp., and *Canadoceras* (?) sp. Shichi shale is best referred to the Upper Campanian. According to ICHIKAWA and MAEDA (a letter dated May 31, 1961), loc. 610507-4 is in the upper part of Shichi shale member, about 700 m. E.S.E. of Okubo, Mihara-machi, Mihara-gun, Hyogo Prefecture. The fossils were contained in two limy nodules.

OCU. MM764 and 765 are, according to ICHIKAWA and MAEDA (a letter dated Dec. 11, 1960), from loc. 73, Nagata, Hirota, Midori-mura, Mihara-gun, Hyogo Prefecture, in the Minato shale member of the Izumi group. From the same member previous authors listed *Inoceramus orientalis* SOKOLOW, *I. balticus* BÖHM var. *kunimiensis* NAGAO and MATSUMOTO, *Didymoceras awajiense* (YABE), *Pravitoceras sigmoidale* YABE, *Canadoceras* (?) sp. Minato shale is best correlated to the Lower Campanian.

Baculites cf. *princeps* MATSUMOTO and OBATA

Pl. 22, fig. 2; Pl. 25, fig. 2; Pl. 27, fig. 10; Text-figs. 171, 197-199

Synonymy.—

1956. *Baculites* sp., TANAKA, *Todoroki, Explanatory text of geological map of Japan* (in Japanese), p. 24, listed only.

Material.—GK. H5299-H5308 (Coll. K. TANAKA) and GK. H4908-H4913 (Coll. I. OBATA), from the Futakawa formation.

Measurements.—

Specimen	Height	Breadth	(B/H)
GK. H5301	7.4	5.8	(0.78)
GK. H5306	8.9	6.6	(0.74)
GK. H4909	7.0	6.0	(0.86)
GK. H4913b	5.2	4.2	(0.81)
GK. H4913c	4.2	3.1	(0.74)

Descriptions.—Small specimens at hand are unfortunately all fragmentary and poorly preserved. The section is egg-shaped, with a narrow, somewhat acute venter, and is broadest somewhat below the mid-flanks. The surface of the internal mould is almost smooth, but the obscure subcostae are discernible on a few fragments under the oblique light. They are strongly projected on the venter and show a shallow sinus on the dorsolateral part. The dorsolateral crescentic bula is occasionally discernible.

The sutures are exposed on a few fragments. The first lateral saddle is fairly deeply and nearly symmetrically divided, and its stem is somewhat narrowed by incisions of the lobules. The second lateral saddle is much larger and broader than the first, forming a subrectangular outline, and is subsymmetrically or somewhat asymmetrically divided. The external lobe (E) is wide. The first lateral lobe (L) is nearly equally divided. The top of the median foliole at the bottom of L is lower than the top of one of the two lateral folioles, but is nearly as high as the other. The umbilical lobe is wide and asymmetric. The internal lobe is narrow but relatively deep.

The apertural margin of *Baculites* type is imperfectly preserved on GK. H4909. The lateral sinus of the margin is fairly deep, passing to a broad projection on the dorsum. An aptychi is preserved near the aperture.

Remarks.—The described specimens are very similar in the cross section, ornament and general pattern of suture to *Baculites princeps* MATSUMOTO and OBATA (p. 55, Pl. 13, figs. 1, 2, Pl. 15, figs. 1, 2, text-figs. 134-139) from the Upper Urakawan (approximately Santonian) of Hokkaido. The lobules at the bottom of L in GK. H5300 is more finely incised than those in the examples from Hokkaido.

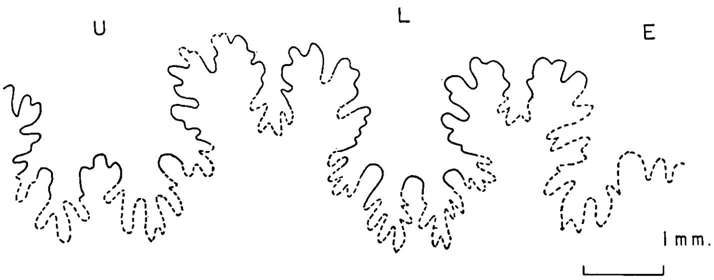


Fig. 171. *Baculites* cf. *princeps* MATSUMOTO and OBATA.
Suture, at height≒8.3, breadth≒6.3 mm., of GK. H5300 from south of Gyō-jyamatsu, upper part of the lower sandstone member of the Futakawa formation, Iwakura-mura, Arita-gun, Wakayama Prefecture.

Occurrence.—TANAKA's locality (T101) and our own are south of Gyōja-matsu, upper part of the lower sandstone member of the Futakawa formation, Iwakura-mura, Arita-gun, Wakayama Prefecture. According to TANAKA (1956, p. 24, 25), the lower sandstone member, from which this *Baculites* came, overlies the lower shale member and is succeeded by the middle shale member of the same Futakawa formation. As *Inoceramus japonicus* NAGAO and MATSUMOTO, which clearly defines the upper part of the Upper Urakawan in the Japanese sequence (approximately Upper Santonian), occurs in both the middle and the lower shale members, the lower sandstone member is safely assigned to the Upper Santonian.

Baculites occidentalis MEEK
Pl. 23, fig. 3; Pl. 25, fig. 1; Pl. 26, figs. 1-3;
Pl. 27, figs. 2-5, 8; Text-figs. 172-186

Synonymy.—

1862. *Baculites occidentalis* MEEK, *Proc. Calif. Acad. Nat. Sci., Philadelphia,* vol. 13, p. 316.
1915. *Baculites* sp. indet., YABE, *Sci. Rep. Tohoku Imp. Univ.*, ser. 2, vol. 4, no. 1, p. 20 (without illustration).
1927. *Baculites* cf. *teres*, YABE, *Sci. Rep. Tohoku Imp. Univ.*, ser. 2, vol. 11, no. 1, p. 66 [40], listed only.
1933. *Baculites* cf. *teres*, INOUYE, *Chikyu* (in Japanese), vol. 19, no. 6, p. 426 [12], p. 427 [13], listed only.
1935. *Baculites* cf. *saghalinensis*, SHIMIZU, *Jour. Shanghai Sci. Inst.*, sec. 2, vol. 1, no. 11, p. 210, 222, table 2, listed only.
1956. *Baculites* sp., TANAKA, *Todoroki, Explanatory text of geological map of Japan* (in Japanese), p. 28, listed only.
1959. *Baculites occidentalis*, MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.*, [D], vol. 8, no. 4, p. 150, pl. 35, figs. 2-3; pl. 36, fig. 1; pl. 41, fig. 1; pl. 42, figs. 1-2; text-figs. 64-71 (containing full list of synonymy).

Material.—GK. H4837-GK. H4842 from loc. TS 5′ (Coll. I. OBATA). GK. H4844-GK. H4862, H5355-H5358, H5350, GK. H5331 (Coll. TOP*). GK. H4863-4884, H4888-4890, H5332-H5341 (Coll. TOM**). GK. H4885-GK. H4887 from loc. TN10 (Coll. I. OBATA). GK. H4891-GK. H4895, GK. H5342-GK. H5349, from loc. TN11 (Coll. I. OBATA) GK. H4896-GK. H4907 from loc. TN11′ (Coll. I. OBATA). GK. H5309-GK. H5320 from loc. TS5′ (Coll. I. OBATA). GK. H5321 and H5322 from loc. T2 (Coll. K. TANAKA); GK. H5324-H5330 from loc. T936 (Coll. K. TANAKA); GK. H5351-H5354 from TS5 (Coll. I. OBATA). Besides the above specimens there are numerous poorly preserved fragments.

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance
GK. H4852	6.8	5.3	(0.78)	15.6
〃	6.1	4.7	(0.77)	
GK. H4853	7.7	6.1	(0.79)	

* Toyajo Primary School.
** Toyajo Middle School.

GK. H4858	7.3	5.6	(0.77)	17.3
〃	6.8	5.1	(0.75)	
GK. H4860	7.6	6.4	(0.84)	20.2
〃	6.4	4.8	(0.75)	
GK. H4868	8.2	6.6	(0.80)	
GK. H4875	12.0	9.1	(0.76)	
GK. H4888	9.5	7.6	(0.80)	24.0
〃	8.1	6.2	(0.77)	
GK. H4891	13.3	9.9	(0.74)	
GK. H4900	11.0	8.3	(0.75)	

Descriptions.—There are numerous small fragmentary specimens. They are all below 13 mm. in heights, except for a few larger fragments. The tapering is moderate to slow. The cross section is egg-shaped, showing a much narrower venter than a broadly rounded dorsum, and broadest in typical specimens slightly below the mid-flank but in others about the mid-flank. In GK. H4891, which is a body chamber, GK. H4892 and some others there is a blunt keel-like ventral elevation, with very faint grooves on both sides of it.

All the specimens at hand are internal moulds. Their surface is smooth. Only three specimens show very feeble ornaments. On the siphonal area of GK. H5324 and GK. H4892, very weak corrugation is discernible as in many examples of smooth *Baculites*. On GK. H4845 the broad projection of subcostae are observable on the dorsum. They are fairly closely spaced and much weakened on the lateral and ventral areas, showing only faint traces of forward projection.

Sutures are finely and deeply incised. The first lateral saddle is nearly equally bipartite by a fairly deep median lobule. Its stem is narrowed by lateral lobules. The second lateral saddle is somewhat higher and broader than the first. Typically it is asymmetrically divided by a deep median lobule. The anti-siphonal saddle is lower than, or occasionally as high as, and much narrower than the first. E is very wide. L is the deepest but much narrower than E. The median foliole of L is usually more or less lower than the lateral folioles, but sometimes nearly as high as one or both of the latter. U is as deep as E and is typically broader than L. The dorsal lobe [I] is comparatively deep. It is

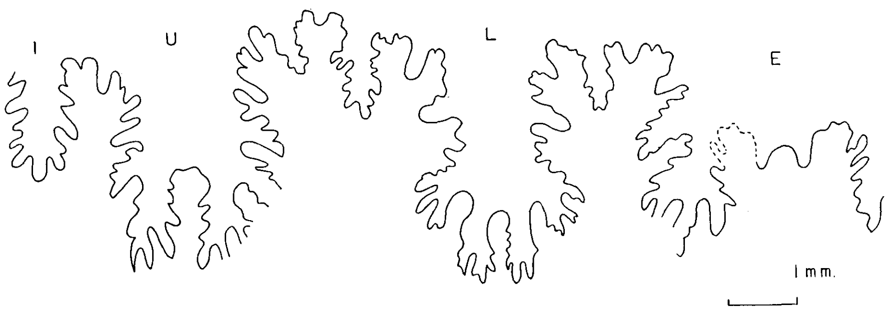
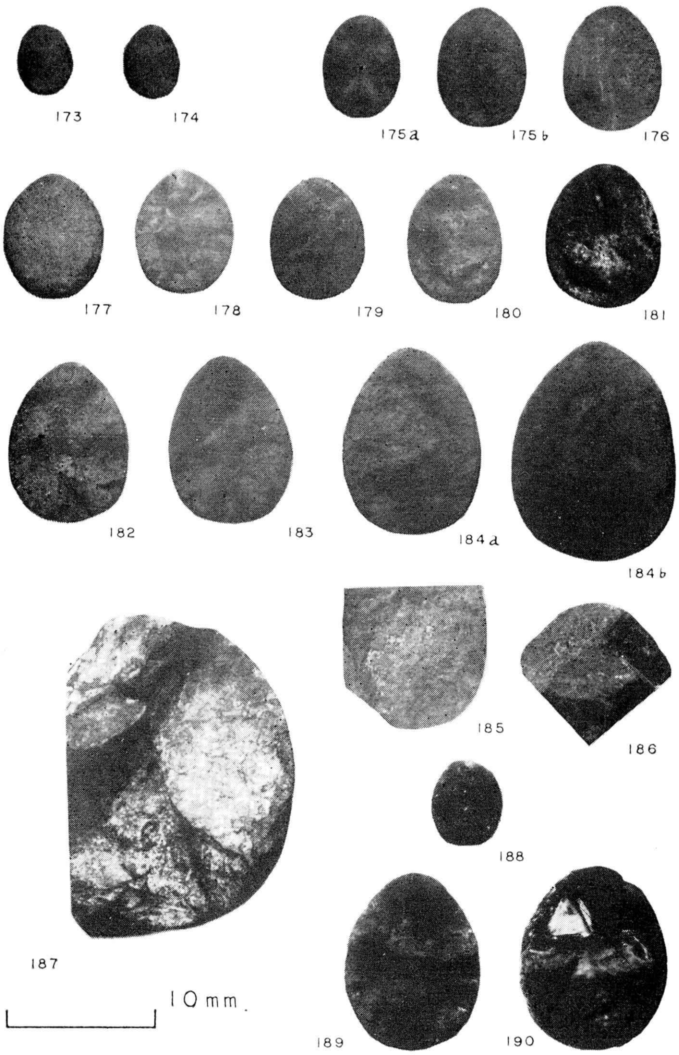


Fig. 172. *Baculites occidentalis* MEEK.
Suture, at height=10.8, breadth=8.2 mm., of GK. H4900, from loc. TN 11′, of half way up, at the north-east of, the Toyajo Hills, the silty fine-grained sandstone member of Toyajo formation.



