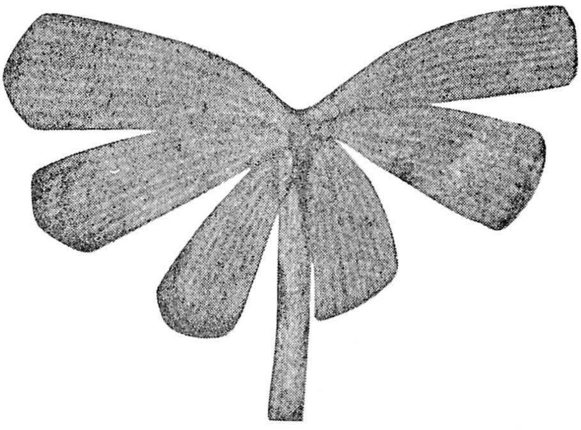
# 日本古生物学會
# 報告・紀事

# Transactions and Proceedings
# of the
# Palaeontological Society of Japan

New Series No. 100



日本古生物学会

Palaeontological Society of Japan
December 25, 1975

*Editor* Takashi HAMADA
*Associate Editor* Ikuwo OBATA



Fossil on the cover is the six leaves in a whorl of *Trizygia oblongifolia* (GERM. & KAULF.) ASAMA from the Maiya formation (*Parafusulina* zone), Maiya, N. E. Japan.

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Trans. Proc. Palaeont. Soc. Japan, N.S., No. 100, p. 175, December 25, 1975

# EDITORIAL

This is the 100th issue of our journal in the New Series. The Palaeontological Society of Japan was founded in 1935, and at the same time the **Old Series** of the Transactions and Proceedings of the Palaeontological Society of Japan commenced as a part of the Journal of the Geological Society of Japan. The **New Series** started in 1951 as a separate journal, and since 1957 our Society has become independent from the Geological Society. Consequently, this 100th issue appears just a quarter century after that memorial event of the Society.

Among some 80 extant jounals of the world specialized in palaeontology and closely related fields of earth sciences, our journal, thus, has rather long history of development. It represents one of the career journals which have been published since a period before World War II.

Excluding short notes and other occasional papers, 656 articles have been published in the journal both in the Old and New Series, of which 465 are in the latter. 199 authors have contributed to the New Series, and distinguished four of them have passed away, i. e. Professors Hisakatsu YABE, Riuji ENDO, Seido ENDO and Rokuro MORIKAWA who had greatly promoted our Society and the journal in their own specialities.

The new taxa proposed through hundred issues of the New Series attain 49 in supra-specific, 651 in specific and 46 in infra-specific levels, respectively. They have been endorsed by many good illustrations on 538 photographic plates.

It is quite evident that the journal has developed as one of the leading scientific publications in our country since its foundation. Actually, our Transactions and Proceedings of the Palaeontological Society was the first specialized journal in European languages in the fields of geological sciences in Japan except some university publications. The character of this journal was apparently to be international, and it has been much strengthened during this past quarter century. 36 papers written by Japanese palaeontologists in the New Series have dealt with the materials from abroad, and 26 articles have been contributed by foreign scientists from various countries.

Special Papers, another series published as monographic works by our Society, will be numbered 20th in 1976 also. The Society decided to publish a supplementary issue of the New Series that entitled "A Concise History of Palaeontology in Japan" as N. S. No. 100s in this memorable year. The reader will find not only a history of the development but also the trends of the Japanese palaeontology in this extensive presentation.

Quite recently, EDITEAST, an Association of Editors in Science in Southeast Asia, Australasia and Oceania, was established being sponsored by UNESCO and IUGS. The aim of the association is said to promote improved communication in science by cooperation of editors of serial publications. This new movement will be welcomed, and our journal would play an important role as, for the time being, a unique international series that is specialized in palaeontology in the region.

(T. HAMADA)

## 日本古生物学会報告・紀事（新編）100号記念事業について

日本古生物学会報告・紀事は，昭和10年に旧編第1号を刊行以来，40年の歳月を経て，本12月号をもって新編100号に達しました。本会ではこの快挙を記念し，今年1月の総会の承認を得て，通常号（年間4号）とは別に，No. 100s (Supplement) の刊行を企画しました。

No. 100s には，日本の古生物学の歩みを簡潔に紹介し，先人の業績をふりかえるとともに，将来への展望の基礎ともなるよう「日本の古生物学小史 (A Concise History of Palaeontology in Japan)」を英文で収載します。企画には事業計画委員会があたり，歴史に精通しておられる諸先輩の御指導と，活発に活動しておられる多数の研究者からの御協力を得て，海外の研究者にはもちろん国内の同学の士にも益するところの多いものをつくるよう努力しております。

日本の古生物学界の歩みは，過去・現在を通じて本学会の歩みそのものでもあり，それはまたとりも直さず会員の培ってきた大きな流れであります。その意味でも No. 100s は，現会員には無償でおとどけし，すべての方々にこの100号達成を記念していただきたいと考えております。

つきましては，100号出版は会費以外の資金でまかなわれますので，各会員におかれましては上記刊行の趣旨を十分に御理解のうえ，これが実り多いものとなりますよう，出版計画ならびに募金活動に対して何とぞ御協賛，御支援を賜わりますよう，ここに御案内申し上げます。

日本古生物学会報告・紀事100号記念事業計画委員会
委員長　　松　本　達　郎

### 出版概要

規　　模‥‥報告・紀事通常号1号分の大きさ。
刊　　行‥‥昭和51年2月末日完成予定。
内容目次（概略）
序，1. 概説（学界初期，学会誌小史，古生物学年表），2. 古生代微古生物，3. 中生代一新生代微古生物，4. 腔腸動物，5. 苔虫動物，6. 腕足動物，7. 軟体動物（除頭足類），8. 頭足類，9. 節足動物，10. 脊椎動物，11. 古生代植物，12. 中生代植物，13. 新生代植物，14. パリノロジー，15. その他，16. 総説，17. 主要文献〔他，各種付表あり〕

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### 募金状況中間報告

1975年12月現在で，募金は計約130名，およそ22万円となっております。今後ともさらに強大な御支援を下さるよう期待しています。

100s 出版計画についての各種のお問合せは，下記の委員宛にお願いいたします。

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# 652. ON A NEW NON-MARINE PELECYPOD GENUS FROM THE UPPER MESOZOIC GYEONGSANG GROUP OF KOREA*

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韓国上部中生界慶尚層群産非海生二枚貝類新属について：上部中生界非海成層である韓国慶尚層群洛東亜層群から多産する二枚貝を研究し，新属 *Nagdongia* を設けて記載した。これはかつて鈴木が *Nakamuranaia chingshanensis* として記載したものと外形は似るが，内部構造は鈴木の記載と合わず，また中国産の *Leptesthes chingshanense* GRABAU の記載とも合わない。筋こんと鉸歯等はむしろ *Nippononaia, Wakinoa, Plicatounio* と類似するが，これらの属とは表面装飾で区別される。それらの他に，現生のものとしてアフリカ産の *Caelatura* (*Laevirostris*) *bourguignati* (ROCHEBRUNE) 及び *C.* (*Zairai*) *elegans* (ROCHEBRUNE) が鉸歯の数と配列において本属との類似性を示している点が注目される。 梁 承 栄

## Introduction

Until now, there have been reported four non-marine pelecypod genera from the Upper Mesozoic Gyeongsang Group of Korea, i.e., *Trigonioides*, *Plicatounio*, *Schistodesmus* and *Nakamuranaia*, all of which were established by Japanese authors about thirty years ago.

Recently I have collected a large number of specimens from four localities of the Lower Gyeongsang Group (Nagdong Subgroup) which represent a new species of a new genus.

In this paper I give a systematic description of it and a discussion on the comparison with other non-marine Mesozoic pelecypod species from the Far East.

* Received April 8, 1975; read June 15, 1974 at Osaka.

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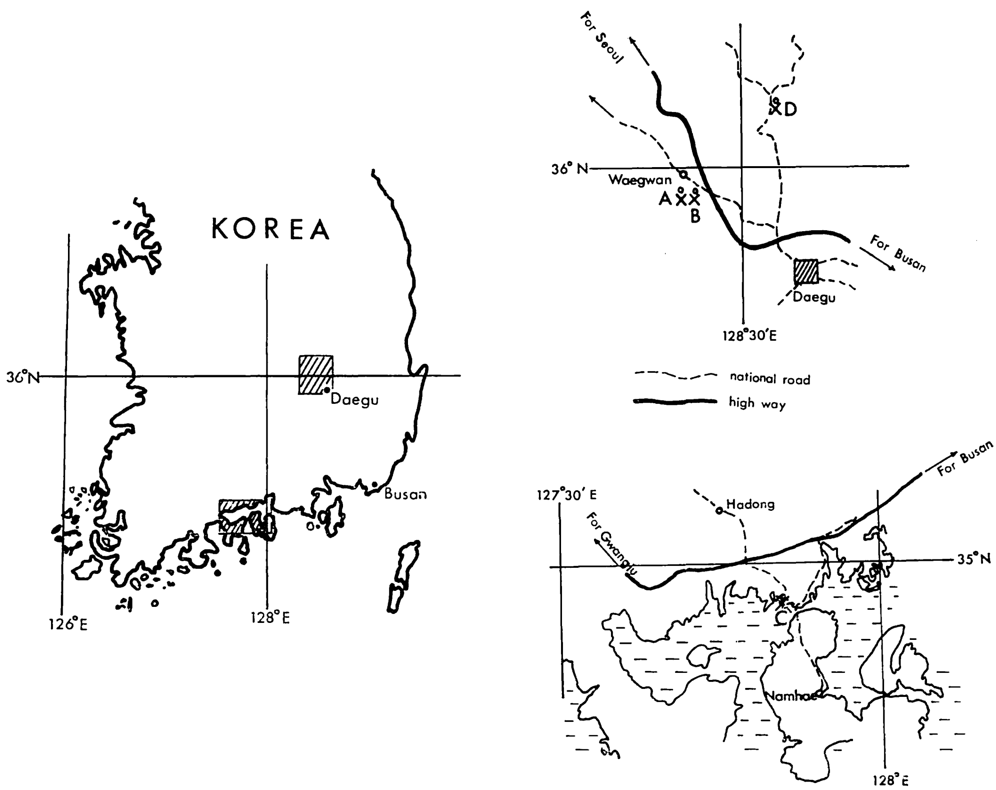
## Acknowledgements

I express my hearty appreciations to Professor Tatsuro MATSUMOTO for his kind supervision and critical reading of the typescript of this paper, and to Associate Professor Kametoshi KANMERA for his continuous encouragement and advice, and Dr. Tomowo OZAWA, Dr. Hiromichi HIRANO, Mr. Kazushige TANABE and Miss Mutsuko HAYASHIDA of the Kyushu University for their kind helps in various ways. And my sincere thanks are due to Professor Yoshihisa OHTA of the Fukuoka University of Education for his instructive suggestions, and to Associate Professor Itaru HAYAMI of the University of Tokyo and Professor Shiro MAEDA of the Chiba University for the loan of their valuable specimens, and to Assistant Professor Sangwook KIM of the Kyungpook National University for sending me some papers which were inaccessible here.




Text-figure 1. Index and locality maps of *Nagdongia soni*.

## Systematic description

Family Unionidae

Subfamily Unioninae

Genus *Nagdongia*, nov.

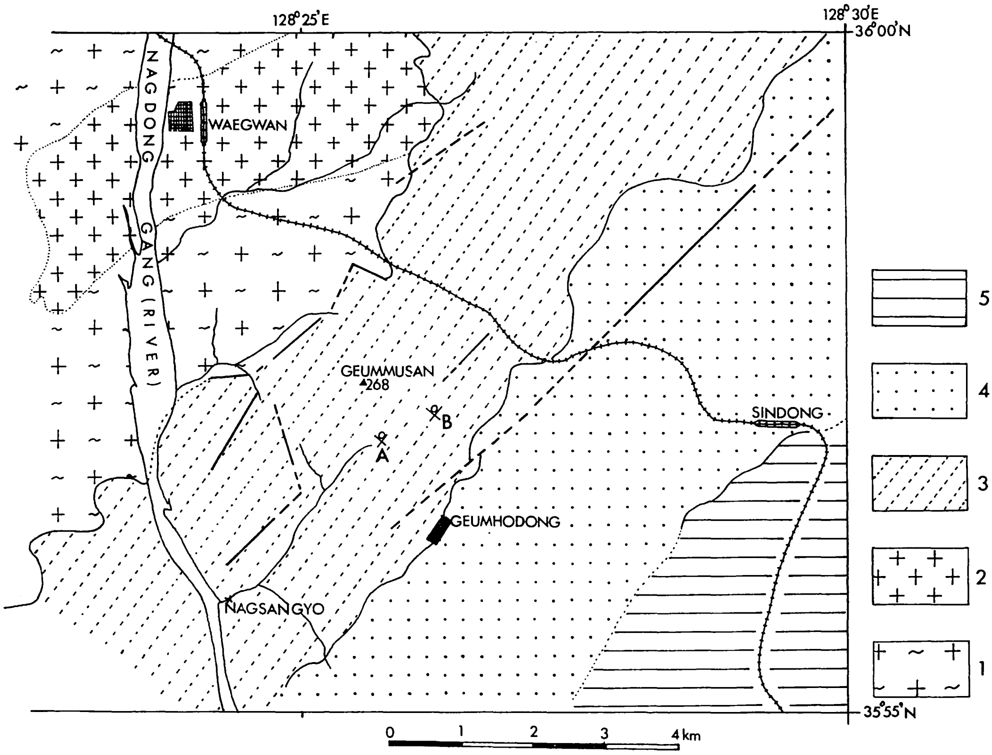
*Type-species*. *Nagdongia soni*, sp. nov., to be described below.

*Generic diagnosis*. Shell medium in size; fairly variable in outline, commonly subtrapezoidal, subelliptical or trigonally elongate; rounded in front, more or less truncated behind, moderately inflated; provided with a fairly distinct posterior ridge; inequilateral and equivalve. Beak fairly prominent, prosogyrous and situated rather anteriorly. Surface ornamented with concentric growth lines only. Hinge teeth well developed; 3 on each valve; 2 pseudocardinal and 1 posterior lateral on right valve; 1 pseudocardinal and 2 posterior lateral on left valve; forming a dental formula:

$$\frac{3 \quad 1 \qquad\qquad \mathrm{PIII} \qquad\qquad}{2 \qquad\qquad \mathrm{PII} \qquad\qquad \mathrm{PIV}}\ .$$

Two adductor scars fairly distinct and the anterior one accompanied with a minute but definite pedal scar on inner side. Inner margin smooth. Beak cavity deep. Pallial line simple. Test fairly thick.

*Remarks*. The type-species of this new genus is fairly similar to a species from Korea described under "*Nakamuranaia chingshanensis* (GRABAU)" by SUZUKI (1943). However, the hinge structure

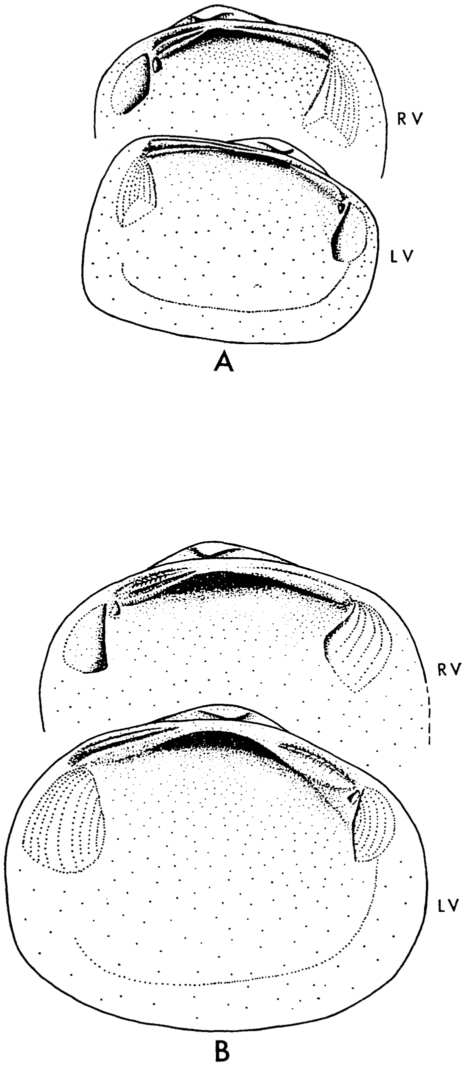



Text-figure 2. Geological map around the type-locality of *Nagdongia soni*.
1. Granitic gneiss 2. Granite 3. Yeonhwadong Formation
4. Hasandong Formation 5. Dongmyeong Formation

of the present type-species is distinct from that of the latter in SUZUKI's description. *Leptesthes chingshanense* GRABAU, 1923, from North China, the type-species of *Nakamuranaia* SUZUKI, 1943, is quite distinct from the type-species of the present genus in the hinge structure as well as the shell-form and thickness of the test, as is described in detail below.

The number of hinge teeth and their disposition are the same as of the recent *Caelatura* (*Laevirostris*) *bourguignati* (ROCHEBRUNE) and *C.* (*Zairai*) *elegans* (ROCHEBRUNE) from Central and Western Africa, respectively. But in detail, the recent African bivalves and the present genus are distinctly different from each other as follows:

| Characters | the African bivalves | the present genus |
|---|---|---|
| cardinals | blade like | blunt and stout striated in adult |
| hinge plate | narrow | moderate |
| pedal scar | non | present |
| adductor scar | small | fairly large |
| beak | not prominent | prominent |
| posterior part | high | not so high |
| test | thin | thick |




Text-figure 3. Internal structure of *Nagdongia soni*.
A. immature B. adult

And also taking account of much separated geographical distribution and the chronological difference, the similarity of the hinge teeth seems to be considered not of genetic relation but of a convergence.

On the other hand, the internal structures, such as adductor scar, pedal scar and the disposition of hinge teeth, are fairly similar to those of *Nippononaia*, *Wakinoa* and *Plicatounio*, but this genus has no radial ribs, the typical ornamentation on the disk of these genera.

The generic name is taken from the Nagdong River, one of the largest rivers in Korea, flowing near the type-locality (Text-figs. 1 and 2).

*Nagdongia soni* YANG, sp. nov.

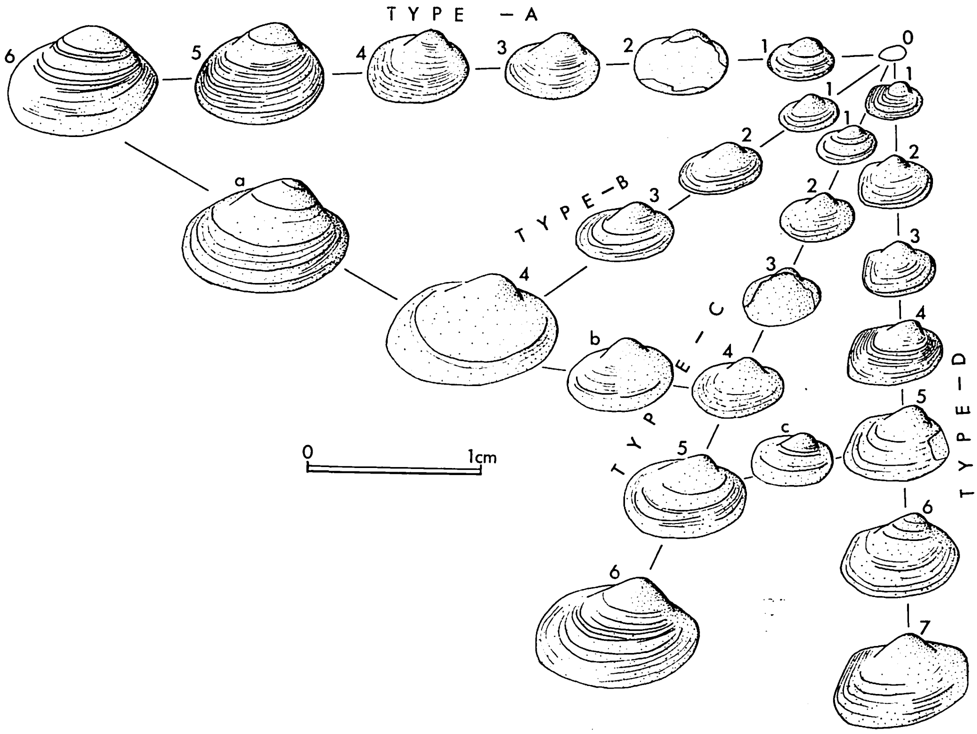
Pl. 16, Figs. 1–11; Pl. 17, Figs. 1–44,
Text-figs. 3, 4 and 6

*Material.* The specimen KPE 1111, a well preserved right valve, is designated as the holotype. It is one of the largest specimens, with dimensions: 72.1 mm in length, 47.3 mm in height, 31.7 mm in the distance between the umbo and the anterior extremity and 11.6 mm in inflation. The other specimens are the paratypes (KPE 1112–1242). All of the specimens numbered with prefix KPE are preserved in the Department of Earth-Science, College of Education, Kyungpook National University, Daegu, Korea. The plaster cast of the holotype is kept in the Department of Geology, Faculty of Science, Kyushu University, Fukuoka, Japan.

*Etymology.* The specific name is dedicated to Professor Chi-Moo SON of the Seoul National University who has contributed much to the development of Geology in Korea.

*Specific diagnosis.* Shell fairly large and subtrapezoidal or subelliptical in outline. Hinge teeth 3 on each valve as described in generic diagnosis. The posterior lateral teeth almost smooth and rather lamellar, but the pseudocardinal teeth provided with faint cross striations in the adult shell. The other characters same as presented in generic diagnosis.

*Description.* Shell outline is quite vari-




Text-figure 4. Variation of the outline of immature shells (right valves) from Locality A.

able as shown in Text-fig. 4. For convenience' sake, the shells are divided into 4 types. Type A is characterized by the blunt umbo and fairly rounded ventral margin and the high ratio of H/L. Type B is similar to Type A except for the ratio of H/L. Type C seems to be intermediate between Type A and Type B. Type D is relatively angular at the postero-ventral and postero-dorsal corners. Among the above types, Type D is a majority group and Type B a minority. Type B and Type D are quite different from each other. However, the difference in shell-form can not be regarded specific, for there are many intermediate forms between them.

Surface is nearly smooth except for the growth lines roughened at irregular intervals.

Hinge plate is moderate in breadth, provided with opisthocline antero-pseudocardinal and postero-lateral teeth. The antero-pseudocardinal ones are 2 on right valve and 1 on left valve; they rather smooth in immature shells but striated faintly in the adult; the postero-lateral teeth are 1 on right valve, 2 on left valve, lamellar in both immature and adult shells. The pseudocardinal ones are relatively higher and stouter, while the postero-lateral ones are longer and sharper and originated from a point apart posterior to the umbo; all of the hinge teeth are parallel to the dorsal margin.

Two adductor scars are situated close to the ventral ends of the pseudocardinal and postero-lateral teeth, subcircular in shape and subequal in size, but the anterior one is more impressed and slightly smaller than the posterior one. In the adult specimens, the adductor scars are distinctly marked by the nearly vertical and very fine riblets. The anterior adductor scar is accompanied with a subtriangular minute pedal scar. Pallial line is shown immediately below the anterior adductor scar and running backward parallel to the marginal outline of the shell and disappeared in the posterior part, without showing pallial sinus. The inner marginal side is smooth (see Text-fig. 3).

*Formation and locality.* The fossiliferous beds under consideration are widely distributed in Nagdong Subgroup of the Gyeongsang Group, Korea. The Nagdong Subgroup is lithostratigraphically divided into Yeonhwadong, Hasandong, Dongmyeong and Chilgok Formations in ascending order (CHANG, 1966). The present species has been found in the sequence from the lower part of the Yeonhwadong Formation to the middle part of the Hasandong Formation. However, the present knowledge of the geological age and correlation of Korean Mesozoic deposits is not sufficient to determine the chronological relationship between the fossil populations between distant areas. The studied specimens were collected from the following four localities (Text-fig. 1).

Yeonhwadong Formation:

Locality A, at a point south of Geummu-san, Waegwan-ub, Gyeongsang-buk-do (type-locality).

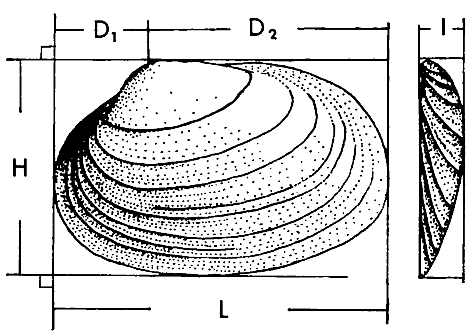
Locality B, at a point north of Buldong-ri, Jicheon-myeon, Chilgok-gun, Gyeongsang-buk-do.

Hasandong Formation:

Locality C, on a seaside of Sumoon-dong, Geumnam-myeon, Hadong-gun, Gyeongsang-nam-do.

Locality D, at a point east of Cheonpyeong-gyo, Gasan-myeon, Chilgok-gun, Gyeongsang-buk-do.

I have collected altogether about 200 shells, of which 93 are measurable for statistical treatment, from these four localities. The sample from Locality A is the largest (more than 140) in sample size, and those from Locality B (more than 30) and Locality C (more than 10) are much smaller than that from Locality A, but they deserve statistical examination for comparison. The sample from Locality D is the smallest (N=3) and consists of too much deformed and fragmentary specimens to be measured.




Text-figure 5. Basic morphology and measurements.

*Simple ratios.* From the bivariate data the fundamental values are calculated in relation to the characters L/H, D/L and I/L. The results are summarized in Table 1. In Table 1, the mean values are represented as range at 95% confidence level and the chi-square test on the sample from Locality A is shown in the right side. As seen in the Table 1, the coefficients of variation of the ratio L/H are smaller than those of other ratios. In other words, the character L/H is the highest in stability among the considered characters, whereas D/L is shown most

Table 1. Arithmetic means of the simple ratios L/H, D/L and I/L.

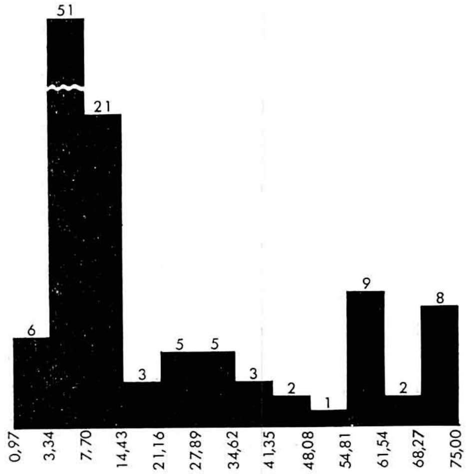
1) L/H

| Loc. | N | $\overline{X} \pm t_{0.05}\sigma_{\bar{x}}$ | V | s | $\sigma_{\bar{x}}$ | O. R. | $X^2$ | Remarks |
|---|---|---|---|---|---|---|---|---|
| A | 77 | 1.550±0.028 | 7.93 | 0.123 | 0.014 | 1.29–1.87 | 3.5101 | N. S. |
| B | 11 | 1.462±0.064 | 6.74 | 0.095 | 0.029 | 1.33–1.59 | | |
| C | 5 | 1.675±0.183 | 8.80 | 0.147 | 0.066 | 1.57–1.83 | | |
| 2) D/L | | | | | | | | |
| A | 77 | 0.298±0.013 | 19.76 | 0.059 | 0.067 | 0.17–0.48 | 6.8458 | N. S. |
| B | 11 | 0.314±0.053 | 25.26 | 0.079 | 0.024 | 0.23–0.48 | | |
| C | 4 | 0.394±0.107 | 16.99 | 0.067 | 0.034 | 0.33–0.49 | | |
| 3) I/L | | | | | | | | |
| A | 38 | 0.163±0.009 | 16.34 | 0.027 | 0.004 | 0.10–0.20 | 1.1022 | N. S. |
| B | 9 | 0.184±0.025 | 17.97 | 0.033 | 0.011 | 0.14–0.24 | | |
| C | 4 | 0.169±0.020 | 7.48 | 0.013 | 0.006 | 0.16–0.18 | | |

$\overline{X} \pm t_{00.5}\sigma_{\bar{x}}$: arithmetic mean with 95% confidence level
V: Pearson's coefficient of variation
s: standard deviation
$\sigma_{\bar{x}}$: standard error of the mean
O. R.: observed range
$X^2$: chi-square
N. S.: not significant at 95% confidence level
N: sample size

variable and the value of the chi-square is also largest. However, the results of the chi-square test indicate that the null hypothesis for a normal distribution is not rejected for the characters considered.

