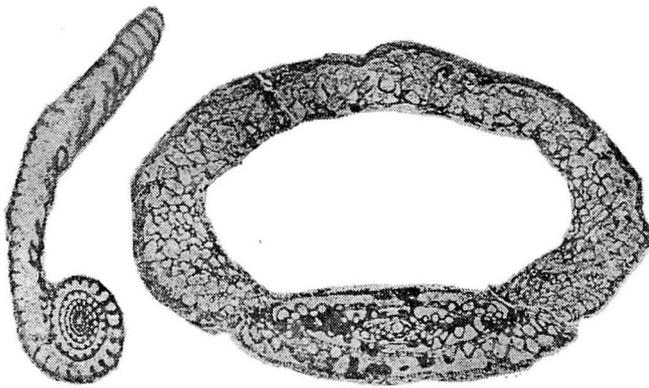


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The fossil on the cover is *Nipponitella explicata* HANZAWA, an aberrant uncoiled fusulinacean from the Lower Permian Sakamotozawa Formation, southern Kitakami, Northeast Japan.

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698. SOME LATE EARLY CRETACEOUS PLANTS FROM FUKUI
PREFECTURE, IN THE INNER ZONE OF JAPAN*

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Abstract. This paper deals with the palaeobotanical descriptions of the following newly discriminated species from the Chinaboradani Formation: Cfr. *Osmundopsis efimoviae*, ? *Osmunda* sp., *Gleichenites nipponensis*, *Coniopteris* cfr. *arctica*, *Birisia onychioides*, *Asplenium dicksonianum*, *Onychiopsis elongata*, *Podozamites eichwaldii* and *Coniferae* sp. These species as well as those described by KIMURA (1975) constitute the Tamodani Flora, the youngest flora lacking angiosperms in the Inner Zone of Japan. Judging from the available information about the Tamodani Flora, this flora would be characterized by the predominance of ferns including such younger types as *Coniopteris* cfr. *arctica*, *Asplenium dicksonianum* etc. and by the rarity of cycadophytes. The fern composition of the Tamodani Flora is close to the coeval floras in Siberia and is different from the coeval Wealden-type floras in the Outer Zone of Japan.

Introductory notes

The uppermost formation of the Lower Cretaceous part of the Tetori Supergroup consists of alternation of tuff, shale and sandstone, and is sporadically distributed in the Inner Zone of Japan as follows; along the Omichidani and the Takinamigawa valleys on the border (type area) of Ishikawa and Fukui Prefectures (Kitadani Formation, MAEDA, 1958); along the upper course of Tamodani valley, Fukui Prefecture (Uppermost Formation of Tamodani Group, KIMURA, 1975); and along the Uchinamigawa and the Itoshirogawa valleys, Fukui Prefecture (partly in Gifu Prefecture) (Chinaboradani and Oyama Formations, MAEDA, 1957a, b). The stratigraphic sections of these areas are correlated with each other in Fig. 1.

These tuffaceous formations conform-

* Received August 22, 1978; read June 3, 1978 at Tsukuba.

ably overlie the Akaiwa Formation consisting mainly of sandstone with intercalated shales, and in the type area are overlain unconformably by the Upper Cretaceous Omichidani Formation consisting of alternation of tuff, sandstone and shale.

The Omichidani Formation containing rich angiosperms, is similar in rock facies to the Kitadani Formation and its equivalents, but the latter lacks angiosperms.

Except the Omichidani Formation, such tuffaceous layers have only been known in the Kitadani Formation and its equivalents in the Tetori sedimentary sequence. In the Kitadani Formation and its equivalents, fossil plants have been known from the Uppermost Formation of the Tamodani Group and the Chinaboradani Formation.

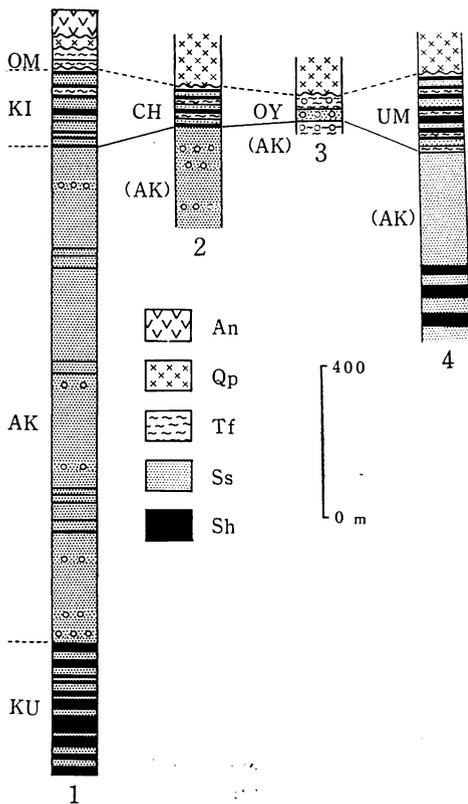
In 1975, KIMURA subdivided the 'Tetori Flora' stratigraphically into the Kuzuryu

(late Jurassic), the Oguchi (early Neocomian), the Akaiwa (late Neocomian) and the Tamodani (Aptian) Floras (in the sense of stratofloras). Therefore, the Tamodani Flora, including the plants from the Chinaboradani Formation, is the youngest one without angiosperms in the Inner Zone of Japan.

Recently one of us, HORIUCHI collected many fossil plants from the Chinaboradani Formation. They are poorly preserved, but the best preserved specimens are described here together with additional information about the Tamodani Flora.

Previous work

KIMURA (1975) described the following species from the Uppermost Formation



of Tamodani Group (on the right are the revised names accepted in the present work).

<i>Osmundopsis</i> ? sp.	= <i>Osmundopsis</i> sp.
<i>Gleichenites</i> aff. <i>porsildi</i>	= <i>G. porsildii</i>
<i>Arctopteris</i> sp.	
<i>Jacutopteris</i> sp.	
<i>Adiantites</i> sp. A	= <i>Adiantopteris</i> sp. A
<i>Cladophlebis</i> ex gr. <i>denticulata</i>	
<i>C.</i> cfr. <i>pseudolobifolia</i>	
<i>Sphenopteris</i> <i>kochibeana</i>	
<i>Sphenobaiera</i> ? sp.	
<i>Ginkgoidium</i> ? sp.	
<i>Podozamites</i> sp. cfr. <i>eichwaldi</i>	= <i>P. eichwaldii</i>
<i>Pityophyllum</i> sp.	= <i>P. lindstroemii</i>
<i>Conites</i> sp.	

Fig. 1. Correlative columnar sections of the upper part of Itoshiro Group, the Totori Supergroup.

1: along the Omichidani valley (after MAEDA, 1958).

2: along the Chinaboradani and the Itoshirogawa valleys (compiled by us from MAEDA, 1957a).

3: along the Nobudani valley (Oyama area), at the upper course of the Itoshirogawa valley (after MAEDA, 1957b).

4: along the Tamodani valley (after KIMURA, 1975).

KU: Kuwashima Formation. AK: Akaiwa Formation. (AK): Equivalents of the Akaiwa Formation. KI: Kitadani Formation. OM: Omichidani Formation (Upper Cretaceous). CH: Chinaboradani Formation. OY: Oyama Formation. UM: Uppermost Formation of the Tamodani Group. Sh: shale. Ss: sandstone. Tf: tuff, Qp: quartzporphyry. An: andesite.

In the Oyama area, the tuffaceous conglomerate Formation (the Nobudani Formation by MAEDA, 1957b; 10-28 m thick) underlying the Oyama Formation and overlying unconformably the Palaeozoic System, might be included in the Oyama Formation, although MAEDA (1957b) correlated the Nobudani Formation with the Akaiwa Formation.

In addition to the above, MATSUKAWA collected *Nilssonia* sp. from the same locality.

The Tamodani Flora (stratoflora)

The genera and species from the Uppermost Formation of Tamodani Group and those newly recognized from the

Chinaboradani Formation are shown in Table 1. The species from the two localities are listed and *Podozamites eichwaldii* alone is common to both localities.

This flora is different in composition from the coeval floras in the Outer Zone of Japan, and is also different in some features from its underlying floras in

Table 1. The list of species (Tamodani Flora) from the equivalents of Kitadani Formation, the uppermost formation in the Itoshiro Group, the Tetori Supergroup.

Genera & species	Localities			
	TM	CH	SI	RY
Cfr. <i>Osmundopsis efimoviae</i> SAMYLINA		○	△	
<i>O.</i> sp.	○		△	
? <i>Osmunda</i> sp.		○	△	
<i>Gleichenites nipponensis</i> OISHI		○		△
<i>G. porsildii</i> SEWARD	○		△	
<i>Coniopteris</i> cfr. <i>arctica</i> (PRYNADA) SAMYLINA		○	△	
<i>Birisia onychioides</i> (VASSILEVSKAJA & KARA-MURSA) SAMYLINA		○	△	
<i>Asplenium dicksonianum</i> HEER		○	△	
<i>Arctopteris</i> sp.	○		△	
<i>Jacutopteris</i> sp.	○		△	
<i>Adiantopteris</i> sp. A	○		△	
<i>Cladophlebis</i> ex gr. <i>denticulata</i> (BRONGNIART) NATHORST	○		△	△
<i>C.</i> cfr. <i>pseudolobifolia</i> VACHRAMEEV	○		△	
<i>Sphenopteris kochibeana</i> (YOKOYAMA) OISHI	○		△	
<i>Onychiopsis elongata</i> (GEYLER) YOKOYAMA		○	△	△
<i>Nilssonia</i> sp.	●		△	
<i>Sphenobaiera?</i> sp.	○		△	
<i>Ginkgoidium?</i> sp.	○		△	
<i>Podozamites eichwaldii</i> SCHIMPER	○	○	△	
<i>Pityophyllum lindstroemii</i> NATHORST	○		△	
<i>Conites</i> sp.	○			
Coniferae sp. (catkin-like cone?)		○		

TM: Uppermost formation of the Tamodani Group (KIMURA, 1975).