Figs. 173-186. *Baculites occidentalis* MEEK, cross sections.
173: GK. H4848, 174: GK. H4846, 175a: GK. H4858(p.), 175b: GK. H4858(a.), 176: GK. H4864, 177: GK. H4860, 178: GK. H4868, 179: GK. H4853, 180: GK. H4903, 181: GK. H5324, 182: GK. H4900, 183: GK. H4867, 184a: GK. H4891(p.), 184b: GK. 4891(a.), 185: GK. H4896, 186: GK. H4837.

Figs. 187-190. *Baculites inornatus* MEEK, cross sections.
187: GT. I-654a, 188: GK. H5364, 189: GK. H5361, 190: GK. H5362.
(p.): posterior and (a.): anterior parts of the same specimen.

divided into several lobules. The aperture of *Baculites* type is poorly preserved on GK. H4839.

Remarks.—Some of the previous authors referred the *Baculites* from Toyajo formation to *B.* cf. *teres* FORBES. This is not warrantable, because the cross section of the former is egg-shaped, instead of subcircular. One of the specimens from Toyajo preserved at Tohoku University, with No. 52654, has a label of *Baculites* cf. *saghalinensis* SHIMIZU, a *nomen nudum*, but this can be identified as *Baculites* cf. *occidentalis*.

Occurrence.—Locs. TS 5 and TS 5′ of half way up, on the south of, the Toyajo Hills; locs. TN-10, TN11 and TN11′ of half way up, on the north-east of, the Toyajo Hills; locs. T2, T928 and T930 from the south-west of the Toyajo Hills; all in the silty fine-grained sandstone member of Toyajo formation. In the same member occur *Inoceramus schmidti* MICHAEL, *Inoceramus balticus toyajoanus* NAGAO and MATSUMOTO, *Didymoceras awajiense* (YABE) etc. Thus, the age is clearly indicated as the Lower Hetonaian, approximately Middle to Upper Campanian.

The specimens from loc. T928 are associated with *Tetragonites* (*Saghalinites*) *nupersus* VAN HOEPEN [="*Tetragonites cala*" of YABE, 1915] and *Glyptoxoceras* sp. in one and the same nodule. *Baculites* is usually preserved fairly abundantly in calcareous concretions, while the specimens from locs. TS5 and TN11 are associated with many individuals of *Nanonavis sachalinensis* (SCHMIDT) in dark-coloured siltstone.

Baculites regina sp. nov.

Pl. 22, figs. 3-6; Pl. 23, figs. 1, 2; Pl. 24, figs. 1-5; Pl. 25, figs. 3-5; Pl. 27, figs. 1, 6, 7, 9; Text-figs. 191-196, 200-214

Synonymy.—

1931. *Baculites* sp., KOBAYASHI, *Jour. Geol. Soc. Japan*, vol. 38, p. 634, listed only.

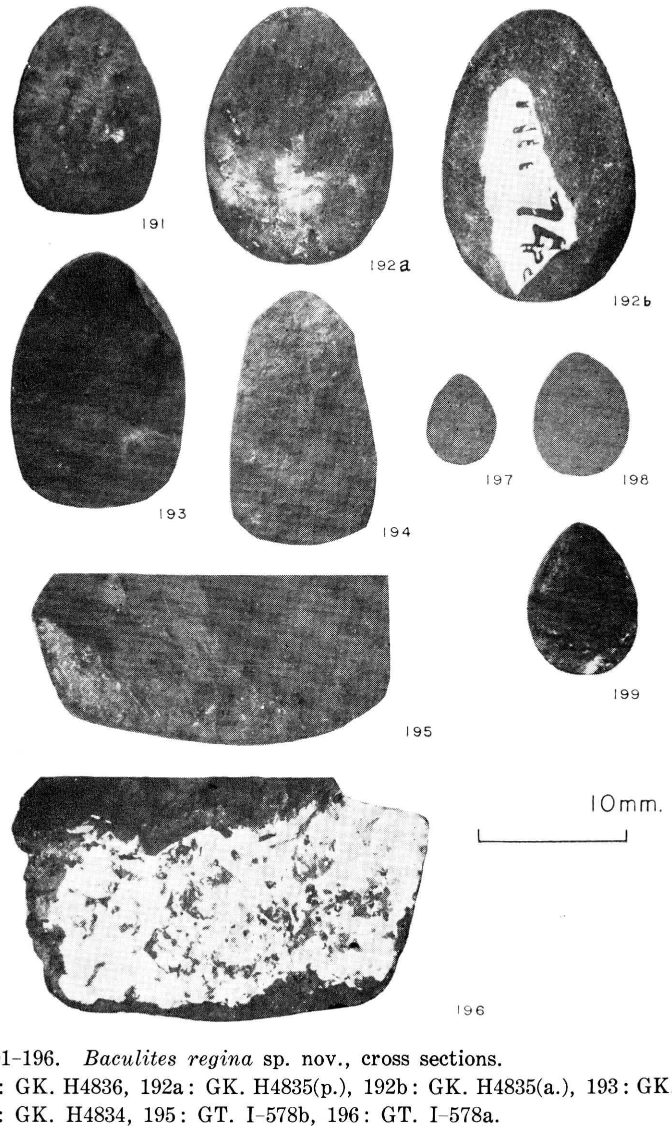
?1935. *Baculites occidentalis*, ANDERSON and HANNA, *Proc. Calif. Acad. Sci.*, [4], vol. 23, no. 1, p. 24, pl. 8, figs. 3, 4.

1960. *Baculites occidentalis*, ICHIKAWA and MAEDA, *Yukochu* [*Foraminifera*], no. 11, p. 10, listed only.

Material.—Holotype: GT. I-575 [=MM. 7716] b, from the Azenotani shale member, at Kuratani, Shinke-mura, Sennan-gun, Osaka Prefecture (Coll. T. KOBAYASHI).

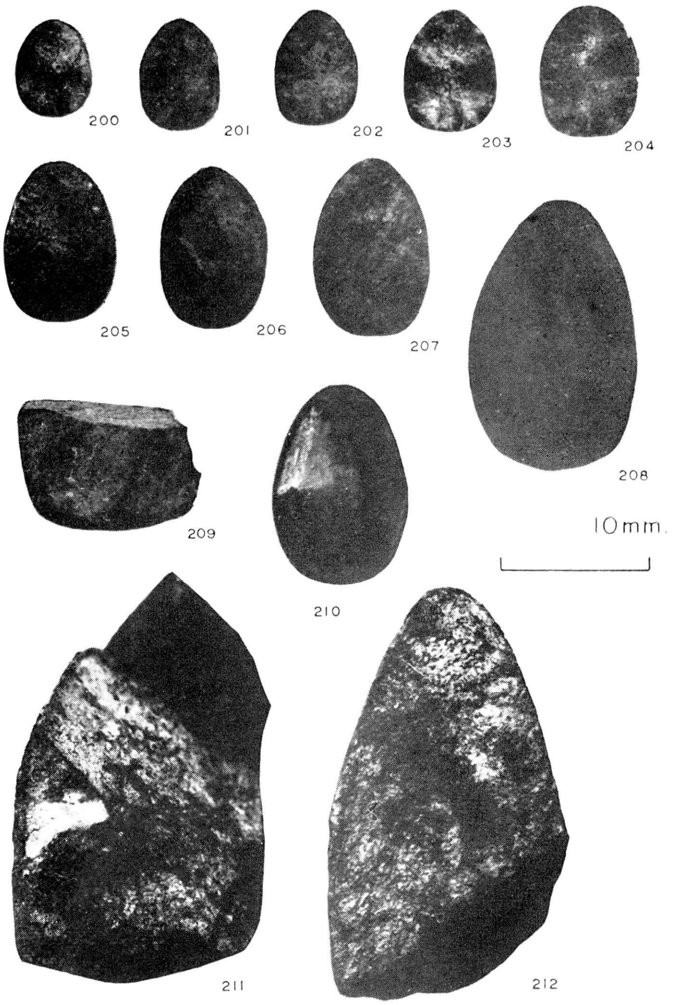
Paratypes.—GT. I-574 [=MM. 7715] a-c, GT. I-575 [=MM. 7716] a, c-j, GT. I-576 [=MM. 7717] a-f, GT. I-578 [=MM. 7718] a-c, from the same locality as the holotype, and GT. I-580 [=MM. 7719], from the same member at Takinoike, Izumi-Sano City, Osaka Prefecture, all in the collection of T. KOBAYASHI (1931), who listed them as *Baculites* sp.; GK. H5292, from loc. KK1149, Mutsuo, Shindachi-machi, and GK. H5270, from loc. KK1231, Hinenoiwakura, Izumi-Sano City, Osaka Prefecture, both from the lower part of the Azenotani shale member (Coll. K. TANAKA); GK. H4834 [=OCU. MM743], GK. H5412 [=OCU. MM766] and GK. H5413 [=OCU. MM767] from loc. 148, Azenotani, Sennan-gun, Osaka Prefecture (Coll. K. ICHIKAWA and Y. MAEDA); GK. H5411 [=OCU. MM745], from loc. 151, Azenotani (Coll. K. ICHIKAWA and Y. MAEDA); GK. H4835 [=OCU. MM742a] and GK. H4836 [=OCU. MM742b], from loc. 116, Takinoike, Izumi-Sano City and GK. H4843 [=OCU. MM746], GK. H5398 [=OCU. MM701a], GK.

H5399 [=OCU. MM721], GK. H5400 [=OCU. MM723]a-c, GK. H5401 [=OCU. MM728]a, b, GK. H5402 [=OCU. MM729] a-c, GK. H5403 [=OCU. MM732], GK. H5404 [=OCU. MM733], GK. H5405-GK. H5409 [=OCU. MM735-OCU. MM739] and GK. H5410 [=OCU. MM748], from loc. 115, Takinoike, all of them collected by ICHIKAWA and MAEDA from the Azenotani shale member and donated to the type room in the Kyushu University; also GK. H5252-GK. H5269, from loc. Az. 12, GK. H5272-GK. H5291, from loc. Az. 13, and GK. H5293-GK. H5298, from loc.



Figs. 191-196. *Baculites regina* sp. nov., cross sections.
191: GK. H4836, 192a: GK. H4835(p.), 192b: GK. H4835(a.), 193: GK. H5276, 194: GK. H4834, 195: GT. I-578b, 196: GT. I-578a.

Figs. 197-199. *Baculites* cf. *princeps* MATSUMOTO and OBATA, cross sections.
197: GK. H4912, 198: GK. H4909, 199: GK. H5306.
(p.): posterior and (a.): anterior parts of the same specimen.



Figs. 200–212. *Baculites regina* sp. nov., cross sections.
200: GK. H5278, 201: GK. H5281, 202: GK. H5254, 203: GK. H5270, 204: GK. H5279, 205: GK. H5274, 206: GT. I-575a, 207: GT. I-574a, 208: GK. H4843, 209: GT. I-575c, 210: GT. I-575b, 211: GK. H5269, 212: GK. H5268.

Az. 11, all at Azenotani from the lower part of the Azenotani shale member (Coll. I. OBATA).