*Observation.* In Text-fig. 6, the size-frequency distribution of the shell length in the sample from Locality A is shown. All of the specimens possess well preserved test and several of them are conjoined. The shells at hand range widely in size, i. e., 1.6-74.5 mm in length in the sample from Locality A, 4.2-80.0 mm in that from Locality B and 5.8-47.5 mm in length from Locality C. This probably means that shells of various growth stages are observable. The internal structures have been observed on the 11 specimens of wide range of growth stage from 9 mm to about 67 mm in length. The striations are distinctly developed on the anterior pseudocardinal teeth in




Text-figure 6. Frequency histogram of size in length of *Nagdongia soni* from Locality A.

the specimens larger than 60 mm, but not in the smaller ones. This is probably an ontogenetic variation.

All the fossiliferous beds consist of very fine sediments, black shale or very fine siltstone. Although a definite orientation of a shell is not always examined, the state of its preservation seems to depend on the orientation of the commissure plane to the stratification. When the shell is embedded in parallel to the stratification, it is fairly well preserved, but when it is oblique or vertical to the bedding plane, it is more or less deformed. This suggests that the fossil bearing beds were compressed normal to the bedding plane.

## Discussion

As pointed above, the present species possesses the same pattern of hinge teeth as the African Recent bivalves, *Caelatura* (*Laevirostris*) *bourguignati* and *C.* (*Zairaï*) *elegans*, but differs from the latter species in many other characters. And it seems to be related to certain species of *Nippononaia*, *Wakinoa* and *Plicatounio* in some internal characters, but the features of its hinge teeth are not accord with those of the latter genera as well as its surface is not ornamented with the typical radial ribs of those genera.

In the surface ornamentation and the outline, this species is fairly similar to the so-called *Nakamuranaia chingshanensis* from Korea described by SUZUKI (1943) (non GRABAU, 1923). Although SUZUKI's specimens are not accessible to me (according to SUZUKI they were destroyed out during World War II), that species was reported to possess two pseudocardinal teeth on each valve and two posterior lateral ones on right valve and one on left valve, while the present species has two pseudocardinal teeth on right valve and one on left valve, and one posterior lateral on right valve and two on left valve. Furthermore, in the present species the pseudocardinal teeth are distinctly striated, but in SUZUKI's

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### Explanation of Plate 16

(All figures are of natural size.)

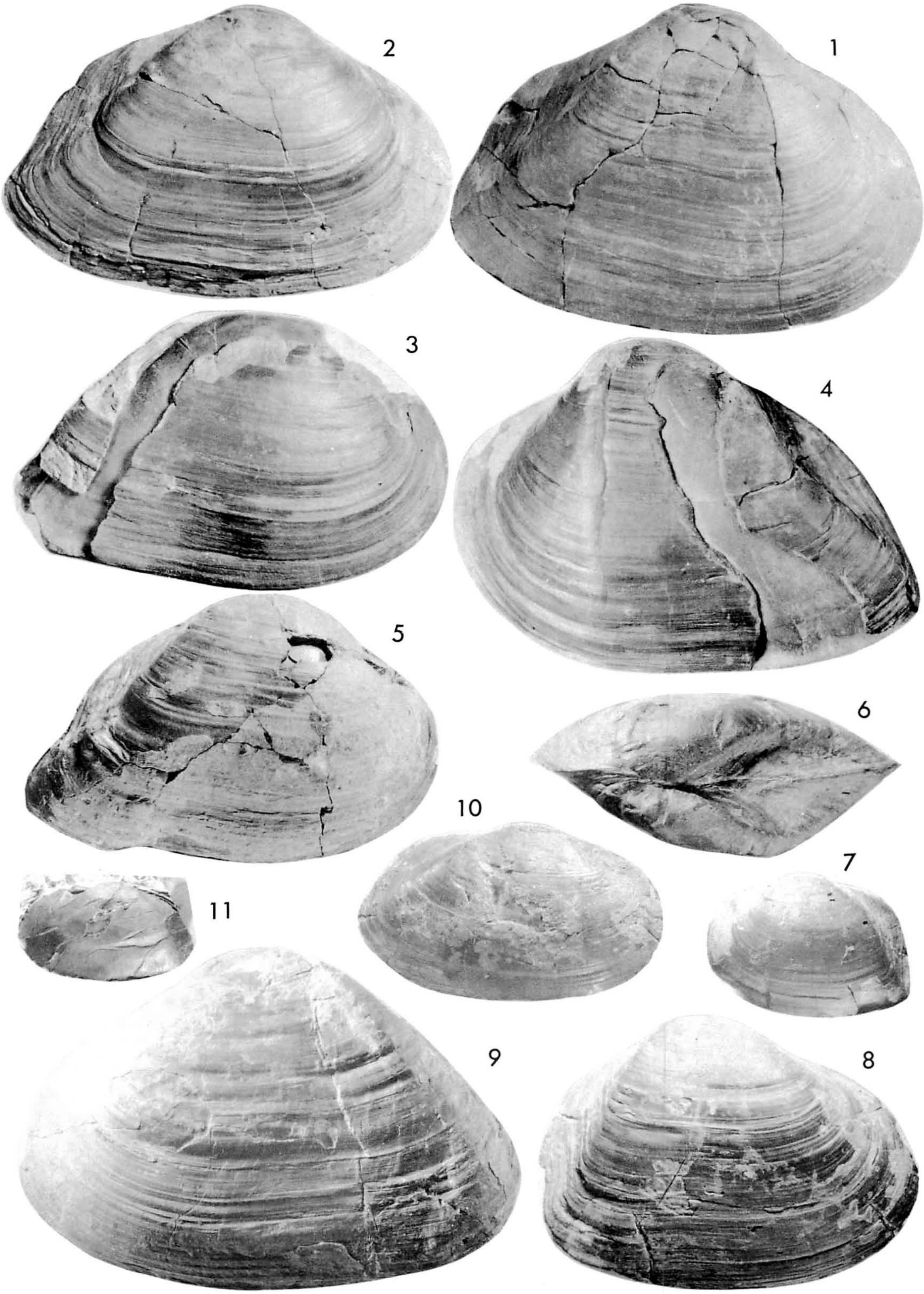
Figs. 1-11. *Nagdongia soni* YANG, gen. & sp. nov.

1. Right valve (KPE 1111), holotype.
2. Right valve (KPE 1112).
3. Right valve (KPE 1130) showing the shell thickness.
4. Left valve (KPE 1113) showing the shell thickness.
5. Right valve (KPE 1131)
6. Conjoined valve (KPE 1123) showing the dorsal part strongly deformed vertically.
7. Left valve (KPE 1138)
8. Right valve (KPE 1114)

All of the above specimens were collected from a point south of Geummu-san, Waegwan-ub, Chilgok-gun, Gyeongsang-buk-do, Korea (Loc. A).

9. Left valve (KPE 1146). Loc.: At a point north of Buldong-ri, Jicheon-myeon, Chilgok-gun, Gyeongsang-buk-do, Korea (Loc. B).
10. Right valve (KPE 1151)
11. Internal mould of left valve (KPE 1152)

These two specimens were collected at the sea side of Sumoon-dong, Geumnam-myeon, Hadong-gun, Gyeongsang-nam-do, Korea (Loc. C).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they are lamellar. In virture of Professor MAEDA, I have observed one (R. 61102602) of the specimens described by him under the name "*Nakamuranaia chingshanensis*" from the Kitadani alternation, Akaiwa Subgroup, Tetori Group, Japan. It has the same surface ornaments and outline as the present species, but to my regret, its internal structure cannot be observable. According to his description (1962, p. 349), the structure of the hinge teeth is in accord with SUZUKI's description.

KOBAYASHI and SUZUKI (1936) described *Corbicula* (*Leptesthes*?) *coreanica* and *Cristaria*? sp. aff. "*Leptesthes chingshanense* GRABAU from the Nagdong Subgroup, here and there. After that, SUZUKI (1943) included them into the *Nakamuranaia chingshanensis.* I have observed these fossils kept in the University of Tokyo. But the preservation is too bad to examine clearly their characters, especially the internal structures. The specimens identified as "*Cristaria*? sp. aff. *Leptesthes chingshanense*" may be regarded as the immature ones of my collection. And those of *Corbicula* (*Leptesthes*?) *coreanica* seem to be distinct from the above *Cristaria*? sp. in outline, thickness and the pointness of the umbo and to be similar to my specimens from Locality C. However, the differences between those and mine can not be said certainly.

*Nakamuranaia chingshanensis*(GRABAU, 1923) from China certainly differs from the present species in outline, shell thickness and the internal structures. GRABAU described the Chinese species on the basis of much smaller specimens compared with the Korean adult specimens. Thus, I took a special consideration on the specimens of similar size in comparison. In the present species the test is never thin and the muscle impressions are distinctly shown. According to GRABAU's description, in the Chinese species the test is thin and the muscle impressions are not clearly shown. The difference in the shell outline is evident (compare GRABAU's text-figure with the present species in Text-figs. 4 and 5). GRABAU's species is characterized by a fairly straight ventral margin, but the present species is well rounded. GRABAU observed the faint cross striations or transverse notching on the postero-lateral teeth, but the present species shows no striations on the postero-lateral teeth, except for those on the antero-pseudocardinal teeth of adult specimens larger than 60 mm in length.

At the beginning of this study, I considered that the present species might belong to *Nakamuranaia chingshanensis* and that Locality A was the same as that of SUZUKI's original collection. But I have never found at Locality A the specimens which are in accord with SUZUKI's description (1943). As there was no locality map in his paper, I cannot certify the identity of my locality A with his.

So far as the accessible monographs are concerned, there are no species, fossil and the Recent, with which the present species could be identified.

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## Explanation of Plate 17

Figs. 1-44. *Nagdongia soni* YANG, gen. & sp. nov.

1-38. Immature specimens showing the variation of outline. ×2.

Figs. 2, 5, 6, 8, 10, 11, 12, 13, 14, 16, 19, 20, 21, 22, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33; Right valves, and the others left valves. Figs. 1 (KPE 1199), 2 (KPE 1155), 3 (KPE 1158), 4 (KPE 1157), 5 (KPE 1156), 6 (KPE 1160), 7 (KPE 1159), 8 (KPE 1198), 10 (KPE 1161), 11 (KPE 1162), 13 (KPE 1167), 14 (KPE 1232), 15 (KPE 1165), 16 (KPE 1168), 17 (KPE 1196), 19 (KPE 1166), 20 (KPE 1164), 21 (KPE 1163), 22 (KPE 1170), 23 (KPE 1173), 24 (KPE 1175), 25 (KPE 1171), 26 (KPE 1172), 27 (KPE 1174), 28 (KPE 1176), 31 (LPE 1177), 32 (KPE 1178), 33 (KPE 1179), 34 (KPE 1180), 36 (KPE 1182), 37 (KPE 1183); from Locality A. Figs. 18 (KPE 1184), 29 (KPE 1185), 30 (KPE 1186), 35 (KPE 1237), 38 (KPE 1187); from Locality B. Figs. 9 (KPE 1188) and 12 (KPE 1189); from Locality C.

39a and b: Internal mould and rubber cast, showing the internal structures of immature shells, left valve (KPE 1134).

40: Internal mould of right valve, showing the hinge teeth (KPE 1129).

41: Internal mould of conjoined valve, showing the hinge teeth (KPE 1190).

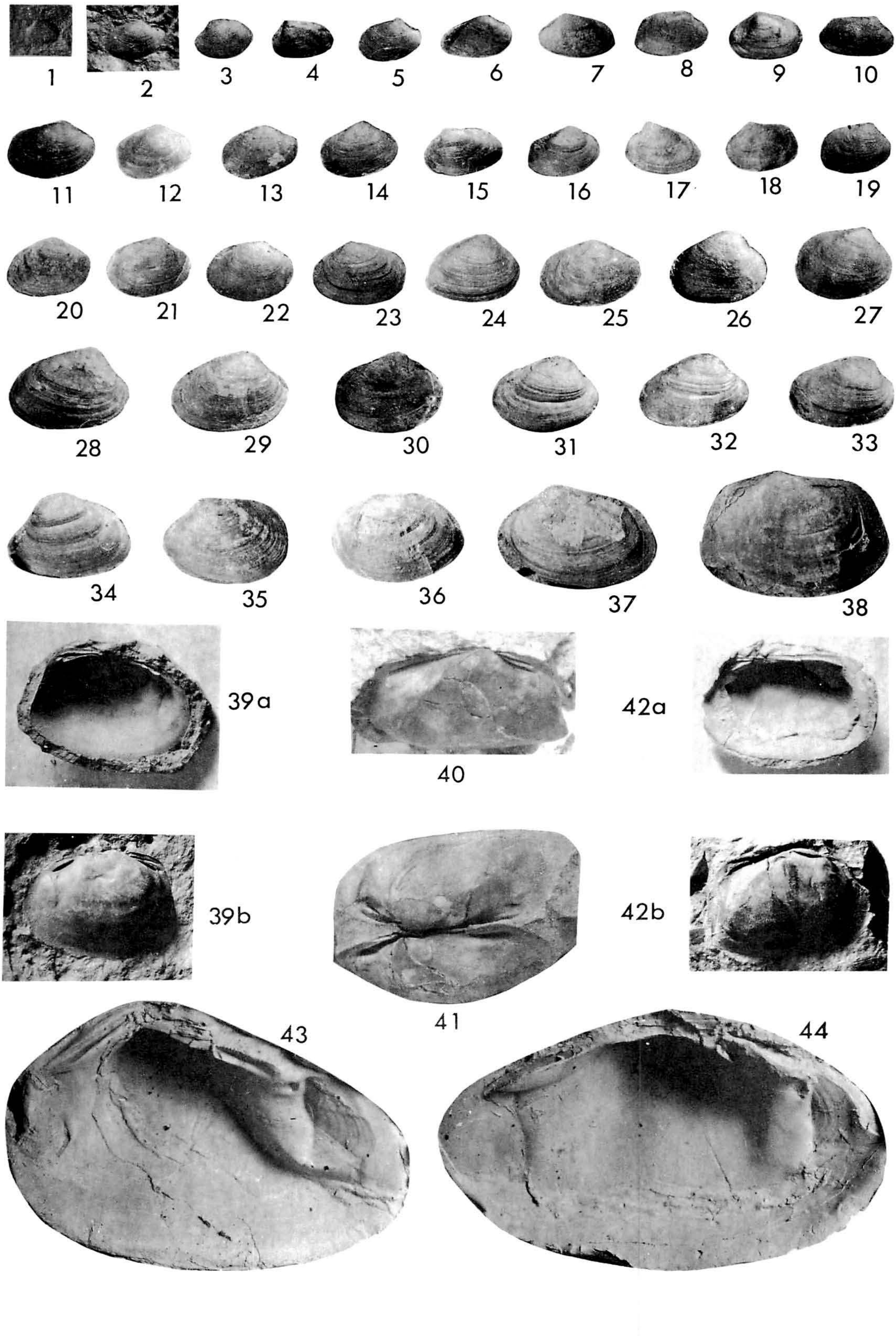
42a and b: Internal mould and rubber cast, showing the internal structures of immature shell, right valve (KPE 1135).

43: Rubber cast of the left internal mould, showing the internal structures of adult (KPE 1119). Posterior part strongly deformed.

44: Rubber cast of the left internal mould, showing the internal structures of adult (KPE 1118).

Figs. 39-44 of natural size, from locality A.

All of the above specimens are kept in the Department of Earth-Science, College of Education, Kyungpook National University, Daegu, Korea. A plaster cast of the holotype (KPE 1111) is kept in the Department of Geology, Faculty of Science, Kyushu University, Fukuoka, Japan.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| Buldong-ri | 仏洞里 | Gyeongsang-buk-do | 慶尚北道 |
| Busan | 釜山 | Gyeongsang-nam-do | 慶尚南道 |
| Cheonpyeong-gyo | 泉坪橋 | Hadong-gun | 河東郡 |
| Chilgok | 漆谷 | Hasandong | 霞山洞 |
| Daegu | 大邱 | Jicheon-myeon | 枝川面 |
| Dongmyeong | 東明 | Nagdong | 洛東 |
| Gasan-myeon | 架山面 | Nagsangyo | 洛山橋 |
| Geumhodong | 錦湖洞 | Namhae | 南姿 |
| Geummu-san | 錦舞山 | Sindong | 新洞 |
| Geumnam-myeon | 金南面 | Sumoon-dong | 水門洞 |
| Gwangju | 光州 | Waegwan-ub | 倭舘邑 |
| Gyeongsang | 慶尚 | Yeonhwadong | 蓮花洞 |

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# 653. NOTES ON *INOCERAMUS LABIATUS* (CRETACEOUS BIVALVIA) FROM HOKKAIDO

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and

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北海道産 *Inoceramus labiatus* について：本種は白亜系チューロニアン階下部の示準化石として世界に広く分布するが，わが国ではまだその図示・記載がなかった。本種に同定できる標本の北海道における産出を，層序を明記しながら説明した。第1，2図に要約されるように，本種は各地から少なからず産出し，地域間対比に有効である。また同伴種（菊石）ならびに上・下位の特徴種をも併せ考慮すれば，帯化と国際対比にも役立つ。次に古生物学的記載を行ない，とくに層序的に上下の別のある試料について，変異を若干数量的に検討し，亜種程度の差を示すことを知り得た。この変異の傾向はチューロニアン中部の *Inoc. teraokai* や同階上部の *Inoc. incertus* との関係を究明する上にも重要である。またこの結果を欧米における本種ならびに近縁種と比較して，本種を含む系列の時代的変化について予察的に論議を試みるとともに，今後の研究方向についての見解を述べた。　松本達郎・野田雅之

## Introduction

*Inoceramus labiatus* (SCHLOTHEIM) is a world-wide guide species of the Lower Turonian. For some reasons, however, it has been considered rather rare in Japan. In a comprehensive monograph of NAGAO and MATSUMOTO (1939-40) this species was not described.

It was, however, pointed out that some of the specimens labelled as *Inoceramus incertus* JIMBO, from a zone with *Pseudaspidoceras sorachiense* in central Hokkaido, closely resemble *Inoc. labiatus* (MATSUMOTO and HASHIMOTO, 1953, p. 100). Furthermore, MATSUMOTO (1959, p. 85) mentioned of the occurrence of *Inoc.* cf. *labiatus* in a bed of the Cretaceous sequence along the River Ikushumbetsu, together with *Kanabiceras septemseriatum*. Subsequently KANIE (1966) found an unmistakable example of this species from an isolated locality in the Urakawa area. Recently MATSUMOTO and OKADA (1973) have recorded in their stratigraphic paper, written in Japanese, *Inoc. labiatus* and allied species found at several localities, with details of the stratigraphic position. Furthermore, one of us (T.M.) has continued, together with H. HIRANO and K. TANABE, a biostratigraphic investigation of the Obira and Oyubari areas, getting more specimens. Most of these old and recent acquisitions are included in the material

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of the present study.

In this paper we give a concise note on the stratigraphic occurrence and a palaeontological description of *Inoceramus labiatus* from Hokkaido. Although one of us (T. M.) had opportunities to look at some of the specimens labelled as *Inoceramus labiatus* at several museums in Europe and North America, we avoid to mention too much of those extra-Japanese specimens on this occasion. We intend to present here what sort of forms have been obtained at which stratigraphic positions in the Cretaceous deposits of Hokkaido and endeavour to find a way how to improve our knowledge.

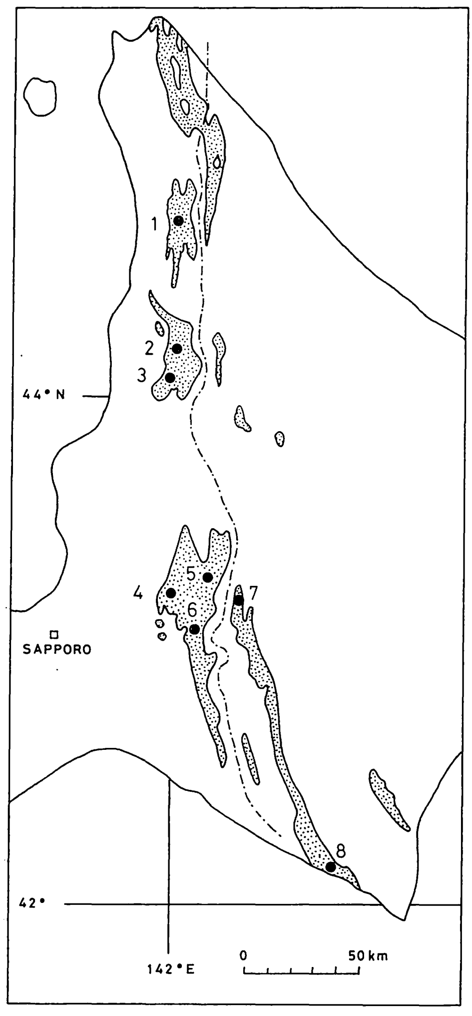
Before going further, we wish to thank Dr. Hakuyu OKADA, Dr. Hiromichi HIRANO and Mr. Kazushige TANABE for their help in various ways and Professor Wataru HASHIMOTO, Dr. Yasumitsu KANIE and Mr. Tatsuo MURAMOTO for their cooperation in offering some valuable specimens for our study. Miss Mutsuko HAYASHIDA assisted us in preparing the typescript.

## Stratigraphical Note

The outcropping areas of the post-Aptian Cretaceous deposits in the central zone of Hokkaido are shown in Text-fig. 1. The places where *Inoceramus labiatus* and allied forms have been obtained are indicated by numbers in the same map. In many areas geological mapping has been laboriously achieved, resulting in the geological maps on scale 1 : 50,000 as well as other stratigraphic papers. Field works are still continued in some areas to know more precisely the biostratigraphic sequences.

The following is a brief account of the stratigraphy relevant to the beds with *Inoceramus labiatus* and allied forms which are concerned with the palaeontological description in this paper.

(1) *Saku area.* For the general stratigraphy and geological mapping of this area see MATSUMOTO (1942), S. NAGAO




Text-fig. 1. Map of central zone of Hokkaido showing the outcrop of the post-Aptian Cretaceous deposits. 1. Saku area, 2. Soeushinai-Kotambetsu area, 3. Obira area, 4. Ikushumbetsu area, 5. Ashibetsu area, 6. Oyubari area, 7. Furano area, 8. Urakawa area; Chain: boundary between western and eastern belts.

(1962), HASHIMOTO (ed.) (1967) and MATSUMOTO and OKADA (1973).

The Cenomanian to Turonian sequence is well exposed along the streams of the Saku-gakko-no-sawa, the Saku-gawa and the Nio-no-sawa. It is subdivided into units IIa, IIb, IIc and IId. *Inoceramus labiatus* was found in a calcareous nodule at loc T5090, Saku-gakko-no-sawa, in the middle of unit IIc, about 130m sequence of claystone. A large shell of *Fagesia* (?) sp. came from the same locality. *Fagesia thevestensis* (loc. T610b), *Fagesia* cf. *rudra* (loc. T1158-59), and *Sciponoceras orientale* (loc. T610 e) were found in other localities of the same unit (MATSUMOTO and OBATA, 1963; MATSUMOTO, 1973), which indicates Lower Turonian.

Unit IIc is conformably underlain by unit IIb, greenish bluish grey fine sandy siltstone, about 350m in thickness, which contains *Inoceramus concentricus nipponicus*, *Inoc. pennatulus*, *Desmoceras* (*Pseudouhligella*) *japonicum*, *D.* (*P.*) *ezoanum*, *Calycoceras orientale* (loc. T711b, T225b and c), *Euomphaloceras* cf. *meridionale* (loc. T5031b), among many others. These species indicate Middle to Upper Cenomanian. Unit IId, which conformably overlies IIc, is characterized by sandstone bedded in various thickness, frequently intercalated or intertongued with siltstone. IId is called the Saku Formation, about 400-450m thick, and is subdivisible into three members, IId1, IId2 and IId3. *Inoceramus hobetsensis* characteristically occurs almost throughout the sequence, except for upper IId3, *Inoc. iburiensis* in lower IId3, and *Inoc. teshioensis* in upper IId3. Among many ammonites there is *Collignoniceras woollgari bakeri* found from lower IId3 (loc. T1022 p7) (see MATSUMOTO, 1965).

(2) *Soeushinai-Kotambetsu area.* The area was geologically mapped by HASHIMOTO et al. (1965). In this area mudstone is more predominant than in the Saku area. A thick monotonous sequence of mudstone, nearly 1000m in thickness, is exposed along the Kiritachi pass of the highway No. 239 between Soeushinai and Kotambetsu, as was explained by MATSUMOTO and OKADA (1973, p. 284, text-figs. 7-8). This is mainly Cenomanian, because of the occurrence of *Inoceramus concentricus nipponicus*, *Inoc. pennatulus* (or *Inoc. reduncus*), *Desmoceras* (*Pseudouhligella*) *ezoanum* and *Calycoceras* aff. *asiaticum* (loc. R100), but from its uppermost part (50m) *Inoceramus labiatus* (loc. R114) and *Sciponoceras kossmati* (loc. R117) were found. This part is conformably succeeded by the lithostratigraphic equivalent of the Saku Formation, but here again the mudstone is predominant and thinner units of alternating sandstone and mudstone, with some intraformational conglomerate, occur at four levels with thicker intervals of mudstone. What was called *Inoc.* aff. *labiatus* by MATSUMOTO and OKADA (1973, p. 285) was obtained from the mudstone immediately above the first alternation (loc. R123). The main part including the second and the third units of alternation is characterized by *Inoc. hobetsensis*, and among many others *Romaniceras* cf. *yezoense* came from this part (loc. R137).

(3) *Obira* [*Obirashibetsu*] *area.* The area was geologically mapped by TSUSHIMA et al. (1958) and IGI et al. (1958). Among the co-authors TANAKA especially devoted himself to the Cretaceous stratigraphy (see also TANAKA, 1963). MATSUMOTO, OKADA, HIRANO and TANABE have recently carried out biostratigraphic investigations in this area, with whom T. MURAMOTO and K. MURAMOTO have cooperated for a while. As their work has not yet been completed,

the following is a preliminary information.

Fairly steeply inclined strata of Cenomanian to Turonian ages are well exposed along the upper main course of the River Obirashibetsu and its tributaries, the Kanashiri-zawa and the Okufutamata-gawa. To the southwest closer to Tappu [Tap], there is a dome called the Nakakinembetsu dome, which is occupied mainly by Turonian strata, though with some minor structural complexity.

As in the preceding area, the main part of the Cenomanian is represented by a thick sequence of mudstone, characterized by the occurrence of *Inoceramus concentricus nipponicus*, *Inoc. concentricus costatus*, *Inoc. pennatulus* and *Desmoceras* (*Pseudouhligella*) *japonicum*. This is succeeded conformably by a member of greenish fine sandy siltstone or sility fine-sandstone (called Member Mi by TANAKA), 30-90m in thickness. *Inoceramus* sp. and *Tragodesmoceroides subcostatus* may occur in it. It is, in turn, succeeded by another member consisting of mudstone and compact tuffite, with intercalated bentonitic tuff (Mj of TANAKA), about 350m. *Inoceramus labiatus* and *Inoc.* n. sp. (thin shelled type apparently allied to but not identical with *Inoc. teshioensis*) are characteristic. *Fagesia* n. sp. (loc. R5231b), *Fagesia* sp. (loc. R5235p), *Vascoceras* aff. *durandi* (loc. R2153), *Pseudaspidoceras* sp. (loc. R5211), *Mammites* sp. (R2307), *Damesites* aff. *laticarinatus* (loc. R4519), *Puzosia intermedia* (R2101, several other localities) and *Sciponoceras* cf. *orientale*, as well as *Scaphites*, *Otoscaphites*, *Tetragonites* and *Gaudryceras* are found at various levels of this member. Although zonal subdivision is impossible, this member, Mj, and probably also Mi, are altogether referred to Lower Turonian.

The succeeding sequence (Mk through Mn *plus* lower Ua of TANAKA), about 700m, of mudstone with sandstone intercalations is characterized by the predominance of *Inoc. hobetsensis*. *Collignoniceras woollgari bakeri* (locs. R2004, R2008, R2026) and then *Subprionocyclus bravaisianus* (locs. R2003, R2027c) are occasionally found from its middle part among many other ammonites. In the higher part *Inoc. iburiensis* and *Inoc. teshioensis* occur. *Reesidites minimus* was found at an isolated locality.

(4) *Ikushumbetsu area*. It may be called the Mikasa district in accordance with the recently given administrative name. Fine exposures of the Cretaceous strata were seen along the River Ikushumbetsu [=Ikushumbets] and its tributaries, but since the construction of the Katsura-zawa dam, the condition has become unfavourable. The data depend much on the observation (of T. M.) and collections before the appearance of the artificial lake. For the general geological maps see YOSHIDA and KAMBE (1955) and MATSUNO et al. (1964), and for a route map and columnar sections see MATSUMOTO (1965, figs. 2-5).