CH: Chinaboradani formation (present work); ● not described.

SI: common or allied species to those in the coeval floras in Siberia, NE-China and Mongolia.

RY: common or allied species to those in the coeval floras in the Outer Zone of Japan.

the Tetori Supergroup, as mentioned below.

1. Ferns.

1) This flora is not a member of the Wealden-type floras in the Outer Zone of Japan, but a member of the Tetori-type floras characteristic of the Inner Zone of Japan, because this flora contains such Dicksoniaceous ferns as *Coniopteris* cfr. *arctica* and *Birisia onychioides*, and does not contain Matoniaceous ferns characteristic of the early Cretaceous floras in the Outer Zone of Japan (KIMURA & HIRATA, 1975; KIMURA, 1976).

2) The species of ferns as seen in the underlying Oguchi and Akaiwa Floras, are absent in this flora.

3) *Osmunda*-like ferns and *Asplenium* which are considered to be younger elements in the early Cretaceous, are first recognized in this flora and neither of them has so far been found in the underlying floras.

4) So far as the fern composition is concerned, the Tamodani Flora is different from the coeval Wealden-type floras in the Outer Zone of Japan, but very close to the early Cretaceous floras in VAKHRAMEEV's Siberian Palaeofloristic Area. Fern genera in the Tamodani Flora such as *Coniopteris*, *Birisia*, *Asplenium*, *Arctopteris*, *Jacutopteris* and some *Cladophlebis* (e. g. *C.* cfr. *pseudolobifolia*) are common in the early Cretaceous floras in the Siberian Palaeofloristic Area, but have not been found in the early Cretaceous floras in the Outer Zone of Japan.

However, the Tamodani Flora does not correspond fully to the coeval Siberian floras, because in this flora, Gleicheniaceous ferns are fairly abundant, especially in the Oguchi Flora, while in the Siberian floras, they are rare and

only sporadically known, the same is true for *Onychiopsis*.

5) Fern genera such as *Osmunda*, *Osmundopsis*, *Asplenium* and *Arctopteris* are also common in the late early Cretaceous floras in the Siberian Palaeofloristic Area.

2. Cycadophyte. The only cycadophyte found in the Tamodani Flora is undetermined *Nilssonia*. Cycadophytes are abundant in the underlying floras.

3. Ginkgos. Only two forms are known in the Tamodani Flora. They possibly belong to *Sphenobaiera* and *Ginkgoidium*. No ginkgo-leaves have been found in the early Cretaceous floras in the Outer Zone of Japan, except for a doubtful record (OISHI, 1940, p. 368, pl. 38, fig. 4 regarded by him as *Baiera brauniana*).

4. Conifers.

1) Broad-leaved conifers are only represented by *Podozamites eichwaldii* which occurs fairly commonly. No specimen referable with confidence to *Podozamites* has been found in the early Cretaceous floras in the Outer Zone of Japan. *Podozamites* leaves recorded by previous authors from the Lower Cretaceous plant beds in the Outer Zone of Japan, are now referable to *Cycadolepis* or *Nageiopsis* (KIMURA & KANSHA, 1978).

2) The only narrow-leaved conifer is *Pityophyllum lindstroemii*, of Pinacean affinity, which has not been found in the early Cretaceous floras in the Outer Zone of Japan. Both *Podozamites eichwaldii* and *Pityophyllum lindstroemii* are fairly common in the Siberian early Cretaceous floras. Furthermore, two incomplete coniferous cones are known, but their identification is still uncertain, because of their poor preservation.

The interesting point of the small flora

described here is, first that it is the youngest flora lacking angiosperms in the Inner Zone of Japan and second that it resembles to the Siberian flora but is different from the coeval floras in the Outer Zone of Japan.

Acknowledgements

We first express our sincere thanks to Professor Emeritus Thomas M. HARRIS, F.R.S. of the University of Reading for his very helpful suggestions and kindest reading over the present manuscript. We also give our thanks to Miss Tamiko OHANA, a graduate student of the Tokyo Gakugei University for her kind help in drawing the figures in this paper.

Systematic description

Unfortunately neither cuticles nor organs are preserved in the present material. The specimens here described are all deposited in the Department of Astronomy and Earth Sciences, Tokyo Gakugei University.

Osmundales

Osmundaceae

Genus *Osmundopsis* HARRIS, 1931a: 136

This genus was first proposed by HARRIS (1931a, p. 136), for the Osmundacean leaves, instead of *Osmundites*. The diagnosis given by him (1931b, p. 48) was emended also by him (1961, p. 99) as follows; sterile and fertile leaves dimorphic. Sterile leaf bipinnate, a *Cladophlebis*. Fertile leaf as a whole lanceolate, bipinnate or tripinnate with no lamina, ultimate branches filiform, bearing groups of sporangia. Sporangia pear-shaped, whole apical region of wall

thickened, dehiscence by a longitudinal stomium. Spores rounded with triradiate scars.

Cfr. *Osmundopsis efimoviae* SAMYLINA

Pl. 1, figs. 1-2; Text-figs. 1a, b

Comparable specimens:

Osmundopsis efimoviae SAMYLINA; 1964, p. 50, pl. 3, figs. 1-3; text-figs. 3a, b (Buor-Kemyuss Formation, Zyrianka Coal-Basin).

Cladophlebis sp. a (pars); OISHI, 1941, p. 171, pl. 36, figs. 2, 2a (non figs. 1, 1a) (Lo-tzu-Kou Series, NE-China).

Description: Many sterile pinna fragments were obtained, two of which were illustrated here (Pl. 1, figs. 1-2).

Sterile frond is at least tripinnate, but whole shape is uncertain. Ultimate pinnae are long and narrow, typically 2.3 cm long and 0.5 cm wide at base, narrowing gradually towards the acute apex, attached to the axis at an angle of 45 degrees, flexible, sometimes falcate and bearing 11-12 pairs of small sized pinnules. Pinnules are set closely, katepistichous in order, deltoid in form, with obtusely pointed apex, entire and contiguous at base; the upper margin is generally straight and the lower one rounded as shown in Text-fig. 1a. Mid-nerve is distinct, persisting to the tip and sending off typically 4-5 pairs of simple secondaries at wide angle as shown in Text-fig. 1b. (The fructification has not been found).

Remarks: The present fern is characterized by its deltoid pinnules which are contiguous each other at base and with simple secondaries.

The present fern, although its fertile part has not been found, resembles externally the sterile leaves originally described by SAMYLINA as *Osmundopsis efimoviae* (pl. 3, figs. 1-3) from the

Zyrianka Coal-Basin. But the present pinnules are somewhat different from the Siberian ones with acutely pointed apex and with twice forking secondaries on the lower half of midnerve. Then we treat the present fern as Cfr. *Osmundopsis efimoviae*.

The fertile fragments described by KIMURA from the Tamodani Group (1975, pl. 5, figs. 2-5; fig. 4-a, b) as *Osmundopsis?* sp. are like those of SAMYLINA's *Osmundopsis efimoviae*, but the associated sterile fragments are different and the species may be distinct.

Occurrence: Common (sterile leaves).

Specimens: CH-007, CH-016, CH-017, CH-018, CH-036, CH-042, CH-048, CH-055.

Genus *Osmunda* LINNÉ, 1753

? *Osmunda* sp.

Pl. 1, fig. 3; Text-figs. 2a, b

Description: Pl. 1, fig. 3 shows a small pinna fragment bearing pinnules which are oval in form, entire, with constricted and decurrent base, and with bluntly pointed apex. Pinnules are 0.45-0.55 cm long and 2-2.5 mm maximum wide and attached nearly perpendicularly to pinna axis. Nerves are distinct, midnerve is persisting to the tip, sending off 5-6 pairs of secondaries forking dichotomously once except an apical pair.

Remarks: Judging from the outline of pinnules and their constricted base, it would be sure that this specimen belongs to the genus *Osmunda*, though its fertile part has not been found.

In outline of pinnules and venation, this specimen resembles *Osmunda* sp. 2 described by SAMYLINA (1976, p. 21, pl. 1, figs. 7, 8; text-fig. 1) from the middle member of Omsukchan Formation in the Kolyma Basin, though in the

Siberian specimen, secondary nerves are more densely crowded than those of ours.

It would be worthy to note that *Osmunda*-type ferns became abruptly common or abundant in occurrence in the late early Cretaceous floral sequence in Siberia.

We have not encountered such *Osmunda*-type ferns as mentioned above in the Oguchi and the Akaiwa Floras, the lower and the middle parts of the early Cretaceous floral sequence in the Tetori Basin.

Specimen: CH-006 (one specimen only).

Filicales

Gleicheniaceae

Genus *Gleichenites* GOEPPERT, 1836: 172

Gleichenites nipponensis OISHI

Text-figs. 3a, b

Gleichenites nipponensis OISHI; 1940 (pars), p. 202, pl. 3, figs. 3, 3a (non fig. 2) (Mochiana, Upper Jurassic Kuzuryu Group); 1941, p. 169, pl. 37, figs. 1, 2, 2a, Lo-tzu-kou Series, NE-China; KIMURA, 1958b, p. 13, pl. 1, figs. 2, 3, pl. 3, fig. 4; pl. 4, fig. 5; text-figs. 1, 2 (Mochiana).

Cladophlebis exiliformis (GEYLER) OISHI; 1940 (pars), p. 261, pl. 13, fig. 2; pl. 15, figs. 2, 2a (Kuwashima, Oguchi Formation); 1941, p. 170, pl. 36, fig. 4 (Lo-tzu-kou Series); KIMURA, 1958b (pars), p. 21, pl. 1, fig. 5 (Hakogase, Oguchi Formation).

Cladophlebis sp. a; OISHI, 1941, p. 171, pl. 36, figs. 1, 1a (non figs. 2, 2a) (Lo-tzu-kou Series).