There are many other comparable specimens from locs. Az. 11-13 and in the collections of ICHIKAWA and MAEDA (OCU. MM700-MM720, MM722, MM724-MM727, MM730, MM731, MM734, MM740, MM741, MM746, MM747, MM749, MM752-MM756, MM762 and MM763), those of ITO (OCU. MM750, MM751, MM759, MM760 and MM768-MM771), that of SHOJI (OCU. MM745) and those of K. ICHIKAWA (OCU. MM757, MM758 and MM761), from the Azenotani shale member.

Measurements.—

Specimen	Height	Breadth	(B/H)	Distance	Interval between ribs on the dorsal half of the flanks
GT. MM7716b	14.1	9.8	(0.70)		7.5/6.7/6.6
GT. MM7715a	13.6	9.3	(0.68)		9.1/8.8
GT. MM7716a	15.4	9.6	(0.62)	41.3	8.2
〃	12.1	8.2	(0.68)		
GK. H4834	16.5	12.3	(0.75)		13.5
GK. H4835	21.2	15.8	(0.75)	31.7	12.4/14.2
〃	19.5	13.3	(0.68)		
GK. H4836	16.2	11.1	(0.69)	28.9	5.7/8.0/7.1/6.7
〃	14.2	9.8	(0.69)		
GK. H5405	10.2	7.4	(0.73)		7.6/6.5/5.9
GK. H5404	11.3	8.2	(0.73)		
GK. H5412	15.5	10.2	(0.66)		7.5/9.1
GK. H5413	9.9	7.2	(0.73)		5.2
GK. H5270	8.3	6.5	(0.78)		
GK. H5279	9.7	7.2	(0.74)		
GK. H5294	5.7	4.5	(0.79)		
GK. H5298	7.2	5.5	(0.76)		

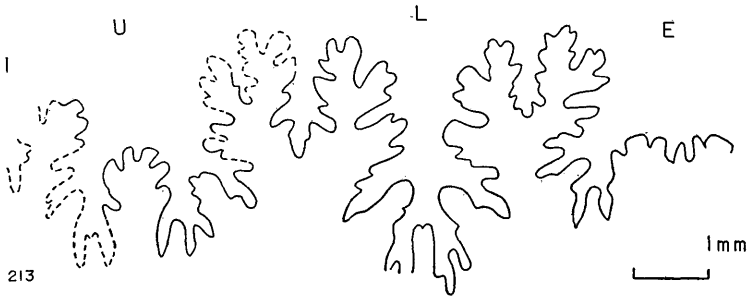
Diagnosis.—The shell is small to moderate in size. The tapering is moderate in the early growth-stage but very slow in the adult stage. The section is higher than broad, broadest near the mid-height. The shell increases more rapidly in height than in breadth with growth and the proportion between height and breadth in the late growth-stage is about 10: 7(±0.6) on the average. The dorsum is flattened or gently rounded, the dorsolateral part is subangular or at least abruptly rounded, the main part of the flank is very gently inflated or nearly flattened, the ventrolateral parts form in the late growth-stage blunt shoulders from which the rest of the sides are convergent towards the narrowly rounded venter. The approximate outline of the section is, accordingly, rounded subtrigonal in the young stage and high subpentagonal in the late stage, showing an acute angle at the top, obtuse upper two and nearly rectangular lower two edges, although the edges may be more or less rounded. The tendency to the angulation of the edges and the flattening of the dorsum and flanks is generally more distinct in the adult shell than in the immature.

The surface of the shell is almost smooth in the early growth-stage, but at a certain point (e.g. with a height of about 9 mm.) in the middle growth-stage a characteristic ornament begins to develop. The ornament is differentiated into two parts, the distant, broad and low, arcuate ribs on the dorsal half of the flank and the numerous, fine and weak, oblique riblets and lirae on the ventral half. The latter forms an angle of 22°-30° with the long axis of the shell and crosses the venter with projection. Some of the latter may be continued from the former with thinning, but the extension of the former may be cut obliquely by a set of the ventral riblets. The former are slightly elevated at the dorsolateral edge, as in the holotype and many specimens, but the elevation is hardly discernible in some cases. The dorsum has very weak subcostae, lirae or striae, which are broadly convex forward.

The suture, as exposed on GK. H5270, GK. H5274 and some others, is deeply incised and complex. The stems of the first lateral lobe (L) and saddle are narrowed by the deep incision of the lobules. In the lower part of L the median foliole is typically overhung by the adjacent lateral folioles. The external lobe is wide. The first lateral saddle is slightly smaller than the second. They are subsymmetrically to asymmetrically bipartite. L is the deepest. The second lateral lobe [U] is wide and has a large median foliole. The dorsal lobe [I] is narrow but fairly deep. The saddle between I and U is much narrower and lower than the lateral saddles.

The aperture is imperfectly preserved in GK. H4834, H5414 and GT. I-574 [=MM7715]a. The long ventral rostrum is very slightly and gradually curved inward near the apex. The inner sinus is broadly concave at about one third from the venter, passing to a broad dorsal projection. The aperture is slightly expanded on the dorsal part. The adult body-chamber is, therefore, very gently concave on the dorsal side in lateral view. The length of the body chamber is not precisely known, but is at least 65 mm. when the heights are 12 to 16 mm.

Variation.—The shell seems to vary in size to some extent. The fragment



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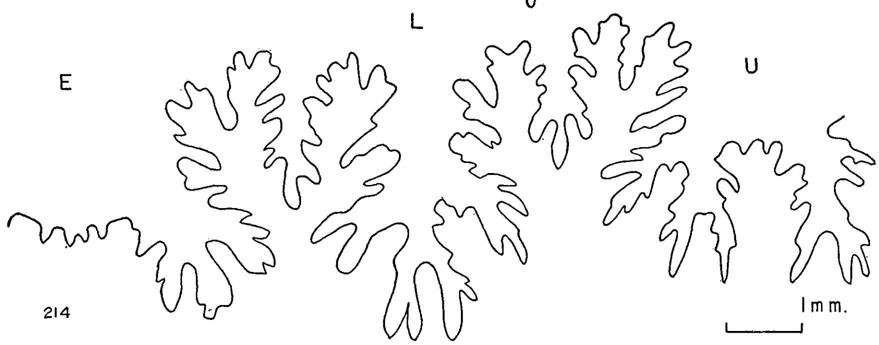

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Figs. 213, 214. *Baculites regina* sp. nov.
213. Suture, at height=8.9, breadth=7.1 mm., of GK. H5270, a paratype, from loc. KK1231, Hinenoiwakura, Izumi-Sano City, the lower part of the Azenotani shale member, Osaka Prefecture.
214. Suture, at height=11.0, breadth=8.2 mm., of GK. H5274, a paratype, from loc. Az13, Azenotani, Sennan-gun, the lower part of the Azenotani shale member, Osaka Prefecture.

of the largest body-chamber is about 30 mm. in height and 20 mm. in breadth. There are, however, smaller body-chambers, which are 15 to 20 mm. in heights but have the shell-form and ornament of the adult type.

The change of the shell-form with growth from rounded subtrigonal to subpentagonal is characteristic of this species, but the change appears in dissimilar rates and in various degrees by individuals. Thus, for example, GT. I-574a has more angular dorsolateral edges than GT. I-575a, b, although they are of nearly equal size.

The figures in the measurements indicate the extent of variation in the proportion between height and breadth.

The ribs and riblets vary in strength to some extent between the specimens. The ornament is comparatively strong in GK. H5292, but very weak in GK. H5407. Numerous specimens have the ornament of moderate intensity. The ribs also vary in spacing to some extent, although the interval is usually somewhat shorter than the breadth of the cross section. The figures in the measurements show the actual state.

The suture is variable in minor details, such as depth of incisions and breadth of stems of saddles and lobes. The top of the median foliole at the bottom of L is usually lower than the lateral folioles, but in a few specimens (e.g. GK. H5280) it is nearly as low as one of the lateral folioles, as in some cases of the sutures of *Baculites rex* ANDERSON (see MATSUMOTO, 1959, text-figs. 45a and 48b) and *B. occidentalis* MEEK (described above).

Affinity.—This new species is closely allied to nearly contemporary *Baculites occidentalis* MEEK (see above description) in many respects, but the former has more angular dorsolateral edges than the latter and a simply convergent, narrowly rounded venter, without showing a keel like elevation and grooves as in the latter. Although there is variation in the intensity of the ornament, *B. regina* has on the average stronger ribs on the dorsal half of the flank and more distinct riblets on the ventral half, showing thus more remarkable differentiation of the ornament on the two halves, than *B. occidentalis*.

The specimen from Santa Catarina Landing, Baja California, which was described by ANDERSON and HANNA (1935, p. 24, pl. 18, figs. 3, 4: Univ. Calif. 36118) as *B. occidentalis* is more similar to *B. regina* than to *B. occidentalis* in its angular dorsolateral edge and more flattened dorsum. As it is nearly smooth and does not clearly show the suture, the precise identification is difficult. Similarly the specimen (GSC. 5952), from loc. 502, upper Lambert formation, Hornby Island, British Columbia, which was described by USHER (1952, p. 96, pl. 28, fig. 1; text-fig. 4) as an example of *B. occidentalis* is more closely allied to *B. regina* than to the lectotype of *B. occidentalis*.

In the flattened dorsum, the subangular dorsolateral edges and the differentiation of the lateral ornament *B. regina* is somewhat similar to *Eubaculites ootacodensis* (STOLICZKA) (1866, p. 199, pl. 90, fig. 14; also see MATSUMOTO, 1959b, p. 166, pl. 43, fig. 6; pl. 44, figs. 1-3; text-figs. 84, 85), but has not such a tabulated keel as in that species. In *E. ootacodensis* the ribs on the dorsal two thirds of the flank is less arcuate and the suture is much more reduced with shallower incisions than in *B. regina.*

In short *B. regina* is probably a lateral off-shoot from *B. occidentalis* but is not on the main line of descent from *B. occidentalis* to *E. ootacodensis.*

Occurrence.—The detailed locality records are described above. To sum up the species is common in the Azenotani shale member of the Izumi group in the Izumi Mountain-range. According to our revised identification, *Neophylloceras* sp., *Gaudryceras striatum paucistriatum* MATSUMOTO, *Pachydiscus kobayashii* SHIMIZU (related to *P. preegertoni* COLLIGNON) and *Inoceramus* cf. *orientalis,* among other mollusca, occur from the Azenotani shale member, which is probably Campanian in age.

Summary of Results

As a summarized result we list here the species of the Baculitidae from Honshu which have been described above, with their stratigraphic positions.

(1) *Baculites* cf. *yokoyamai* TOKUNAGA and SHIMIZU (Lower Futaba formation, Fukushima Prefecture) (Lower Urakawan [K5 α]: Coniacian)

(2) *Baculites inornatus* MEEK (Minato and Shichi shale members in the lower subgroup of the Izumi group, Island of Awaji) (Lower Hetonaian [K6 α]: Campanian)

(3) *Baculites* cf. *princeps* MATSUMOTO and OBATA (Lower sandstone member of the Futakawa formation, Aritagawa valley, Wakayama Prefecture) (Upper Urakawan [K5 β]: Santonian)

(4) *Baculites occidentalis* MEEK (Silty fine-grained sandstone member of the Toyajo formation, Wakayama Prefecture) (Lower Hetonaian [K6 α]: Campanian)

(5) *Baculites regina* sp. nov. [related to *B. occidentalis*] (Azenotani shale member, in the lower subgroup of the Izumi group, northern part of the Izumi Mountain-range, Osaka Prefecture) (probably Lower Hetonaian [K6 α]: Campanian).

They are all Indo-Pacific elements. *B. yokoyamai* and *B. princeps* occur more commonly in the Lower and the Upper Urakawan of Hokkaido. *B. inornatus* and *B. occidentalis* are common in the Campanian of the west coast of North America. Their distribution has now proved to extend to Southwest Japan. A new species, *B. regina,* which is characteristic of the Izumi group, is intimately related to *B. occidentalis* and its wider distribution around the northern Pacific region can well be expected. Possibly identical, or at least closely allied, examples are known in British Columbia and Baja California.