In this area the Cenomanian *plus* Turonian are mainly represented by the Mikasa Formation, which is characterized by sediments of generally shallower and coarser facies than in other areas. Two kinds of sequence are observable on both wings of the Ikushumbetsu anticline, with shallower facies in the west. The Mikasa Formation, about 400m, is subdivisible into four members, IIa, IIb, IIc and IId in ascending order on the eastern wing. For the biostratigraphic succession of IIa to IIc see an up-to-date account of MATSUMOTO (1975, p. 156). Although sandstone generally predominates in the formation, member IIc consists of siltstone, about 60m thick, containing calcareous nodules. Its main part (45m) is characterized by large shells of *Inoc. pennatulus* and a find of *Calycoceras* cf. *naviculare.* Its top 15m, as represented by loc. Ik 1038 and loc. Ik 987, has a distinct faunule consisting of *Kanabiceras septemseriatum*, *Sumitomoceras faustum*, *Sciponoceras kossmati*, *Allocrioceras* sp., *Gaudryceras* aff. *varagurense* and *Puzosia* aff. *intermedia orientalis.* Recently *Pseudocalycoceras* aff. *dentonense* and *Eucalycoceras* (?) aff. *collignoni* have been found from this zone, as reported by MATSUMOTO and KAWANO (1975). Several specimens of *Inoc. labiatus* were obtained from the same zone (same locality). As the top of IIc is demarcated by a basal green sandstone of IId and the suceeding lower part of IId is rather poor in fossils, how far *Inoc. labiatus* ranges upward in this sequence cannot be decided. It is noted that bentonitic tuff is frequently intercalated in the lower part of IId, which may be correlatable with the tuff and tuffite in the Lower Turonian of the Obira area. IId is unfavourable for ammonites, except for a record of fragmentary collignoniceratid, but *Inoc. hobetsensis* occurs in its main part, with larger forms in the upper part.

The succeeding 130m sequence of silty fine sandstone or fine sandy siltstone is lithostratigraphically referred to the lower part of the Upper Yezo Group, denoted as IIIa. Its lower part still contains *Inoceramus hobetsensis* but its main part, with an interbed of green sandstone, is characterized by *Inoc. teshioensis*, with associated *Subprionocyclus normalis* in the green sandstone and abundant *Reesidites minimus* above that sandstone.

On the western wing the Mikasa Formation contains less commonly ammonites and inocerami, except for the lowest part, but more abundantly trigonians. Therefore, *Inoc. labiatus* is not found. Only a remarkable bentonitic tuff at the midst of the sandstone formation (exposed at loc. Ik 2017 of the Pombetsu route) suggests the possible position of Lower Turonian. A 130m sequence (IIIa′) of fine sandy siltstone above the Mikasa Formation exposed along the Pombetsu route represents the Upper Turonian by the occurrence of *Subprionocyclus neptuni*, *S. normalis* (loc. Ik 2014) and then *Reesidites minimus* (loc. Ik 2013b) and also *Prionocyclus cobbani*, *Pr. aberrans* and *Pr. wyomingensis* (loc. Ik 2012) (see MATSUMOTO, 1965, 1971). *Inoc. teshioensis*, *Inoc. tenuistriatus* and *Inoc. incertus* occur in this part (especially common at loc. Ik 2014-2013). How far these species range down cannot be decided along this route, because IIIa′ is underlain by massive pebby sandstone of the upper part of the Mikasa Formation, which contains trigonians (*Steinmannella*), the facies unfavourable for inocerami.

(5) *Ashibetsu area.* For this area two geological maps are available, one by TANAKA and IMAI (1953) and the other by YOSHIDA and KAMBE (1955). MATSUMOTO partly cooperated witn them in the survey of selected routes and subsequently made another investigation, with OKADA, along the route of the Soashibetsu, an eastern branch of the River Ashibetsu.

The area is divided to two parts by a syncline. In the western part the Mikasa Formation is extended northward from the Ikushumbetsu area, but in the eastern area a thicker sequence of mudstone predominates in the Cenomanian and Turonian parts. Alternating sandstone and shale of the flysch facies occur frequently there and especially in the main part of the Turonian, forming a lithostratigraphic equivalent of the Saku Formation. The strata are overturned and affected by minor folding, thrusting and faulting in the eastern part, but in a rough estimation the Turonian may be about 400m or more. Its upper part, about 100m, consists of shale and sandy shale with some intercalations of thin layers and laminae of sandstone. *Inoceramus teshioensis* occurs there. Its middle part, about 200m, is made up of alternating sandstone and shale, with occasional occurrence of thick sandstone which may show a channel structure. Flute casts are common. *Inoceramus hobetsensis* and *Jimboiceras planulatiforme* occur in the middle part. The lower part is similar in lithologic constitution to the middle part but *Inoceramus* cf. *labiatus* was found there (loc. As 1039), along with *Puzosia intermedia orientalis* and *Allocrioceras* sp. These fossils were contained in a calcareous nodule embedded in a mudstone of the alternation.

(6) *Oyubari area.* A geological map of the Oyubari sheet by NAGAO et al. (1954) is available. The upper reaches of the River Yubari [=Shiyubari] in the northeastern part of the sheet was biostratigraphically studied by MATSUMOTO (1942, p. 215-243, maps of pl. 13-15). The southern part of the same sheet has recently been investigated by MATSUMOTO and OKADA (1973) and now under investigation by TANABE, HIRANO and MATSUMOTO.

As in the eastern Ashibetsu area the strata are overturned and cut at intervals by minor thrusts and faults. Therefore it is fairly hard to establish a precise biostratigraphic succession. The Upper Albian through Turonian is comprehensively called the Middle Yezo Group, which consists primarily of mudstone with members of alternating sandstone and shale at intervals. On the basis of a detailed field work on good exposures along several routes in the upper reaches of the Shiyubari, MATSUMOTO (1942) subdivided the group into 18 members (IIa to IIs), of which IIm, IIn, IIp, IIq, IIr and IIs, about 400 to 500m thick, were regarded as lithostratigraphic equivalent of the Saku Formation on account of general similarity in lighology and fossil contents. Member IIm, less than 100m, however, should be referred to a part of Cenomanian, because it contains *Marshallites olcostephanoides* and *Inoc. pennatulus.* The succeeding Member IIn, fine sandy siltstone or silty fine sandstone, about 100m, with intercalated layers of calcareous sandstone and bentonitic tuff is regarded as Lower Turonian, since it contains *Inoc. labiatus. Inoceramus* n. sp. (undescribed species apparently allied to *Inoc. teshioensis*), *Puzosia intermedia orientalis* and *Sciponoceras orientale* are found from IIn in addition to other long ranging ammonites. The overlying members IIq to IIs contain more commonly *Inoc. hobetsensis* and IIs has *Inoc. teshioensis.* Among ammonites *Yubariceras yubarense* came from IIq and IIr, whereas *Subprionocyclus neptuni* from IIs.

The biostratigraphic succession in the southern part of the Oyubari area is best observable along the section of the Hakkin-zawa [=Shirokin-zawa]. Recently TANABE, HIRANO and MATSUMOTO have recognized a bed of shale at loc. Y5228 which contains remains of *Inoc. labiatus* in abundance in several laminae. Fossils of the same species were obtained at another locality nearby Y5226. These are within a unit of siltstone, more or less fine sandy, with occasional interbeds of calcareous sandstone and noticeable bentonitic tuff. This unit is exposed from loc. Y5226 to loc. Y5232, at least 150m in thickness and contains another *Inoceramus* (*Inoc.* n. sp. aff. *I. teshioensis*), *Sciponoceras orientale, Damesites* cf. *laticarinatus*, immature shells of desmoceratids, etc. It is very similar to and probably an extension of Member IIn of the Shiyubari section.

About 100m sequence which conformably underlies the above explained unit consists of mudstone with more frequent interbeds of sandstone and less frequent and thinner tuff, as is finely exposed at locs. Y5233 and Y5234. It contains large fossils of *Inoc. pennatulus, Austiniceras* sp. and *Pachydesmoceras* sp. It is probably an extension of Member IIm of the Shiyubari section. Thus the Cenomanian-Turonian boundary should be somewhere near the boundary of Y5232 and Y5233, although good guide species have not yet been found at the very boundary.

The sequence which comes above the unit with *Inoc. labiatus* is exposed rather intermittently for a longer distance from loc. Y5225 to Y5200 along the lower course of the Hakkin-zawa. It is made up of clayey to silty mudstones often with fine sandy laminae and sometimes with thin interbeds of sandstone and tuff. The strata seem to be repeated by minor folding and thrusting and the true thickness is hardly estimated. For the most part of this sequence occurs *Inoc. hobetsensis* and in the uppermost part *Inoc. teshioensis*. *Scaphites* and other heteromorph ammonites are common; drifted fragments of wood which is often suffered from *Teredo* tubes occur frequently in calcareous nodules along with ammonites and inocerami as in other cases of the Saku Formation. At loc. Y5206 *Collignoniceras woollgari* and *Romaniceras* aff. *deverianum* were identified (MATSUMOTO, 1971, '73).

As a supplementary route the Takinosawa [=Penkemoyuparo], a branch of the Hakkin-zawa, may be selected. MATSUMOTO and OKADA (1973) collected a number of specimens labelled provisionally as *Inoc.* aff. *teraokai* (which is revised as *Inoc. labiatus* in this paper) from loc. Y5102 and Y5109. They are in a unit of fine sandy siltstone with intercalated layers of bentonitic tuff and sandstone. *Inoc.* n. sp. aff. *I. teshioensis* occurs in the same unit (locs, Y5102–Y5113). A large specimen of *Fagesia* sp. was obtained by K. MURAMOTO in a transported nodule at a point somewhat downstream of Y5102. In the mudstone (at loc. Y5101) immediately above Y5102 occurs *Inoc. hobetsensis*, whereas *Inoc. pennatulus* and *Inoc. concentricus costatus* are found in the subjacent mudstone with frequent interbeds of sandstone (locs. Y5114–Y5117). Thus the *Inoc. labiatus*-bearing unit is referable to Member IIn of the Shiyubari section. The bed exposed at loc. Y5102 probably represents the uppermost part of IIn.

In the Hobetsu area to the south of the Oyubari area *Ionc. labiatus* has not yet been found. Middle to Upper Turonian strata are more extensively exposed there, as is expressed by the specific names of *Inoc. hobetsensis* and *Inoc. iburiensis*. Lower Turonian strata should crop out somewhere within the area though narrowly, because *Fagesia* n. sp. (undescribed) was found in one of the transported nodules of the Nutapomanai (collection of the Hokkaido Colliery & Steamship Co., at Yubari). Although geological structure is fairly complicated in this area, future discoveries of *Inoc. labiatus* as well as ammonites in situ would give valuable key to settle certain problems.

(7) *Furano area.* This area belongs to the eastern belt of the Cretaceous in central Hokkaido, whereas the foregoing areas (1 to 6) all belong to the western belt. The two belts are separated by a belt of the Kamuikotan blue schists and serpentinite. The Cretaceous deposits in the eastern belt, except for certain limited

portions, are generally poor in fossils, because sediments of the flysch facies predominate there and because the strata are tectonically much disturbed.

In the Furano area the fossiliferous Turonian is exposed in a limited portion along the River Sorachi between the villages called Yamabe and Kanayama. A geological map by W. HASHIMOTO (1953) is available for the area and a sketch map around the fossil localities was shown with a stratigraphic note by MATSUMOTO and HASHIMOTO (1953, text-fig. 1 and p. 100). Their description on the stratigraphy of the fossiliferous beds is essentially correct, but what they called *Inoc. incertus* in that paper should be revised as *Inoc. labiatus*.

It should be noted that the lower half (i. e. KY9E) of the 70m sequence exposed at loc. KY9, which consists of alternating mudstone and sandstone, contains a fossiliferous bed rich in *Inoc. labiatus*, whereas the upper half (i. e. KY9W), made up of predominant mudstone, extends southward to loc. KY301, where *Pseudaspidoceras sorachiense* and a somewhat broader form of *Inoc. labiatus* (as represented by GK. H10060) were obtained.

As there is a major fault on the west side and as the strata are repeatedly folded on the east side and then covered by Cenozoic valcanic ejecta, more continuous succession cannot be observed at this place.

(8) *Urakawa area.* This is situated in the southern part of the eastern belt. It is famous for rich fossils since the date of YOKOYAMA (1890), but the fossiliferous beds mostly belong to the Senonian. Turonian and older strata are rather poor in fossils and tectonically complicated. KANIE (1966) reported a revised stratigraphy of this area, in which Coniacian to Lower Maestrichtian sequence was finely subdivided. According to him a specimen of *Inoc. labiatus* was obtained at Higashi-horobetsu from a mudstone bed in the block of the Middle Yezo Group bounded by faults. The stratigraphic sequence is not precisely known in this block.

Summarizing the foregoing stratigraphical note, the following may be led as a conclusion.

(1) *Inoceramus labiatus* is distributed widely in the Cretaceous deposits of Hokkaido from north to south and in both the western and the eastern belts.

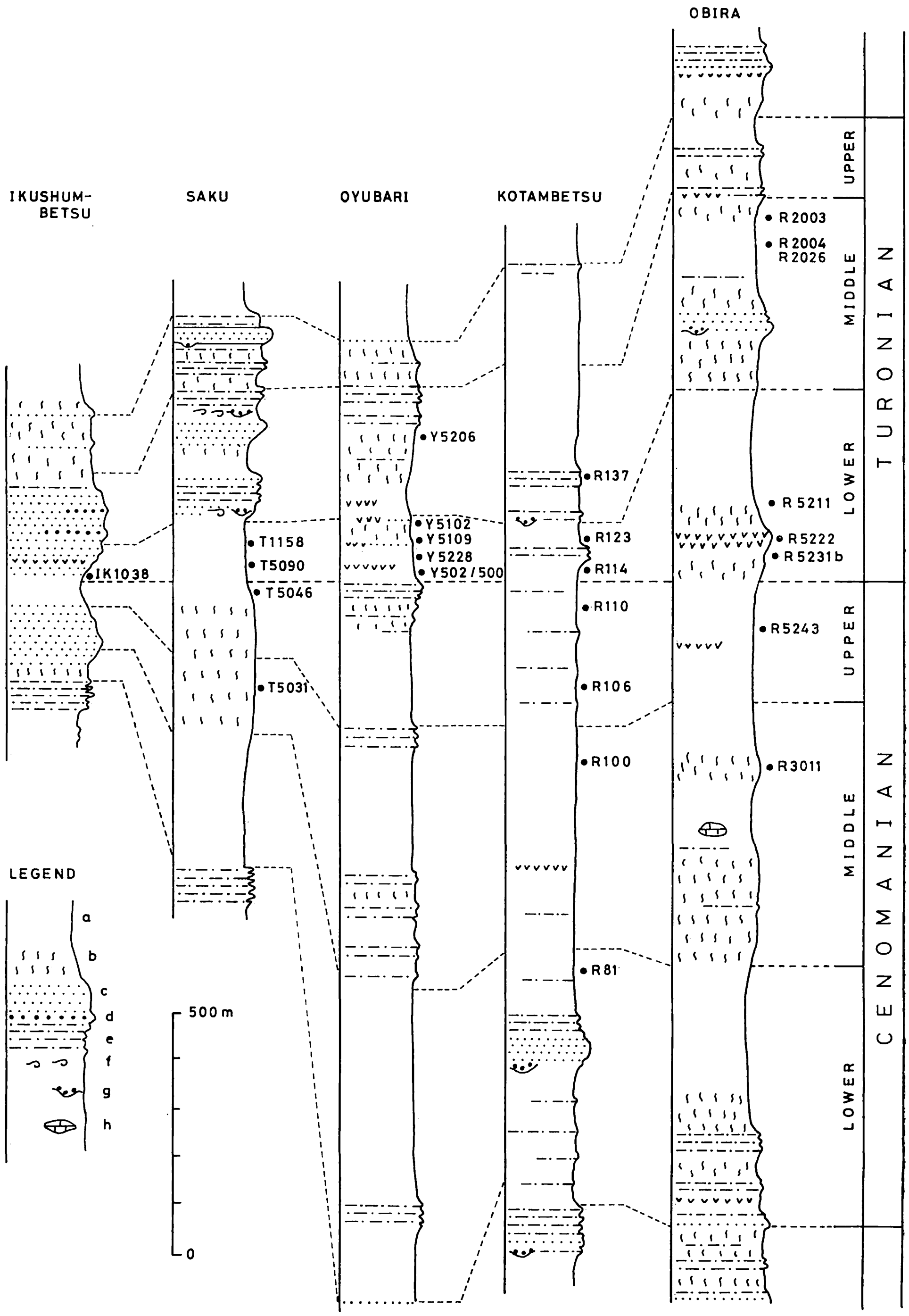
(2) It occurs characteristically in the lower part of the Turonian sequence. The zone of *Inoc. labiatus* is distinguishable from that of *Inoc. pennatulus* below and that of *Inoc. hobetsensis* above.

(3) The stratigraphic sections of the above explained areas (which include the localities of *Inoc. labiatus*) may be correlated as shown in Text-fig. 2.

(4) The formational unit which contains *Inoc. labiatus* occupies the part approximately as thick as or somewhat less than a third of the entire Turonian sequence, as far as the well investigated areas are concerned.

(5) In the same unit occur certain ammonite species which indicate a Lower Turonian age, such as *Fagesia thevestensis*, *Fagesia* sp., *Vascoceras* aff. *durandi*, *Pseudaspidoceras sorachiense* etc. *Allocrioceras* sp., *Sciponoceras orientale*, *S. kossmati*, *Damesites* aff. *laticarinatus* and *Puzosia intermedia* may be also characteristic, although some of them may slightly extend beyond the unit. At present further subzonal subdivision of the *labiatus* zone is practically impossible.

(6) *Inoc. labiatus* seems to have a certain stratigrapyic range, as is suggested by its occurrences in the Kotambetsu, Oyubari and Furano areas. Whether or




Text-fig. 2. Diagram showing the Cenomanian to Turonian sequences of selected areas in Hokkaido. a : mudstone, b : fine-sandy siltstone, c : sandstone, d : conglomerate, e : alternation of sandstone and shale, f : slump structure, g : abnormal conglomerate (fluxoturbidite?), h : limestone.

not there is any chronological change during that time range is to be palaeontologically examined (see below).

### Palaeontological note

*Material.* The specimens listed in Table 1, from the localities in Hokkaido explained in the preceding pages, are concerned with the present description. Some of the extra-Japanese specimens, which one of us (T. M.) observed at the British Museum (N. H.), Sedgwick Museum, U. S. National Museum, U. S. Geological Survey (Denver), University of Kansas and California Academy of Sciences, may be referred to for comparison.

Table 1. Material.

| sample | sample size | specimen (L) = left valve, (R) = right valve | area (Fig. 1) | collector |
|---|---|---|---|---|
| T5090 | 2 | GK. H10044(L), H10046(R) | (1) | T. M. |
| R114 | 1 | GK. H10039(L) | (2) | T. M. + H. O. |
| R123 | 3 | GK. H10041(L), H10042(L), H10043(R) | (2) | T. M. + H. O. |
| R2302p | 2 | GK. H10056(L), H10057(L) | (3) | M. ; T. M. |
| R4802 | 3 | GK. H10074(L), H10075(R), H10076(L) | (3) | H. H. + K. T. |
| Ik1038 | 1 | GK. H10045(R) | (4) | M. |
| As1039 | 1 | GK. H10047(L) | (5) | T. M. |
| Y418 | 1 | GK. H519(L) | (6) | T. M. |
| Y500 | 1 | GK. H522(L) | (6) | T. M. |
| Y502 | 5 | GK. H520a(R), b(R), H521a(L), b(R), c(L) | (6) | T. M. |
| Y5102 | 9 | GK. H10048a(R), b(L), H10049(R), H10050(L), H10051(R), H10053(L), H10099(L), H10100(R), H10101(L) | (6) | T. M. + H. O. |
| Y5109 | 3 | GK. H10052(R), H10054(L), H10098(L) | (6) | T. M. + H. O. |
| Y5228h | 8 | GK. H10061(R), H10062(R), H10063(L), H10064(L), H10065(L), H10066(R), H10067(R), H10068(R) | (6) | K. T. + H. H. + T. M. |
| Y5194b | 1 | GK. H10078(R) | (6) | H. O. |
| KY9E | 4 | GK. H10040(L), H10102(L), JG. H2128(L), JG. H2129(L) | (7) | W. H. + K. F. + T. M. |
| KY301 | 1 | GK. H10060(R) | (7) | T. M. + W. H. |
| U413 | 1 | G. P. Ur413001(L + R) | (8) | Y. K. |

Collector: H. H. = Hiromichi HIRANO, H. O. = Hakuyu OKADA, K. F. = Koji FUJII, K. T. = Kazushige TANABE, M. = Tatsuo MURAMOTO, T. M. = Tatsuro MATSUOMTO, W. H. = Wataru HASHIMATO, Y. K. = Yasumitsu KANIE. Repository. G. K. Type Room, Department of Geology, Kyushu University, G. P. = KANIE Collection, JG. = NODA Collection.

Table 2. Dimension of L at successive growth stages.
above: length in mm. below: L/H in parentheses.

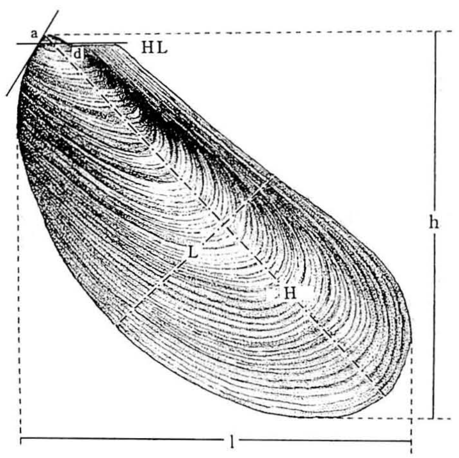
| Sample | specimen | H=20mm | 30mm | 40mm | 50mm | 60mm | 70mm | 80mm |
|---|---|---|---|---|---|---|---|---|
| Y5228h | GK. H10061 (R) | 16.6 (0.83) | 24.8 (0.83) | 29.5 (0.74) | 34.5 (0.69) | 38.2 (0.64) | 41.8 (0.60) | 47.0 (0.59) |
| | GK. H10062 (R) | 16.9 (0.85) | 23.8 (0.79) | 27.5 (0.69) | 32.1 (0.64) | 35.7 (0.60) | | |
| | GK. H10063 (L) | 14.5 (0.73) | 21.2 (0.71) | 27.8 (0.70) | 30.7 (0.61) | 33.3 (0.56) | 38.0 (0.54) | |
| | GK. H10064 (L) | 16.8 (0.84) | 22.8 (0.76) | 28.7 (0.72) | 32.4 (0.65) | 36.1 (0.60) | 41.5 (0.59) | 47.7 (0.60) |
| | GK. H10066 (R) | 15.6 (0.78) | 21.0 (0.70) | 26.6 (0.67) | 31.5 (0.63) | 36.7 (0.61) | | |
| | GK. H10067 (R) | 14.9 (0.75) | 21.0 (0.70) | 26.0 (0.65) | 31.0 (0.62) | 35.8 (0.60) | 38.2 (0.55) | 45.0 (0.56) |
| | GK. H10068 (R) | 15.7 (0.79) | 21.0 (0.70) | 26.7 (0.67) | 33.0 (0.66) | | | |
| Y5109 | GK. H10052 (R) | 16.7 (0.84) | 24.6 (0.82) | 31.5 (0.79) | 36.2 (0.72) | 41.0 (0.68) | 47.7 (0.68) | 53.4 (0.67) |
| Y5102 | GK. H10048a (R) | 17.3 (0.87) | 24.0 (0.80) | 32.0 (0.80) | | | | |
| | GK. H10048b (L) | 18.7 (0.94) | 24.6 (0.82) | 34.9 (0.87) | | | | |
| | GK. H10049 (R) | 18.0 (0.90) | 24.2 (0.81) | 33.0 (0.83) | | | | |
| | GK. H10051 (R) | 18.8 (0.94) | | | | | | |
| | GK. H10053 (L) | 19.4 (0.97) | 28.1 (0.94) | 36.0 (0.90) | 43.8 (0.88) | | | |
| Y502 | GK. H520a (R) | 17.9 (0.90) | 21.7 (0.72) | 27.6 (0.69) | | | | |
| | GK. H520b (R) | 14.0 (0.70) | 20.2 (0.67) | | | | | |
| | GK. H521a (L) | 12.0 (0.60) | 18.3 (0.61) | | | | | |
| | GK. H521b (R) | 13.6 (0.68) | | | | | | |
| | GK. H521c (L) | 18.4 (0.92) | 25.0 (0.83) | 35.1 (0.88) | | | | |
| R114 | GK. H10039 (L) | 16.0 (0.80) | 21.3 (0.71) | 27.6 (0.69) | 30.7 (0.61) | 35.0 (0.58) | | |

| Sample | specimen | H=20mm | 30mm | 40mm | 50mm | 60mm | 70mm | 80mm |
|---|---|---|---|---|---|---|---|---|
| R123 | GK. H10041 (L) | 18.3 (0.92) | 26.3 (0.88) | 32.1 (0.80) | 35.6 (0.71) | | | |
| | GK. H10042 (L) | 19.0 (0.95) | 26.6 (0.89) | | | | | |
| | GK. H10043 (R) | 18.2 (0.91) | 25.2 (0.84) | | | | | |
| R2302p | GK. H10056 (L) | 17.7 (0.89) | 25.4 (0.85) | 31.7 (0.79) | 38.3 (0.77) | 43.8 (0.73) | 46.8 (0.67) | |
| | GK. H10057 (L) | 19.5 (0.98) | 25.3 (0.84) | 33.7 (0.84) | 41.7 (0.83) | | | |
| R4802 | GK. H10074 (L) | 18.4 (0.92) | 25.0 (0.83) | | | | | |
| | GK. H10075 (L) | 19.4 (0.97) | | | | | | |
| | GK. H10076 (L) | 19.8 (0.99) | 27.7 (0.92) | 34.5 (0.86) | | | | |
| Ik1038 | GK. H10045 (R) | 18.0 (0.90) | 25.6 (0.85) | 31.9 (0.80) | 39.5 (0.79) | | | |
| KY9E | JG. H2128 (L) | 11.7 (0.59) | 18.1 (0.60) | 23.7 (0.59) | 30.5 (0.61) | 33.4 (0.56) | 37.4 (0.53) | 41.2 (0.52) |
| | JG. H2129 (L) | 15.2 (0.76) | 20.0 (0.67) | 23.1 (0.58) | 27.0 (0.54) | 27.0 (0.45) | | |
| | GK. H10040 (L) | 16.7 (0.84) | 21.8 (0.73) | 25.8 (0.65) | 30.0 (0.60) | 34.6 (0.58) | 39.9 (0.57) | |
| KY301 | GK. H10060 (R) | 19.2 (0.96) | 24.8 (0.83) | 32.6 (0.82) | 40.0 (0.80) | | | |
| U413 | GPUr413001 (L) | 16.0 (0.80) | 22.0 (0.73) | 27.1 (0.68) | 33.5 (0.67) | 38.8 (0.65) | 43.2 (0.62) | 48.8 (0.61) |

*Diagnosis.* Shell of moderate size, nearly equivalve, inequilateral, oblique, typically mytiliform, much elongated from the umbo to the postero-ventral extremity; umbonal region moderately convex, with steep or almost vertical antero-dorsal part; shell gradually becoming less convex with growth, with rather gently sloping anterior part and flattened posterior part. Umbo terminal or nearly terminal, slightly projected over the hinge-line. Narrow posterior ear may be discernible in some specimens, e. g. GK. H10039, H10053, H10056 and JG. H2129).

Hinge-line rather short, less than half of the shell length, though variable to a certain extent. Obliquity of the shell gradually enlarged with growth, with decreasing angle between the hinge-line and the growth-axis, resulting in anteriorly convex growth-axis. Anterior margin gently curved, passing to a long, broadly arcuate ventral margin; postero-ventral extremity narrowly rounded in the typical from but less so in some others, and rather abruptly bent to the long nearly stratight posterior margin, which, in turn, forms an obtuse angle with the hinge-line.

Surface ornamented with concentric ribs and numerous concentric rings. The concentric ribs of moderate intensity on the convex younger part and also the anterior part but rather low on the rest main part, wavy in cross section with rounded top, normally regularly disposed, separated by interspaces nearly as narrow as the ribs, but occasionally crowded or rather irregularly disposed (e. g. GK.