Remarks: Many sterile and fertile pinna fragments were obtained. The fertile ones agree well with those from Mochiana and Lo-tzu-kou as *Gleichenites nipponensis*, and the sterile ones also agree with those from Kuwashima of the

Oguchi Formation and Lo-tzu-kou. The sterile leaves now referable to this species have so far been regarded as *Cladophlebis exiliformis* (pars) and *C. sp. a* (pars) by OISHI and KIMURA.

Recently KIMURA & SEKIDO collected a good number of both sterile and fertile leaves in organic connection, from Kuwashima and Mekkodani, of the Oguchi Formation. These new material will be described in detail in their monograph of the Oguchi Flora (KIMURA & SEKIDO, MS) in the near future.

KIMURA & KANSHA (1978) described *Gleichenites yuasensis* sp. nov. from the Upper Neocomian Arida Formation, Wakayama Prefecture, in the Outer Zone of Japan. They included OISHI's *Gleichenites nipponensis* from Kaisekiyama of the Ryoseki Group (OISHI, 1940, pl. 3, fig. 2) and NATHORST's *Pecopteris geyleriana* (NATHORST, 1890, pars) in this new species. They pointed out differences in the form of the sterile pinnules.

Occurrence: Common.

Specimens: CH-001, CH-002, CH-010, CH-011, CH-012, CH-022, CH-026, CH-027, CH-041, CH-045, CH-046, CH-049, CH-050, CH-052, CH-054, CH-061, CH-100.

Dicksoniaceae

Genus *Coniopteris* BRONGNIART, 1849: 26

Coniopteris cfr. *arctica* SAMYLINA

Pl. 1, figs. 4, 5; Text-figs. 4a-c

Comparable specimens:

Coniopteris arctica (PRYNADA) SAMYLINA; 1963, p. 70, pl. 2, figs. 2-7; pl. 3, fig. 5a (Lower Cretaceous of the Aldan and the Amga); 1964, p. 56, pl. 5, figs. 11-13 (Buor-Kemyuss Formation, Zyrianka Coal-Basin); 1976, p. 25, pl. 7, fig. 2a; pl. 41, fig. 13a (Middle member of Omsukchan Formation,

Kolyma Basin).

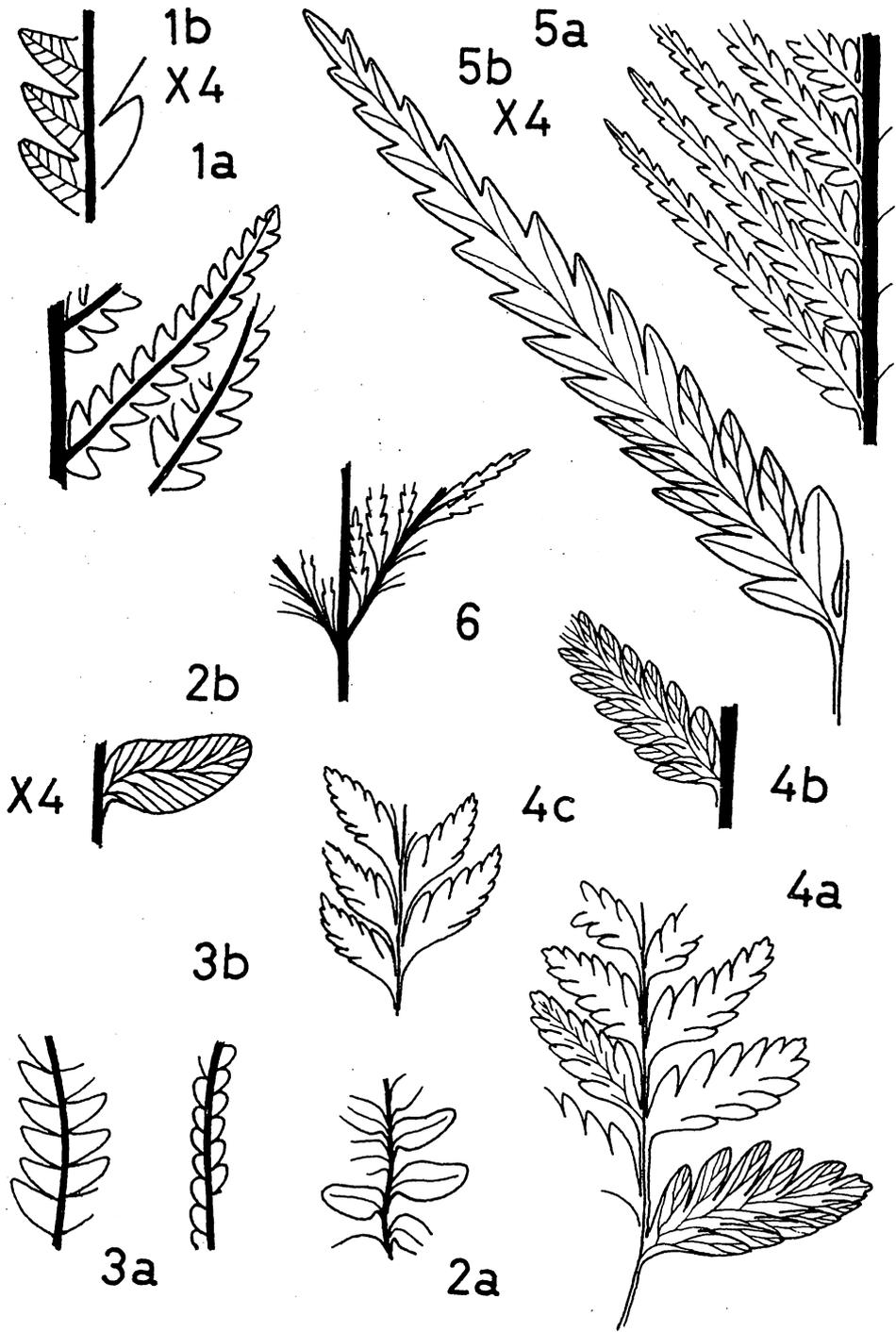
Coniopteris cfr. *arctica* (HEER); VASSILEVSKAJA & PAVLOV, 1963, pl. 3, fig. 1 (Kyu-syur Formation, Lena Basin).

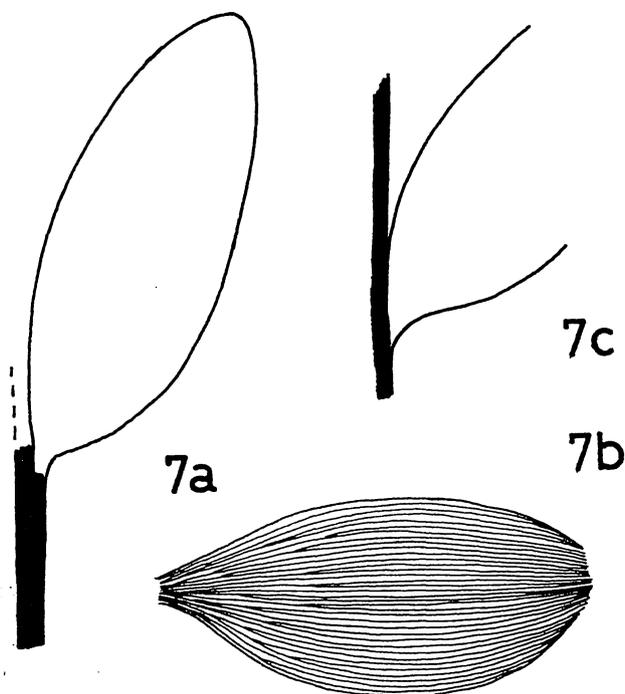
Dicksonia arctica (PRYNADA) KRASSILOV; 1973, p. 32 (Tschenitschuko Formation, Bureja Basin).

Description: Several pinna fragments were obtained. Owing to the incompleteness of our material, the shape of the whole leaf is not known. Pinnules examined by us are all sterile, varied in form and size, set closely or somewhat remotely on the slender pinna axis which has a median longitudinal furrow on its upper surface (Text-fig. 4a) as commonly seen in those of other Dicksoniaceae ferns. Pinnules are typically oval or rhomboidal in form, decurrent at base, their laminae are deeply divided into 5-6 pairs of lobes, but the sinuses do not reach the midnerve. Lobes are entire, generally directed forwards and with bluntly pointed or rounded apex. Nerves are delicate and typical *Sphenopteris*-type as if sympodial branching in appearance; each lobe receives one set of sympodially branched secondaries are shown in Text-figs. 4a, b.

Remarks: Among more than 30 Dicksoniaceae species known at present from the Upper Jurassic to the Lower Cretaceous strata in Siberia, the present sterile leaves most closely resemble in the form of pinnules and the venation those of *Coniopteris arctica* from the Lower Cretaceous of Kolyma Basin and its adjacent area and of *C. cfr. arctica* from the Lower Cretaceous of Lena Coal-Basin. *Dicksonia arctica* from the Lower Cretaceous of Bureja Basin would also be similar in form to the present leaves, though KRASSILOV has not illustrated this species.

However, we hesitate to refer our





Text-figs. 1-7 (All enlarged twice, unless otherwise stated).

1. Cfr. *Osmundopsis efimoviae* SAMYLINA; 1a: sterile pinna fragment (CH-016). 1b: enlarged partly from 1a to show the venation.
2. ? *Osmunda* sp.; 2a: sterile pinna fragment (CH-006). 2b: enlarged from 2a to show the outline of a pinnule and its venation.
3. *Gleichenites nipponensis* OISHI; 3a: sterile pinna fragment (CH-026). 3b: fertile pinna fragment in close association with 3a in occurrence.
4. *Coniopteris* cfr. *arctica* (PRYNADA) SAMYLINA; showing varied forms of pinnules, partly with their venation (4a: CH-053, 4b: CH-057, 4c: CH-023).
5. *Birisia onychioides* (VASSILEVSKAJA & KARA-MURSA) SAMYLINA;
5a: long and narrow pinnules on the posterior part of a frond (CH-014).
5b: enlarged from 5a to show the venation.
6. *Asplenium disksonianum* HEER; a part of penultimate pinna, showing the outline of pinnules (CH-028).
7. *Podozamites eichwaldii* SCHIMPER; showing the leaf-form and the venation (7a: CH-015, 7b: CH-008, 7c: CH-059).

sterile leaves fully to *C. arctica* and treat them here as *C. cfr. arctica*, because in our collection fertile leaves have not been found. This is the first occurrence of a fern like *Coniopteris arctica* in the Inner Zone of Japan.