The three Campanian species, *B. inornatus, B. occidentalis* and *B. regina,* have not yet been confirmed to occur in Hokkaido. This is probably due to the sedimentary environment of the Lower Hakobuchi group, which is not favourable for *Baculites.* There is, however, a lateral change of facies in the Lower Hetonaian. Therefore the specimens of the three species should be searched for in the Hetonaian of Hokkaido, too.

In addition to the specimens examined in this paper there are some others from Honshu. For instance, T. SAITO (1960) listed the following three species*.

(i) *Baculites* cf. *yokoyamai* TOKUNAGA and SHIMIZU (Lower Futaba formation, Fukushima Prefecture)

(ii) *Baculites* cf. *inornatus* MEEK (Isoai member of the Nakaminato formation, Naka group, Ibaragi Prefecture, in its lower horizon of *Baculites*)

(iii) *Baculites* cf. *rex* ANDERSON (Isoai member of the Nakaminato formation, Naka group, Ibaragi Prefecture, in its upper horizon of *Baculites*)

* Dr. Toshio SAITO kindly showed us his collections and photographs. A full descriptions of them will be done by himself.

Part III

Concluding Remarks on the Baculitidae from Japan

By

Tatsuro MATSUMOTO and Ikuwo OBATA

Part III

Concluding Remarks on the Baculitidae from Japan

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Abstract

The palaeontologic and stratigraphic results from the studies of the Baculitidae from Japan, as described in Parts I and II, are summarized. Of the twenty-five described species seven are new and a new subspecies is introduced. The stratigraphic succession of the baculitid species in Japan is very distinct and many species are useful for zonal correlation. The elements of the baculitid faunas are mostly Indo-Pacific, with the highest percentage of the species common between Japan and California. There are several world wide species. Five of the seven new species are particular to Japan in our present knowledge. Interesting similarity is recognized between the Indo-Pacific and the American Interior-Gulf Coastal species, but they are in parallel relationship. In the history of the Baculitidae from Albian to Maestrichtian, the evolutional change from Upper Turonian to Coniacian is rather remarkable. In other stages there are also some changes. At least three lines of descent are recognized in the Indo-Pacific species of *Baculites*. The baculitids are very sensitive to the change of facies as seen in their occurrence, owing probably to the ecological factors. As an example the occurrence in Hokkaido is explained with reference to the palaeogeographic history.

Contents

Classification

The systematic descriptions in Parts I and II have dealt with almost all the representatives of the Upper Cretaceous baculitids from Hokkaido and Honshu. A few others have been only briefly mentioned. So far as the present knowledge is concerned, twenty five species including three indefinite ones are known from Hokkaido and Honshu.

On the occasion of describing the North American West Coast species MATSUMOTO (1959-1960) demonstrated that *Baculites* comprises a large number of species, but did not propose new genera or subdivide new subgenera, because the numerous species are very intimately connected with one another. In this paper some more species of Baculitidae are newly added to the previous ones, but all the described species belong to already established genera, and no new generic or subgeneric names are required for any of them.

Of twenty five described species seven are new: they are *Sciponoceras orientale, Sciponoceras intermedium, Baculites uedae, Baculites tanakae, Baculites princeps, Baculites regina* and *Baculites pseudobaculus.* In addition, a new subspecies, *Baculites anceps pacificus* is introduced.

Zonal Succession

Basic foundation.—For the Upper Cretaceous of Japan a workable biostratigraphic classification has been established on the basis of ammonites and inocerami, and the Japanese stages and zones are correlated with those of the international scale (see MATSUMOTO, 1942-43, 1954, 1959a). The recently established scheme is a good foundation for the age determination of the ammonite-bearing beds in Japan.

The standard or type areas of the Upper Cretaceous in Hokkaido give us comparatively continuous records of baculitids. The stratigraphic occurrence of baculitids in Honshu is generally discontinuous and rather sporadic, although from some localities in a limited area they occur fairly abundantly. The necessary information of the stratigraphy has been supplied for this study by many persons. The data have been obtained from their careful field work in detailed mapping, measuring sections, zonal collecting of fossils etc. For the Cretaceous stratigraphy of Hokkaido and Honshu one of us (T.M.) is mainly responsible, but we partly depend on K. TANAKA, K. ICHIKAWA and Y. MAEDA. The other of us (I.O.) also did field work in Honshu. In addition to the field observation, all the fossils associated with baculitids bearing nodules have been examined in the laboratory. Thus the stratigraphic occurrence of each species has been determined, as described in Parts I and II.

The Baculitidae from California has recently been monographed (MATSUMOTO, 1959b, 1960). This is another important foundation for the interregional comparison. For other oversea areas we mainly depend on literature, although valuable new information from C. W. Wright and W. A. Cobban about the succession of species in Europe and North America is also taken into consideration.

Zonal succession of the species of Baculitidae in Japan.—On the basis of the above mentioned procedures the succession of the baculitid species in Japan may be summarized as follows. Fig. 216 is another representation of the summary of results.

(1) *Sciponoceras* (?) sp. (Lower Lower Cenomanian).—This is not yet precisely identified and occurs in Japan so rarely that it cannot be listed as a good zonal index. It is associated with *Graysonites* cf. *lozoi* YOUNG or *Graysonites* cf. *fountaini* YOUNG and *Desmoceras kossmati* MATSUMOTO. Its association with

Series			Stages or Substages	Zonal Indices: *Inoceramus* etc.	Zonal Indices: Ammonites	Subzonal Indices: Relatively Short-ranged Species	Succession of the Species of the Baculitidae in Japan	Correlation with the International Scale	
HETONAIAN	K6	β	Upper Hetonaian	*I. hetonaianus* + *I.* (?) *awajiensis*; *I. shikotanensis*	*Pachydiscus subcompressus* + *Pachy.* (*Neodesmoc.*) *japonicus*	[*Kitchinites* sp., *Brahmaites saghalinensis*] *Patagiosites compressus*	*Baculites rex*	Maestrichtian (S. l.)	UPPER CRETACEOUS
		α	Lower Hetonaian	*I schmidti* [*I. ezoensis* + *I. balticus*]	*Canadoceras kossmati* [*Desmophyllites diphylloides*]	*Metaplacenticeras subtilistriatum* [*Natalites* sp.]	*B. inornatus*; *B. anceps pacificus*, *B. occidentalis*, *B. regina*	Campanian (SENONIAN (S.S.))	
URAKAWAN	K5	γ	Infra-hetonaian	*I. orientalis*	*A.* (*Neopachydiscus*) *naumanni* [*Eupachydiscus haradai*]		*B. chicoensis*; *B. tanakae*		
		β	Upper Urakawan	*I. japonicus*; *I. amakusensis* [*Inoc. naumanni*]	*Anapachydiscus sutneri* + *A. fascicostatus* [*Damesites damesi*]	*Submortoniceras* (?) sp.; *Texanites texanus, etc.*; *Protexanites fukazawai, etc.*	*B. bailyi*; *B. uedae*; *B. princeps*; *Baculites capensis* [*Baculites boulei*]	Santonian	
		α	Lower Urakawan	*I. mihoensis*; *I. uwajimensis* [*Didymotis akamatsui*]	*Kossmaticeras theobaldianum* [*Yokoyamaoceras kotoi*]	*Paratexanites orientalis*; *Peroniceras* aff. *platicostatum*; *Prionocycloceras* aff. *guayabanum*; *Barroisiceras* sp.	*B. yokoyamai*; *B schencki*	Coniacian	
GYLIAKIAN	K4	β	Upper Gyliakian	*I. teshioensis*; *I. hobetsensis*; *I.* cf. *labiatus* [*I. incertus*]	*Tragodesmoceroides subcostatus* + *Scaphites planus* [*Damesites ainuanus*]	*Reesidites minimus*; *Subprionocyclus normalis*; *Subprionocyclus neptuni*; *Collignoniceras teshioense*; *Kanabiceras septemseriatum*; *Romaniceras* spp.; *Yubariceras* spp.; *Fagesia thevestensis*	*S. intermedium*; *B. undulatus*; *S orientale*	Turonian	
		α	Lower Gyliakian	*I. concentricus nipponicus* + *I. yabei*	*Desmoceras* (*Pseudouhligella*) *japonicum* + *D.* (*P.*) *ezoanum*	*Calycoceras* cf. *naviculare*; *Calycoceras stoliczkai*; *C. orientale*, *C. asiaticum*, *C. spinosum*; *Mantelliceras* n. sp.	*Sciponoceras kossmati*; *Sciponoceras baculoides*	Cenomanian	
MIYAKOAN	K3	γ	Infra-gyliakian	*I.* aff. *crippsi*	*Desmoceras kossmati*	*Graysonites* spp.; *Stoliczkaia* spp.	*Sciponoceras* sp.		
		β	Upper Miyakoan	*I.* aff. *bohemicus*	*Desmoceras latidorsatum*	*Mortoniceras* (*Durnovarites*) sp.; *Mort.* (*Deiradoceras*) sp.; *Hoplites* aff. *dentatus*		Albian	LOWER CRETACEOUS
		α	Lower Miyakoan		*Cheloniceras subcornuerianum* + *Colombiceras* sp	*Diadochoceras nodosocostatiforme*; *Parahoplites yaegashii*		Aptian	
	K2				*Crioceratites ishiharai*	*Pulchellia* sp.		NEOCOMIAN	
	K1				*Thurmanniceras isokusense*				

[ ] Those in square brackets are of isolated or doubtful occurrence

Fig. 216. Zonal distribution of the baculitid species in Japan (Adapted from the chart compiled by T. MATSUMOTO, 1959).

Mortoniceras has not yet been confirmed.

(2) *Sciponoceras baculoides* (MANTELL) (Lower Cenomanian).—The species is commonly found in the subzone of *Mantelliceras* sp. in the section of the Ikushumbets. Its association with *Calycoceras* spp. or with *Graysonites lozoi* YOUNG is not yet confirmed.

(3) *Sciponoceras kossmati* (NOWAK) (Middle Cenomanian to Lower Turonian).—The species occurs in abundance in the subzone of *Kanabiceras septemseriatum* in the section of the Ikushumbets, Hokkaido. The earliest appearance of the species in Hokkaido is known from the Middle Cenomanian (bed IIh in Shuyubari).

(4) *Sciponoceras orientale* n. sp. (Lower and Middle Turonian).—The species occurs abundantly in the subzone of *Fagesia thevestensis* and also in that of *Inoceramus hobetsensis.*

(5) *Sciponoceras intermedium* n. sp. (Upper Turonian).—The species ranges from the subzone of *Subprionocyclus neptuni* to that of *Reesidites minimus* in the *Inoceramus teshioensis* zone.

(6) *Baculites undulatus* (ROMAN and MAZERAN) (Upper Turonian).—In Hokkaido this species is known from the subzone of *Subprionocyclus normalis* in the *I. teshioensis* zone.

(7) *Baculites yokoyamai* TOKUNAGA and SHIMIZU and *Baculites schencki* MATSUMOTO (Coniacian).—*B. yokoyamai* occurs abundantly and *B. schencki* rather sparsely in the zone of *Inoceramus uwajimensis.*

(8) *Baculites boulei* COLLIGNON and *B. capensis* WOODS (Coniacian and Santonian).—In Hokkaido the two species are more common in the Santonian than in the Coniacian. *B.* n. sp. (?) aff. *B. sulcatus* BAILY may be contemporary with them.

(9) *Baculites uedae* n. sp., *B. bailyi* WOODS and *B. princeps* n. sp. (Santonian).—The three species occur in the Santonian. So far as the available evidence is concerned *B. princeps* is known only in the Upper Santonian. *B.* cf. *kirki* MATSUMOTO and *B. pseudobaculus* n. sp. rarely occur in the Santonian of Hokkaido.

(10) *Baculites tanakae* n. sp. (Campanian).—In Hokkaido the earliest representative of *B. tanakae* occurs from the bed just above that of *B. capensis* in the section of Abeshinai-Saku. *B. tanakae* is characteristic of the Lower Campanian. *Baculites anceps pacificus* n. subsp. and *B. chicoensis* TRASK is occasionally found in the Campanian. *B. regina* n. sp., *B. occidentalis* MEEK and *B. inornatus* MEEK occur in the Campanian of Southwest Japan.