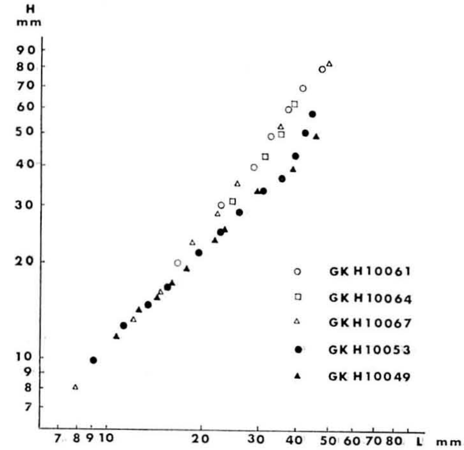

Text-fig. 3. Basic morphology and measurements of *Inoceramus labiatus*. HL: hinge line (length of the hinge-line and its proportion to shell length are to be measured), H: maximum dimension from the umbo to the postro-ventral extremity (which should be measured along the growth-axis, but here conventionally measured along the straight line), L: maximum dimension of the line perpendicular to H, L/H: proportion of L to H, l: shell length, i. e. the maximum dimension from anterior to posterior in parallel to the hinge-line, h: shell length, i. e. the maximum dimension perpendicular to l, l/h: proportion of l to h, d: angle between the hinge-line and growth-axis, obliquity may be expressed as 90°–d.

H10056 and H519). The concentric rings developed on ribs and interspaces in parallel to them, but may not be discernible on the internal mould. Fine parallel striae may be discernible on the posterior ear.

*Biometric analysis.* To know the actual state and meaning of the variation, a biometric analysis of selected characters is here attempted on the samples of different stratigraphic and geographic positions, although the available material is insufficient for more comprehensive examination at population level.

The basic morphology is illustrated in Text-fig. 3, with indication of measurable characters. The proportion of L to H is considerably variable as shown in Table 2, but as a rule it gradually decreases with growth. Measurements are done at successive growth stage in each specimen.

Two samples from the Oyubari area are specially taken, Y5228h (N=7) and Y1202 (N=4). The former is probably




Text-fig. 4. Scattered diagram showing the correlation of bivariables of H and L in individual growth. empty signs: specimens of Sample Y5228h; solid signs: specimens of Sample Y5102.

of lower horizon than the latter in the same area, as is explained in the stratigraphic note. The correlation of the two variables of L and H in individual growth stage is examined. As is clearly shown by the diagram of Text-fig. 4, distinction is clear in the relative growth between the two samples.

As is evident from the numerical data in Table 3, the correlation coefficient is very high in most specimens and there is a considerable difference in the growth ratio ($\alpha$) between the two samples. The significancy of difference in the mean value of the growth ratio ($\alpha$) in the two samples is obtained in the following way.

As the order of calculation of Student's $t$-test, at first $F$-test should be examined by the following equation,

$$F = s_1^2/s_2^2 = 0.083^2/0.045^2 = 3.402$$

where, s=standard deviation of growth ratio ($\alpha$).

The value of $F$ is less than the value of 5 percent limit of the same degree of freedom. Therefore the significancy of difference in the mean value between the two samples is judged by the next formula,

$$t = \frac{x_1 - x_2\sqrt{\dfrac{N_1 \cdot N_2}{N_1 + N_2}}}{\sqrt{\dfrac{(N_1-1)s_1^2 + (N_2-1)s_2^2}{N_1 - N_2 - 2}}}$$

$$= \frac{(1.340 - 0.995)\sqrt{\dfrac{7 \times 4}{7+4}}}{\sqrt{\dfrac{(7-1)0.083^2 + (4-1)0.045^2}{74-2}}}$$

$$= 7.581$$

where,

$x_1$: mean of Sample 1
$x_2$: mean of Sample 2
$s_1$: standard deviation of Sample 1
$s_2$: standard deviation of Sample 2
$N_1$: size of Sample 1
$N_2$: size of Sample 2.

From the above calculation, the $t$ value is very significant comparing the value of 5 percent significant limit at 9 in the degree of freedom $t_{0.05}(\nu=9) = 2.262$.

On the other hand, calculating the coefficience of difference between the two

Table 3. Data of reduced major axis of L and H.

| Sample | Specimen | r | $\alpha$ | log $\beta$ | $\beta$ |
|---|---|---|---|---|---|
| Y5228h | GK. H10061 | 0.994 | 1.386 | −0.42090 | 0.379 |
| | GK. H10062 | 0.995 | 1.487 | −0.54046 | 0.288 |
| | GK. H10063 | 0.989 | 1.323 | −0.26199 | 0.547 |
| | GK. H10064 | 0.997 | 1.374 | −0.38493 | 0.412 |
| | GK. H10066 | 0.999 | 1.283 | −0.22550 | 0.595 |
| | GK. H10067 | 0.998 | 1.289 | −0.21897 | 0.604 |
| | GK. H10068 | 0.998 | 1.238 | −0.17133 | 0.674 |
| | mean | 0.997 | 1.340 | | 0.500 |
| | s | 0.004 | 0.083 | | 0.138 |
| Y5102 | GK. H10048a | 0.997 | 0.972 | 0.10960 | 1.287 |
| | GK. H10048b | 0.979 | 0.964 | 0.12082 | 1.321 |
| | GK. H10049 | 0.999 | 0.984 | 0.05905 | 1.140 |
| | GK. H10053 | 0.997 | 1.061 | −0.02575 | 0.902 |
| | mean | 0.993 | 0.995 | | 1.163 |
| | s | 0.009 | 0.045 | | 0.109 |

Table 4. Angle between the hinge-line and growth-axis at successive growth stages.

| Specimen \ H in mm | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|
| GK. H10049 | 52 | 45 | 40 | 36 | 35 |
| GK. H10056 | 41 | 35 | 33 | 32 | 31 |
| GK. H10048 | 45 | 45 | 42 | 38 | 36 |
| GK. H10052 | 45 | 42 | 38 | 35 | — |
| GK. H10053 | 42 | 40 | 37 | 35 | — |
| GK. H6836 | 69 | 58 | 50 | 49 | 47 |

samples by the method of 75 percent rule, the formula is as follows.

$$\text{C. D.}=\frac{x_1-x_2}{s_1-s_2}=\frac{1.340-0.005}{0.083-0.045}=2.695$$

The result suggests the significant value which is more than the value of conventional significant level of subspecific discrimination (i. e., C. D. =1. 28).

In many species of *Inoceramus* the obliquity gradually decreases with growth, with enlarging angle between the hinge-line and the growth-axis. In the examined specimens, however, it gradually increases as is evidently shown by the data in Table 4.

*Discussion.* The elongate mytiliform with a small L/H and a large obliquity (90°-d) is a diagnostic character of *Inoceramus labiatus* (SCHLOTHEIM, 1813), as represented by the illustrated specimens of WOODS (1911, text-fig. 37, pl. 50, figs. 1-6) and SEITZ (1934, pls. 36-40). In this and other characters described under diagnosis our specimens, especially those of the samples Y5228h, Y5109, Y502, KY9E, R114, R2302p, R4802 and U413, are certainly identified with *Inoceramus labiatus*. There are, however, considerable variations in the ratio between L and H, obliquity, relative length of the hinge-line, degree of curvature of the ribs and growth-lines, rib density and ontogenetic changes of these characters. The variation of L/H and its ontogenetic change are especially noted, as described above.

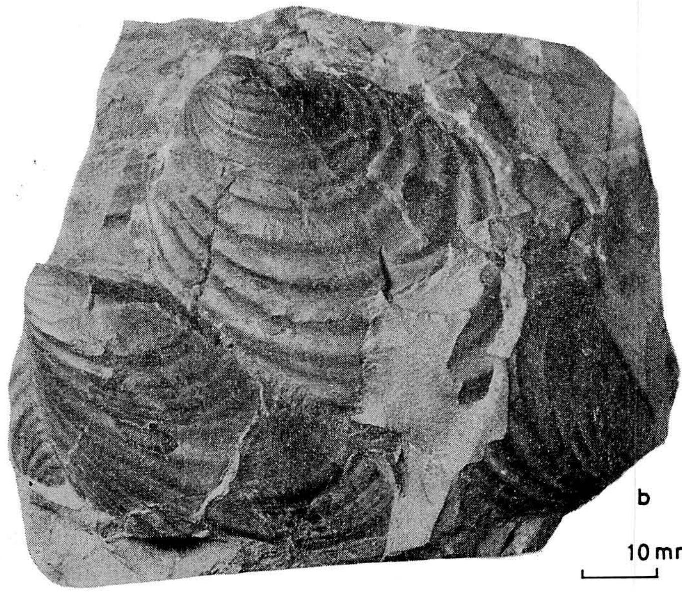
WOODS (1911) regarded *Inoc. latus* SOWERBY, 1828, from the Upper Turonian of England, as a variety of *Inoc. labiatus.* It has a relatively longer hinge-line and broader curvature of the ribs. In other words it is a "broad form", having a larger L/H. SEITZ (1934) described in detail six varieties of *Inoc. labiatus*, in which such broad forms as *Inoc. labiatus* var. *hercynica* PETRASCHECK, 1904 and *Inoc. labiatus* var. *subhercynica* SEITZ, 1934 were included.

In the meanwhile we described *Inoc. teraokai* MATSUMOTO and NODA, 1968, which occurs in the Tano Formation of Kyushu. It is associated with *Inoc. hobetsensis* and *Subprionocyclus neptuni*, which indicate the middle part of the Turonian in the Japanese biostratigraphic scale. We have written that *Inoc. teraokai* is probably intimately related to *Inoc. labiatus*, *Inoc. hercynicus* and *Inoc. latus.* As shown in Text-fig. 6, the scattered diagrams of the individual relative growth of L and H overlap with each other between the two samples, TA 213 (from Kyushu) and Y5102 (from Oyubari, Hokkaido). The fact implies the close affinity of the fossil populations represented by the two samples with respect to this character. Furthermore, as shown in Table 4, the two samples show the same tendency in the change of obliquity with growth. Our previous conclusion is thus supported by the present examination.

The specimens which constitute the sample of Y5102 were collected by MATSUMOTO and OKADA (1973), who called them provisionally *Inoc.* aff. *teraokai.* Most of them indeed resemble typical specimens of *Inoc. teraokai* from Kyushu, in their somewhat broader form, but show more obliquity than the types of *Inoc. teraokai* (see Table 4 and also MATSUMOTO and NODA, 1968, table in p. 320). A few of them, e. g. GK. H10099, are closer to the typical form of *Inoc. labiatus* in the smaller L/H, as are the specimens of sample Y5109, which is probably of somewhat lower stratigraphic position than Y5102 in the same Takino-sawa route. All of these specimens from loc. Y5102 and Y5109 do not show an anterior ear which is characteristic of *Inoc. teraokai.* We now consider them within the extent of variation of *Inoc. labiatus.* Sample Y5102 can be regarded as representing a broader variety of *Inoc. labiatus.*

As is elucidated from the results of Student's *t*-test and the 75 percent rule, the subspecific discrimination between the two pupulations of the samples Y5228h and Y5102 is reasonable, since they are chronologically separated. We hesitate, however, to give a subspecific name, since it is necessary to examine extra-Japanese materials to settle the nomenclatorial problem.

Although a sample size is small, other samples in Hokkaido seem to support the above conclusion. For example, three specimens (one of which, GK. H10041, is




Text-fig. 5. *Inoceramus labiatus* (SCHLOTHEIM). GK. H521a–c, from loc. Y502, the Hinata-zawa, a branch of the Shiyubari, Member IIn (of MATSUMOTO, 1942), Middle Yezo Group. The figure shows an association of a typical (a), intermediate (b) and broad (c) forms.

figured, Pl. 18, Fig. 5) of sample R123 show larger L/H than a typical example of R114 of somewhat lower stratigraphic level in the same Kotambetsu section. Similarly an example of KY301 represents a broader form as compared with the typical one of KY9E of somewhat lower level in the Furano (Sorachi-gawa) section. It is noted that at loc. Y502 a comparatively broader form occurs together with an intermediate and a typical ones (GK. H521 a–c, Text-fig. 5). However, whether this locality is allocated at a level between Y5228h and Y5102 or otherwise is hardly decided by the available field data.

In the meanwhile HASHIMOTO and KOIKE (1973), based on MATSUMOTO's preliminary identification, recorded the occurrence of "*Inoc. teraokai* or *Inoc. latus*" in the Kakaän Formation of Kalimantan in association with a "typical form of *Inoc. labiatus.*" This fact is interesting in that it shows the same case as that of Y502.

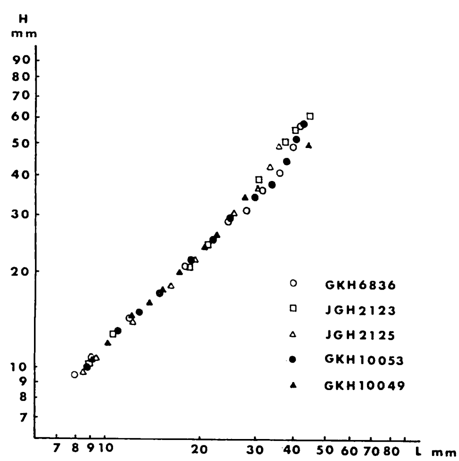
In Germany SEITZ (1934) concluded that the six varieties of *Inoc. labiatus*, in which broad forms are included, do not show orderly succession but occur together in the two shafts of Gneisenau and Sieletz.

In England WOODS (1911, p. 283) remarked that "this species [i. e. *Inoc. labiatus*] is mainly characteristic of the zone of *Rhynchonella cuvieri*. In the zone of *Terebratulina lata* it is not common, and the shell is usually relatively longer than in typical forms of the species." WOODS furthermore described the specimens from the zone of *Holaster planus* under *Inoc. labiatus* var. *latus*. We should like to know how this classic record would be expressed in terms of the up-to-date palaeontology.

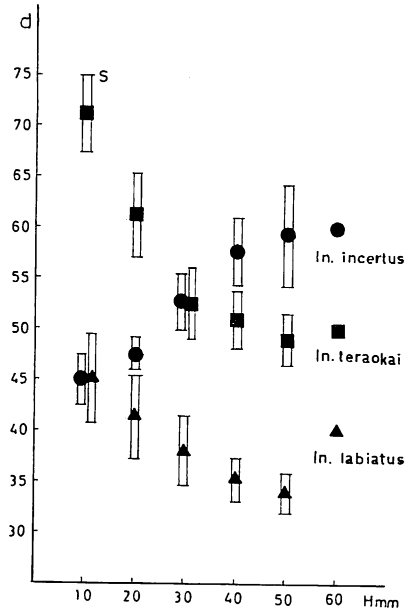
In the United States COBBAN and SCOTT (1972) have recently shown that *Inoc. labiatus* is considerably long ranging, from the zone of *Watinoceras coloradoense* via that of *Mammites nodosoides* to that of *Collignoniceras woollgari*, in the Bridge Creek Limestone Member of the Greenhorn Limestone and furthermore recorded (in p. 19) a broad variety "*Inoc. labiatus* var. *subhercynica*" in the uppermost part of the same sequence (i. e. in the lower part of the Fairport Chalky Shale Member).

This "variety" is associated with *Collignoniceras woollgari*, a distinct index of the Middle Turonian. The association is similar to that of *Inoc. teraokai* and *Subprionocyclus neptuni* in the Tano Formation of Kyushu.

In Japan *Inoc. incertus* JIMBO, from the Upper Turonian of Hokkaido, resembles a broad form of *Inoc. labiatus*, but is distinguisded from the latter and also from *Inoc. teraokai* in having a decreasing obliquity with growth. In other words the growth axis is concave to the




Text-fig. 6. Scattered diagram showing the correlation of bivariables of H and L in individual growth. solid signs: specimens of Sample Y5102, (broad form of *Inoc. labiatus*) ; empty signs: specimens of Sample TA 213 (*Inoc. teraokai* MATSUMOTO and NODA, 1968).




Text-fig. 7. Diagram showing the ontogenetic change in obliquity of *Inoc. labiatus*, *Inoc. teraokai* and *Inoc. incertus*.

anterior in *Inoc. incertus* but convex in *Inoc. labiatus*.

The diagram of Text-fig. 7 shows the ontogenetic change of obliquity in the three species, *Inoc. labiatus*, *Inoc. teraokai* and *Inoc. incertus*. With respect to the obliquity *Inoc. labiatus* and *Inoc. incertus* are indistinguishable at the immature stage with H=10mm. This fact is not negligible for the phylogenetic relationship of the two species.

Should the tendency to decrease the obliquity be still more exaggerated, together with lengthening of the hinge-line, such forms as *Inoc. yubarensis* NAGAO and MATSUMOTO, 1940 and *Inoc. mantelli* BARROIS, 1879 (see SEITZ, 1962) of the Coniacian could be led.

Turning back to the Upper Cenomanian, we have little material in Hokkaido to consider the origin of *Inoc. labiatus*. As has been explained in the stratigraphical note, the upper part of the Cenomanian in Hokkaido is characterized by *Inoc. concentricus costatus* NAGAO and MATSUMOTO, 1939 and *Inoc. pennatulus* PERGAMENT, 1966, (with which *Inoc. reduncus* PERGAMENT, 1966 may be included). The last species is probably an enlarged offshoot of the inequivalve *concentricus* group and has nothing to do with the *labiatus* group. The only available material is a few imperfectly preserved specimens, from loc. R5404 about 100m below the key tuffite in the Obira area, which may be comparable with *Inoc. reachensis*.

WOODS (1912) interpreted that *Inoc. reachensis* ETHERIDGE, 1881 [=*Inoc. crippsi* var. *reachensis* of WOODS, 1911], from the zone of *Holaster subglobosus*, was the ancestor of *Inoc. labiatus*. According to a preliminary observation by one of us (T. M.) of the type specimens in the Sedgwick Museum and the British Museum (N. H.), *Inoc. reachensis* has a larger L/H and less obliquity than typical forms of *Inoc. labiatus* and, accordingly, more similar to *Inoc. latus*. It could then be considered as a working hypothesis that there was a slowly evolving main series from *Inoc. reachensis* of the Upper Cenomanian to *Inoc. latus* of the Upper Turonian and that *Inoc. labiatus* was a specialized offshoot in the Lower Turonian which acquired a mytiliform outline.

The above discussion may have connection with the definition and scope of *Mytiloides* BRONGNIART, 1822, but we do not intend to go into this problem on this occasion. For the time being we use the generic name *Inoceramus* in a broad sense.

In conclusion we should like to suggest that examination of morphological changes from population to population would be useful not only for the refinement of biostratigraphic subdivision but also for the elucidation of phylogenetic relationships. The study of *Inoc. labiatus* and its allied species should be carried on in such areas where numerous well preserved specimens are obtainable at successive stratigraphic levels.

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〔J+E=in Japanese with English abstract〕

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**P. S.** This work has been done within the framework of the IGCP project entitled "Mid-Cretaceous Events".

| | | | |
|---|---|---|---|
| Ashibetsu | 芦 別 | Obirashibetsu | 小平蘂 |
| Furano | 富良野 | Ono | 大 野 |
| Futamata-zawa | 二股沢 | Oyubari | 大夕張 |
| Hakkin-zawa | 白金沢 | Pankemo-yuparo | パンケモユーパロ |
| Higashi-horobetsu | 東幌別 | Pombetsu | 奔 別 |
| Hinata-zawa | 日向沢 | Saku | 佐 久 |
| Ikushumbetsu | 幾春別 | Saku-gakko-no-sawa | 佐久学校の沢 |
| Iwamizawa | 岩見沢 | Shiyubari | 主夕張(シューパリ) |
| Kamuikotan | 神居古潭 | Soashibetsu | 惣芦別(ソウアシベツ) |
| Kanayama | 金 山 | Soeushinai | 添牛内 |
| Katsurazawa | 桂 沢 | Sorachi | 空 知 |
| Kiritachi pass | 霧立峠 | Taki-no-sawa | 滝の沢 |
| Kotambetsu | 古丹別 | Tano | 田 野 |
| Meiji-bashi | 明治橋 | Tappu [Tap] | 達 布 |
| Mikasa | 三 笠 | Urakawa | 浦 河 |
| Nakakinembetsu | 中紀念別 | Ushirogawachi | 後河内 |
| Nio-no-sawa | 仁尾の沢 | Yamabe | 山 部 |
| Nishitappu | 西達布 | Yubari | 夕 張 |
| Notsu | 野 津 | 82 Rimpan | 82 林班 |
| Obira | 小 平 | | |

## Explanation of Plate 18

(All figures of natural size)

Figs. 1–6. *Inoceramus labiatus* (SCHLOTHEIM).

Fig. 1. JG. H2128, plaster model of a left valve originally preserved at GK. Loc. certainly same as that of GK. H10040.

Fig. 2. GK. H10056, left valve (MURAMOTO Coll., 1971), from loc. Ob. rp. 002p=R2302p of T. MATSUMOTO, 82 Rimpan, Nakakinembetsu, Obira area.

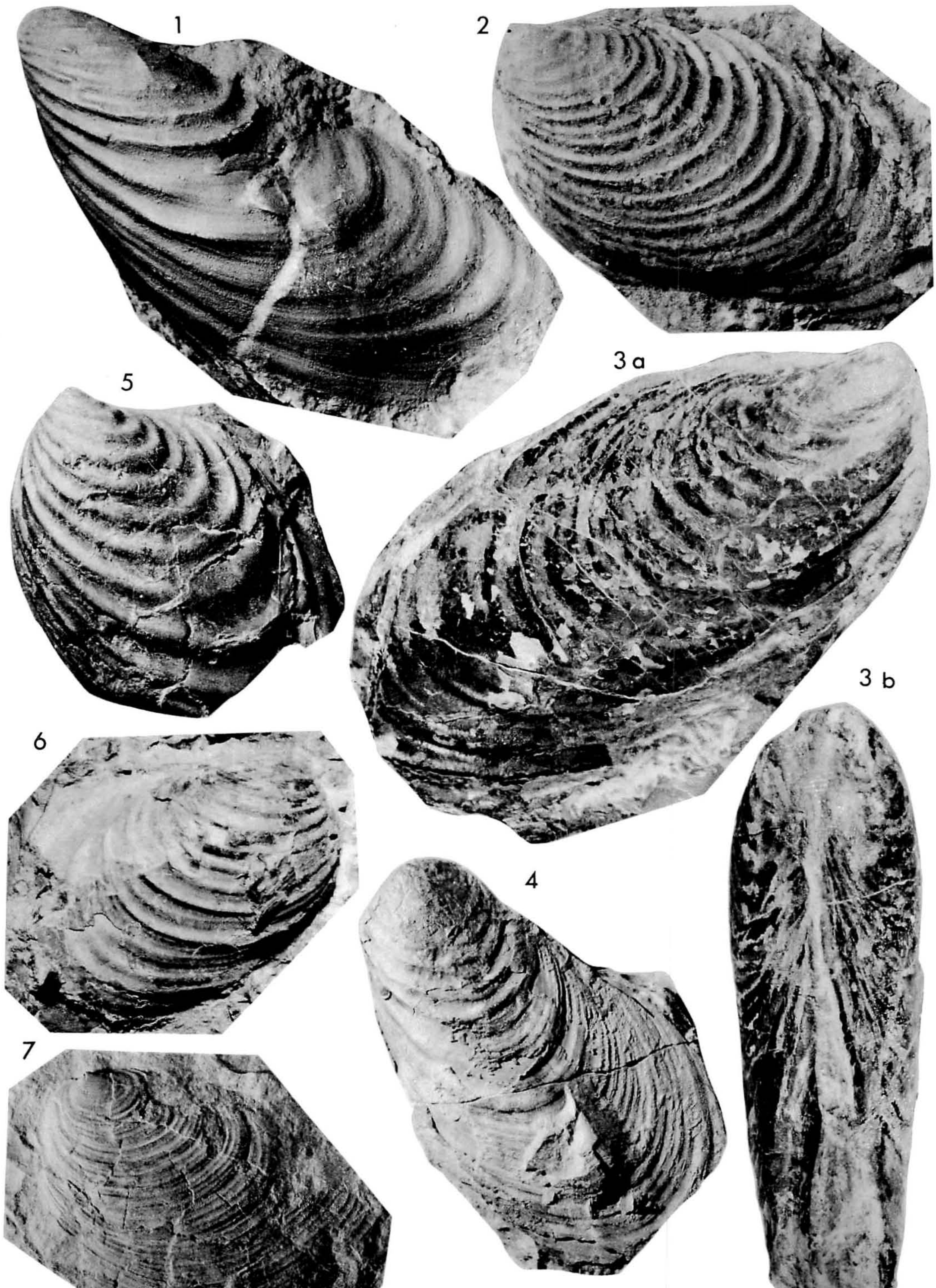
Fig. 3. GP. Ur413001, both valves. (KANIE Coll., 1966), from loc. U413, Higashi-horobetsu, Urakawa area. Lateral view of the right valve (a) and anterior view (b).

Fig. 4. GK. H10040, left valve (MATSUMOTO, HASHIMOTO and FUJII Coll., 1952), from loc. KY9E, right bank of the River Sorachi, about 100m downstream from the confluence with the Nishitappu-zawa, Furano area.

Fig. 5. GK. H10041, left valve (MATSUMOTO Coll., 1967), from loc. R123, a branch of the Futamata-zawa, on road side, about 1600m west of the Kiritachi pass, Kotambetsu area. This was called *Inoc.* sp. aff. *Inoc. labiatus* by MATSUMOTO and OKADA, 1973.

Fig. 6. GK. H10048 a, right valve (MATSUMOTO and OKADA Coll., 1969), from loc. Y5102 h, Takinosawa, Oyubari area. This was labelled as *Inoc.* sp. aff. *Inoc. teraokai* by MATSUMOTO and OKADA, 1973.

Fig. 7. *Inoceramus teraokai* MATSUMOTO and NODA. JG. H2125, left valve (NODA Coll. aided by A. KAI, 1969), from loc. TA213, an eastern hill-side near the Meiji-bashi, Ushirogawachi, Notsu-machi, Ono-gun, Oita Prefecture, Kyushu, upper member of the Tano Formation.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Trans. Proc. Palaeont. Soc. Japan, N. S., No. 100, pp. 209-219, pls. 19-22, Dec. 25, 1975

# 654. AN ARMORED WORM FROM THE MIOCENE YOKO-O FORMATION, NAGANO PREFECTURE, JAPAN*

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長野県中新統横尾層産有殻多毛虫化石について；長野県中新統横尾層中部より産出した有殻多毛虫化石の分類上の検討と，その産出する黒色頁岩の堆積環境について論じた。

有殻多毛虫化石は直径約 2〜3 mm，長さ約 50 mm に達する管状の珪質殻を特徴とし，殻表には，不規則な生長線，体節環及び縦状の細い溝を有する。外形上類似する *Terebellina*, *Longitubus*, *Makiyama*, *Bathysiphon*, *Siphonites* 等と比較検討したが，形態，殻表彫刻，殻構成々分等により Serpulidae 科の 1 新属として新属名 *Yokoia* を提唱した。

畑 井 小 虎・野 田 浩 司

## Introduction

During the summer field work in 1974 in the Sakaki area in Nagano Prefecture, abundant tubular structures were discovered in the black siltstone distributed widely in the area. The majority of the tubular structures occurred in a position parallel with the stratification of the tuff layers interbedded in the black massive siltstone, and only a few specimens were noted to be preserved more or less oblique to the bedding of the formation.

The stratigraphic position of the black colored siltstone of the Yoko-o Formation in the surveyed area is shown in Fig. 1. The Yoko-o Formation is about 1250m in total thickness; the altered andesite and its tuff breccia are intercalated in the lower, and the black massive siltstone develops mainly at the upper part of the formation. The present tubular fossils were collected from the middle part of the formation.

The tubular specimens occurred both horizontally and vertically as a crowded assemblage of complete to fragmental (broken) individuals. Vertically the tubular specimens were found to superpose others obliquely, horizontally or as a mixed assemblage of broken tubes as shown in the annexed illustrations (Pl. 19, Figs. 1-2; Pl. 22, Fig. 1). All of the specimens were found at a locality geographically not remote (about 1.2 km north from the present locality) from the one where HATAI and SAITO (1962) recorded the occurrence of *Terebellina kattoi* HATAI and SAITO. At the time of description of *Terebellina kattoi*, HATAI and SAITO (1962) considered that their new form occurred from the Bessho Formation. However, the stratigraphical work by SHIMIZU (1975MS) and YAMAGISHI (1958, 1964) shows that the black massive siltstone distributed around the area mentioned above should be placed in the middle part of the Yoko-o Formation, a stratal unit proposed by YAMAGISHI (1958) based upon the traceable tuff layers. The discussions on the strati-

* Received July 3, 1975; read June 14, 1975 at Morioka.