Occurrence: Common.

Specimens: CH-003, CH-009, CH-023,

CH-029, CH-034, CH-037, CH-039, CH-044,
CH-047, CH-053, CH-056, CH-057.

Genus *Birisia* SAMYLINA, 1972: 95

Birisia onychioides (VASSILEVSKAJA
& KARA-MURSA) SAMYLINA

Pl. 1, fig. 6; Text-figs. 5a, b

Dicksonia gracilis HEER; 1878, p. 13, pl. 3, figs. 8-11 (Lower Cretaceous of Lena Basin).

Cladophlebis shinshuensis TATEIWA; 1929, plate, fig. 24 (Jinju Formation, Nagdong Group, Korea); OISHI, 1940, p. 285, pl. 20, figs. 5, 6; pl. 21, figs. 5, 5a, 6, 7 (Ditto); KIMURA, 1958a, p. 116, pl. 25, figs. 1, 2; text-fig. 1 (Middle Formation of Tamodani Group).

Coniopteris onychioides VASSILEVSKAJA & KARAMURSA; KRYSHTOFOVICH, 1957, p. 231, fig. 201 (introducing VASSILEVSKAJA's specimen); VAKHRAMEEV, 1958, p. 77, pl. 3, fig. 6; pl. 4, figs. 1-3; pl. 5, figs. 1, 2; pl. 6, figs. 3, 4 (Lower Cretaceous of Lena Basin); VASSILEVSKAJA & PAVLOV, 1963, pl. 11, fig. 3; pl. 19, figs. 5, 6; pl. 31, figs. 6-8, 9a (Ditto); SAMYLINA, 1964 (pars), p. 60, pl. 8, fig. 2; pl. 9, figs. 1, 3, 5 (Lower Cretaceous of Zyrianka Coal-Basin); ABRAMOVA, 1970, p. 38, pl. 1, figs. 3-5 (Lower Cretaceous of Lena Basin).

Birisia onychioides (VASSILEVSKAJA & KARAMURSA) SAMYLINA; 1972, p. 100 (nomenclature); KIMURA, 1975, p. 71, pl. 5, figs. 6-9; pl. 6, figs. 1-4; text-figs. 4-2a-d (Middle Formation of Tamodani Group); KIMURA & SEKIDO, 1976, p. 352 (Ditto); SAMYLINA, 1976, p. 24, pl. 3, figs. 1-3; pl. 4, fig. 1 (Lower Cretaceous of Omsukchan).

Remarks: The above list shows how common is this species in the early Cretaceous floras in Eastern Siberia and its adjacent areas. This species is easily distinguishable from other Dicksoniaceae ferns by its *Cladophlebidium*-type sterile pinnules with many pairs of lobes strongly directed forwards. Many sterile leaf-fragments were found in our collection and one of them is illustrated here (Pl. 1, fig. 6). Judging from the characteristic pinnules as shown in Text-figs. 5a and 5b, the present leaves are undoubtedly referable to this species, although the fertile leaves have not been found.

Recently many good specimens referable

to this species were collected from the Mekkodani of the Oguchi Formation. They will be described in detail by KIMURA & SEKIDO in the near future.

Accordingly, this species is one of the characteristic elements in the early Cretaceous floras in the Inner Zone of Japan.

Occurrence: Common.

Specimens: CH-004, CH-005, CH-014, CH-033, CH-043, CH-063, CH-064.

Aspleniaceae

Genus *Asplenium* LINNÉ, 1753

Asplenium dicksonianum HEER

Pl. 1, fig. 7; Text-fig. 6

Asplenium dicksonianum HEER; 1874, p. 31, pl. 1, figs. 1-5 (Lower Cretaceous ? of Greenland); KRYSHTOFOVICH & BAIKOVSKAJA, 1960, p. 11, pl. 1, figs. 1-6; pl. 2, figs. 1-4; text-figs. 2-4 (Upper Cretaceous of Sakhalin); VASSILEVSKAJA & PAVLOV, 1963, pl. 33, figs. 1-3 (Ukin Formation, Lena Basin); SAMYLINA, 1964, p. 63, pl. 11, figs. 1-3 (Siliap and Buor-Kemyuss Formations, Zyrianka Coal-Basin); LEBEDEV, 1974, p. 40, pl. 6, fig. 4 (Albian Formation of Priokhotie); SAMYLINA, 1976, p. 34, pl. 14, figs. 3-5; pl. 17, fig. 6 (Omsukchan and Toptan Formations, Kolyma Basin). For further references, see KRYSHTOFOVICH & BAIKOVSKAJA, 1960, p. 11.

Description: Pl. 1, fig. 7 shows an incompletely preserved delicate fern frond closely referable to this species, especially to the original specimens described by HEER. Pinnules are long and narrow, linear, attached to the slender pinna axis at acute angle and shallowly divided into four pairs of lobes, typically 8.5 mm long and 1 mm wide. Lobes are directed forwards and with acutely pointed apex. (The fructification has not been found).

Text-fig. 6 shows the outline of pinnules. The figure suggests that the arrangement of the pinnule is anadromic but we can not be certain that this is correct.

Remarks: In this species, pinnules fairly vary in form as shown in previous illustrations. Although the present specimens are incomplete, their pinnules agree with those of original specimens of this species.

This species has been known from the plant beds after the Aptian age mainly in Siberia and Greenland. The occurrence of this species is the first record in Japan, although KIMURA & SEKIDO (1976) described two fern fragments under the name of *Asplenium* cfr. *dicksonianum* from the Osugidani of the Akaiwa Formation.

Occurrence: Common (but fragmentarily).

Specimens: CH-021, CH-028.

Unclassified fern

Genus *Onychiopsis* YOKOYAMA, 1889: 26

Onychiopsis elongata (GEYLER)

YOKOYAMA

Onychiopsis elongata (GEYLER) YOKOYAMA; 1889, p. 27, pl. 2, figs. 1-3, 4a-c (Oguchi Formation).

For further references, see KIMURA, 1975, p. 77.

Remarks: This species occurs richly in the underlying plant beds, but is rare in the Chinaboradani Formation and has not been found in the Uppermost Formation of Tamodani Group.

This species was luxuriant in the early Cretaceous age both in the Outer and the Inner Zones of Japan, but has not been found in rocks of that age in Siberia

(VAKHRAMEEV, 1971, p. 81).

Occurrence: Rare.

Specimens: CH-019, CH-030, CH-031, CH-032, CH-060, CH-158 (all minor fragments).

Unclassified conifer

Genus *Podozamites* BRAUN, 1843

Podozamites eichwaldii SCHIMPER

Text-figs. 7a-c

Podozamites lanceolatus eichwaldi HEER; 1876, p. 109, pl. 23, fig. 4; pl. 26, figs. 2, 3, 9; pl. 27, fig. 1 (Jurasso-Cretaceous of Bureja Basin).

Podozamites eichwaldii SCHIMPER; VASSILEVSKAJA & PAVLOV, 1963, pl. 16, fig. 5; pl. 27, fig. 4; pl. 28, fig. 3; pl. 30, fig. 1a (Bulun and Ogoner-Yuryakh Formations, Lena Basin); SAMYLINA, 1967, p. 151, pl. 8, fig. 9b; pl. 12, figs. 11-13 (Ozhoghina and Buor-Kemyuss Formations, Zyrianka Coal-Basin); LEBEDEV, 1965, p. 123, pl. 34, fig. 2 (Upper Jurassic of the Zeia); 1974, p. 95, pl. 27, fig. 1 (Albian Formation of Priokhotie).

Podozamites ex gr. *eichwaldii* SCHIMPER; SAMYLINA, 1976, p. 61, pl. 33, figs. 1-3 (Omsukchan Formation, Kolyma Basin).

Podozamites sp. cfr. *P. eichwaldi* SCHIMPER; KIMURA, 1975, p. 84, pl. 8, fig. 10 (Uppermost Formation of Tamodani Group).

For further references, see SAMYLINA, 1967, p. 151.

Description: Several fragments of *Podozamites* shoots bearing spirally disposed leaves. Leaves are generally small-sized, variable in form, elongate-oval (Text-fig. 7a) to oval (Text-fig. 7b), gradually narrowing towards the rounded or obtusely pointed apex and abruptly narrowing to pass to short petiole (Text-fig. 7c). Nerves are numerous, simple, parallel to each other, converging at apex, 36 in number in a leaf shown in Text-fig. 7b.

Remarks: The present specimens agree macroscopically with *Podozamites eichwaldii* which is widely known in the Upper Jurassic to the Lower Cretaceous plant beds in Eastern Siberia.

Podozamites eichwaldii differs in leaf-form from such comprehensively defined species as *P. ex gr. lanceolatus* widely known in the Mesozoic plant beds in the world. In *P. ex gr. lanceolatus*, as shown in its specific name, leaves are generally lanceolate in form, but in this species they are not lanceolate but generally elongate-oval or oval.

Externally most nearly allied one to this species is *Podozamites reinii* known not only from the Lower Cretaceous in the Inner Zone of Japan, but also from the Lower Cretaceous in Korea and Eastern Siberia. But *Podozamites eichwaldii* differs from *P. reinii* in that in *P. reinii* leaf bases are commonly rotund while in *P. eichwaldii* they are unexceptionally attenuate. Moreover, leaf-form of *P. eichwaldii*, although it is fairly varied, is outside the range of variation of *P. reinii* as shown by KIMURA & SEKIDO (1967, p. 418).

We now identify *Podozamites* sp. cfr. *P. eichwaldii* previously described by KIMURA (1975, p. 84, pl. 8, fig. 10) from the Tamodani as *P. eichwaldii*.

Occurrence: Common.