(11) *Baculites rex* ANDERSON (Maestrichtian ?).—In our present knowledge *B. rex* is rare in Japan and is not associated with other indices. Judging from the stratigraphical position, the horizon of *B. rex* is probably early Maestrichtian but could be late Campanian. The unmistakable example of *Eubaculites* is not yet found in Japan.

The geological age indicated above in parentheses is determined from various kinds of evidence. The stratigraphic positions of the species in Japan are of course taken into consideration, which are recorded in detail in the palaeontological description and are summarized at the ends of Parts I and II and also in another chart (Fig. 216). Some of the named species have a world-wide distribution in which case the geological age in terms of the international scale can be readily determined. Others are widespread in the Indo-Pacific realm, in which case the stratigraphic occurrence of the named species in Japan and the oversea areas gives an approximate age on the international scale. The assemblage of the associated species other than baculitids is, of course, considered.

Many of the species of the Baculitidae not only have restricted stratigraphic ranges but also occur in abundance and are widely distributed. Therefore, in many cases a species of the Baculitidae has proved to be one of the good zone indicators in every stage of the Upper Cretaceous. To sum up it may be said that the baculitids in Japan are as valuable as in California (MATSUMOTO, 1959-1960) for biostratigraphic subdivision and correlation.

Records of the species of Baculitidae from the Indo-Pacific region.—The following species of the Baculitidae from various areas of the Indo-Pacific regions, with their localities and stratigraphic positions, are cited from some reliable references. The generic name is revised, so far as the revision is necessary. When there is a different opinion about the identification of a species from the original author's, remarks are given in square brackets. The geological age in our opinion is indicated on the international scale.

1. Japan
   a. Hokkaido
      see (1)-(21) in pages 70-71 in Part I
   b. Honshu
      see (1)-(5) in page 91 in Part II
   c. Shikoku (KATTO *et al.*, 1961, listed only)
      Baculites cf. *occidentalis* MEEK (Arioka formation, Upper Campanian)
   d. Kyushu (MATSUMOTO, 1938)
      Lechites (?) sp. (Member IIb, Goshonoura group) [The original specimen, which was preserved at the University of Tokyo, is missing. A specimen recently collected by H. OGURI from member IId of the Goshonoura group, Lower Lower Cenomanian, is *Sciponoceras* sp.]
2. Saghalien [Sakhalin] (SHIMIZU, 1935, listed only)
   Baculites saghalinensis SHIMIZU, *nom. nud.* [Since the original specimens are missing, we cannot decide what it is.] (Highest ammonite bearing bed in the sequence of the Naibuchi-Kawakami area, Maestrichtian?)
3. Alaska (GRANTZ and JONES, 1960, listed only)
   (1) *Sciponoceras* aff. *bohemicum* (FRITCH) [*S. intermedium* n. sp.] (Member C, Turonian)
   (2) *Baculites occidentalis* MEEK (Member E, Upper Campanian and Maestrichtian (?))
   (3) *Baculites* n. sp. [*B.* (?) *teres* (FORBES), revised by JONES, as indicated in a letter in reply to our inquiry] (Upper Campanian and Maestrichtian (?), all from the Matanuska formation, Matanuska Valley, Nelchina area, south central Alaska)
4. British Columbia (MEEK, 1876; USHER, 1952; MATSUMOTO, 1959b)

(1) *Baculites occidentalis* MEEK [*B. occidentalis* and *B.* cf. *regina* n. sp.] ("Komooks," Vancouver Island) (Upper Campanian)
(2) *Baculites inornatus* MEEK (Vancouver Island) (Campanian)

5. Washington (MEEK, 1876; USHER, 1952; MATSUMOTO, 1959b)
Baculites inornatus MEEK (Sucia Island) (Middle or Upper Campanian)

6. California (MATSUMOTO, 1959b, 1960)
(1) *Lechites* aff. *L. gaudini* (PICTET and CAMPICHE) (Upper Albian or Lower Cenomanian)
(2) *Sciponoceras baculoides* (MANTELL) (Cenomanian)
(3) *S. kossmati* (NOWAK) (primarily Lower Turonian, possibly Upper Cenomanian and Middle Turonian)
(4) *S.* aff. *bohemicum* (FRITSCH) [*S. intermedium* n. sp.] (Upper Turonian)
(5) *Baculites* cf. *yokoyamai* TOKUNAGA and SHIMIZU (Coniacian)
(6) *B. schencki* MATSUMOTO (Lower Senonian, especially Coniacian)
(7) *B. boulei* COLLIGNON (Lower Senonian)
(8) *B. capensis* WOODS (Lower Senonian)
(9) *B. lomaensis* ANDERSON (Lower Maestrichtian, but may be the Uppermost Campanian)
(10) *B.* aff. *anceps* [*B. anceps pacificus* n. subsp.] (Upper Campanian)
(11) *B. rex.* ANDERSON (Maestrichtian, possibly going down to the highest part of the Campanian)
(12) *B. kirki* MATSUMOTO (Santonian)
(13) *B. chicoensis* TRASK (Lower Campanian)
(14) *B. occidentalis* MEEK (Upper Campanian)
(15) *B. inornatus* MEEK (Middle and Upper Campanian)
(16) *B. columna* MORTON (Maestrichtian)
(17) *B.* (?) aff. *B. teres* FORBES (Maestrichtian)
(18) *Eubaculites ootacodensis* (STOLICZKA) (most probably Maestrichtian, but possibly ranging down to latest Campanian)

7. Baja California, Mexico (ANDERSON and HANNA, 1935; MATSUMOTO, 1959b)
(1) *Baculites occidentalis* MEEK [*Baculites* cf. *regina* n. sp.] (Santa Catarina Landing) (Rosario formation, Upper Campanian or Lower Maestrichtian)
(2) *Baculites inornatus* MEEK (Santa Catarina Landing) (Rosario formation, Upper Campanian or Lower Maestrichtian)

8. Chile (D'ORBIGNY, 1848) (SPATH, 1953, mentioned)
(1) *Baculites anceps* LAMARCK (Conception Bay) (probably Maestrichtian)
(2) *Eubaculites lyelli* (D'ORBIGNY) (Conception Bay) (probably Maestrichtian)
(3) *E. ornatus* (D'ORBIGNY) (Conception Bay) (probably Maestrichtian)

9. Southern Patagonia (PAULCKE, 1907)
(1) *Baculites* cf. *anceps* LAMARCK [probably referable to *B. anceps pacificus* n. subsp.] (Cerro Contreras e, Cazador f, Upper Senonian)
(2) *B. cazadorianus* PAULCKE [probably identified as *B. anceps anceps* LAMARCK] (Cerro Cazador i, k, Upper Senonian)

10. Graham Land (SPATH, 1953)
Baculites aff. *rectus* MARSHALL (Lachman Crags, South) (probably Upper Campanian)

11. New Zealand
(1) *Baculites* sp. cf. *vagina* FORBES (WOODS, 1917) [probably referable to *B. rectus* MARSHALL] (Amuri Bluff) (probably Campanian)
(2) *Baculites rectus* MARSHALL, (MARSHALL, 1926) (Bull's Point); (SPATH, 1953) (Kaipara Harbour) (probably Campanian)

12. New Caledonia (FRENEIX, 1958, listed only)
    Baculites sp. (Basin of Saint-Vincent, horizon of Bangou with *Baculites*, Coll. PIROUTET) [The specimens from loc. no. P-1374, Tene Valley near Bourail in the Bourail basin, collected by Prof. P. ROUTHIER, were sent to Kyushu University through Mrs. S. FRENEIX. We identify them as *Baculites* cf. *rectus* MARSHALL] (probably Campanian).
13. West Australia (SPATH, 1940, 1953)
    Eubaculites ootacodensis (STOLICZKA) (Maestrichtian)
14. South India
    (FORBES, 1846; STOLICZKA, 1863-1866; KOSSMAT, 1895, 97, 98)
    a. Trichinopoly area
        (1) *Lechites gaudini* (PICTET and CAMPICHE) (Lower Ootatoor group, Upper Albian—Lower Cenomanian)
        (2) *Sciponoceras* cf. *baculoides* (MANTELL) (Lower Ootatoor group, Upper Albian—Lower Cenomanian)
        (3) *S. kossmati* (NOWAK) (Lower Trichinopoly group, Turonian)
        (4) *Eubaculites* (?) *simplex* (KOSSMAT) (Lower Ariyaloor group, Campanian)
        (5) *E. ootacodensis* (STOLICZKA) (Lower Ariyaloor group, Campanian)
    b. Pondicherry area
        (1) *Baculites* (?) *teres* (FORBES) (Valudayur beds, *Trigonoarca* beds, Lower Maestrichtian)
        (2) *Eubaculites vagina* (FORBES) (Valudayur beds, *Trigonoarca* beds, Lower Maestrichtian)
        (3) *E. ootacodensis* (STOLICZKA) (Valudayur beds, Lower Maestrichtian)
15. Madagascar
    a. Diego-Suarez area (BOULE, LEMOINE and THEVENIN, 1906-1907)
        (1) Cf. *Lechites gaudini* (PICTET and CAMPICHE) (Mont-Raynoud) (Cenomanian)
        (2) *Sciponoceras baculoides* (MANTELL) (Cenomanian)
        (3) "*Baculites vagina*" (probably identified as *B. boulei* COLLIGNON) (Ambohimarina) (Lower Senonian)
    b. Mahagaga, northern part of Madagascar (COLLIGNON, 1931) (Lower Senonian)
        (1) *Baculites* cf. *brevicosta* SCHLÜTTER [probably better referable to *B. boulei* COLLIGNON]
        (2) *B. boulei* COLLIGNON
        (3) *B. sulcatus* BAILY
        (4) *B. besairiei* COLLIGNON [probably synonymous with *B. yokoyamai* TOKUNAGA and SHIMIZU]
        (5) *B. roedereri* COLLIGNON
        (6) *B. latelobatus* COLLIGNON
    c. Diego, east of Antsirane (COLLIGNON, 1928-1929) (Cenomanian); Antsatramahavelona, Analalava area (COLLIGNON, 1933) (Cenomanian)
        (1) Cf. *Lechites gaudini* (PICTET and CAMPICHE)
        (2) *Sciponoceras baculoides* (MANTELL)
    d. Antsalova area, western Madagascar (COLLIGNON, 1931) (Lower Senonian)
        (1) *Baculites* cf. *asperoanceps* LASSWITZ [may be better referable to *B. boulei* COLLIGNON]
        (2) *B.* aff. *capensis* WOODS [probably referable to *B. capensis* WOODS]
16. South Africa
    a. Pondoland (BAILY, 1855; WOODS, 1906; VAN HOEPEN, 1921) (probably Santonian)

(1) *Baculites bailyi* WOODS
(2) *B. sulcatus* BAILY
(3) *B. capensis* WOODS

b. Zululand (SPATH, 1921; VENZO, 1936) (Santonian or Lowest Campanian)
(1) *B. capensis* WOODS
(2) *B.* sp. aff. *capensis* WOODS
(3) *B.* cf. *aspero-anceps* LASSWITZ [better referable to *B. boulei* COLLIGNON]
(4) *B.* cf. *brevicosta* SCHLÜTTER [possibly referable to *B. capensis* WOODS]
(5) *B.* sp. cf. *sulcatus* BAILY
(6) *B. bailyi* WOODS

As demonstrated in the preceding paragraphs, the biostratigraphic value of baculitid species is appreciable not only for the Cretaceous of Japan and California but also for that of other areas in the vast Indo-Pacific region. Species of the Baculitidae from this region would become more useful for zonal correlation, if their stratigraphic occurrences in various areas were known more precisely and more frequently than at present.

Geographical Distribution

An outline of the paleogeographic distribution of the baculitid species from Japan is given in the summary of results of Parts I and II. Most of the species from Japan are Indo-Pacific, including the northern Pacific ones. In our present knowledge some are endemic and a few are cosmopolitan.