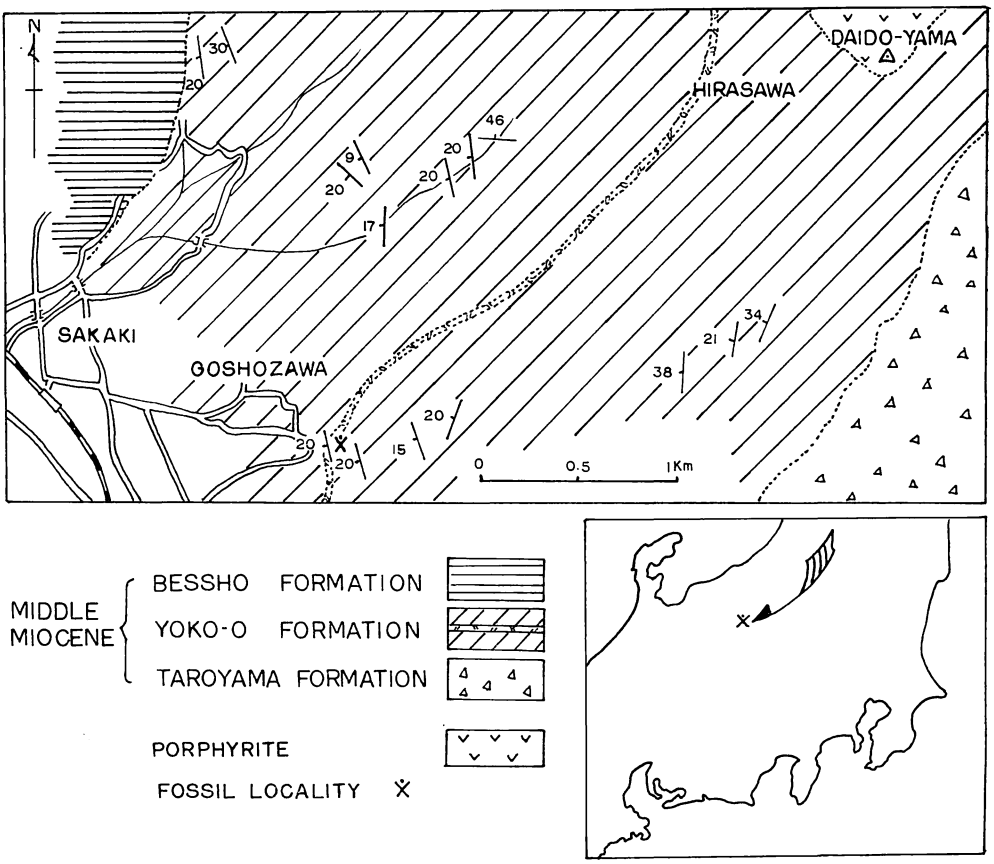


Fig. 1. Stratigraphy and geological map around the fossil locality (SHIMIZU, 1975MS).

graphy will be published at another opportunity.

The tubular specimens are thought to be worthy of description and illustration for several reasons. The reasons are; (1) specimens comparable with but distinct from the present ones are known to, or have been recorded (*Hyalinoecia tubicola*) from the continental slope and shelf of the western north Atlantic Ocean (HEEZEN and HOLLISTER, 1971; WIGLY and EMERY, 1962) from depths of 274-1170 meters in the former area and at 1935 meters depth at the latter area. The Recent specimens called *Hyalinoecia tubicola* show similarity with the fossil ones dealt with in this article, and is stated by WIGLEY and EMERY (1961) to have a depth range of 13-4380 meters for all oceans. The average density of that species is 461/m$^2$ on the Atlantic continental slope, 272/m$^2$ for the western North Atlantic Ocean, 15/m$^2$ for off California. The length of the mentioned Recent species is 6-15 cm, but most tubes are 8-12 cm in length, (2) the fossil specimens are similar to the Recent species cited above in some morphological features, but quite different in others; they represent an undescribed form, (3) the black colored siltstone in which the fossil tubes were found suggests the kind of marine bottom sediments on and in which the living *Hyalinoecia tubicola* has been recorded. The resemblance of bottom conditions seem to be noteworthy, (4) since little work has been published on the fossil tubular structures of the kind presented in this article, their descriptions and illustrations are thought to contribute to our knowledge on the group, and (5) the rather rare and few occurrences of fossils from the thick black siltstone is a characteristic of the formation.

Before entering into the description and discussion of the fossil tubular structures, sincere gratitude should be expressed to Professor Tamio KOTAKA of the Tohoku University and Associate Professor Yutaka SAITO of the Shinshu University for their kind discussions on the stratigraphy. Deep acknowledgements are due to Dr. Munemoto NEDACHI, and Mr. Kenshiro OGASAWARA of the Tohoku University for their EPMA and X-ray operations and analyses. The writers also thank Mr. Toshihide SHIMIZU of the Teikoku Petroleum Company for his information on the stratigraphy and fossil locality, and Mr. Kimiji KUMAGAI and Mr. Shohei OHTOMO of the Tohoku University for photographic work.

## Description and remarks

Family Serpulidae BURMEISTER, 1837

Genus *Yokoia*, new genus

*Type species: Terebellina kattoi* HATAI and SAITO, Yoko-o Formation, Miocene.

*Diagnosis:* Straight, sigmoidal to slightly convex, calcareous and siliceous, solid tubular structures. Shell surface with irregular concentric growth lines and irregularly spaced periodic swellings. Generally creased longitudinally along middle.

*Remarks:* The genus *Yokoia* shows morphological resemblance with the genus *Longitubus* HOWELL, 1943 (HOWELL, 1962, p. 158, fig. 98-3) from the Upper Cretaceous of North America (HOWELL, 1962, p. 162) but differs from it by "the concentric ridges not being closely spaced" by the more irregular growth lines and by the characteristic development of irregularly spaced periodic buldges or swellings.

In order to know the characteristics of the newly discovered tubular structure, EPMA and X-ray analyses were made, and photomicrographs are annexed to show the details. EPMA and X-ray analyses of the tubular structure show that they consists of siliceous material embedded in a matrix that is composed of both calcareous and siliceous materials. The abundant spiculate structures noted within the shell are all composed of $SiO_2$ and the abundant grains distributed within the matrix also consist of $SiO_2$. X-ray analysis of the Nagano tubes show the first peak at 26.6 and the second one at 20.8 degrees in $2\theta$, both of silica. *Terebellina shikokuensis* KATTO (1960) shows the first peak at 26.7 and the second one at 20.9 in $2\theta$ also for silica. In comparison the X-ray analyses of the sponge hitherto known as *Makiyama* (previousely as *Sagarites;* MAKIYAMA, 1931) from the Taga Formation in the Joban coal-field, Fukushima Prefecture and from the type area of the genus in the Sagara oil-field, Shizuoka Prefecture show the first peak of Silica at 26.7 and the second one at 20.8 for the specimens from both of the areas. Thus from X-ray analyses the Sagara and Taga so-called *Makiyama* are identical in their silica peaks, and also similar to the Shikoku *Terebellina* and the Nagano *Yokoia*

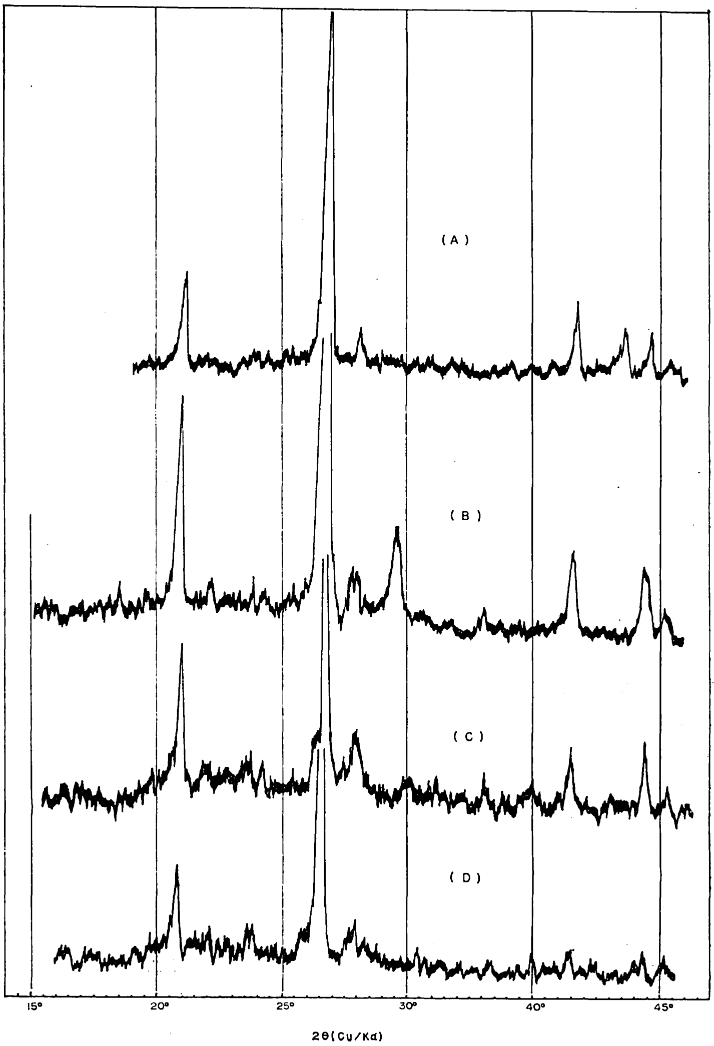


Fig. 2. X-ray diffraction patterns of (A) *Terebellina shikokuensis* KATTO from the Naharigawa Formation, (B) *Yokoia kattoi* (HATAI and SAITO) from the Yoko-o Formation, (C) *"Makiyama" chitanii* (MAKIYAMA) from the Sagara Formation, and (D) *"Makiyama" chitanii* (MAKIYAMA) from the Taga Formation. Target/Filter: Cu/K$\alpha$, Intensity: 30 kV, 15 mA.

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## Explanation of Plate 19

Figs. 1–3. *Yokoia kattoi* (HATAI and SAITO).

Showing the straight and slightly convexed shells with weak concentric growth lines, some swellings and medial creasing in part. The longest specimen (fig. 3 ×2, IGPS coll. cat. no. 92616-b) measures 54.5 mm and a mixed assemblage of broken tubes (fig. 2 ×3, IGPS coll. cat. no. 92618-a) are illustrated. Some orientations of the worm tubes are observable (fig. 1 ×3, IGPS coll. cat. no. 92616-c).

Locality and geological formation is mentioned in the text.

K. KUMAGAI photo.

(n. gen.) (Fig. 2).

The spiculate structure found within the tubular structure of *Yokoia* are all monaxons in shape, silica in substance, crowded in arrangement and generally 150–200 microns in length, being nearly straight to weakly curved along their length. From the arrangement of the spiculate structures it is difficult to decide whether they represent their original orientation, subsequently arranged orientation, or secondary developed ones. Whatever be the case it seems that the original animal that occupied the tubular structures may have been able to secrete siliceous substance to make the spiculate structures, to have devoured foreign spiculate organisms and retained the spicules in their shells as waste matter, or to have secreted siliceous spicules to make the tubular structures, or less probably to have the spicules agglutinated on their shells for self protection.

Whatever be the real cause of the spiculate structures, it is evident that the chemical and X-ray analyses made for the tubular structures of *Yokoia*, the so-called *Makiyama* and the *Terebellina shikokuensis* are almost identical and closely similar with one another but their structures differ. This may point to the intimate relationship of the three kinds of tubular structures just mentioned.

Showing a remote similarity with *Yokoia* is the genus *Bathysiphon* M. SARS, 1872 which is described and illustrated by LOEBLICH and TAPPAN (*in* Treatise on Invertebrate Paleontology, Part C, Protista, vol. 1, p. C186, fig. 105, 4–10). It is said to have an agglutinated shell that is long (up to 50 mm), narrow and may have annular constrictions. The wall is described to be agglutinated "commonly of siliceous sponge spicules and fine sand or other mineral matter in calcareous cement", features which seem to be similar to the shell of *Yokoia kattoi* (HATAI and SAITO). However, the agglutinated shell of *Bathysiphon* differs from both *Yokoia* and *Makiyama* (discussion reserved for another opportunity) in the following features, namely, (1) the material filling the interior of the tubular structure of *Yokoia* is composed of sediments the same as the matrix, (2) the periodically and irregularly spaced concentric buldges or constrictions of *Yokoia* are more defined on the calcareous to siliceous shell, (3) the length of *Bathysiphon* is said to be up to 50 mm, whereas that of the tubular structures of *Yokoia* exceed that length, and the true length remains unknown because both ends are broken in all of the preserved specimens, and (4) the shell wall is not agglutinated as in *Bathysiphon*. From these reason, the shell of *Yokoia* can not be identified with that of *Bathysiphon* (Foraminifera). However, whether *Bathysiphon* is a true Foraminifera may be in need of a re-examination. Dr. Yasumoti MATOBA, foraminiferologist at the Akita University of Mining, informed the junior writer that he has a similar thinking about *Bathysiphon* with the writers. Detail examination of *Bathysiphon* and *Makiyama* will be reserved for another opportunity. Other organisms, such as the foraminiferal genera showing a more or less remote resemblance with the shell of *Yokoia* may be *Nodellum* RHUMBLER, 1913 (Op. cit., p. C179, fig. 97, 3–4); *Protobotellina* HERON-ALLEN and EARLAND (Op. cit., p. C190, fig. 106, 7–9); and *Schixammina* HERON-ALLEN and EARLAND, 1929 (Op. cit., p. C194, fig. 107, 6–10). But these three genera can be distinguished from *Yokoia* in the same way as *Bathysiphon*.

The generic name is taken from the name of the formation.

*Yokoia kattoi* (HATAI and SAITO, 1962)

Pl. 19, figs. 1-3; Pl. 20, figs. 1-7a; Pl. 21, figs. 1-7; Pl. 22, fig. 1

*Terebellina kattoi* HATAI and SAITO, 1962, *Japan. Jour. Geol. Geogr.*, vol. 33, nos. 2-4, p. 246, fig. 2.

*Description:* Tube long, narrow, string-like, orifices rounded, surface with strong to weak concentric growth lines and periodic, irregularly spaced concentric buldges or swellings; tube rounded originally, generally creased medially and longitudinally; tube straight to broadly sigmoidal to more or less broadly bow-shaped. Length exceeds 50 mm because both ends lost, width about 2 mm when not creased medially, but measuring 3 mm or a little more when creased. Concentric buldge or swellings or annulations separated by distances of about 0.2 mm to 1.5 mm in width.

*Locality:* Road side cliff at the entrance to the forest road at Goshozawa (Hirasawa-rindo), Sakaki-cho, Hanishina-gun, Nagano Prefecture.

*Geological formation* and *age:* Middle part of the Yoko-o Formation, Middle Miocene.

*Depository:* Illustrated specimens (IGPS coll. cat. nos. 92615, 92616, 92617, 92618) are preserved in the collection of the Institute of Geology and Paleontology, Faculty of Science, Tohoku University and some specimens collected from the same locality are in the collection of the Saito Ho-on Kai Museum of Natural History.

*Associated fossils: Eutrephoceras izumoensis* (YOKOYAMA), some thin shelled pelecypods, detached fish scales and drifted plant leaves.

*Remarks:* Most of the specimens referred to *Yokoia kattoi* are creased medially and longitudinally, some due to compressive agencies after death of the organism. But many specimens still retain the original shape and are also found mixed in the same assemblage of individuals. Some specimens are creased only in part, and the creasing may be hardly noticable to strongly impressed. Creasing medially is also shown in many specimens of *Terebellina* illustrated by DANNER (1955) from the Neogene rocks of several localities in western Washington, U.S.A. This phenomenon is a common feature in specimens of the so-called *Makiyama chitanii* (MAKIYAMA) of wide distribution in Japan and recorded originally as a sponge from the Neogene rocks of the Sagara district in Shizuoka Prefecture (MAKIYAMA, 1931), and probably sometimes mistaken for the present new genus especially in Nagano Prefecture. Besides the tubular structures known to be creased medially and

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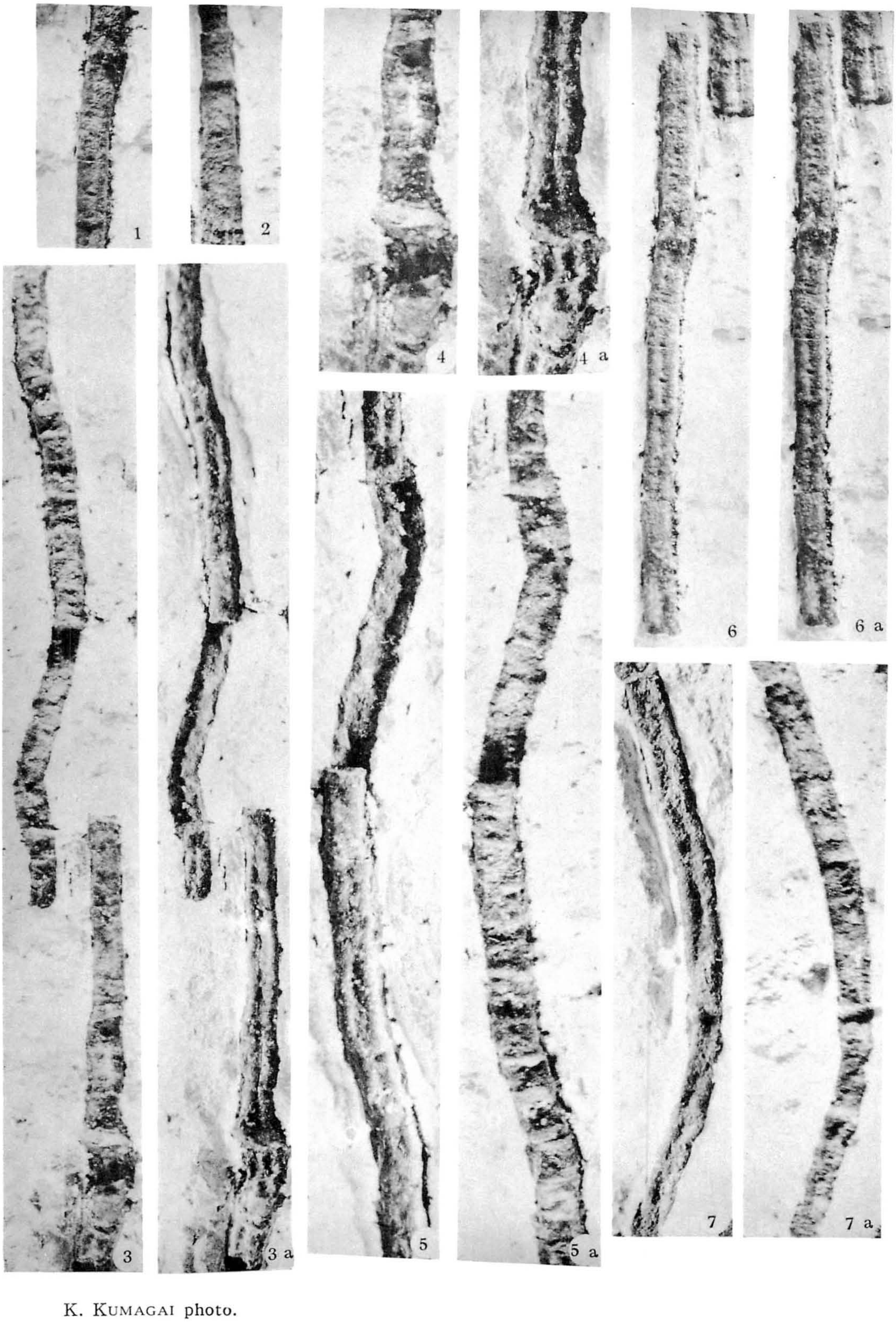
Explanation of Plate 20

Figs. 1-7a. *Yokoi kattoi* (HATAI and SAITO).

(All figures ×3 excluding figs. 3-3a ×2)

All figures are different views taken with different focus depth. Figs. 3-3a, 4-4a, 5-5a, 6-6a and 7-7a show the pair of specimens photographed with different focus depths to show how different the surface features will appear. Identification of the worm tubes will arise from the magnification used, thus both natural and enlarged views are important for classification of the armored worms. Figs. 1-2, 6-6a, IGPS coll. cat. no. 92615-b; Figs. 3-3a, 4-4a, 5-5a, IGPS coll. cat. no. 92615-a; Figs. 7-7a, IGPS coll. cat. no. 92615-c.

Locality and Formation is mentioned in the text.




K. KUMAGAI photo.

longitudinally, there are several species of so-called worm tubes that have been described from the geological formation of Japan and of the North Pacific borderland. These are given in the list cited below.

**List of fossil armored worms from the North Pacific borderland**

*Terebellina shikokuensis* KATTO, 1960, *Sci. Rep., Tohoku Univ., Ser. 2, Geol., Spec. Vol.*, no. 4, p. 328, pl. 34, figs. 1, 3, pl. 35, fig. 7, Type loc.--Sea cliff at Kannoura, Toyo-cho, Aki-gun, Kochi Prefecture, Naharigawa Formation, Eocene.

*Terebellina kattoi* HATAI and SAITO, 1962 [Misspelled as *Terebrellina*]. This is the type species of the genus *Yokoia*, n. gen., *Japan. Jour. Geol. Geogr.*, vol. 31, nos. 2-4, p. 246, fig. 2. Type loc.—One kilometer east of Minamihina, Sakakicho, Hagishina-gun, Nagano Prefecture, Bessho Formation, Miocene.

*Vermitubus sumitaensis* HATAI, MURATA and KAWAKAMI, 1972, *Saito Ho-on Kai Mus., Res. Bull.*, no. 41, p. 29, pl. 4, figs. 1-14. Type loc.—Motoizawa, Kawaguchi, Sumita-cho, Kesen-gun, Iwate Prefecture, Sakamotozawa Formation, Permian.

*Terebellina palachei* ULRICH, 1910, Howell, B.F., 1962, *in* Treatise in Invertebrate Paleontology, *ed.* by R.C. MOORE, *Geol. Soc. Amer.* and *Kansas Univ. Press*, p. 162, fig. 101-4. Type loc.—Yakutat Bay area, Alaska, Yakutat Formation, Jurassic.

*Ditrupa miyazakiensis* HATAI, NODA and OGASAWARA, 1970, *Trans. Proc. Palaeont. Soc. Japan, N.S.*, no. 87, p. 409, figs. 1-2. Type loc.—Uzutsumi near the Kagamisu Pass on the road from Nagayama to Koguchi, south of Kiyotake-cho, Miyazaki-gun, Miyazaki Prefecture, Boroishi Member of the Udo Formation, Miocene.

All of the species given in the list above can be distinguished from the new genus described in this article by several important characters as, the strong concentric growth lines, periodic and irregularly spaced buldges or swellings that are especially noteworthy at and from the middle towards the anterior part of the tube. The tube may be straight, sigmoidal to slightly curved. The creasing medially and longitudinally is noticed on both large and small specimens. None of the tubes seem to be agglutinated as to consist of cemented grains of rock, shells, sand or other small objects as in *Terebellina*.

Observations on the known fossil worm tubes described from Japan reveal that the outstanding characteristics that are also of taxonomic importance are the strong growth lines, periodic and irregularly spaced buldges or swellings of the tube, irregular growth and non-agglutinated shell. The genus *Siphonites* SAPORTA, 1872 described and figured by HÄNTZSCHEL (1962, p. 215) is stated to have the "Tubes about 1 cm in diameter with sandy lining, mostly washed out and collapsed on bedding planes." This genus has been recorded from the Upper Triassic of France. The figure given by HÄNTZSCHEL (1962, p. 216, figs. 135-4) shows specimens creased medially and longitudinally, and in this respect, resemblance is found with the broken specimens of *Yokoia*. However, the diameter of *Siphonites* is stated to be about 1 cm and in this respect it is much larger than any of the specimens of *Yokoia* in the present collection. The collapsed specimens of *Siphonites* also show a remote resemblance with the compressed and medially creased specimens of the Miocene and Pliocene so-called *Makiyama* distributed widely in Japan and with *Yokoia kattoi* (HATAI and SAITO) from the Miocene of Nagano Prefecture. *Makiyama* is in need of detail study to confirm its true characteristics and relation with similar forms. *Siphonites* differs from the two just mentioned in the much larger diameter, much shorter and stouter tube. Among the species given in the list, *Terebellina shikokuensis* KATTO, 1960, from the Eocene Naharigawa and Muroto Formations of Kochi Prefecture is the first record to the genus *Terebellina* from Japan. *Terebellina shikokuensis* is characterized by the wall being composed of "fine grained sands firmly cemented". Subsequent study of the holotype of *T. kattoi* shows that its wall is not composed of "minute siliceous grains" as in *Terebellina*, and in this respect, *kattoi* should be referred to a genus other than *Terebellina*. Examination of some of the tubes called *Terebellina shikokuensis* KATTO, taken from the original mass of specimens illustrated by KATTO (1960), shows that the external shell is composed of minute grains and that the matrix also consists of minute grains. There is no periodic irregularly spaced concentric swellings as in *Yokoia*, and from the characteristics just mentioned its reference to the genus *Terebellina* is without doubt. *Shikokuensis* can be retained in the genus *Terebellina* and the genus is represented in the Cenozoic rocks of Japan by the single species, *shikokuensis*.

The wall of *Yokoia*, n. gen. proposed in this article is calcareo-siliceous, and in this respect its reference to the family Serpulidae BURMEISTER, 1837 (HOWELL, 1962, p. 155) seems to be justified it the original tube was calcareous but subsequently changed into silica. And it is characterized by the shape of the tube, its longitudinal creased structure, and with characteristic concentric, periodically arranged swellings.

Among the abundant specimens of tubular structures found in the black mudstone in the Sakaki area, there were many without the external shell that could be identified with *Terebellina kattoi* described by HATAI and SAITO. Under the circumstances, it was decided that the tubular shells are identical with the mould specimens described and illustrated by HATAI and SAITO. The presence of abundant siliceous material in the matrix of both specimens, that is to say in the ones described by HATAI and SAITO and in the ones newly found is noteworthy as stated already. Chemical and X-ray analyses of both of them are also identical.

## Remarks in the paleoecology of the worm

As mentioned already the tubes of *Yokoia kattoi* were all found in black colored siltstone, and in association with some strongly and laterally compressed shells of the cephalopod genus *Eutrephoceras*, some thin shelled pelecypods, many small detached fish scales arranged at random and also with some fragments of plant leaves which are now under examination by Professor Hidekuni

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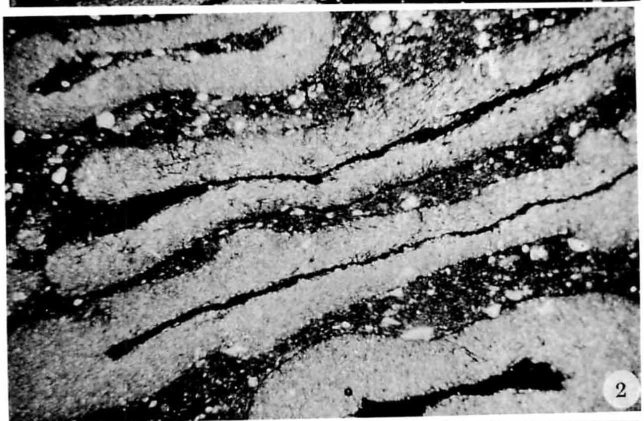
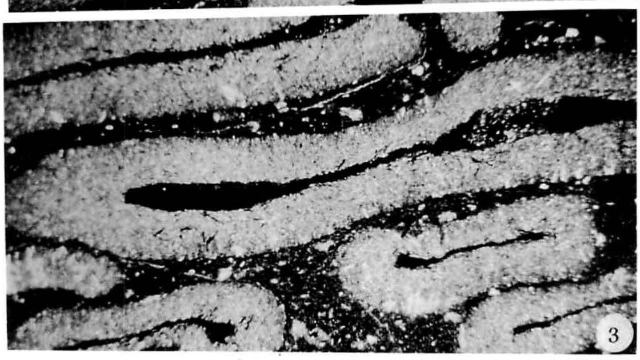
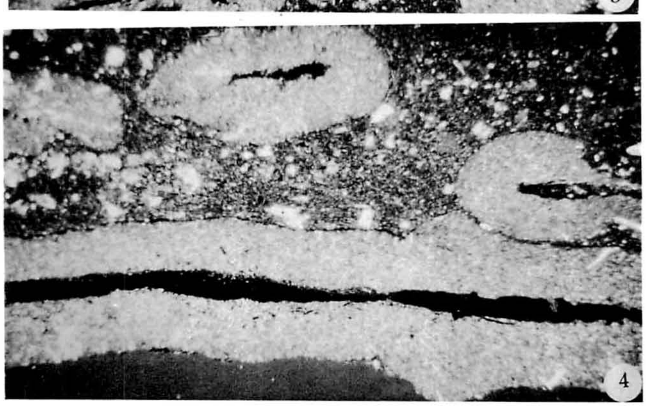
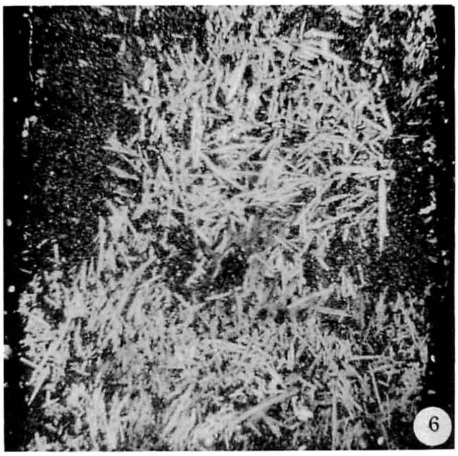
Explanation of Plate 21

Figs. 1-7. *Yokoia kattoi* (HATAI and SAITO).
(All figures ×35 excluding fig. 7, ×87)
Microscopic figures show some vertical sections and longitudinal sections (figs. 1-4). Spiculate structures shown in figs. 5, 6 and 7 (enlarged in part from figs. 5 and 6). Shell material and spiculate structure composed of silica (analysed by EPMA and X-ray opperations). (IGPS coll. cat. no. 92616-a).
Locality and Formation is mentioned in the text.