Specimens: CH-008, CH-015, CH-051, CH-059, CH-062.

Coniferae sp. (cone?)

Pl. 1, fig. 8

Pl. 1, fig. 8 shows a problematic organ which looks like a catkin-like cone probably belonging to some conifer, more than 6 cm long and 1.5 cm across measured on impression. This organ is consisting of numerous and irregularly

disposed circular or oval cone-scale-like imprints, 2-2.5 mm in diameter.

Full description and discussion of this organ must await the discovery of better specimens.

Specimen: CH-038 (one slab only).

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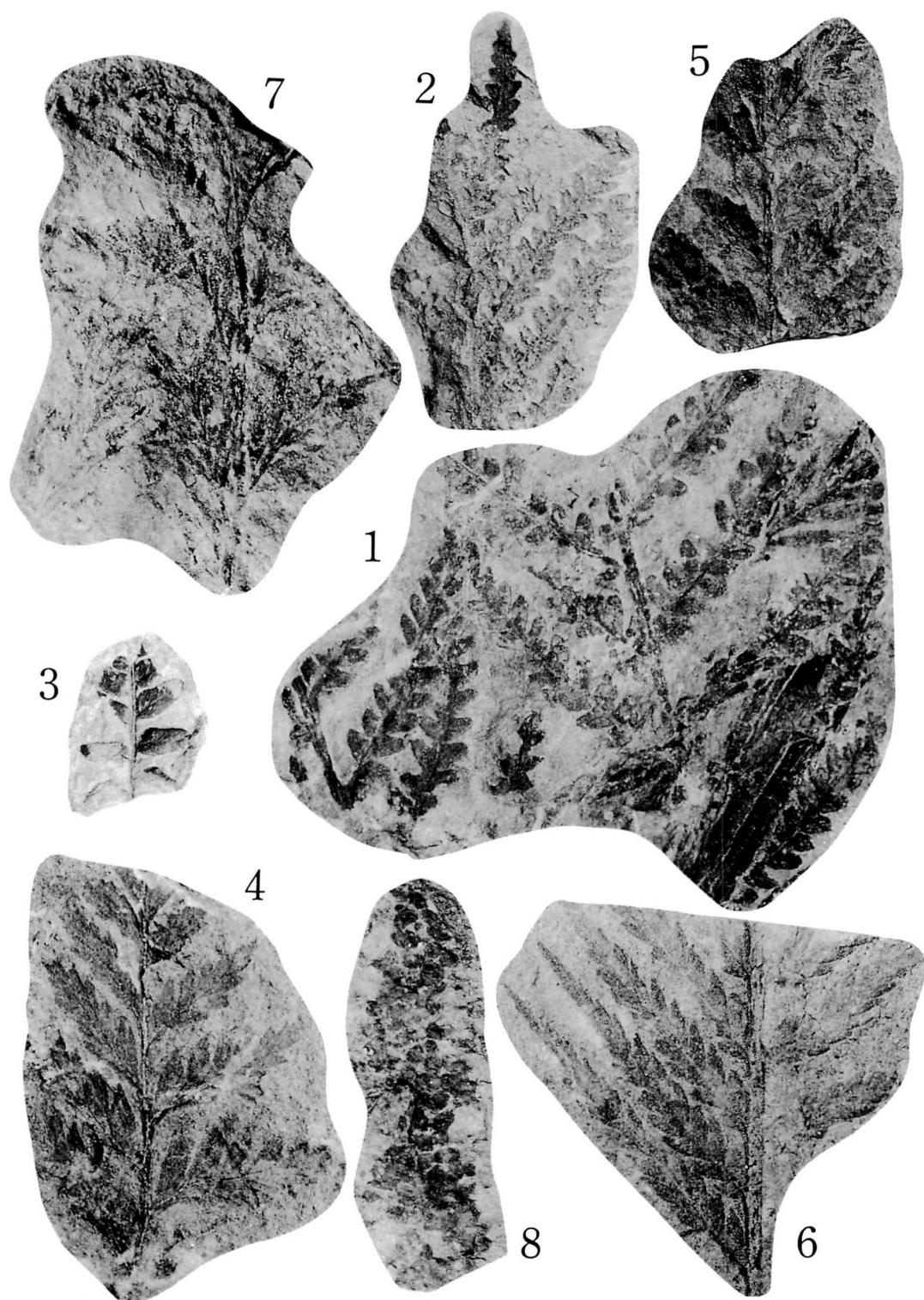
日本内帯福井県産前期白亜紀後期植物化石: 石徹白層群の最上位部は凝灰岩・砂岩・頁岩の互層からなり、模式地では北谷層と命名されている。北谷層はネオコミアン上部と考えられている赤岩層を整合に被い、上部白亜系の大道谷層により不整合に被われる。北谷層相当層は田茂谷上流、打波川および石徹白川上流地域に分布し、その植物群は田茂谷植物群と命名された (KIMURA, 1975)。今回、石徹白川上流地域の北谷層相当層である知那洞谷層から、つぎの植物種を識別したのでここに記載、報告する。Cfr. *Osmundopsis efimoviae*, ? *Osmunda* sp., *Gleichenites nipponensis*, *Coniopteris* cfr. *arctica*, *Birisia onychioides*, *Asplenium dicksonianum*, *Onychiopsis elongata*, *Podozamites eichwaldii*, Coniferae sp.

田茂谷植物群の組成は以上を加え22種となった。田茂谷植物群に関する資料は未だ乏しいため多くを述べることはできないが、日本内帯において、被子植物を含まない最新の植物群であり、またシダが優勢で、ゼンマイに似たシダをはじめ、*Coniopteris* cfr. *arctica*, *Asplenium dicksonianum*, *Arctopteris* などの新期型のシダを含む。

田茂谷植物群は、その組成から VAKHRAMEEV のいうシベリア植物地理区の同時期の植物群により近縁であり、同時期の日本外帯のいわゆる Wealden 型の植物群の組成とは著しく異なる。
木村達明・堀内順治

Explanation of Plate 1

- Figs. 1, 2. Cfr. *Osumundopsis efimoviae* SAMYLINA (Fig. 1; CH-016, Fig. 2; CH-048), ×2.
 Fig. 3. ? *Osmunda* sp. (CH-006), ×2.
 Figs. 4, 5. *Coniopteris* cfr. *arctica* (PRYNADA) SAMYLINA (Fig. 4; CH-053, Fig. 5; CH-056), ×2.
 Fig. 6. *Birisia onychioides* (VASSILEVSKAJA & KARA-MURSA) SAMYLINA (CH-063), ×2.
 Fig. 7. *Asplenium dicksonianum* HEER (CH-028), ×2.
 Fig. 8. Coniferae sp. (cone?) (CH-038), ×1.



699. OCCURRENCE OF CRETACEOUS SHALLOW-SEA BIVALVES
FROM THE NORTHERN BORDER OF SHIMANTO TERRAIN,
KII PENINSULA, SOUTHWEST JAPAN*

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Abstract. Bivalve fossils collected from the northern border of the Shimanto Terrain are characterised by shallow marine species, such as *Spondylus* aff. *decoratus*, *Plicatula* aff. *hanaii*, *Amphidonte* cf. *subhaliotoidea*, *Rastellum*? sp., *Ostrea* sp. and others, the age of which is considered to be early Cretaceous. The fossil-bearing sandstones also show a shallow shelf environment, while the surrounding sandstones indicate turbidity current origin under bathyal environment. The presence of shallow-sea sediments among the turbidite sequence is explained by sea-level change and not by submarine slide of the shallow-sea sediments.

Introduction and acknowledgments

The Shimanto Terrain represents one of the major geosynclinal belts in Japan, extending along the Pacific coast of Central and West Japan and ranging from late Jurassic to earliest Miocene in age. In Kii Peninsula it is divided into two belts, namely, the northern Hidakagawa belt occupied by the late Mesozoic Hidakagawa Group and the southern Muro belt made of the Paleogene to earliest Miocene Muro Group. The former consists mainly of flysch-like alternations and shales intercalated with cherts, conglomerates, submarine basic rocks, and acid tuffs. Very few fossils have been discovered so far. Only *Inoceramus* cf. *amakusensis* NAGAO and MATSUMOTO, *I.* cf. *cycloides* WEGNER, and *I.* cf. *ezoensis* YOKOYAMA have been described, which indicate the late Urakawan (=Santonian) age (MOROZUMI, 1970).

* Received Oct. 6, 1978; read Jan. 20, 1978 at the Annual Meeting of 1978 at Kyoto.

HASHIMOTO (1968, 1970) reported the occurrence of several late Cretaceous bivalves belonging to *Acila*, *Mesosacella*, *Nanonavis*, *Inoceramus*, and *Periploma*, and NOHDA (1966, MS) collected *Inoceramus concentricus costatus* NAGAO and MATSUMOTO of early Gyliakian (=Cenomanian) age. Very recently NAKAJO (oral comm.) distinguished early Cretaceous and latest Jurassic-earliest Cretaceous radiolarian assemblages in chert. All of these fossils have not been described yet, however. In the present article the authors will describe newly discovered bivalves of very shallow-sea origin and discuss the sedimentological significance.