Some of the Cenomanian and the Turonian species are common between distant regions, just as in the case of certain ammonite species. Examples are as follows, with the indication of a geological age:

Sciponoceras baculoides (MANTELL) (Cenomanian)

Baculites undulatus ROMAN and MAZERAN (Upper Turonian)

If we furthermore take consideration of the species whose representatives in separate regions are very closely allied, certain baculitids from the Upper Campanian are to be added to the above species. Examples of the species from Japan (indicated on the left side) and the corresponding representatives in Europe (indicated on the right side) are as follows:

Baculites inornatus MEEK: *B. vertebralis* LAMARCK (Upper Campanian—Lower Maestrichtian)

Baculites anceps pacificus subsp. nov.: *B. anceps anceps* (Upper Campanian—Lower Maestrichtian)

Comparison of the Upper Cretaceous ammonite faunas between California and Japan has been attempted by MATSUMOTO (1960, p. 166); The conclusion is that species common to California and Japan constitute the highest percentage of the whole faunas and that the intimate connection between the faunas of California and Japan is evident in every age of the Late Cretaceous. Support is given to this conclusion from the present study of the Baculitidae, too. The common species are listed below, with the indication of a geological age:

Sciponoceras baculoides (MANTELL) (Cenomanian)

S. kossmati (NOWAK) (Lower Turonian)
S. intermedium sp. nov. (Upper Turonian)
Baculites yokoyamai TOKUNAGA and SHIMIZU (Coniacian)
B. schencki MATSUMOTO (Lower Senonian)
B. boulei COLLIGNON (Lower Senonian)
B. capensis WOODS (Santonian + Upper Coniacian)
B. kirki MATSUMOTO (Santonian)
B. chicoensis TRASK (Lower Campanian)
B. occidentalis MEEK (Upper Campanian)
B. anceps pacificus subsp. nov. (Upper Campanian)
? *B. regina* n. sp. (Campanian)
B. rex ANDERSON (Maestrichtian)

Examples of the Indo-Pacific elements, which are not only common in the northern Pacific provinces but also distributed over other parts of the vast Indo-Pacific realm, are *S. kossmati* (NOWAK), *B. yokoyamai* TOKUNAGA and SHIMIZU [≑ *B. besairiei* COLLIGNON], *B. boulei* COLLIGNON and *B. capensis* WOODS. The two species from Japan listed below have not been reported from California but are identical with or very closely allied to the species from other areas. Their geological age in these areas is indicated in parentheses.

Baculites undulatus ROMAN and MAZERAN: itself (Upper Turonian of Europe)
Baculites bailyi WOODS: itself (probably Santonian of South Africa)

In our present knowledge *Sciponoceras orientale* n. sp., *Baculites uedae* n. sp., *B. tanakae* n. sp., *B. princeps* n. sp. and *B. pseudobaculus* n. sp. are apparently endemic in the Japanese province, but in the future some of them would be found in other regions. As a conclusion with regard to the distribution of Baculitidae the Upper Cretaceous of Japan is most intimately connected with the California province, considerably related to other parts of the Indo-Pacific provinces, and presumably indirectly related to Europe and other remote parts.

None of the baculitid species are common between the Japanese and the North American Interior-Gulf Coast provinces. Even in America the common species are rare between the Pacific and the Gulf-Atlantic regions, although *Baculites columna* MORTON and *B. lomaensis* ANDERSON occur in both California and Gulf-Atlantic provinces (see MATSUMOTO, 1959b, 1960). There are, however, interesting examples which show a similarity between the separated biogeographic regions. They are as follows:

Indo-Pacific		Interior-Gulf-Atlantic (Age)
Sciponoceras orientale	:	*S. gracile* (Turonian)
Baculites yokoyamai—*B. boulei* or *schencki*	:	*B. mariasensis*—*B. sweetgrasensis* (Coniacian)
B. capensis—*B. tanakae*	:	*B. asper*—*B. taylorensis* (Lower Senonian-Campanian)

The resembling species are probably in parallel relationship, although the ultimate origin may be in common.

Evolutional History

From the palaeontologic and the stratigraphic facts, which are described in detail in Parts I and II, we have attempted to get an idea about the evolutional history of the examined species and genera. In connection with this we have endeavoured as far as possible to bring into order the hitherto known species of the Baculitidae from the Indo-Pacific region and related areas. Our present knowledge is by no means perfect, but the described species from Japan fill up some blanks in the records of the evolutional history of the family. A summary of results may be shown in Figs. 217 and 218.

The ultimate origin of the Baculitidae is probably in *Hamites*, as was already discussed by SPATH (1941). *Sciponoceras* (?) sp. (p. 12 in Part I), from Hokkaido, which resembles in some respects *Hamites* (?) *glaber* WHITEAVES (1884) (KOSSMAT, 1895), may be the one which can be furnished from the Japanese material for the above problem. The intimate relationships of *Sciponoceras* with the preceding *Lechites* on one hand and the succeeding *Baculites* on the other have already been known (SPATH, 1941; WRIGHT *in* MOORE [Editor], 1957; MATSUMOTO, 1959) and is confirmed by the present study. An undescribed species from the lower Lower Cenomanian beds (with *Graysonites* spp.) in Hokkaido and Kyushu has a character which could link Upper Albian *Lechites gaudini* with Lower Cenomanian *Sciponoceras baculoides*. There is some evidence to prove the gradual transition from *Sciponoceras* to *Baculites*, as seen in *S. bohemicum*, *S. intermedium*, *B. undulatus* and *B. yokoyamai*. The resemblance between *Euhomaloceras incurvatus* and *Baculites capensis* is noted by WOODS (1906) and MATSUMOTO (1959). As WRIGHT has suggested us (in his recent letter to T.M.), *B. undulatus* could be another possible source of *Euhomaloceras*. COBBAN (1952) established *Pseudobaculites*, comparing it with *Baculites*. *B. pseudobaculus* from Japan, which is intimately related to *B. yokoyamai*, is

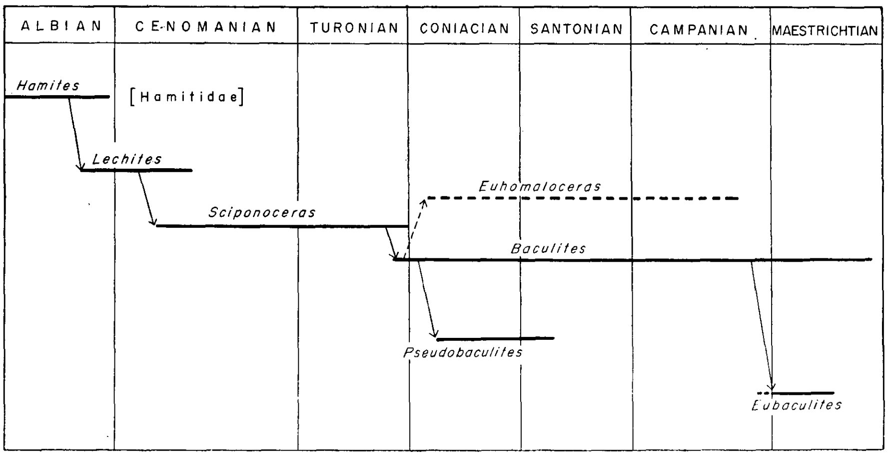

Fig. 217. Evolution of baculitid genera.

interesting in that it shows a tendency to show the peculiar suture of *Pseudobaculites* type. This suggests that *Pseudobaculites* itself may have been derived from some North American Western Interior species which is allied to, if not identical with, *B. yokoyamai*. MATSUMOTO (1959) has already demonstrated, in the description of *Baculites occidentalis* and *Eubaculites ootacodensis*, that *Eubaculites* is a descendant of *Baculites*. Thus, the evolution of the Baculitidae at the generic level can be summarized in Fig. 217.

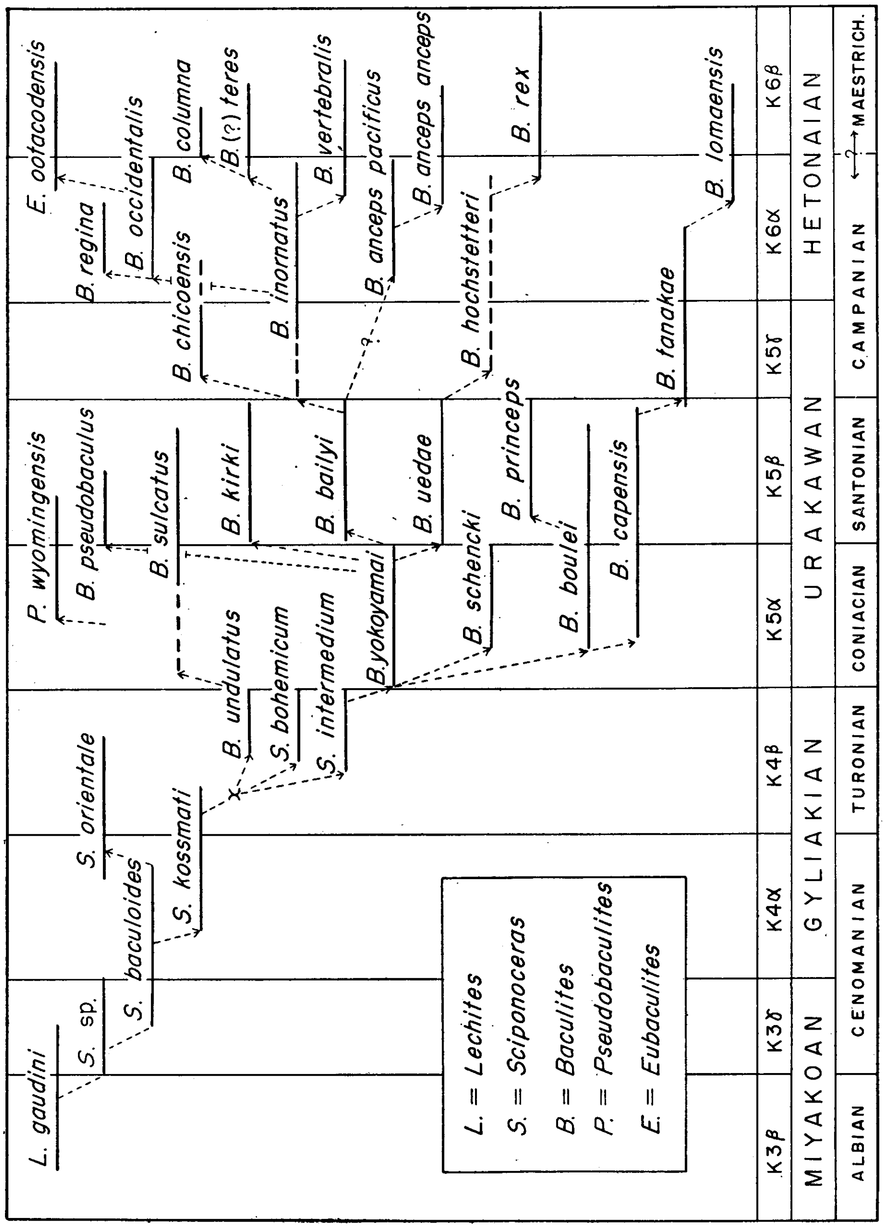

Fig. 218. Evolution of species of the Baculitidae in the Indo-Pacific region and related areas. (A dotted arrow indicates a possible line of descent; a broken line a presumed geological range.)

Fig. 218 is a summary of the evolution of the baculitid species in the Indo-Pacific region and related areas. In the early epoch of the history, from Albian to Turonian, a gradual evolutional change proceeded. In the late Cenomanian *Sciponoceras baculoides* gave rise to *S. orientale* on one hand and *S. kossmati* on the other, the latter of which, in turn, probably led to *S. bohemicum* and *S. intermedium* in the Turonian.

Some specialization was revealed several times at or near the boundary of the stages from Turonian to Maestrichtian. From the late Turonian to early Coniacian, particularly, numerous species were developed. Upper Turonian *Baculites undulatus* seems to have given rise to such Lower Senonian species as *B. sulcatus*. Upper Turonian *Sciponoceras intermedium* is an immediate ancestor of Coniacian *Baculites yokoyamai*, which, in turn, is probably a good source of various Indo-Pacific species of *Baculites*. At least three lines of descent are recognized in the evolutional history of them. The first is from *B. yokoyamai* through *B. bailyi* and *B. inornatus* to *B. vertebralis*, in which slow tapering, subelliptical cross section and nearly smooth surface are retained, and thus rather conservative, but it seems to have led to various offshoots. The examples of the offshoots are Santonian *B. kirki* (directly from *B. yokoyamai*) and Lower Campanian *B. chicoensis* (probably from *B. bailyi*), both of which have a keeled venter, *B. anceps*, with a narrowly arched to angular venter and crescentic ribs, Campanian *B. occidentalis* (possibly from *B. inornatus*) and then specialized *B. regina*, with a narrowed venter and flattening of flanks and dorsum, and probably other specialized species, such as *B. teres* and *B. columna* (from *B. inornatus*?).