K. KUMAGAI and S. OHTOMO photo.

MATSUO of the Kanazawa University. Among the several kinds of fossils, only the worm tubes are abundant whereas the nautiloid shells are common only locality, the fish scales are rather common and of wider distribution than the cephalopod but only of a few types a feature that does not point to that the original fish were abundant, and the fragmental remains of plant leaves are very rare, probably because of being drifted to their place of burial. From the massive nature of the black colored siltstone, kind of fossils and their resemblance to the present day marine bottom sediments as well as bathymetric environment of the Recent *Hyalinoecia tubicola* recorded by HEEZEN and HOLLISTER (1971) and by WIGLEY and EMERY (1967) and which resembles *Terebellina shikokuensis* serve to bring forth the following interpretation on the paleoecology of *Yokoia kattoi*.

The paucity of benthic and planktic (MARTINSSON, 1975) and the abundancy of only worm tubes of the benthic community and the common occurrence of nautiloids locally all serve for the following interpretation. During and after deposition of the dark colored bottom muds (Black siltstone) it is thought that the bottom conditions were oxygen-poor and sulphurous gas have generated in the soft, dark colored, bottom muds. Under the conditions probably of low temperature, issuing sulphurous gas and oxygen-poor environment, the possibility of benthic life was probably restricted to armored worms that devoured debris and planktic to pelagic invertebrates that settled to the bottom. The nautiloids that were swimming in the surface waters or drifted to the area underlain by the dark muds were probably affected or paralised by the sulphurous gas issuing from the bottom muds and thus died and then sank to the bottom to become buried there. This seems to be an analogue to the graptoloids (TWENHOFEL, 1931) occurring in black shales. Also from the occurrence of abundant broken worm tubes, it may be probable that the nautiloids were predators of the worms.

Judging from the foregoing, it is thought that the bottom condition of the sea was influenced by oxygen-poor water contrary to the warm surface waters in which the vagrant nautiloids wandered. The association of fish scales with the armored worms and nautiloids may not mean the existence there of a rich fish fauna because a single fish can supply many scales. Some fish bones occurred in association with some different types of scales (TANAKA *et al.*, 1966) or even in the black siltstone adjacent to the armored worm remains, they probably were either destroyed by bacteria, decay or devoured by the armored worms or some other cause. The rare occurrence of fragmental plant leaves may point to the distance from the land. They were wind transported or current carried to the sea area of their burial. Their presence in the marine fauna is of no use for interpretation of the paleoecological conditions of the armored worms. That no planktic protozoans were found in the black siltstone suggests that after death they sank to sea bottom to become the food of the armored worms on one hand and the oxygen-poor and sulphur gas generated bottom conditions may have accelerated chemical destruction of the protozoan test, thus explaining their absence in the bottom muds.

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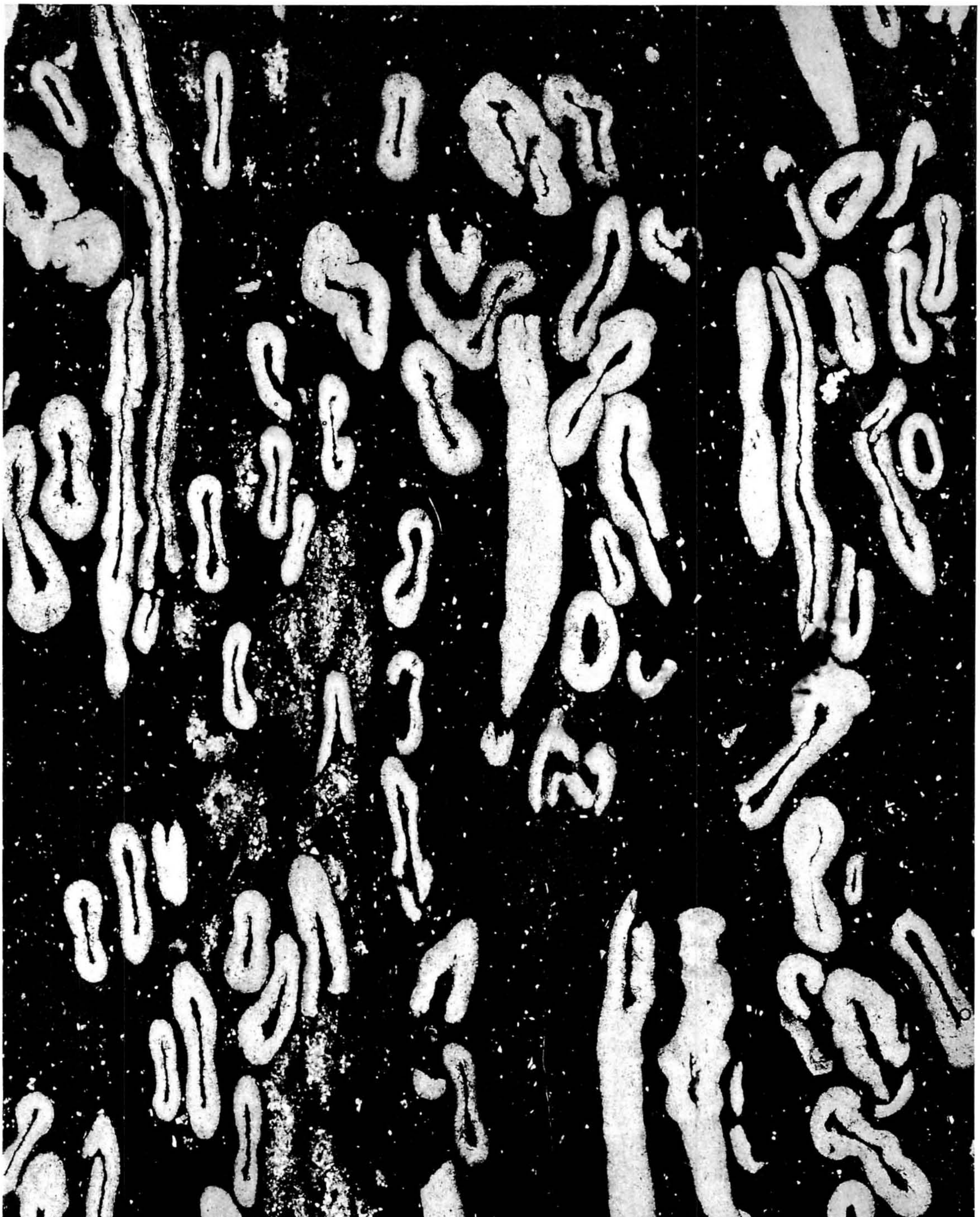
## Explanation of Plate 22

Fig. 1. *Yokoia kattoi* (HATAI and SAITO) ×9.

Vertical sections to show the mode of occurrence of *Yokoia kattoi* (HATAI and SAITO). The specimens are arranged along the lamination dominantly. The most dominant part contained 70-80 specimens per 2 cm³. Figure shows the medial impression, thickness of the wall, irregular buldges and arrangement to the bedding plane (longitudinal of plate). (IGPS coll. cat. no. 92616-a).

Locality and Formation is mentioned in the text.

IGPS coll. cat. no. is of abbreviation for the collection catalogued number of the Institute of Geology and Paleontology, Faculty of Science, Tohoku University, Sendai, Japan.




K. KUMAGAI photo.

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|---|---|---|---|
| Bessho | 別所 | Sagara | 相良 |
| Goshozawa | 御所沢 | Sakaki | 坂城 |
| Hirasawa | 平沢 | Taga | 多賀 |
| Kannoura | 甲の浦 | Yoko-o | 横尾 |
| Naharigawa | 奈半利川 | | |

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 100, pp. 220-229, pls. 23, 24, Dec. 25, 1975

# 655. *PALAEOFUSULINA-REICHELINA* FAUNA CONTAINED IN THE PEBBLES OF INTRAFORMATIONAL CONGLOMERATE DISTRIBUTED IN THE OKUTAMA DISTRICT, WEST TOKYO*

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奥多摩産層内礫岩中の *Palaeofusulina-Reichelina* 動物群: 都下五日市北方 5 km の地点で採集した層内礫岩中の石灰岩礫の転石に含まれる *Palaeofusulina nana* LIKAREV, *Reichelina cribroseptata* ERK, *R.* cfr. *tenuissima* K.M. MACLAY, *Staffella* sp. の4種を記載報告する。あわせて従来報告されている *Palaeofusulina* 18種について種の検討を行ない, *P. prisca* DEPRAT, *P. nana* LIKAREV, *P. laxa* SHENG, *P. ellipsoidalis* SHENG, *P. minima* SHENG and CHANG, *P. simplex* SHENG and CHANG の6種に整理され得ると結論した。 小 林 文 夫

## Introduction

Late Paleozoic and Mesozoic sedimentary rocks are widely distributed in the Okutama district, southern part of the Kwanto Mountainland. These sediments are separated into narrow belts by thrust faults running from NW to SE and constitute the so-called sandwich-structures. FUJIMOTO (1932), SAKAGAMI (1956, 1958, 1972) and others engaged in stratigraphical and paleontological studies of this area. During my field study in the northern part of Itsukaichi, Tokyo Prefecture, I obtained many new informations concerning geological structure, distribution of stratigraphic units and paleontological evidence.

In this paper I intend to describe the *Palaeofusulina-Reichelina* fauna yielded from this area. Based upon the statistics of several biocharacters, I also discuss the validity of the previously described species of the genus *Palaeofusulina*.

*Acknowledgement:* I wish to express my sincere thanks to Dr. Hisayoshi IGO, Associate Professor of the University of Tsukuba, for his supervision, and Dr. Toshio KOIKE of Yokohama National University, for his valuable suggestions. Cordial thanks are also due to Professor Mosaburo KANUMA and Assistant Professor Atsushi ISHII of Tokyo Gakugei University, for their encouragements and fruitful suggestions in many ways. Mr. Masami SUGAYA, post-graduate student of Tokyo Gakugei University, helped me in statistical study.

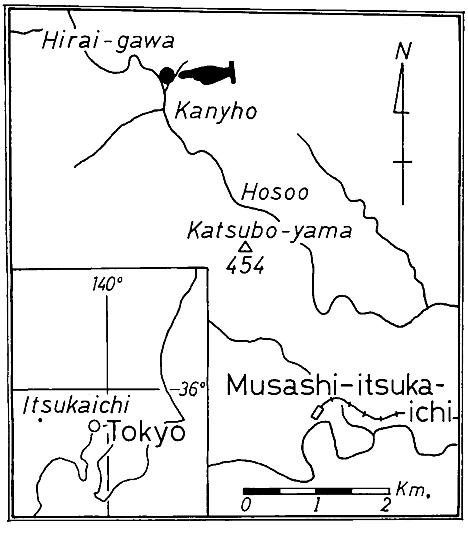
## Summary of geology

A remarkable intraformational conglomerate is exposed in the northern part of Itsukaichi. This conglomerate

* Received July 9, 1975; read Oct. 20, 1974 at Tokyo.

was named "Nishinoiri Conglomerate" by SAKAGAMI (1958) and intercalated within greywacke of about 100 m in thickness. Many limestone, sandstone, shale, chert and schalestein pebbles and cobbles are cemented by the coarse to medium grained sand. Fusulinacean fossils ranging from Moscovian to Kungurian are yielded from these limestone pebbles. This intraformational conglomerate has been considered to be chronologically equivalent to the Upper Permian Yasuba Conglomerate in Southwest Japan (SAKAGAMI, 1958). The stratigraphic relationship between this conglomerate and the Triassic conodont-bearing bedded cherts show that the geologic age of this conglomerate must be revised as Triassic instead of Upper Permian. Detailed discussion concerning geologic age, correlation, lithologic characteristics and other fusulinids of this conglomerate will be presented at another opportunity.

The materials studied were obtained from the limestone erratics found at the tributary of Hirai-gawa, north of Kanyho, 5 km NNW of Musashi-Itsukaichi Station (Text-fig. 1). This limestone erratics were derived from the above mentioned intraformational conglomerate. The limestone is grey biomicrudite, and contains *Palaeofusulina*, *Reichelina*, *Staffella* and other smaller foraminifers. One hundred and twenty thin sections are prepared to discuss the intraspecific variation of *Palaeofusulina*. All of them are stored at the Institute of Geology and Mineralogy, Tokyo University of Education.



Text-fig. 1. Index map showing sampled locality.

## Description and discussion of species

### Genus *Palaeofusulina* DEPRAT, 1912

### *Palaeofusulina nana* LIKAREV

Pl. 23, Figs. 22-29; Pl. 24, Figs. 1-18

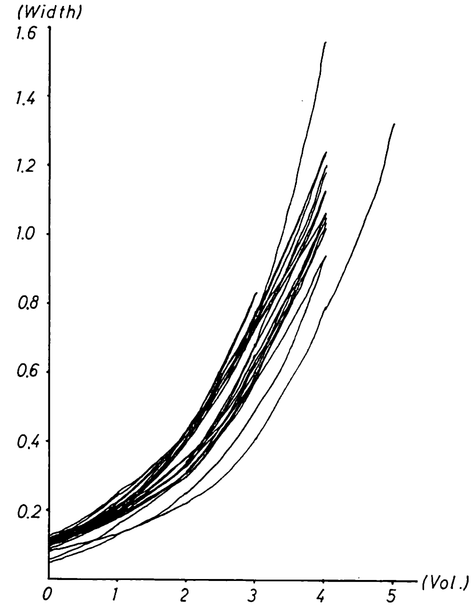
1926. *Palaeofuslina nana* LIKAREV, *Comm. Geol. Leningrad*, *Bull.*, Vol. 45, pp. 59-66, pl. 2, figs. 1-13.
1955. *Palaeofusulina sinensis* SHENG, *Acta Palaeontologica Sinica*, Vol. 3, No. 4, p. 305, pl. 4, figs. 1-15, pl. 1, figs. 13, 16.
1955. *Palaeofusulina sinensis fusiformis* SHENG, *Ibid.*, p. 306, pl. 1, figs. 14-15.
1955. *Palaeofusulina wangi* SHENG, *Ibid.*, pp. 303-304, pl. 3, figs. 1-5, 7.
1955. *Palaeofusulina wangi chumipuensis* SHENG, *Ibid.*, pp. 304-305, pl. 3, fig. 6.
1958. *Palaeofusulina* cfr. *sinensis* SHENG; SHENG and CHANG, *Ibid.*, Vol. 6, No. 2, p. 212, pl. 1, figs. 21-25.
1963. *Palaeofusulina nana* LIKAREV; SHENG, *Ibid.*, N. S. B, No. 10, pp. 175-176, pl. 9, figs. 10-16.
1963. *Palaeofusulina sinensis* SHENG, *Ibid.*, p. 175, pl. 9, figs. 1-9.
1963. *Palaeofusulina fusiformis* SHENG, *Ibid.*, p. 176, pl. 10, figs. 5-9.
1963. *Palaeofusulina bella* SHENG, *Ibid.*, pp. 179-180, pl. 10, figs. 25-27.

Shell small, inflated fusiform in shape with almost straight axis of coiling, broadly arched periphery, convex to somewhat straight lateral sides and rounded or bluntly pointed poles. The first volution nautiliform but subsequent ones inflated fusiform. Adult specimens with 4 to 4.5, rarely 5 volutions, 1.49 to 2.03 mm in axial length and 1.03 to 1.56 mm in median width, giving form ratio 1: 1.2 to 1: 1.7. Proloculus spherical, rather large for the size of shell and 0.06 to 0.13 mm in outside diameter. Spirotheca thin, principally composed of distinct tectum and translucent layer (diaphanotheca), but not differentiated at a part of inner three volutions in some specimens. Septa closely spaced and strongly fluted throughout shell. Fluting makes septa in contact with each other about half of their height. Axial deposits lacking, but frequently the last volution filled with secondary calcite.

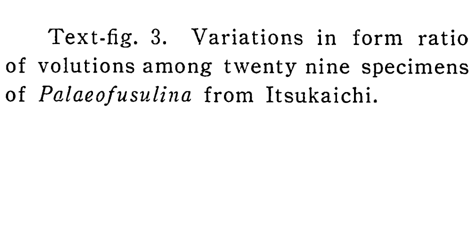
*Remarks:* There are broad variations in the heights of volutions, size of proloculus, form ratios of volution, septal fluting and others within the present specimens. The former three biocharacters are shown in Text-figs. 2 and 3. As clearly shown in these figures, individual variations are graditional from specimen to specimen, and no significant differences are recognized among them.

*Reg. nos.:* 27001-27008, 27010-27027.

Statistics of *Palaeofusulina nana* LIKAREV from Itsukaichi (in mm.). N: number of measurements, Max.: heighest value recorded per each variate, Min.: lowest value recorded per each variate, $\overline{X}$ : arithmetic mean, s : standard deviation.




Text-fig. 2. Variations in proloculus size and width of volutions among twenty three specimens of *Palaeofusulina* from Itsukaichi.




Text-fig. 3. Variations in form ratio of volutions among twenty nine specimens of *Palaeofusulina* from Itsukaichi.

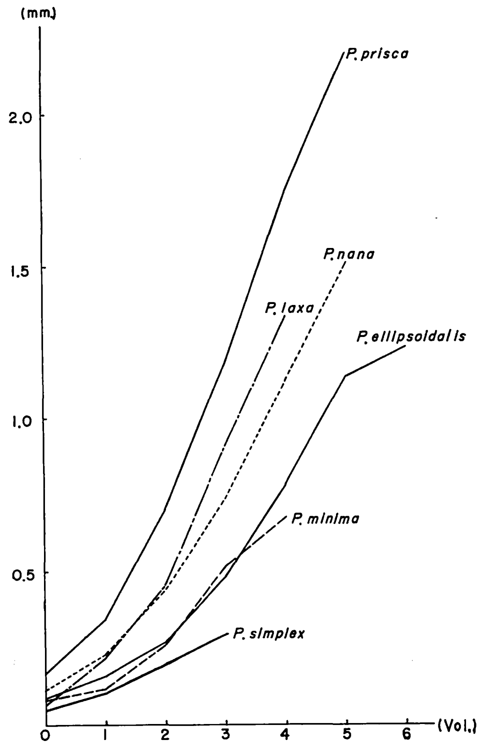
| | L | W | P | Half Length | | | | | Radius Vector | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| N | 23 | 23 | 29 | 29 | 29 | 29 | 23 | 3 | 29 | 29 | 29 | 23 | 3 |
| Max. | 2.03 | 1.56 | 0.13 | 0.23 | 0.45 | 0.75 | 1.06 | 1.08 | 0.15 | 0.28 | 0.51 | 0.96 | 0.75 |
| Min. | 1.40 | 1.03 | 0.05 | 0.06 | 0.15 | 0.35 | 0.63 | 0.98 | 0.06 | 0.11 | 0.23 | 0.44 | 0.72 |
| $\overline{X}$ | 1.76 | 1.30 | 0.11 | 0.13 | 0.29 | 0.53 | 0.80 | 1.01 | 0.10 | 0.19 | 0.37 | 0.61 | 0.73 |
| s | 0.18 | 0.30 | 0.02 | 0.04 | 0.07 | 0.11 | 0.11 | 0.06 | 0.02 | 0.04 | 0.07 | 0.10 | 0.02 |

| | Width of Volution | | | | | Thickness of Spirotheca | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| N | 23 | 23 | 22 | 18 | 1 | 29 | 29 | 29 | 23 | 3 |
| Max. | 0.25 | 0.43 | 0.83 | 1.56 | — | 0.010 | 0.020 | 0.040 | 0.035 | 0.025 |
| Min. | 0.13 | 0.22 | 0.41 | 0.79 | — | 0.003 | 0.008 | 0.010 | 0.008 | 0.010 |
| $\overline{X}$ | 0.20 | 0.36 | 0.66 | 1.11 | 1.32 | 0.007 | 0.013 | 0.022 | 0.019 | 0.020 |
| s | 0.03 | 0.06 | 0.11 | 0.16 | — | 0.002 | 0.005 | 0.006 | 0.006 | 0.009 |

*Discussion:* As already pointed out in the earlier lines, the present materials show considerable variations in septal fluting, height of volutions, size of proloculus and form ratio of shell. However, these variations seem to be intraspecific rather than specific. Gradational variations of these characters are also recognized in the previously described species, such as *P. sinensis* SHENG, *P. fusiformis* SHENG, *P. wangi wangi* SHENG, *P. wangi chumipuensis* SHENG, *P. bella* SHENG and *P. nana* LIKAREV. Although SHENG (1955, 1963) mentioned these six species are distinctive, I become to believe that *P. sinensis*, *P. fusiformis*, *P. wangi wangi*, *P. wangi chumipuensis* and *P. bella* are junior synonyms of *P. nana*.

*Palaeofusulina prisca* DEPRAT, *P. pseudoprisca* (COLANI) and *P. mutabilis* SHENG are characterized by large size of shell and proloculus and great height of volutions than those of *P. nana* and the above mentioned similar species (see Text-fig. 4). *P. mutabilis* SHENG has smaller shell than *P. prisca* and *P. pseudoprisca*. Judging from the number of volutions, statistics of the size of proloculus and width of each volution, *P. mutabilis* may be immature forms of *P. prisca* and *P. pseudoprisca*. *P. pseudoprisca* and *P. mutabilis* are entirely conspecific, and they are synonyms of *P. prisca* DEPRAT.

SHENG (1963) pointed out the similarity between *P. simplicata* SHENG and *P. fusiformis* SHENG. However, the former has weaker and more irregular septal fluting and smaller proloculus than the latter. *P. fusiformis* with small proloculus (SHENG, 1963, pl. 10, fig. 8) indicates that the species is of the microspheric generation. Also, SHENG (1963) emphasized the close relationship between *P. laxa* and *P. mutabilis* in general shape of shell and number of volutions, but no common characteristics are recognized between size of proloculus, expansion of shell or septal fluting of the two species. In my opinion, however, *P.*




Text-fig. 4. Growth curve of six species of *Palaeofusulina*; measurements based on SHENG's (1955, 1963) and SHENG and CHANG's (1958).

*laxa* SHENG and *P. simplicata* SHENG have many common characteristics, such as minute proloculus, tightly coiled inner volutions, rapid expansion of shell in outer volutions and rather weak and irregular septal fluting. These two species are conspecific, but they differ from *P. nana* and *P. prisca*.

According to SHENG (1963), *P. ellipsoidalis* SHENG, *P. pulla* SHENG and *P. compacta* SHENG have close similarities, but there are slight differences in the number of volutions, coiling pattern of shell and size of shell. However, the above mentioned three species have many common characteristics in elongate ellipsoidal shell, strongly and rather regularly fluted septa, tightly coiled inner volutions, slowly and almost constantly expanded shell in outer volutions and a large numbers of volutions for the size of shell. Accordingly, these three species are distinguished from *P. nana*, *P. prisca* and *P. laxa*, but, *P. pulla* and *P. compacta* are synonyms of *P. ellipsoidalis*.

*P. minima* SHENG and CHANG has minute inflated shell, less numbers of volutions and very tightly coiled first volution, and it resembles closely *P. ellipsoidalis*. There are some possibilities that *P. minima* represents the immature form of *P. ellipsoidalis*. According to the statistics, however, *P. minima* has more tightly coiled first volution and less number of volutions than *P. ellipsoidalis*. Both species have very similar growth curve (Text-fig. 4) and *P. minima* occupies slightly lower stratigraphic position than *P. ellipsoidalis* in South China. From the mentioned evidence, I treated tentatively *P. minima* and *P. ellipsoidalis* are independent species and the former represents an ancestor of the latter species.

*P. simplex* SHENG and CHANG is the simplest form among the previously proposed species of *Palaeofusulina*. SHENG (1963) stated that this species was the smallest and most primitive palaeofusulines.

In addition to the above mentioned *Palaeofusulina*, *P. weberi* (SCHUBERT) and *P. pamirica* LEVEN were described. The former was originally described by SCHUBERT (1915) as *Fusulina weberi* SCHUBERT from east of Pualaca, Portuguse Timor. Later, THOMPSON (1949) revised SCHUBERT's specimen as *Palaeofusulina weberi* (SCHUBERT) to *Palaeofusulina prisca* DEPRAT based on the similar spirothecal structure and the other features. *P. weberi* has ellipsoidal shell and rather irregular inner volutions and is associated with the Lower Permian species of *Schwagerina*, *S. granum-avenae* (ROEMER). Therefore, this species probably belongs to *Boultonia* or *Paraboultonia*. *P. pamirica* was described by LEVEN (1967) from Darvas. It has tightly coiled and rather irregular juvenile volutions, small proloculus and strongly fluted septa. Associated fusulinids are *Reichelina pulchra* K. M. MACLAY, *Staffella zisongzhensis* (SHENG), *Codonofusiella lui* SHENG and *C. curtekensis* LEVEN. Therefore, LEVEN's *Palaeofusulina pamirica* may be also revised to *Dunbarula* or *Paradunbarula*.

In conclusion, based upon the above discussed morphological considerations, stratigraphical distribution in the Changshing Limestone in South China, and geographical distribution of the previously described eighteen species of *Palaeofusulina*, the following six species are valid.

1. *Palaeofusulina prisca* DEPRAT
2. *P. nana* LIKAREV
3. *P. laxa* SHENG
4. *P. ellipsoidalis* SHENG
5. *P. minima* SHENG and CHANG
6. *P. simplex* SHENG and CHANG

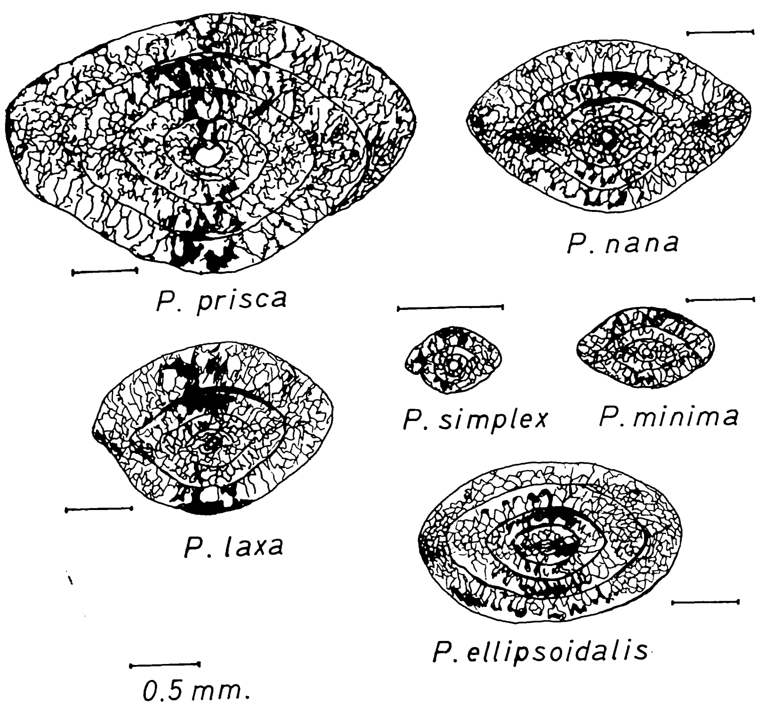
Genus *Reichelina* ERK, 1941

*Reichelina cribroseptata* ERK

Pl. 23, Figs. 1–20

1941. *Reichelina cribroseptata* ERK, *Ecol. Geol. Herv.*, Vol. 34, No. 2, p. 250, pl. 14, figs. 17–21.