The authors take this opportunity to express their cordial thanks to the members of the Kishu Shimanto Research Group for their help in sampling fossils and to Dr. N. YAMAGIWA of Osaka University of Education for his identification of corals. Dr. I. HAYAMI of the University of Tokyo and Dr. A. MATSU-

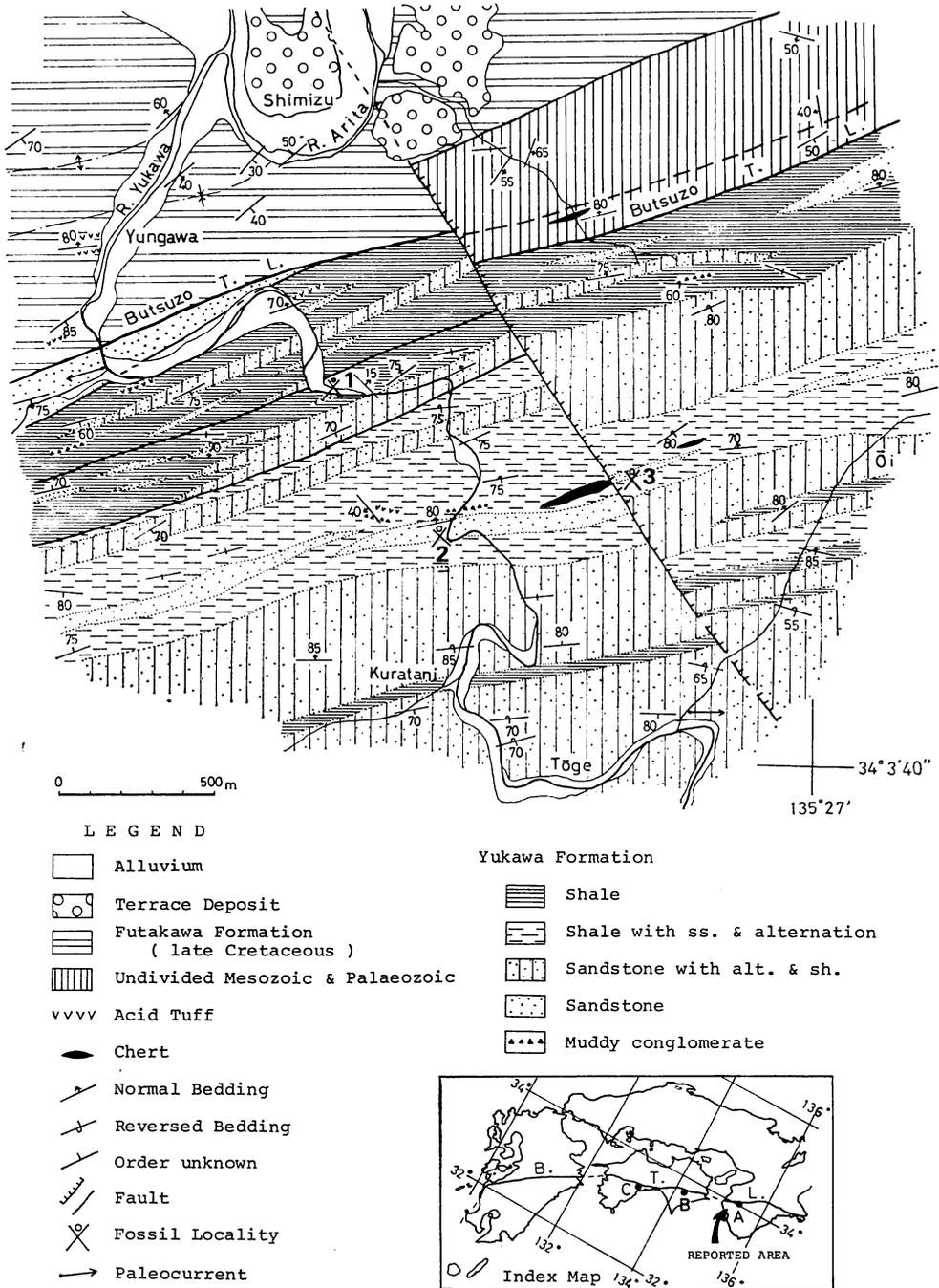


Figure 1. Index map (lower right) and geological map around fossil locality.
A: Shimizu, B: Nonoshiri, C: Doganaro

KUMA of Kyushu University gave the senior author facilities in examining the allied species kept at their universities. Thanks are due to these gentlemen.

Geological note and age-assignment

The Hidakagawa belt is bordered with the Chichibu belt on the north by the Butsujo Tectonic Line. The Hidakagawa Group constituting the former belt in the central Kii Peninsula is divided from north to south into four formations, namely, the Yukawa, the Miyama, the Ryujin, and the Nyunokawa Formations (NAKAZAWA, 1973; KISHU SHIMANTO RESEARCH GROUP, 1975). The Yukawa Formation is in fault contact with the Miyama Formation which overlies conformably the Ryujin Formation. It consists mainly of bedded sandstones, flysch-like alternations, and shales with a small amount of acid tuff, lenticular chert, and conglomerate in the surveyed area. The beds have a general strike of E-W direction dipping to north or south at steep angle (45° to 90°). North-dipping strata show a normal order while south-dipping ones are reversed, and therefore, the structure is as a whole simple, becoming younger to the north, although several strike- and oblique faults are observed (Fig. 1).

Early Gyliakian *Inoceramus concenticus costatus* was once collected by NOHDA from shale in the northern part (Fig. 1, loc. 1).

The fossils under consideration are contained in medium- to coarse-grained sandstones in the middle part at about 3 km upper stream of the R. YUKAWA from SHIMIZU (Fig. 1, loc. 2). Fragmental shells were also found in its eastern extension (Fig. 1, loc. 3). These fossils are identified as in Table 1.

It is interesting to note that most of these fossils show characteristics of a very shallow sea environment, having thick, sessile shells which are frequently burrowed by other organisms. Three bivalve species, *Spondylus decoratus*, *Amphidonte subhalioidea*, and *Plicatula hanaii*, allied to the present materials were all described from the Miyako Group in Northeast Japan, the type of the Miyakoan (Aptian-Albian). The subgenus *Rastellum* (*Rastellum*) ranges from Middle Jurassic to Late Cretaceous and *Rastellum* (*Arctostrea*) is confined to Late Albian-Early Cenomanian in age (STENZEL, 1971). According to Dr. YAMAGIWA, associating corals belong to *Calamophyllia* and are most similar to the Alpine *C. schmidti* (KOBY) of Neocomian age. Judging from these fossils mentioned above, the fossil-bearing sand-

Table 1. List of fossils and the occurrence of the allied species.

species	occurrence of allied species
<i>Spondylus</i> sp. aff. <i>decoratus</i>	Lower Miyako Group (Aptian)
<i>Amphidonte</i> sp. cf. <i>subhalioidea</i>	Miyako Group (Aptian-Albian), Inubo Formation (Aptian), Doganaro Formation (Aptian-Albian)
<i>Plicatula</i> sp. aff. <i>hanaii</i>	Miyako Group (Aptian-Albian)
<i>Ostrea</i> sp. ind.	
<i>Rastellum</i> ? (s.l.) sp. ind.	
<i>Astarte</i> ? sp. ind.	
Bivalvia, gen. et sp. nov. ind.	
<i>Calamophyllia</i> sp. ind.	<i>C. schmidti</i> (KOBY), Neocomian, Alps

stones are assigned to be early Cretaceous and consequently earlier than the *Inoceramus*-bearing shales in this region. This accords with the stratigraphic succession.

In addition to these fossils, an incomplete shell of *Spiriferina*-like brachiopod has been collected from Loc. 3 in association with Cretaceous fossils. This may be a secondarily derived fossil.

Sedimentological consideration

The studied area is composed mostly of bedded sandstones, sandy alternations,

and shales as already stated. Muddy conglomerate or pebbly siltstone, thin acid tuff, and lenticular chert are also found. Sandstones are usually thick-bedded and massive, but graded texture and flute casts on the sole surface are often observed, suggesting the turbidity current origin of these sandstones. Bedded sandstones and sandy alternations around fossil locality are, therefore, considered to have been deposited at proximal site of turbidite deposition. This is supported by grain-size distribution of sandstones as will be stated later. In spite of such environment the fossil as-

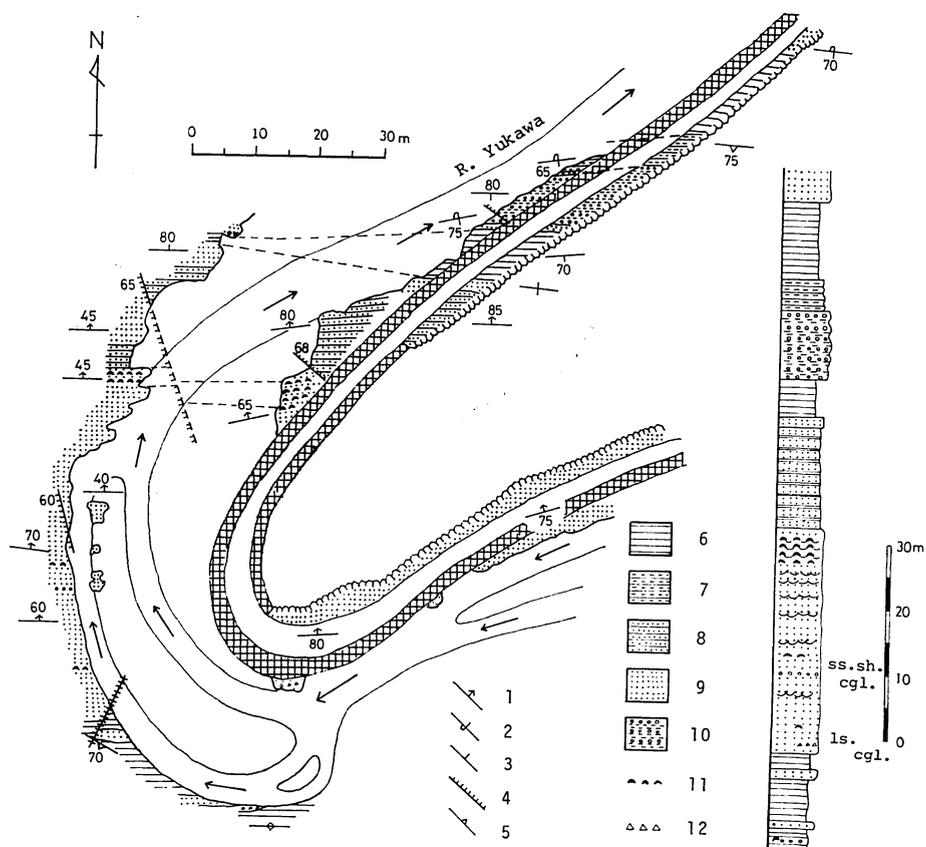


Figure 2. Route map and columnar section near fossil locality. 1: strike and dip, normal, 2: reversed, 3: unknown, 4: fault, 5: fissility, 6: shale, 7: laminated shale with sandstone, 8: bedded sandstone with shaly parting, 9: sandstone, 10: muddy conglomerate or pebbly siltstone, 11: fossil, 12: subangular pebble conglomerate.