The second line of descent is from *B. yokoyamai* through *B. uedae* and probably *B. hochstetteri* to *B. rex*, in which more or less rapid tapering and complication of sutures took place. The third is from *B. yokoyamai* through *B. boulei*, *B. capensis* and *B. tanakae* to *B. lomaensis*, in which tubercles are aquired and strengthened. Coniacian *B. schencki* and Santonian *B. princeps* are probably short branches from this stock.

Sedimentary Facies and Occurrence of Fossil Baculitids

To find any relations between the sedimentary facies and the occurrence of baculitids is an interesting problem. Since the factors concerned are multiple, this should be analysed case by case from various angles. In regard to the palaeoecology of the Baculitidae at least the following three main aspects should be considered:

(1) Mode of life of species of baculitids which can be deduced from the morphological characteristics of the shell

(2) Mode of occurrence of the remains of the baculitids and also the thanatocoenosis

(3) Sedimentary facies

For the general discussion of these aspects we are preparing another paper

(MATSUMOTO and OBATA, 1962). In this paper we present examples from our available data for the facies stratigraphic problem.

The baculitids are found in both the muddy and sandy rocks in Japan. In fact *Sciponoceras intermedium, Baculites undulatus, B. yokoyamai, B. bailyi* and *B. uedae,* for example, often occur in both the muddy and sandy rocks. In many cases of Japanese examples, the baculitids are obtained from calcareous nodules in muddy rocks, such as mudstone and fine-sandy siltstone. In some other cases, however, the baculitids are found in a muddy fine- to medium-grained sandstone which is intercalated between, or immediately underlies or overlies the muddy unit. In some cases of the sandstone, as in *B. yokoyamai* of the Ikushumbets Valley, the remains occur in abundance in a particular layer showing subparallel arrangement of the elongated shells. This seems to indicate the effect of current but suggests, at the same time, that the living place was not far from this place of burial. When the baculitid shells occur in limy nodules, numerous specimens are contained, being usually orientated at random. The associated species in the same nodule or in the same bed have been carefully examined in the present study, although we omit the full list. The aberrant ammonoids, such as those belonging to the Turrilitidae, Nostoceratidae, Diplomoceratidae and Scaphitidae, are common associates among others. Inocerami are also commonly associated, but trigonians and glycymerids usually occur in different beds of sandstone.

It is well known in Europe and other areas that some of the species, including those which are identical with or closely allied to the species from Japan, occur in chalk or limestone. In an extreme and rare case, on the other hand, baculitid shells occur even in conglomerate, probably due to transportation. How the shell could be floated by the current has been recently discussed by REYMENT (1958c), who suggests the possibility of wide distribution of shells after the death. In our examples, however, the sites of burial actually do not seem to have been much separated from the place of living, because there is no evidence to support a long distant transportation.

Although the fine-grained sediments appear to be favourable for the baculitids, the selection of the bottom sediments by species may not be so significant. The distance from the coast line, depth and other conditions of the sea-water as well as food chains must have been more important. It is interesting to note, in this connection, that in our examples the sediments from which baculitids are obtained often contain drifted small fragments of woods and other plant material and sometimes contain glauconite. As far as the examples in Japan is concerned, abundance of fossil baculitids seems to vary in accordance with the facies change.

We can analyse the situation by plotting the abundance data on the diagram of the sedimentary facies in Hokkaido, which has been lead by MATSUMOTO's stratigraphic study (Figs. 219, 220). The stratigraphic positions of the prominent occurrence of baculitids are almost always just on or near the border-lines of facies-stratigraphic units. In other words they are mostly in fine-sandy siltstone which occupies the intermediate position between the near-shore and shallow sandstone unit and the offshore and probably deeper mudstone unit.

If the stratigraphic succession (Figs. 216, 221) of the baculitids is taken into account in addition to the above mentioned factors, the situation can be shown more clearly. The occurrence of baculitids can be explained with refer-

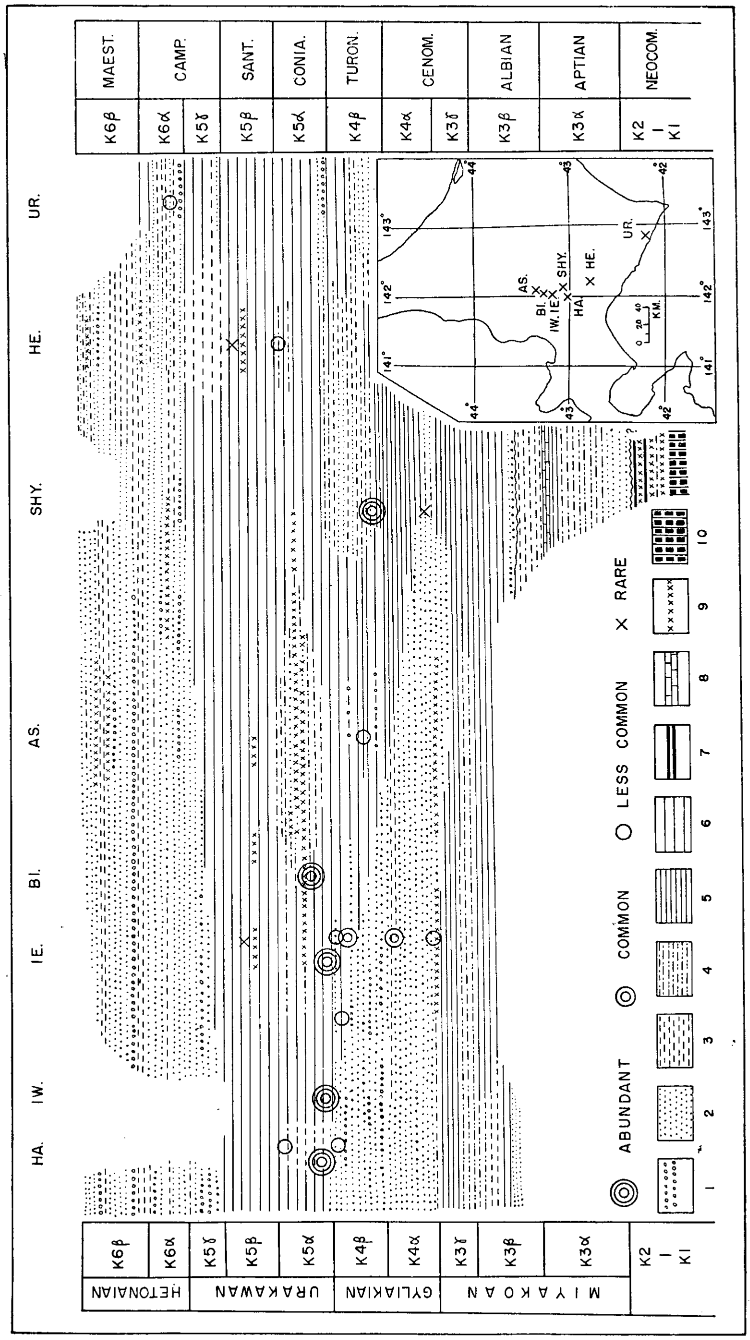

Fig. 219. Stratigraphic and geographic occurrence of the baculitids showing their sedimentary environments in the southern part of Hokkaido. UR.: Urakawa area; HE.: Hetonai [Tomiuchi] area; SHY.: Shuyubari Valley; AS.: Ashibetsu Valley; BI.: Bibai area; IE.: Eastern wing of Ikushumbets area; IW.: Western wing of Ikushumbets area; HA.: Hatonosu Hills. Prevalent lithology: 1. Conglomerate, 2. Sandstone, 3. Siltstone, more or less sandy, 4. Interbedded sandstone and shale, 5. Laminated shale and sandy shale, 6. Mudstone, rather massive, 7. Chert or siliceous shale, 8. Limestone, 9. Tuff, 10. Andesic lava. This figure disregards the thickness of the sediments and the distance between the localities. (Adapted from the figures compiled by T. MATSUMOTO, 1954, partly based on the data of K. TANAKA, 1959, 1960).

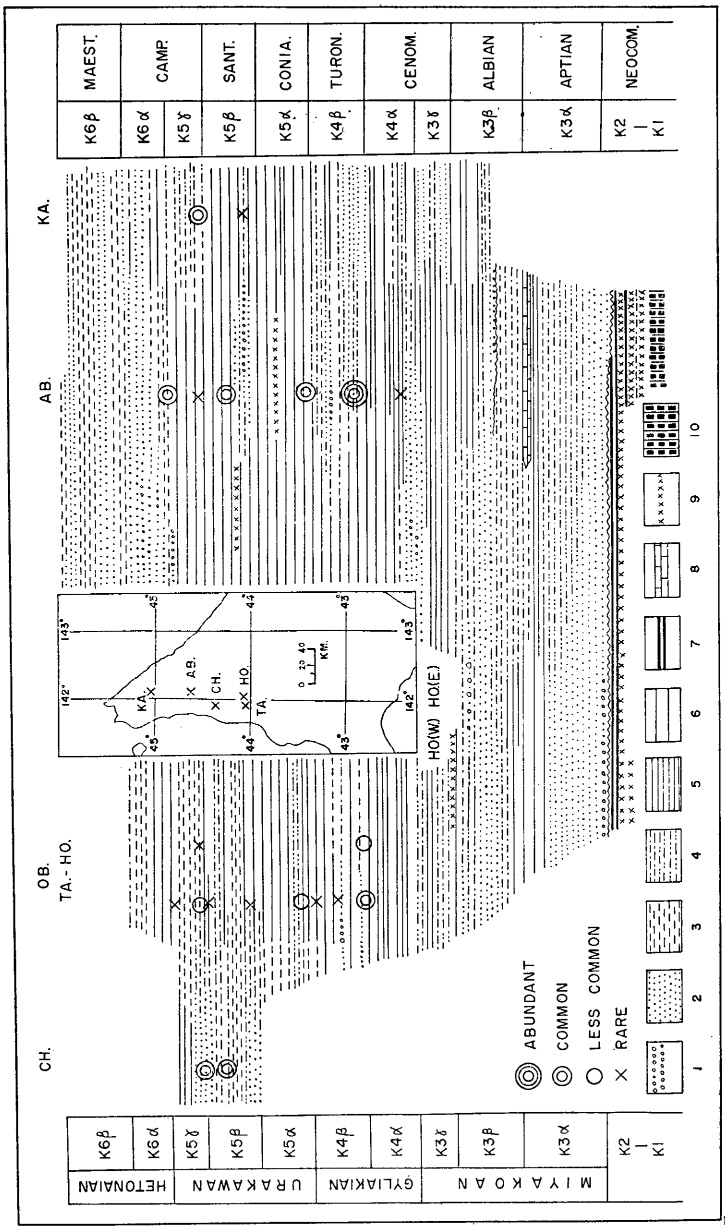

Fig. 220. Stratigraphic and geographic occurrence of the baculitids showing their sedimentary environments of baculitids in the northern part of Hokkaido. KA.: Kamisarufutsu area; AB.: Abeshinai-Saku area; OB. (TA.-HO.): Obirashibets (Tappu-Horokanai) area; CH.: Chikubetsu-Haboro area. Prevalent lithology: 1. Conglomerate, 2. Sandstone, 3. Siltstone, more or less sandy, 4. Interbedded sandstone and shale, 5. Laminated shale and sandy shale, 6. Mudstone, rather massive, 7. Chert or siliceous shale, 8. Limestone, 9. Tuff, 10. Andesic lava. This figure disregards the thickness of the sediments and the distance between the localities. (Mostly based on the data of T. MATSUMOTO, 1954, K. TANAKA, 1958 a, b, 1960, Y. UEDA, T. MATSUMOTO and K. AKATSU, 1962).

ence to the palaeogeographic evolution. Thus, the history in Hokkaido may be summarized as follows:

1. *Cenomanian age.*—At the beginning of the Paleogyliakian age (in the middle of Early Cenomanian) the coast line seems to have been siutated further west from the line of Hatonosu Hills—West Ikushumbets of the present Cretaceous outcrops in Central Hokkaido. At that time *Sciponoceras baculoides* is commonly found in the basal part of a sandy unit, called the *Trigonia* sandstone

or Mikasa formation on the eastern wing of the Ikushumbets anticline. The lower part of the Mikasa formation of middle Paleogyliakian age is more sandy and has no remains of the baculitids. In the more offshore part where the sandstone unit almost thins away, a few species sparsely occur in the same stage, as exemplified by *Sciponoceras kossmati* in the Shuyubari and *Sciponoceras* (?) sp. in the Abeshinai area. The coast line was apparently shifted somewhat

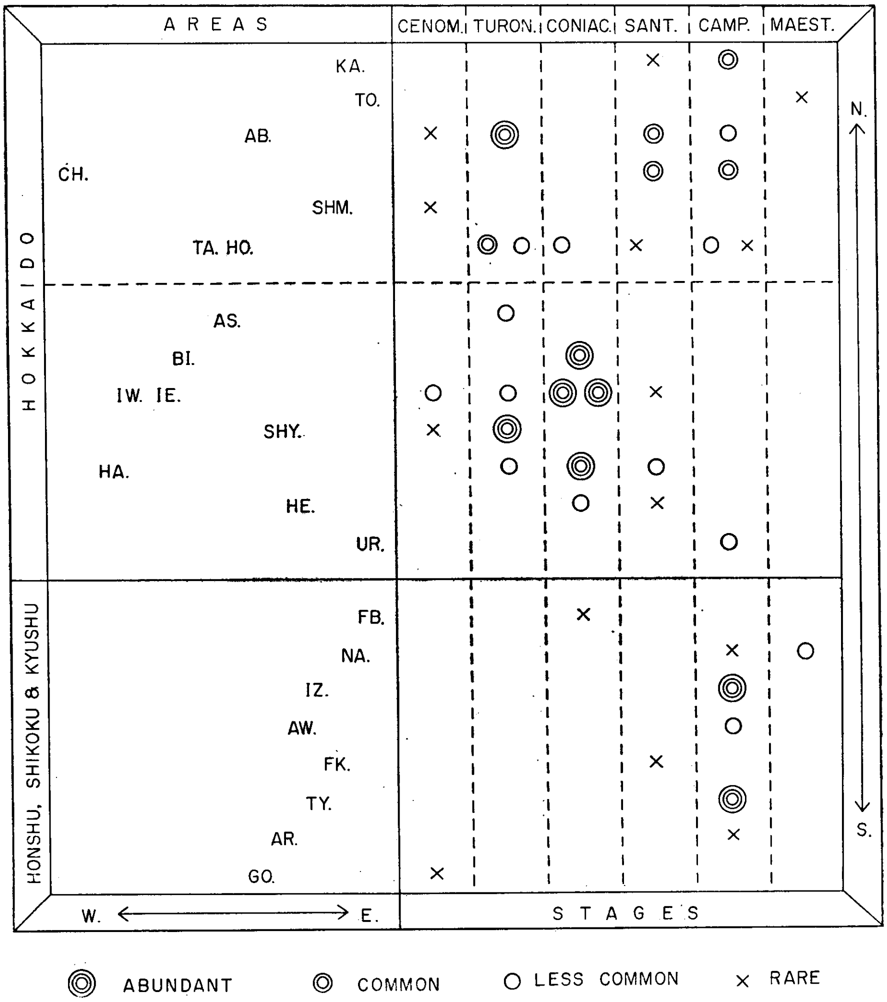

Fig. 221. Chart showing the stratigraphic and geographic occurrence of the baculitids in Japan. KA.: Kamisarufutsu area; TO.: Tonbetsu Valley; AB.: Abeshinai-Saku area; SHM.: Shumarinai area; CH.: Chikubetsu-Haboro area; BI.: Bibai area; IE.: Eastern wing of Ikushumbets area; IW.: Western wing of Ikushumbets area; SHY.: Shuyubari Valley; HA.: Hatonosu Hills; HE.: Hetonai [Tomiuchi] area; UR.: Urakawa area; FB.: Futaba area; NA.: Nakaminato area; IZ.: Izumi Range; AW.: Awaji Island; FK.: Futakawa area; TOY.: Toyajo Hills; AR.: Arioka area; GO.: Goshonoura Island.

eastward in the Middle Cenomanian than in the Lower Cenomanian.

2. *Turonian age*.—The coast line again shifted somewhat westward in the Late Cenomanian and Early Turonian than in the Middle Cenomanian. *Sciponoceras kossmati* occurs fairly commonly at a particular part which is situated in the transitional part from the muddy middle member to the sandy upper member of the Mikasa formation on the eastern wing of the Ikushumbets anticline.

In the Middle Turonian, the age of regression, prominent sandstone with some conglomerate is developed in the Ikushumbets area. No baculitids are found in this part of the Mikasa formation. In the lower to middle part of the Saku formation, which represents the eastern facies of almost the same (Lower-Middle Turonian) age, *Sciponoceras orientale* occur fairly abundantly.

In the Late Turonian the coast line may have shifted gradually westward as compared with that in the Middle Turonian. Thus, *Sciponoceras intermedium* and *Baculites undulatus* occur fairly commonly in a particular part which is transitional from the sandy Mikasa formation to the muddy Upper Yezo group or in the basal fine-sandy siltstone of the Upper Yezo group. Further eastward in the Shuyubari and the Abeshinai-Saku area the Upper Turonian is represented by the upper part of the Saku formation in which sandstone and siltstone is frequently interbedded. *Baculites undulatus* occurs commonly in this part.

3. *Coniacian age*.—The coast line generally shifted further westward in the Coniacian than in the Late Turonian with some oscilations, representing the beginning of the Urakawan transgression. Prominent area of *Baculites* seems to have been in the western part of the present Cretaceous outcrops in central Hokkaido as represented by the Ikushumbets area and the Hatonosu Hills. *Baculites yokoyamai*, for example, occurs abundantly at or near the particular sandy layers which are intercalated between the muddy lower part of the Upper Yezo group.

4. *Santonian age*.—The coast line seems to have been withdrawn still more westward in the Santonian age than in the Coniacian, representing the inundation phase of the Urakawan transgression. The muddy sediments of the offshore facies predominate in many areas. More near-shore, if not coastal, environments in this age are represented by the Chikubetsu area, where sandy beds are frequently intercalated between the muddy sediments. *Baculites uedae*, *B. boulei*, *B. princeps* and *B. bailyi* occur commonly in this area. In the Abeshinai-Saku area, which adjoins to the northeast of the Chikubetsu area, *B. capensis*, *B. uedae* and *B. princeps* occur in somewhat silty facies.

5. *Campanian age*.—The coast line probably shifted again eastward. In a particular part of the Uppermost Urakawan, a transitional part from the muddy Upper Yezo to the sandy Hakobuchi group, in the Haboro and Saku areas, *Baculites tanakae* occurs commonly. In the Abeshinai area *B. chicoensis* is found rarely.

Baculitids occur very sparsely in the Lower Hetonaian of Hokkaido, in which coarse clastics are predominant. Only in the Urakawa area baculitids occur sporadically in somewhat silty facies which are near the boundary of the sandy and the muddy stratigraphic units. They are exemplified by *B. anceps pacificus* and *B.* aff. *hochstetteri.*

In the Lower Hetonaian stage, the prosperous areas of baculitids are recognized in certain parts of Honshu (e.g. in the Izumi Mountain-range and Kii Mountains). The Honshu specimens were mostly obtained from the shale or silty member intercalated in a thick group of predominant sandstone. It should be noted that the elements of the baculitid faunules in this stage are somewhat different between Hokkaido and Honshu. The species from Honshu are *Baculites inornatus, B. occidentalis* and *B. regina.* This contrast is probably due to the difference in the environments between the basins of deposition of uppermost Upper Yezo-Lower Hakobuchi group in Hokkaido and the Izumi-Sotoizumi group in Southwest Japan. In the latter group the baculitids are associated with such peculiar ammonites as *Pravitoceras sigmoidale* YABE and *Didymoceras awajiense* (YABE), which are absent or rare in Hokkaido.

6. *Maestrichtian age.*—No baculitids have yet been found from the sandy facies of the Upper Hetonaian [Maestrichtian], upper Hakobuchi group on the western side of the meridional serpentinite belt of Hokkaido. Thus, the unfavourable environment for baculitids continued. In the Tonbetsu area, which is on the eastern side of the meridional serpentinite belt, the Upper Hetonaian is, on the whole, more muddy and thicker than that of other areas. *B. rex* is only obtained from this muddy facies.

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Alphabetic list of the Romanized place names with their Japanese writings

Abeshinai (アベシナイ) [=安平志内]
Ainu-sawa (愛奴沢)
Arioka (有岡)
Aritgawa (有田川)
Arita-gun (有田郡)
Ashibetsu (芦別)
Awaji (淡路)
Azenotani (畦ノ谷)
Banno-sawa (盤ノ沢)
Bibai (美唄)
Chikubetsu (築別)
Detofutamata (デト二股)
Furenai (振内)
Futaba (双葉)
Futakawa (二川)
Gono-sawa (五ノ沢)
Goshonoura (御所ノ浦)
Gyojyamatsu (行者松)
Haboro (羽幌)
Haborogoe (羽幌越)
Hakobuchi (函淵)
Hatonosu Hills (鳩ノ巣山)
Heitaro-zawa (平太郎沢)
Hetonai (ヘトナイ) [=辺富内]
Hidaka (日高)
Hinenoiwakura (日根野岩倉)
Hirono (広野)
Hirota-mura (広田村)
Horokanai (幌加内)
Iburi (胆振)
Ikushunbetsu [=Ikushumbets] (幾春別)
Ishikari (石狩)
Isoai (磯合)
Itaya (板谷)
Iwakura-mura (岩倉村)
Izumi (和泉)
Izumi-Sano (和泉佐野)
Kamisarufutsu (上猿払)
Katsura-zawa (桂沢)
Kitami (北見)
Kikume-zawa (菊面沢)
Kotan-zawa (古丹沢)
Kotodono-sawa (木椴ノ沢)
Kuratani (倉谷)
Kyowa (共和)
Matsuishi-zawa (松石沢)
Midori-mura (緑村)
Mihara-gun (三原郡)
Mihara-machi (三原町)
Mikasa (三笠)
Minato (湊)
Mutsuo (六尾)
Nagasone-zawa (長曽根沢)
Nagata (長田)
Naka (那珂)
Nakaminato (那珂湊)
Nakatombets (中頓別)
Nishihorobetsu (西幌別)
Ohashi (大橋)
Okubo (大久保)
Opirashibets (オピラシベツ) [=小平蘂]
Oriki (折木)
Panke-zawa (パンケ沢)
Pombets (奔別)
Ponhorokabetsu (奔幌加別)
Popets [=Hobetsu] (穂別)
Porokeshomap (ポロケショマップ) [=幌毛志川]
Porokoashibetsu (幌子芦別)
Sakasa (逆)
Saku (佐久)
Saku-gakko-zawa (佐久学校沢)
Sakura-zawa (桜沢)
Sankebetsu (三毛別)
Sankei (三渓)
Sennan-gun (泉南郡)
Sharu (沙流)
Shichi (志知)
Shindachi-machi (信達町)
Shinke-mura (新家村)
Shisanushibe (シサヌシベ)
Shumarinai (朱鞠内)
Shuyubari [=Shiyubari] (主夕張)
Takanbets (タカンベツ)
Takinoike (滝ノ池)
Tappu (達布)
Tengu-zawa (天狗沢)
Teshio (天塩)
Tokuhara (徳原)
Tomiuchi (富内) [=辺富内]
Tonbetsu [=Tombets] (頓別)
Toyajo (鳥屋城)
Urakawa (浦河)
Wakkawembets (ワッカウェンベツ)
Yubari (夕張)

Index of Genera and Species

Names of genera and species descibed or discussed in Part I (indicated as I/page) and Part II (as II/page) are alphabetically listed below. Plates are indicated by boldface type followed by a number of a figure (as **21**, 5=Pl. 21, fig. 5).