1954. *Reichelina cribroseptata* ERK; K. M.




Text-fig. 6. Six species of *Palaeofusulina*.

MACLAY, *Gosgeolizdat*, p. 71, pl. 14, figs. 1–2, 4.

1963. *Reichelina cribroseptata* ERK; SHENG, *Acta Palaeontologica Sinica*, N.S. B, pp. 148–149, pl. 1, figs. 13–16.

Shell small, lenticular to subdiscoidal in shape with almost straight axis of coiling, straight lateral sides and protruding or slight umbilical poles. Inner two volutions subdiscoidal with narrowly pointed periphery; the third and fourth volutions with pointed periphery, straight lateral sides and protruding or slight umbilical poles; last half or last volution vaulted protruding a long, horn-like prolongation of shell. Mature shells have 4.5 to 5 volutions, 0.28 to 0.33 mm in axial length and 0.78 to 1.58 mm in median width, giving form ratio 1: 0.2 to 1: 0.4. Proloculus minute, spherical and its external diameter 0.05 to 0.06 mm. Spirotheca thin, composed of tectum, lower and upper tectoria. Septa numerous, plane and unfluted throughout the shell. Weak secondary deposits of calcite recognized in axial region. Chomata low and indistinct. Tunnel low and narrow.

*Remarks:* This species resembles closely *Reichelina media* K.M. MACLAY in many respects. However, important dissimilarities are recognized between two species in the length of axis, form ratio of shell and the height of volutions. Compared with the Chinese materials described by SHENG (1963), the present specimens have a horn-like prolongation, while the Chinese ones have a tail-like and shorter prolongation than the present ones. ERK's original specimens have somewhat less developed prolongation.

*Reg. nos.:* 27028–27047.

Statistical values of *Reichelina cribroseptata* ERK are given below in mm.

| | L | W | P | Half Length | | | | | Radius Vector | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| N | 6 | 7 | 8 | 8 | 8 | 8 | 7 | 3 | 8 | 8 | 8 | 8 | 3 |
| Max. | 0.33 | 1.58 | 0.06 | 0.04 | 0.07 | 0.12 | 0.14 | 0.17 | 0.08 | 0.14 | 0.24 | 0.64 | 1.25 |
| Min. | 0.28 | 0.78 | 0.05 | 0.03 | 0.05 | 0.08 | 0.12 | 0.15 | 0.05 | 0.09 | 0.13 | 0.27 | 0.73 |
| $\overline{X}$ | 0.30 | 1.16 | 0.05 | 0.03 | 0.06 | 0.09 | 0.13 | 0.16 | 0.06 | 0.10 | 0.18 | 0.34 | 0.91 |
| s | 0.02 | 0.27 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.03 | 0.13 | 0.29 |

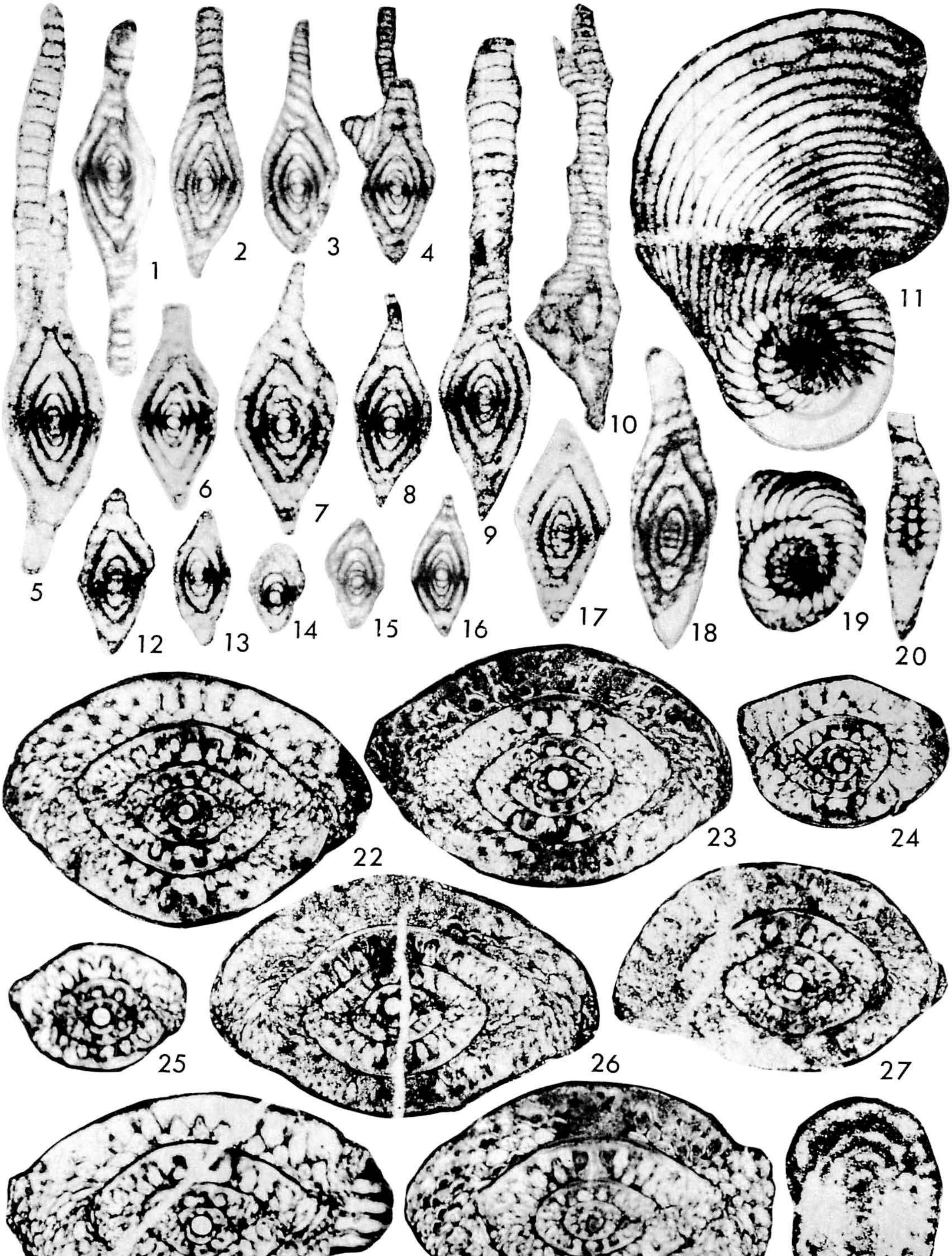
(to be continued)

## Explanation of Plate 23

Figs. 1–20. *Reichelina cribroseptata* ERK
1–9, 12–16. Axial sections; 10, 17–18, 20. Tangential sections; 11, 19. Sagittal sections, 1–4, 15–16 ×40, 5–14, 17–20 ×50, Reg. nos. 27028–27047.

Figs. 22–29. *Palaeofusulina nana* LIKAREV (See also Plate 24)
22–28. Axial sections; 29. Nearly centered tangential section, 22–29 ×30, Reg. nos. 27001–27008.

Fig. 21. *Staffella* sp. (See also Plate 24)
Oblique section ×30; Reg. no. 27009.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| | Width of Volution | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| N | 8 | 8 | 8 | 8 | 6 |
| Max. | 0.13 | 0.24 | 0.42 | 0.90 | 1.58 |
| Min. | 0.09 | 0.15 | 0.25 | 0.49 | 0.78 |
| $\overline{X}$ | 0.11 | 0.19 | 0.32 | 0.58 | 1.16 |
| s | 0.02 | 0.03 | 0.06 | 0.14 | 0.27 |

### *Reichelina* cfr. *tenuissima* K. M. MACLAY

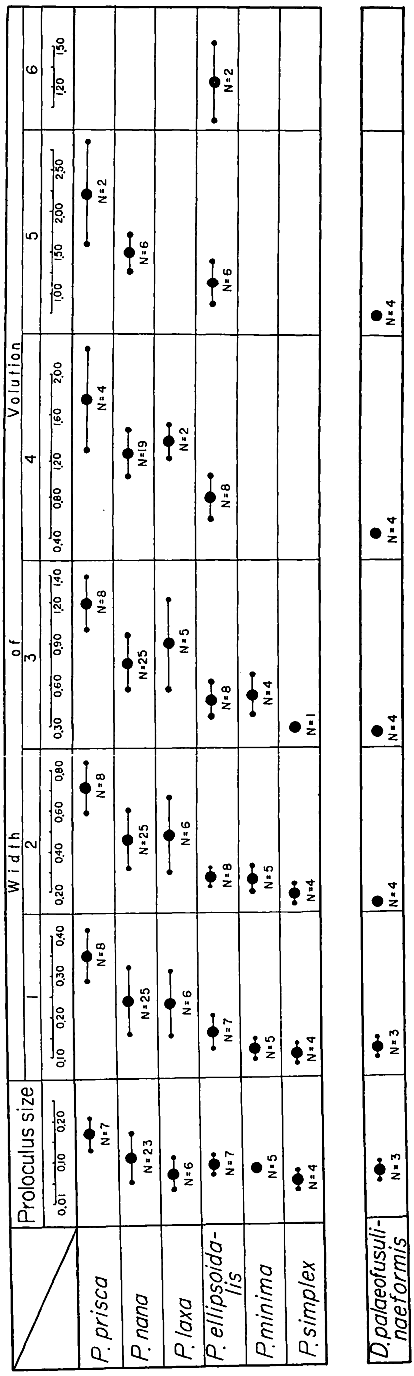
Pl. 24, Figs. 20–24

Cfr. 1954. *Reichelina tenuissima* K. M. MACLAY, *Gosgeolizdat*, p. 73, pl. 14 fig. 3.

Cfr. 1963. *Reichelina tenuissima* K. M. MACLAY; SHENG, *Acta Palaeontologica Sinica*, pp. 149–150, pl. 1, figs. 19–22.

Shell minute, lenticular to subdiscoidal in shape with straight axis of coiling, convex lateral sides, umbilically shallow depressed poles, and bluntly pointed to arched periphery. Mature shell with 4.5 to 5 volutions, 0.20 mm in axial length and 0.53 mm in median width giving form ratio 1 : 0.4. Half length of the first to fifth volutions 0.02, 0.03, 0.05, 0.08 and 0.10 mm; radius vectors 0.04, 0.07, 0.10, 0.18 and 0.28 mm; width of the first to fifth volutions 0.08, 0.13, 0.19, 0.33 and 0.50 mm, respectively. Spirotheca very thin, composed of distinct tectum and lower and upper layers. Septa plane and unfluted. Septal counts from the first to third volutions 8, 13 and 18, respectively. Axial filling developed in polar regions.

*Remarks:* The present materials are comparable to SHENG's form from the Changsing and Wuchiaping Limestones of South China in minute shell, shape of periphery, slight umbilical poles, thin spirotheca and others. However, uncoiled prolongation starts from the fourth




Text-fig. 5. Diagram showing the variation in size of external diameter of proloculus and width of volutions (in mm.) of the six species of *Palaeofusulina* and *Dunbarula palaeofusulinaeformis* SHENG. Measurements based on SHENG (1955, 1963) and SHENG and CHANG (1958).

volution in the Chinese materials, while some of the present specimens, shell coils even at the fifth volution. More numerous specimens are necessary to make a detailed discussion.

*Reg. nos.:* 27049-27053.

### Genus *Staffella* OZAWA, 1925

#### *Staffella* sp.

Pl. 23, Fig. 30; Pl. 24, Fig. 19

*Remarks:* Mineralized shell with staffelloid shape, arched periphery, convex lateral sides and umbilical poles is referred to the genus *Staffella*. Axial length 0.64 to 0.65 mm, median width 0.90 to 1.01 mm and form ratio 1 : 0.6 to 1 : 0.7. External diameter of proloculus 0.05 mm. Dense secondary mineralization obliterates the details of spirotheca as well as inner structure of shell. Specific identification is postponed until more specimens accumulate in the future.

*Reg. nos.:* 27009, 27048.

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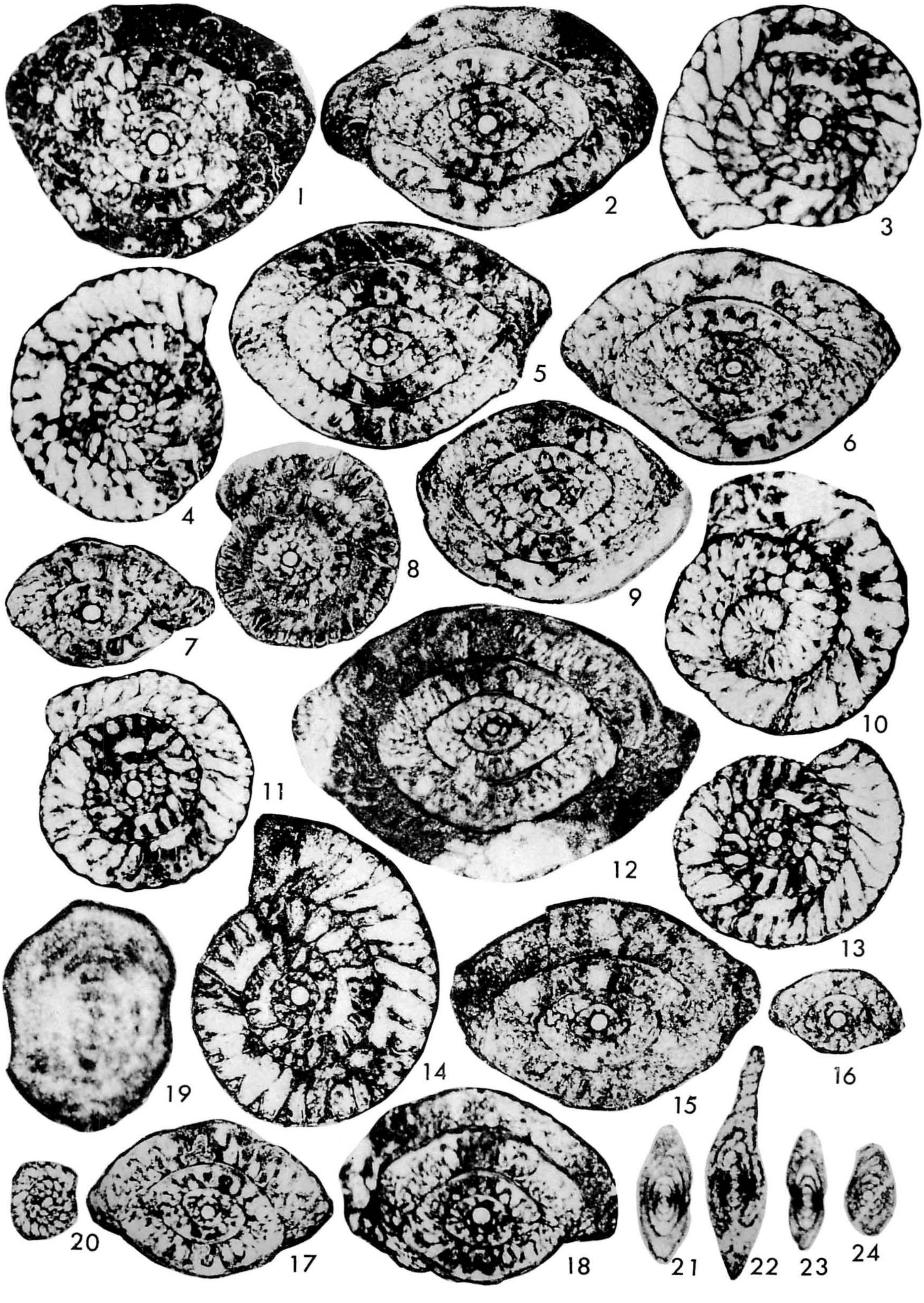
### Explanation of Plate 24

Figs. 1-18. *Palaeofusulina nana* LIKAREV (See also Plate 23)
1-2, 5-7, 9, 12, 15-18. Axial sections; 3-4, 8, 11, 13-14. Sagittal sections; 10. Pararell section, 1-18 ×30, Reg. nos. 27010-27027.

Fig. 19. *Staffella* sp. (See also Plate 23)
Axial section ×30, Reg. no. 27048.

Figs. 20-24. *Reichelina* cfr. *tenuissima* M. MACLAY
20, 24. Sagittal sections, 21-23. Axial sections, 20, 22-23 ×50, 21, 24 ×40, Reg. nos. 27049-27053.



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| Okutama | 奥 多 摩 | Hirai-gawa | 平 井 川 |
| Itsukaichi | 五 日 市 | Kanyho | 肝 要 |
| Nishinoiri | 西 ノ 入 | Musashi-itsukaichi | 武蔵五日市 |
| Yasuba | 休 場 | | |

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# 656. A RECORD OF *MORTONICERAS* (CRETACEOUS AMMONITE) FROM GOSHONOURA ISLAND, KYUSHU

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九州御所浦島産モルトニセラスの記録：熊本県御所浦島江口において，御所浦層群中部のIIb 部層からアンモナイトが産出したので記載・報告する。これは住房が保存され，特有の殼口縁突出 (rostrum) も観察できるよい標本である。英国の上部アルビアン上部産の *Mortoniceras* (*Mortoniceras*) *rostratum* に酷似するが，詳細な点で差異がある。同種の変異が十分よくわかっていない現状では，この化石を *M.* (*M.*) sp. aff. *M.* (*M.*) *rostratum* とよんでおく。この産出により IIb 部層は上部アルビアンと確定し，すでに知られた IIe は，*Graysonites* の産出により下部セノマニアンであるから，上・下白亜系の境は IIb-IIe 間のどこかにあることとなる。他の軟体動物化石がこの間でどのような変化を示すかが今後の課題となる。なおこのアンモナイトについて，堆積環境や生活様式に関する論議を試みる。

松本達郎・田代正之

## Introduction

Goshonoura Island of Kumamoto Prefecture (Fig. 1) is well known for the abundant occurrence of Cretaceous molluscan fossils. As was described in detail by one of us (MATSUMOTO, 1938), the island is geologically made up of the "Middle" Cretaceous Goshonoura Group in the main part, the Senonian Himenoura Group in the northwestern coastal belt, and a faulted block of basement granite cropping out at the northeastern corner. The Goshonoura Group consists primarily of sandstones of various grades of coarseness with some red beds. Its molluscan fossils are primarily bivalvia and gastropoda of shallow sea facies and partly those of brackish water or non-marine facies. Hence it used to be called the *Trigonia* Sandstone (e.g. YEHARA, 1923). Ammonites are rather rare and limited to particular beds.

Among previously reported ammonites, *Graysonites* sp. cf. *G. fountaini* YOUNG, from Member IIe, is the most important, because it indicates the lower part of Lower Cenomanian (MATSUMOTO, 1960).

Fortunately we have recently acquired another good age indicator, an ammonite referable to *Mortoniceras*, from a bed of different horizon. In this paper we give a palaeontological description of this ammonite, discuss the age of the Goshonoura Group and attempt to consider the palaeoecology and palaeoenvironment.

Before going further we thank Mr.

* Received June 17, 1975; read June 14, 1975 at Morioka.

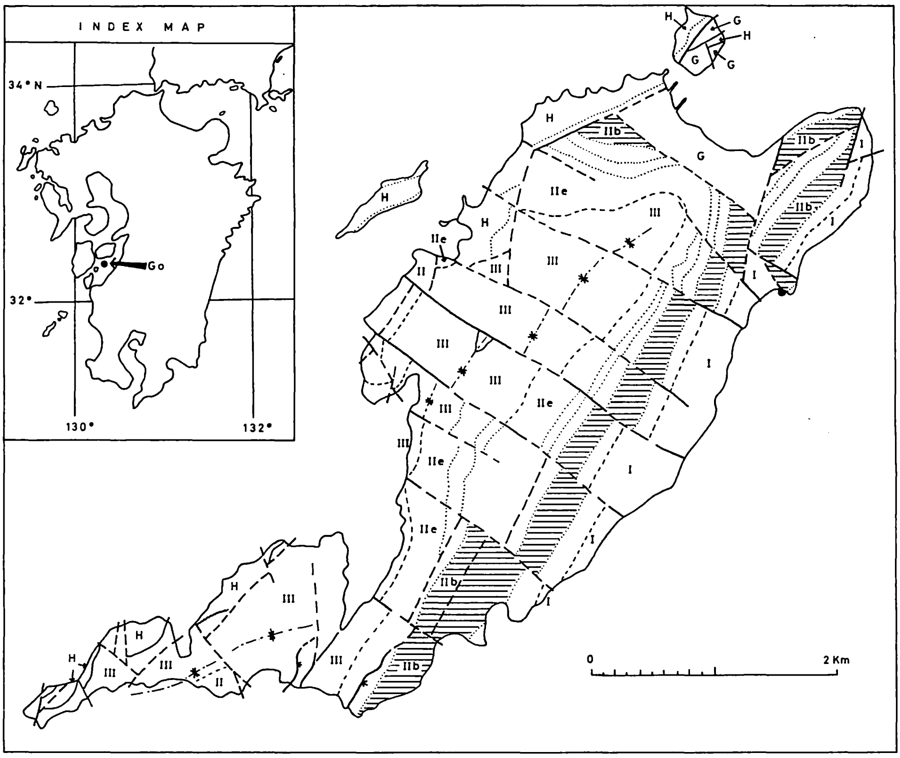


Fig. 1. Outline geological map of Goshonoura island, showing the locality of *Mortoniceras* with a solid circle (•).

Outcrop of Member IIb is indicated with ruled areas; boundary of members with dotted line; that of formation with fine broken line. I, II, III: Lower, Middle and Upper Formations of the Goshonoura Group; H: Himenoura Group; G: Granite.

Inset is a map of Kyushu (upper left corner), indicating with a solid circle the location of Goshonoura Island (Go).

(Adapted from MATSUMOTO, 1938, with revision)

Sanemi KOMATSU, teacher of Kameba (Hondo) Primary School (formerly teacher of Amura Primary School), who cooperated with one of us (M. T.) in collecting fossiliferous rocks. Miss Mutsuko HAYASHIDA has assisted us in preparing the manuscript. This work is one of the contributions to the IGCP Mid-Cretaceous Events.

## Palaeontological description

Superfamily Acanthocerataceae

Family Brancoceratidae

Subfamily Mortoniceratinae SPATH, 1925

Genus *Mortoniceras* MEEK, 1876

*Type-species:* *Ammonites vespertinus* MORTON, 1834.

*Remarks:* One of us (T. M.) had opportunities to study the syntypes (ANSP. 4783) of MORTON (1834, p. 40, pl. 17, fig. 1) at the Academy of Natural Sciences, Philadelphia, and other good examples from the Duck Creek Limestone in the collection of U. S. Geological Survey, Denver, by courtesy of Dr. W.A. COBBAN, gave a brief note on them (MATSUMOTO, 1960, p. 37, fig. 1), and as a result, agreeed WRIGHT's (1957, p. L406) definition of the genus and also the subgenus *Mortoniceras* (s. s.), rejecting YOUNG's (1957, p. 3) concept in which the characters of the type-species were ignored.

### *Mortoniceras* (*Mortoniceras*) sp. aff. *M.* (*M.*) *rostratum* (J. SOWERBY)

Pl. 25, Fig. 1; Text-fig. 2

Compare:

1932. *Mortoniceras* (*Pervinquieria*) *rostratum* (J. SOWERBY, 1817), SPATH, Ammonoidea of the Gault, part 9, p. 400 (with full synonymy list).

*Material:* KE. 2241, collection of M. TASHIRO, from Enokuchi, Goshonoura island, Amakusa-gun, Kumamoto Prefecture. It is represented by an external mould in the sandstone and partly by an internal mould, but the shell material is dissolved away. A plaster cast of this specimen, GK. H5738, is preserved at Kyushu University.

*Description:* This single specimen is secondarily modified to an elliptical outline, owing probably to a tectonic deformation. It is about 155mm in the longest diameter of the deformed shape and the width of the umbilicus is measured at 39 percent of the diameter. The ratio of whorl-breadth to height cannot be precisely measured, but the whorl seems to be somewhat higher than broad.

Despite the secondary deformation the living chamber is almost wholly preserved. It occupies a little more than a half (200°) of the outer whorl and the rostrum at its apertural margin shows a recurved shape, although the very apex of the rostum is not preserved.

The main part of this adult living chamber is ornamented with fairly distant, coarse, strong, equally long ribs, each of which has a bullate umbilical, nodate mediolateral, prominent inner ventrolateral and clavate outer ventrolateral tubercles. The last two tend to be approximated as the shell grows, resulting in a doubled appearance. They are finally amalgamated into a large ventrolateral tubercle at the stage anteriorly about 90° from the last suture. On the last part (about 30°) of the living chamber the ribs gradually become less distant, by which the tubercles tend to be absorbed, and finally the ribs remain on the inner half and branched to riblets and lirae on the outer part which extends to the rostrum.

The keel, which is partly preserved, is fairly sharp on the internal mould but moderately thick on the external mould.

The septate whorl is ornamented with densely spaced ribs which consist of primaries and inserted or branched secondaries. The umbilical tubercles are bullate; the mid-lateral tubercules are at first indiscernible, then becoming more distinct on the later part, although not so strong as those on the living chamber.

The last suture, which is preserved at the posterior end of the fragmentary internal mould, shows the broad, massive, bipartite saddle between E and L and the widely open L.

*Comparisons:* If the deformed shape be restored, this specimen closely resembles the holotype of *Mortoniceras* (*Mortoniceras*) *rostratum* (J. SOWERBY), from the Malmstone of Oxfordshire, England (see SPATH, 1932, text-fig. 136). The two specimens show the same recurved shape

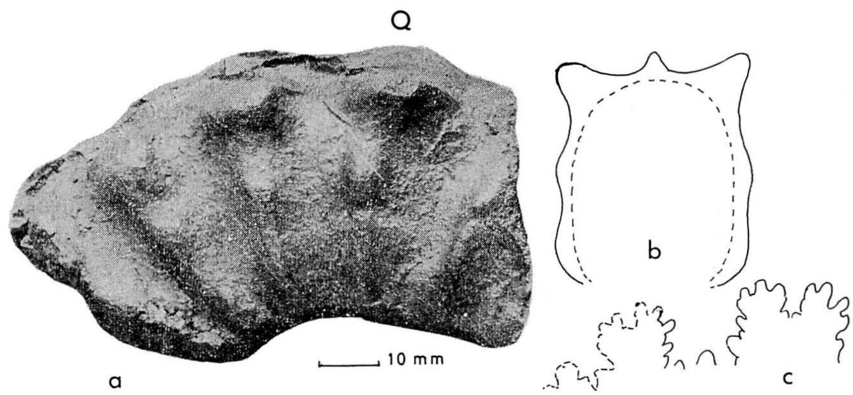


Fig. 2. *Mortoniceras* (*Mortoniceras*) sp. aff. *M.* (*M.*) *rostratum* (J. SOWERBY). Internal mould of the posterior part of the living chamber (part of KE. 2241), with the last septum at its end. Side view (a), restored whorl-section (b) at Q, and the last suture (partly restored from that of the other side) (c). See Pl. 25, Fig. 1d for the ventral view.

of the rostrum. In another typical specimen of *M.* (*M.*) *rostratum* from the Malmstone, illustrated by SPATH (1931, pl. 36, fig. 6), the lateral tubercles seem to appear earlier and are more distinct on the inner whorl than in the present specimen but as strong as ours on the outer whorl; they are situated closer to the ventrolateral tubercles than in ours.

In the same character and in the narrower ribs as well as broader whorls, *M.* (*M.*) *stoliczkai* SPATH, 1921, from India (STOLICZKA, 1865), Angola (SPATH, 1925) and Madagascar (COLLIGNON, 1963), is distinguished from ours, but its ribbing on the inner whorl is as densely spaced as ours.

In the mode of ribbing and tuberculation on the outer whorl the Goshonoura form is similar to *M.* (*M.*) *vespertinum* (MORTON), but the latter has distinctly coarser ribs on the inner whorl and a depressed section and larger size of the adult whorl. The apertural margin is not known in this Gulf Coast species.

Despite the well known specific names, the true extent of variation and the relationships of the three species mentioned above are not necessarily clear. Therefore it is hardly decided whether or not the above described differences are great enough for specific or subspecific distinction. Moreover, our material itself is insufficient. For the time being the described specimen from Goshonoura is called *Mortoniceras* (*Mortoniceras*) sp. aff. *M.* (*M.*) *rostratum* (J. SOWERBY).

*Occurrence:* The described ammonite was collected from one of the fallen blocks of sandstone at Enokuchi, southeastern coast of Goshonoura island. It was associated with *Glycymeris* (*Hanaia*) *solida*, *Acanthotrigonia ogawai*, *Crassatellites* (*Pachythaerus*) *nagaoi*, "*Callista*" *crenulata*, etc. The block was undoubtedly derived from Member IIb, middle formation of the Goshonoura Group.