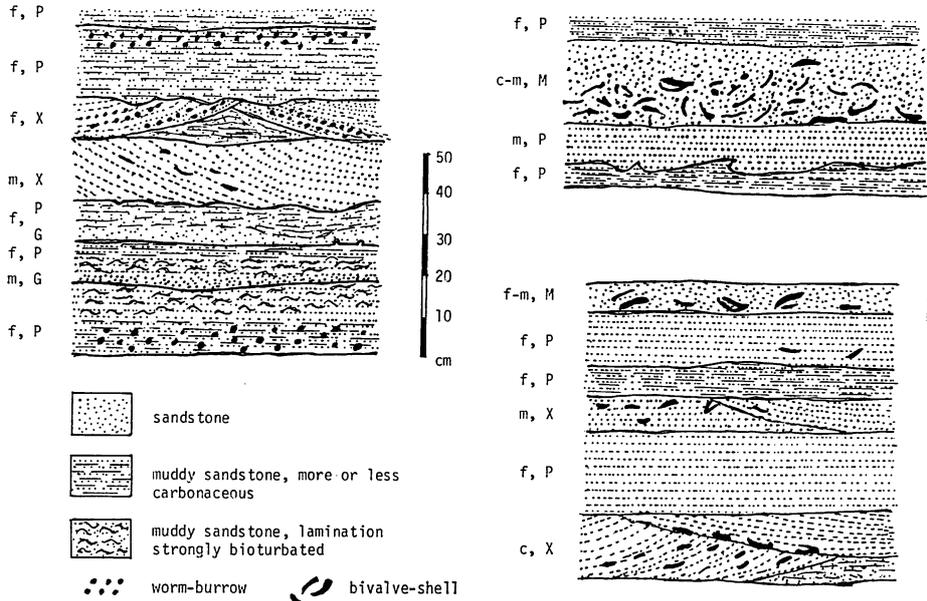


Figure 3. Sketch showing sedimentary structures and fossil occurrence.

c: coarse-, m: medium-, f: fine-grained sandstone, P: parallel-laminated, X: cross-laminated, G: graded.

semblage shows a very shallow habitat, and detailed survey was done around the fossil locality, paying special attention to the sedimentological features (Figs. 2 and 3).

Fossil-bearing sandstone beds are 35 m thick along the R. YUKAWA and in beds 10-60 cm thick. It is traceable laterally over 1 km, conformably overlying fissile shales and is graded into bedded sandstones with shale parting. The latter is in turn covered by black laminated sandy shales, black shales, and muddy conglomerates or pebbly siltstones. The conglomerates contain round to subangular pebbles of sandstone surrounded by sandy mud matrix, presumably formed by submarine slumping.

The fossil-bearing sandstone beds are intercalated with lenticular conglomerates at two horizons; one contains many limestone pebbles of round to

irregular shape and the other shale and sandstone clasts. Trough- and wedge-shape cross lamination and parallel lamination are common throughout. Shells are crowded in the uppermost part of the beds, sometimes making cross laminae (Fig. 3). Coarse-grained, fossil-bearing portion contains angular fragments of highly carbonaceous black shale of various sizes. Worm-burrows are especially abundant in muddy part and muddy laminae arranged parallel or oblique to the bedding plane. These sedimentary features indicate a high energy condition of flow regime under shallow environment.

Composition of sandstones is essentially not different between fossil-bearing sandstones and the surrounding turbiditic ones (Fig. 4), all plotted within a compositional area of Cretaceous sandstones in other regions of the Hidakagawa belt

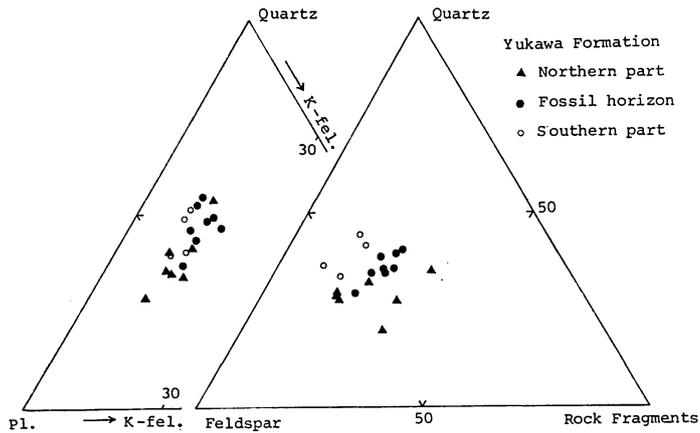
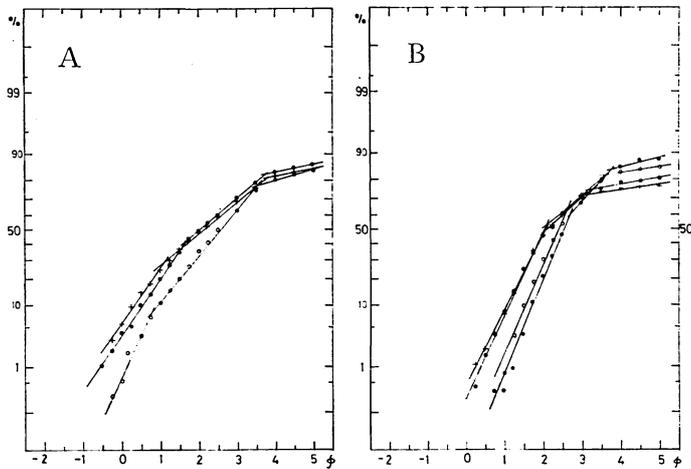


Figure 4. Triangular diagram showing composition of sandstone.

Figure 5. Cumulative curves on log-probability scale graph.
A: turbiditic sandstones, B: sandstones of fossil horizon.

(KISHU SHIMANTO RESEARCH GROUP, 1977), and clearly distinguished from that of the Paleogene Muro Group in less amount of quartz and larger amount of rock fragments. It also resembles that of the Cretaceous Hinodani Formation (KUMON, 1976, MS) and the Hayama Formation (MIYAMOTO, 1976) in Shikoku. There is a tendency in this area that rock fragments increase from south to north (Fig. 4, right).

On the other hand, grain-size analysis under microscope shows a different sedimentary mechanism between the two. Cumulative curves of the fossil-bearing sandstones plotted on log-probability scale graph (Fig. 5) indicate that distribution curves consist of two major segments with a small transitional part, which represent suspension population and well-sorted saltation population. Such distribution pattern is somewhat

similar to that of ancient fluvial sandstones or channel sands of VISHER (1969), although the latter usually lacks transitional part. Contrarily to this, the turbiditic sandstones consist of rather poorly sorted three populations and the distribution curves are not comparable to any shape of recent sediments studied by VISHER (1969). He included such type in the miscellaneous curve shapes and suggested debris flow origin. According to VISHER turbidity current sediments consist of two populations only, namely, ill-sorted saltation population and suspension population. However, similar pattern to the present sandstones is frequently found in the typical turbidite sandstones of the Cretaceous rocks in Shikoku (KUMON, unpublished data) and the Miocene Kumano Group in Kii Peninsula (HISATOMI, unpublished data), especially in coarse-grained ones. It is probable that this pattern of grain-size distribution represents another distribution shape of turbidity current sediments.

All of these sedimentological data stated above strongly suggest different sedimentary environments between the fossil beds and the surrounding ones, that is, a shallow shelf environment of the former and bathyal one of the latter. How, then, can be explained such a shallow sediment intercalation among the turbidite sequence? There is no disturbance even at the contact of the sandstone beds with the underlying shaly beds. This favours a continuous sedimentation of the sandstones on the shales rather than submarine sliding.

In this connection, it should be mentioned that in the Chichibu belt immediately north of this area, the late Urakawan (\approx Santonian) Futakawa Formation directly overlies the so-called Paleozoic beds with a remarkable clinounconformity, lacking the lower Cretaceous

and Jurassic rocks in between (HIRAYAMA and TANAKA, 1956; SAKA, 1968). This fact means that the sea coast must have been situated close to the Butsozu Tectonic Line in the early Cretaceous time. In other words the fossil locality was very near the sea coast (Fig. 6B). Direction of trough-type cross lamination indicates the supply of the sediments from the north. Predominance of proximal turbidite facies of this area also suggests a relatively shallow environment in the geosynclinal sea. Consequently, it is possible that a shelf condition was locally generated due to relative sea-level change,

Overlying shaly beds with slump conglomerates may be a proof of rapid deepening of the sea after the deposition of the fossil-bearing beds. A huge lenticular body of chert, about 30 m thick and more than 200 m long, is found in the eastern extension of the slump conglomerate horizon. The very contact with the surrounding rocks is difficult to be examined owing to thick cover of chert debris, but a small exposure of the lower surface of another chert lens is wavy and the underlying shale containing small blocks of sandstone is a little disturbed. The chert mass may be an exotic block derived presumably from the Chichibu belt. It contains spherical radiolarian remains, but unfortunately, the preservation is too bad for age determination.

Lastly, it is noticeable that shallow marine faunas of similar age to this area are found near the northern border of the Shimanto Terrain not only in this area but also in Shikoku, such as the Miyakoan Doganaro fauna of Kochi Prefecture (HAYAMI and KAWASAWA, 1967) and the lower Cretaceous (Neocomian?) fauna of Nonoshiri, Tokushima Prefecture (SHINOAKE, 1958) (see Fig. 1,

index map).