## Age of the Goshonoura Group

The Goshonoura Group is lithostratigraphically divided as follows in ascending order (MATSUMOTO, 1938; OKADA, 1961):

I. Lower Formation, 200m.

Ia. Coarse-grained, feldspathic arenite, sometimes conglomeratic, cross-laminated, massive or thick bedded, with lenticular red beds, almost barren of fossils.

Ib. Feldspathic wacke of various grades of coarseness, bedded, with thin coaly seams, mudstone and several prolific fossiliferous layers of shallow sea to brackish water facies.

II. Middle Formation, about 550m. Sandstones (mainly feldspathic wacke and partly feldspathic and quartz-feldspathic wacke and partly feldspathic and quartz-feldspathic arenite) containing molluscan fossils of generally shallow sea environments (the so-called *Trigonia* Sandstone). This is subdivided into five members, IIa to IIe in ascending order. Members IIb (180m) and IIe (150m) consist of massive well-sorted, medium- to fine-grained sandstones, containing abundantly molluscan fossils (trigonians, *Cucullaea*, *Anthonya*, "*Callista*" etc.) of shallow open sea facies in lenticular beds and calcareous nodules. Ammonites are occasionally associated with them. Members IIa (100m) and IIc (70m) are ill-sorted, coarse-grained, sometimes conglomeratic, feldspathic wacke, containing trigonians and other mollusca. Member IId (50m) consists of conglomerate and sandstone with some red beds and brackish-water mollusca.

III. Upper Formation, 200 m or less. Sandstones of various grades of coarseness, conglomerate (sometimes boulder-bearing), mudstone and red beds, with fossiliferous layers of brackish to fresh water facies. Sandstones are mainly of lithic wacke. This formation may be subdivisible into several members in accordance with the predominant rock assemblage among the above, but there is lateral change in the details of facies.

One of us (MATSUMOTO, 1938) once stated that the Goshonoura Group is mid-Cretaceous, that its main part is approximately referable to Cenomanian [Gyliakian] and that its lower part possibly ranges down to Albian [Upper Monobegawa]. This conclusion was a rough estimation on the basis of the provisional study of the molluscan fauna as well as the stratigraphic sequence, but it is now confirmed on more reliable evidence.

*Mortoniceras* (*Mortoniceras*) *rostratum* occurs, according to SPATH (1932, p. 405), in the Zone of *Stoliczkaia dispar*, upper part of Upper Albian in England and France. *M.* (*M.*) *stoliczkai* occurs from the Upper Albian of southern India, Madagascar and Angola. *M.* (*M.*) *vespertinum* probably came from the Duck Creek Limestone (ADKINS, 1928), which is assigned to the lower part of Upper Albian (STEPHENSON et al., 1942).

How far the zonal sequence established in western Europe can be maintained in Japan, which was much distant and belonged to a different biogeographical province, may be a question. This is especially questionable when the species are not quite identical.

So far as the better studied material is concerned, most of the species belonging to the Acanthocerataceae do not show discrepancy in the biostratigraphic succession at substage level between Europe and Japan, if identical or closely allied species are taken into consideration (e. g. MATSUMOTO, 1975). Of course there can be local difference in the subzonal succession. Consequently we are reasonably led to regard the age of

Member IIb as Upper Albian, if not convinced of the upper Upper Albian. To determine whether it is upper Upper Albian or otherwise, we should complete the list of associated ammonites.

It has already been concluded (AMANO et al. *in* MATSUMOTO, 1960) that Member IIe is most probably assigned to lower Lower Cenomanian on account of *Graysonites* cf. *fountaini* YOUNG and *Desmoceras kossmati* MATSUMOTO obtained from it. In Texas *G. fountaini* occurs in the Zone of *Graysonites adkinsi*, which is in the lower, but not basal, part of Lower Cenomanian, since the Zone of *Plesioturrilites brazoensis* is allocated at the base of the Cenomanian (YOUNG, 1958). Should this succession be maintained in Japan, there would be some room below Member IIe for the basal Cenomanian. In other words Member IId may still be within Lower Cenomanian. As the fossils contained in IId are mostly of endemic species, direct evidence for the correlation with the international scale is not available for IId.

To sum up, the Albian-Cenomanian boundary would be either at the base of IId or at the base of IIc; or could be somewhere within Member IIc. Since ammonites could scarcely be expected from IId and IIc in view of their facies, further search for more ammonites from Members IIb and IIe would give evidence to decide one of the alternatives. Another problem to be settled in the future is whether and how other molluscan fossils, such as species of the Trigoniidae and Glycymeridae, are changed or unchanged across the Albian-Cenomanian boundary in the Goshonoura and other sequences in Japan.

Incidentally the Upper Formation of the Goshonoura Group is most probably correlated with the lower part of the Mifune Group, southwest of Kumamoto, on account of common occurrence of such diagnostic species as *Matsumotoa japonica* OKADA, *M. unisulcata* (AMANO), *Acanthotrigonia yeharai* (NAKANO and NUMANO) and *Crassostrea* sp., as clearly discussed by TAMURA et al. (1968). Recently *Eucalycoceras* sp. cf. *E. spathi* (COLLIGNON) and *Inoceramus concentricus costatus* NAGAO and MATSUMOTO have been discovered from a part of the Lower Mifune, which indicate Middle to Upper Cenomanian (TAMURA et al. 1974). Therefore, the Goshonoura Group is not likely to extend to Turonian in age and there should be an unconformity or hiatus between the Goshonoura Group and the Senonian Himenoura Group.

## Further remarks

(Tatsuro MATSUMOTO*)

It should be noted that the adult living chamber is preserved in the specimen of *Mortoniceras* from Member IIb as in the case of *Graysonites* from Member IIe. This implies that the sedimentary condition was rather quiet during the deposition of IIb and IIe. The petrographical characters of the sandstones (well sorted, medium to fine-grained wacke with muddy matrix) support this as investigated by OKADA (1960).

The bottom sediments where adult shells of *Mortoniceras* were embedded are not always of the same kind. For instance, Malmstone (fine-grained glauconitic sandstone) in the case of Oxfordshire examples, and limestone in the case of Duck Creek ones, and medium to fine grained sandstone with muddy matrix in our case. They are all sediments

* T. MATSUMOTO alone is responsible for this article.

under calm shallow sea, although the absolute depth is hardly estimated with the available data.

As can be judged from the difference in the characters of ribbing and tuberculation between the adult and immature shells, the animals of *Mortoniceras* may have changed to some (if not great) extent their mode of living during their life history. Especially the rostrum at the apertural end of the shell suggests a particular mode of life of the adult animal. The function of the rostrum, especially a recurved one as in *M. rostratum*, has not yet been sufficiently investigated, although the morphology itself was noticed long ago (e. g. STIELER, 1922).

Presumably the animal of *Mortoniceras* must not have been a rapid swimmer. The rectiradiate, strong ribs with fairly strong tubercles and the subquadrate whorl section would be shell characters against the stream. The adult animal may have moved up and down in the sea-waters to some extent, controlling the buoyancy of air-chambers, and also could have swimmed slowly backward. The raised or recurved rostrum may have served as a kind of anchor when she settled herself on the bottom sediments under the sea water. A moderately long and broad living chamber occupied by the animal would make the entire shell less buoyant.

The above is a working hypothesis which should be examined further by some model experiment or by theoretical calculation. Another, more serious problem is about the funnel. In *Nautilus* and most of Paleozoic Ammonoidea (Goniatitida defined by MATSUMOTO, 1974) the hyponomic sinus is distinctly present on the ventral (i. e. external) side of the shell. In most of the Mesozoic Ammonoidea (Ceratitida and Ammonitida, except some Lytoceratina), there is no hyponomic sinus on the ventral side but instead the external part of the shell is more or less projected. This is extreme in the case of *Mortoniceras* which bears rostrum. I dare propose an idea as a working hypothesis that the funnel in many Mesozoic ammonoids may have doubled openings or have been in pair, being produced somewhere at the ventrolateral part. HOEPEN (1951) described a distinct sinus at the ventrolateral part (or outer lateral part) of "*Pervinquieria*" *scobina*. This sinus may correspond to the hyponomic sinus (one of the pair). Many other Mesozoic ammonites (e. g. *Holcophylloceras*, *Harpoceras*, *Desmoceras* etc.) show a more or less sinuous apertural margin which has a pair of outer lateral (or ventrolateral) and inner lateral or umbilical) sinuses. The former is presumably one of a paired hyponomic sinuses, while the latter is certainly an ocular sinus. How to prove or disprove this working hypothesis a future problem.

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## Explanation of Plate 25

Fig. 1. *Mortoniceras* (*Mortoniceras*) sp. aff. *M.* (*M.*) *rostratum* (J. SOWERBY). Specimen from Goshonoura island, KE. 2241. Lateral view (a), the other side of a part of the rostrum (b), the other side (c) of the plaster cast; ventral view of the internal mould of the posterior part of the living chamber (d) (see Text-fig. 2 for the same internal mould). All figures of natural size. Repository: Department of Geology, Faculty of Education, Kumamoto University, Kumamoto 860.

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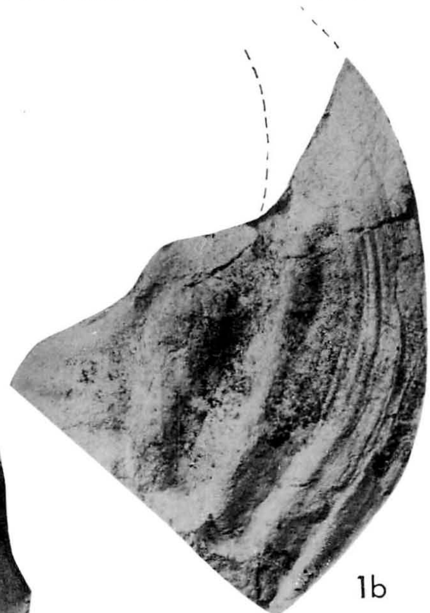
|---|---|---|---|
| Amakusa | 天草 | Honto | 本渡 |
| Amura | 阿村 | Kameba | 亀場 |
| Enokuchi | 江口 | Kumamoto | 熊本 |
| Goshonoura | 御所浦 | Mifune | 御船 |
| Himenoura | 姫浦 | | |


1a


1b


1c


1d

# PROCEEDINGS OF THE PALAEONTOLOGICAL SOCIETY OF JAPAN

日本古生物学会第116回例会は，1975年9月23日(火)・24日(水)に金沢大学理学部において開催された(参加者50名)。

## 個人講演

手取統植物群に産出した毬果植物(その1：*Walchia*-typeの針葉樹について)........松尾秀邦

New discovery of the Tetori-type Flora from the Tokura Formation, Gumma Prefecture, Japan ............................T. KIMURA, S. SAITO & T. TOJO

The new occurrence of some dipteridaceous ferns from the Daedong Group, Korea.. .................... T. KIMURA & B. KIM

金沢市郊外の大桑層から産出したクルミ堅果について(代読)......................大村一夫

北陸地域における珪藻層位学とその意義について ...............................小泉　格

浜名湖周辺佐浜泥層より得た浮遊性緑藻類クンショウモ属について ......松岡数充・長谷憲治

宮崎層群の石灰質ナンノプランクトン層序 .................................... 西田史朗

Growth rate of marine manganese nodule. ................ K. HARADA & S. NISHIDA

北陸における海胆化石による生層序学的研究 .................................. 森下　晶

"宇治貝層"について..................藤井昭二

金沢市周辺の"高窪層"産軟体動物化石について ............................ 小笠原憲四郎

大桑フォーナ，特に貝化石群集について(その1) ............................ 小笠原憲四郎

掛川地方新第三系における*Suchium*とその変遷 ................................ 土　隆一

再び南方属*Bassina* (Pelecypoda)について.. ................................ 小高民夫

日本のシルル・デボン紀のこけ虫化石について(代読) ..........................坂上澄夫

和歌山県白崎石灰岩産出の二畳紀珊瑚化石の新種について ..............山際延夫・鈴木康之

盛産*Syringopora*の微細構造について ...... ............................... 岡村長之助

Discovery of *Palaeofusulina* from the Toyoma Formation in the Kitakami Massif, Northeast Japan (代読).................................. M. MURATA & K. ISHII

Upper Carboniferous fusulinacean from the Omi Limestone ............K. WATANABE

小笠原諸島母島産 Discocyclinidae (Larger Foraminifera) ..........紺田　功・奥田　悟

富山県北西部の新第三系の微化石層位 .......... ............................... 長谷川四郎

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ハマグリの成長線 ....................小池裕子

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(ロ) 無節サンゴモ ....三井さち子・小西健二

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# 日本古生物学会報告・紀事 編集出版規約

（1973年1月16日）

## I 出版・編集

### IA 発行

—1 日本古生物学会報告・紀事（以下報告・紀事と略称）は，年4回発行される。

### IB 掲載

—1 報告・紀事には，本会の会則第2条の目的にかなう原著論文，短報および学会紀事，古生物学界ニュース等を掲載する。

—2 投稿された論文は，原則として受理順に掲載される。

### IC 配布

—1 報告・紀事は，本会のすべての会員ならびに評議員会の認める若干の機関に配布され，会員外の者はこれを購読することができる。

### ID 編集委員会

—1 報告・紀事の編集は，会の編集出版規約にもとづき，編集委員会がこれを行なう。

—2 編集委員会は，評議員である編集長1名および常務委員会で認められる若干の委員から構成され，編集会議は編集長の召集により開かれる。

—3 編集長は，必要に応じて受付原稿のコピーを編集委員以外の適切な人に示し，その意見を徴することができる。

—4 原稿の採否は，編集会議において編集委員会の責任で決定し，編集長はその結果を常務委員会に報告する。

—5 不採用原稿は，その理由を付して著者に返却する。

—6 編集委員会の決定に不服の著者は，評議員会に対して異議申立を行なうことができる。編集委員会および著者は，評議員会の裁定にしたがう。

### IE 校正

—1 校正は，原則として編集委員会がこれを行なう。ただし，著者は初校について1回限り著者校正をとることができる。このとき正規の原稿は著者に返送されない。

## II 投稿

### IIA 資格

—1 本会の会員は，報告・紀事に投稿する権利を有する。ただし，常務委員会で認める特例については，非会員でも投稿できる。

—2 投稿論文は欧文（英・仏・独のいずれかが望ましい）で書かれたもので，本学会の年会・例会等で講演されたものとする。

### IIB 執筆制限

—1 原稿はタイプスクリプトとする。原著論文では，挿図，表などを含めて24印刷頁，および図版2葉を限度とする。ただし，4印刷頁以内の論文については，とくに認められた場合を除いて図版を付さない。短報類は1印刷頁以内とし，かつ図版を用いないものとする。

—2 挿図は，1論文につき10図，あるいは印刷延面積で600 $cm^2$ を限度とする。ただし，4印刷頁以内の論文では2図，あるいは合計面積 200 $cm^2$ までとする。挿図は印刷時に，1つの図の幅が本文の1段幅（6.4 cm）か2段幅（=1頁幅，13.4 cm）のいずれかの大きさに縮小されるので，原図はそれに適した大きさと鮮明さを備えたもので，原稿本文とは別紙に画かれたものとする。

—3 上に示されたそれぞれの執筆制限をこえる場合には，超過分の印刷出版に要する実費を著者自身が負担する。

### IIC 原稿の体裁

—1 属種名などの学名や特殊な語についての字体の指定は，原稿中に著者自身が行なう。

—2 挿図・表等の挿入希望箇所を，原稿の欄外に指定する。

—3 挿図・表の題および説明，ならびに図版説明等は，本文とは別紙にまとめる。

—4 引用文献は本文の最後の部分にまとめ，著者名の姓のアルファベット順および発表年代順に配列し，原則として下記の要領にしたがう。

著者名，年，論文表題，雑誌名（斜体指定のため下線をほどこす），巻，号，頁数，図版数，その他。

—5 日本など漢字でかく地名を含む論文については，ローマ字表現と漢字とを対照した表を本文の末尾に付すことが望ましい。

—6 著者の現所属機関名とその所在地，あるいはそれらに代わる住所を，タイトル頁の著者名の下に完記する。

—7 短報類以外の論文には，邦題，著者名を含めて800字以内にまとめた邦文要旨を別紙として付ける。（日本語を常用しない著者の論文については，英文要旨を付しておけば，それにもとづいて編集委員会が邦文要旨を作成する。）

II D **著者の責務**

—1 著者は，編集上の諸事項に関して可能な限り編集委員会の指示にしたがわなければならない。

—2 原稿の受付後に，著者が大幅改訂を希望する場合は，原稿は返却されるが，改訂した原稿は新規の投稿とみなされる。

—3 投稿に際しては，正規の論文原稿の他に，図，表，図版等を含む完全なコピー1組を付して下記へ送付する。

113 東京都文京区弥生 2—4—16
日本学会事務センター気付
日本古生物学会　編集長

—4 投稿に際しては，別に定める投稿カードに必要事項を記入し，原稿類とは別便で上記事務局宛に送付する。

II E **別 刷**

—1 別刷は，無表紙120部までを無償で著者（複数の場合は分配）に供与する。それ以上の部数または表紙等に要する費用は，著者自身の負担とし，直接印刷所に支払うものとする。

**付 則**

i) 本規約の発効・改訂・廃止に関しては，評議員会の議を経て，総会の承認を得なければならない。

ii) 本規約の発効により，従来の「日本古生物学会報告・紀事出版規定」は失効する。

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◎日本古生物学会報告・紀事投稿案内（1973年1月）の一部訂正。

p. 2 IIB-2　600 $cm^2$ で限度——→600 $cm^2$ を限度

p. 6 II7　章の見出しは左に寄せて——→章の見出しは中央部に，節，項などの見出しは左に寄せて

# List of Contributors

## to the TPPSJ, New Series, Nos. 1–100

(n: single author, *n*: co-author, **n**: presidential address, ***n***: short note etc.)

## 「Bibliography of Palaeontology in Japan, 1961-1975」の刊行計画

日本古生物学会では，日本における古生物学および関連分野の文献集 (Bibliography of Japanese Palaeontology and related Sciences) をこれまでに 2 篇発行した。うち第 1 篇は 1951 年に Palaeontological Society of Japan, Special Paper, No. 1 として 1941-1950 年度の文献を収録し，さらに第 2 篇は 1961 年に，1951-1960 年度分を同誌 No. 9 として発行した。

このたび，それらの続篇として 1961-1975 年度分を収録する上記文献集を刊行することになり，刊行委員会 (6 月 13 日の評議員会にて決定) が設置された。現在，分類・対象別に各専門家が分担して原稿作成中で，1977 年度の文部省二次刊行物助成金を申請し，1977 年 11 月ごろ出版の予定である。

◎ **各種学術奨励金の学会推薦について** 本学会以外の各種学術奨励金・助成金は原則として個人またはグループが直接応募申請するのがたてまえであるので，本会としては，昭和 49 年度からは推薦のご希望の申出があったものについてのみ，賞の委員会で審議のうえ，推薦を決めることにした。しかし自薦だけでは応募申請が減る傾向があるので，昭和 49 年度後半からは他薦を含めて審議の対象とすることにした。会員各位には，古生物学発展のため下記のような奨励金にふるってご応募・ご推薦されたい。

昭和 51 年度の下記のような各種奨励金に本会の推薦を希望される場合は，**昭和 51 年 2 月 20 日までに**，① 研究者および協力者氏名所属 ② 希望される奨励金名称 ③ 課題名と大略の内容を記して，東京大学理学部地質学教室気付日本古生物学会賞の委員会事務局あて申込まれたい。

○ 朝日学術奨励金　　金額に制限なし，研究進行中，またはこれから始めるもの。学会関係者の推薦を要する。締切 3 月 1 日。

○ 三菱財団自然科学研究助成金　　1 件 3,000 万円以内 (300～1,000 万円程度)，重点対象分野の指定あり，推薦は不要，助成期間は原則として 1 年間，締切 5 月末頃。

なお上記の締切日は昭和 50 年度のものであるから，51 年度には多少変更があるかも知れない。(従来上記のほかに毎日学術奨励金，山路自然科学振興財団研究助成金があつたが，51 年度から廃止される)。

## 第 1 回太平洋地域第三系国際会議 (1st CPNS)

CPNS (Regional Committee on Pacific Neogene Stratigraphy) は，IUGS 中の Commission on Stratigraphy の下部組織として 1972 年に発足した。その第 1 回の会合が 1976 年 5 月 16 日～21 日に東京の日本学術会議で行なわれる。

会議の主題は太平洋地域新第三系の年代層序区分と対比で，ほかに古環境・構造・資源など関連ある諸問題もとりあげられる。また会議の前後には，男鹿半島・房総半島・掛川地方・大阪地方への巡検，さらに会期中に IGCP の新第三紀第四紀境界，新第三系対比などのプロジェクトの会合も行なわれる。

現在，本年 6 月に送付した 1st Circular への返答者に対し，2nd Circular を発送した段階である。参加予定者 140 名のうち国外 (16 ケ国) は 60 名，発表予定論文数は 75。

連絡先：東京都港区六本木 7-22 (〒 106) 日本学術会議内 CPNS 組織委員会，または同委総務幹事高柳洋吉 (東北大)。

## IGCP Project—Mid-Cretaceous Events [MCE] 第 2 回国際研究集会の日本開催

この第 1 回国際研究集会は 1975 年 9 月 29 日～10 月 4 日 ウプサラ大学で開催されたが，その際に第 2 回国際研究集会を日本 (北海道) で，1976 年 8 月 29 日～9 月 6 日にわたり開催することが正式に決定した。討論会 (三笠市) と現地検討会 (幾春別川と大夕張の 2 地区) を含む日程が決まり，すでにサーキュラーが渡っている。参加者はＭＣＥのメンバーに限るが，本会が後援者となっている。　連絡先 九大・松本達郎。

## 日 本 学 術 会 議 第 6 9 回 総 会 報 告　　日本学術会議広報委員会

日本学術会議第 69 回総会は，1975 年 10 月 22 日から 3 日間，本会議講堂を会場に開催された。なお総会前日連合部会が開かれ，研究連絡委員会の整備，及び「科学研究者の地位に関するユネスコ勧告」の国内実現のための措置に関し，関係委員会から詳細に報告された。

〔諸　報　告〕

まず前回総会以降の経過について会長報告がなされ，了承された。この中で原子力委員会から原子力に関するシンポジウム開催について協力方の要請があり，会長から特に異存はない旨回答したことの報告がなされた。これに関し会員から，原子力の研究・開発に対するこれまでの学術会議の原則的立場を堅持するため，シンポジウムの性格，それへの協力のあり方について慎重に対処すべきであるとする意見が相次いで出された。

ついで，運営審議会付置の各小委員会，国際環境保全科学会議組織委員会，各部，常置・特別委員会，中央選挙管理会の報告が行われた。財務委員会からは，大幅な予算の節約を余儀なくされたことにより，諸活動に支障を来たしていることの報告がなされ，ＩＣＳＵ（国際学術連合会議）小委員会からは，本年９月のＩＣＳＵ総務委員会で，科学者の自由交流の確保に関し，日本に対し強く要望された旨報告された。国際環境保全科学会議組織委員会は，来月に迫つた同会議の準備が着々進められていることを報告し，同会議成功のため会員の一層の協力を要請した。

常置・特別の各委員会は，それぞれ今期の重点的な活動計画案等を報告した。その中で，ユネスコ勧告特別委員会は「科学研究者の地位に関するユネスコ勧告」を国内で実現するために，「再び科学研究基本法の制定について（勧告）第一次草案」「研究公務員の地位の確立について（中間報告）」を示し，会員の検討を求めた。また，科学研究計画委員会からは，「新たな総合的な科学研究将来計画策定の準備」等に取り組むにあたつて，まず各会員，各研究連絡委員会に対して「それぞれの専門分野に関連して研究課題と研究動向」の報告を依頼する旨の要請がなされた。これをめぐり，科学論，学問論をふまえた論議が熱心にかわされた。そして，原子力特別委員会は，前記原子力委員会のシンポジウムへの協力のあり方に関し，本会議が「平和利用三原則の提唱以来一貫して主張してきた原子力研究・開発のあるべき方向に沿ってこのシンポジウムが行われるべき」であることを骨子とする同特別委員会の申合せを報告した。

〔提 案 審 議〕

３日間を通じ，次の諸提案が審議採択された。「当選無効の申立てに関する再審査の裁決について」「生体工学基礎研究所（仮称）の設立について（勧告）」「野生動物の保護について（要望）」「研究連絡委員会の組織運営の整備に関する措置について（申合せ）」「研究連絡委員会の名称の変更並びに分科会の設置及び総合研究連絡委員会的運用の実施について（申合せ）」

生体工学基礎研究所（仮称）については，「生体工学」の概念等をめぐって多数の会員から質疑，意見が出された。その多くは，学術研究に人間性の尊厳を貫こうとする学際的な立場からのものであつた。

野生動物の保護については，ニホンカモシカ等の捕獲，射殺許可を安易に行わないこと，さらに野生動物の実態調査及び保護のための抜本的対策を行うことを政府に要望した。

〔以上日本学術会議広報委員会からの要請により掲載しました〕

## 陸の古生態に関するシンポジウム

昭和50年10月6日（月）10時～17時に，日本学術会議第4部会議室において，下記のような「陸の古生態に関するシンポジウム」が，日本学術会議古生物学研究連絡委員会主催，日本古生物学会および日本地質学会の後援で開催された。（日本古生物学会の世話人：氏家　宏，高柳洋吉）参加者約40名。

(1) 開会の辞
　松本達郎（古生物学研究連絡委員会幹事）
(2) 世話人によるシンポジウムの趣旨説明
　高柳洋吉（古生物学研究連絡委員会委員）
(3) 講　　演
　Ⅰ 氷期の問題
　　湊　正雄（北海道大学理学部教授）
　Ⅱ 最近の古生態学研究の現状と問題点
　　a）野尻湖の発掘成果を基礎とした脊椎動物の古生態
　　　亀井節夫（京都大学理学部教授）
　　b）琵琶湖の古生態学的研究の意義
　　　石田志朗（京都大学理学部助教授）
　Ⅲ 古気候をめぐる問題
　　a）古気候ーパリノロジーからのアプローチ
　　　相馬寛吉（東北大学理学部助教授）
　　b）古植生の復元と古気候の推定について
　　　鈴木敬治（福島大学教育学部教授）
　　c）古地磁気変動と気候変化
　　　川井直人（大阪大学基礎工学部教授）
　　d）気候の空間的構造-現在，ヒプノサーマル，ヴュルム氷期
　　　鈴木秀夫（東京大学理学部助教授）
(4) 総合討論
(5) 閉会の辞
　大森昌衛（古生物学研究連絡委員会幹事）

## 例会等の通知

| | 開催地 | 開催日 | 講演申込締切日 |
|---|---|---|---|
| 1976年総会・年会 | 鳴子川渡<br>共同セミナーハウス | 1976年1月30，31日 | 1975年11月20日 |
| 117回例会 | 広島大学 | 1976年6月26日 | 1976年5月15日 |

注：前号（No. 99）でお知らせしました北海道大学での117回例会予定は，秋の118回例会に変更される見通しとなりました。決定され次第公示します。

## 学界ニュース

◎ 日本学術会議発行の Japanese Journal of Geology and Geography（略称 J. J. G. G.）は，財政上の理由により，昭和50年3月31日発行の Vol. XLV, Nos. 1-4 をもって廃刊となった。

◎ International Congress on Carboniferous Stratigraphy and Geology が9月8日〜9月13日に Moscow において開催された。日本からの参加者は猪郷久義（筑波大），加藤　誠（北大），小池敏夫（横浜国大），高橋良平（九大）の4君。

◎ 1st International Fossil Algae Symposium が10月6日〜10日に Erlangen において開催された。日本からの参加者は小西健二君（金沢大）。

◎ 2nd International Symposium on Fossil Corals and Coral Reefs が9月22日〜27日に Paris において開催された。日本からの参加者は湊　正雄，加藤　誠（北大），浜田隆士（東大）の3君。

◎ UNESCO-IUGS Meeting of Scientific Editors in the Southeast Asian-Australian Region が11月3日〜6日に Bandung において開催された。日本からは浜田隆士君が日本古生物学会報告・紀事編集長として参加。当会議において Association of Editors in Science in Southeast Asian, Australasian and Oceania (EDITEAST と略称）が結成され，会長に K. A. TOWNLEY（オーストラリア），副会長に S. SINGH（マレーシア），会計に A. M. DALISAY（フィリピン）が就任した。

## 日本古生物学会報告・紀事（旧編）復刻のお知らせ

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