Systematic description

(by K. NAKAZAWA)

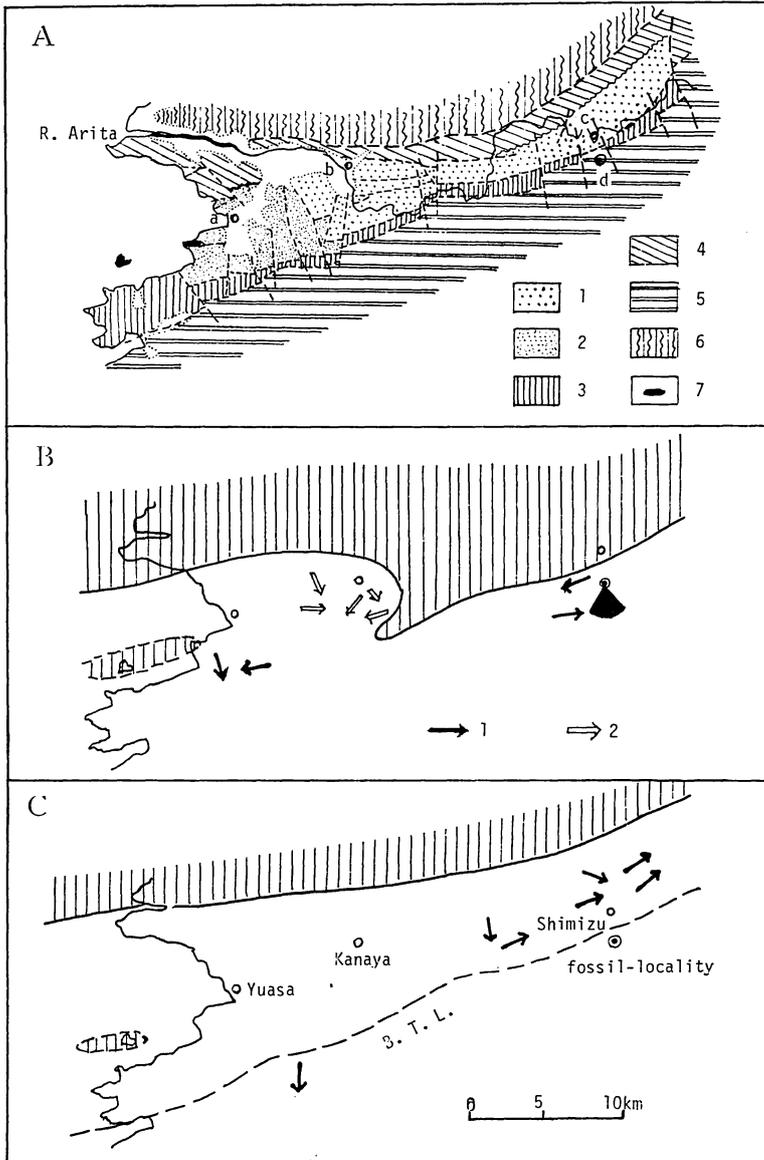
Order Pterioida NEWELL, 1965

Superfamily Pectinacea

RAFINESQUE, 1815

Family Spondylidae GRAY, 1826

Genus *Spondylus* LINNÉ, 1758



Spondylus (*Spondylus*) sp. aff. *S.*
decoratus NAGAO, 1934

Plate 2, Figures 1-6

Compare:—

1934. *Spondylus decoratus* NAGAO, p. 210, pl. 27, figs. 2, 5-7.
1934. *Spondylus* sp. aff. *decoratus*: NAGAO, p. 211, pl. 27, fig. 8.
1965a. *Spondylus decoratus*: HAYAMI, p. 324, pl. 47, figs. 4-9; pl. 52, fig. 1.
1975. *Spondylus* (*Spondylus*) *decoratus*: HAYAMI, p. 84, pl. 3, figs. 11, 12.

Description:—Shell medium in size, suboval, a little inaequilateral, inaequivalve, extended posteroventrally. Left valve moderately inflated, slightly prosocline, a little higher than long, hinge length short, posterodorsal margin longer than anterodorsal one; umbo pointed, orthogyrate, a little salient above hinge margin having apical angle of about 90°; hinge consisting of two, stout, granular cardinal teeth intervened with two subcircular cardinal sockets which have a narrow resilifer pit in between, bordered by ridge-like projection on both sides; cardinal area amphidetic, obtusely triangular; surface sculptured with numerous radial ribs, primary ones six or seven in number, more or less stronger than

secondaries, which amount 4-7 in each interspace between primaries, and in some cases provided with irregularly spaced short spines. Right valve only a part of ventral margin being preserved, ornamented by concentric costae.

Remarks and comparison:—Most of the materials are represented by left valve, and the exact comparison with known species is difficult.

Strength of primary ribs of left valve is fairly variable; in many specimens not so broader than secondaries and provided with no spines, but some have relatively wide primaries with short spines (Pl. 1, Fig. 4).

There are known four species belonging to *Spondylus* in the Mesozoic in Japan, namely Aptian *S. decoratus* NAGAO, 1934 of the Miyako Group in northeast Japan, Santonian *S. pseudocalcaratus* TASHIRO, 1976 and *S.* sp. (TASHIRO, 1976) of the Himenoura Group in Kyushu, and the Upper Cretaceous *S. amanoi* HAYAMI, 1975 (= *S. japonicus* AMANO and MARUI, 1958) in Central Japan. The present species is distinguished from *S. amanoi* in much smaller size, less numerous radial ribs in the left valve, and weaker concentric sculpture in the right valve. *S. pseudocalcaratus* differs from this species in more de-

Figure 6. Generalized geological map and paleogeography

A. Geological map of Yuasa-Shimizu area.

1: Upper Cretaceous, 2: Lower Cretaceous, 3: Upper Paleozoic to Jurassic, 4: Upper Paleozoic and Triassic, 5: Hidakagawa Group (Cretaceous) of Shimanto Supergroup, 6: Sambagawa metamorphic rocks, 7: Kurosegawa complex (Silurian and pre-Silurian), a: Yuasa, b: Kana-ya, c: Shimizu (Modified from TANAKA, 1974).

B. Paleogeography and paleocurrent direction of Miyakoan-Early Urakawan stage.

- 1: paleocurrent direction of Miyakoan-Gyliakian,
2: paleocurrent direction of Early Urakawan.
(Data added to those of TANAKA, 1974)

C. Paleogeography and paleocurrent direction of Late Urakawan stage.

B. T. L.: Butsuzo Tectonic Line.
(Paleocurrent data after TANAKA, 1974)

veloped primary ribs in the less convex left valve and stronger concentric ornaments in the right. In general outline and ornamentation, it is most allied to *S. decoratus* which has some resemblance with the early Cretaceous *S. roemeri* DESHAYES, 1842 and *S. gibbosus* D'ORBIGNY, 1847 of west Europe, but slightly differs in less developed primary ribs.

Nearly complete shell is 50 mm long, 58.5 mm high, 16 mm deep and has L/H = 0.85. Umbo lies at about 27 mm behind anterior end, that is, a little anterior to the middle of shell.

Family Plicatulidae WATSON, 1930

Genus *Plicatula* LAMARCK, 1801

Plicatula sp. aff. *P. hanaii* HAYAMI, 1965

Plate 3, Figures 5-7

Compare:—

1965a. *Plicatula hanaii* HAYAMI, p. 322, pl. 47, figs. 1-3.

Description:—Shell medium in size, a little inaequilateral, inaequivalve, variable in shape but usually ovate; higher than long, ranging from 24 to 45 mm in length and from 34 mm to 50 mm in height; hinge consisting of two divergent cardinal teeth in each valve, intervening a resilifer pit at the center of hinge plate, that of left valve bounded by ridges on both sides; posterior adductor muscle scar large, circular, lying a little posterior to the middle of shell, anterior one not observed; left valve more convex than the right, consisting of inflated umbonal half and less convex ventral part, the latter of which is sculptured with eleven, weak radial ribs arranged at wide interval; right valve nearly flat, sculptured with irregular radial ribs

broader than those of left valve and very weakly nodose.

Remarks and comparison:—Shell is fairly thick being about 5 mm and in some cases bored by organisms. Convex umbonal half of left valve is considered to correspond to attachment area of right valve judged from the recent species. In Japan one Triassic species of *Plicatula* (*P. hekiensis* NAKAZAWA, 1955), five Jurassic species (*praenipponica* HAYAMI, *dichotomocosta* TAMURA, aff. *dichotomocosta* TAMURA, *subcircularis* HAYAMI and *yatsujiensis* TAMURA) and two Cretaceous ones (*kiiensis* HAYAMI and *hanaii* HAYAMI) have been described. Among them *P. kiiensis*, *P. praenipponica*, *P. dichotomocosta* and *P. aff. dichotomocosta* are easily distinguished from the present species in close-set, strong radial ribs. *P. hekiensis* and *P. subcircularis* also differ in spinose reticulate surface sculpture.

Plicatula hanaii, though only left valve is known, is very similar to this species in shape, size and hinge character, but differs from the latter in having central crenulation and smaller size. Further comparison is impossible due to the lack of right valve of *hanaii*.

Measurements:—

valve	length	height	L/H	depth
Right	24.0	34.0	0.71	—
Left	37.0	50.0	0.74	9.5
Left	27.0	40.0	0.69	—
Left	45.0	39.5	1.13	—

Plicatula sp. ind.

Plate 3, Figure 8

There is a left internal mold which considerably differs in outline from the preceding species. Shell is roundly crescent, extending posteriorly. Hinge is of

Plicatula-type. It is not certain whether this is a varietal form of the preceding species or not.

Superfamily Ostreacea
RAFINESQUE, 1815

Family Ostreidae RAFINESQUE, 1815

Genus *Ostrea* LINNÉ, 1758

Ostrea sp. ind

Plate 3, Figures 9, 12

A complete left internal mold and several incomplete shells are observable. A complete one shows suboval outline meridionally elongated and gently inflated. Ligament area is relatively narrow provided with a shallow, wide, indistinct ligament pit. Presence of radial ribs in left valve is suggested by plication along posterior margin. Right valve is nearly flat, sculptured with concentric costae only. Identification is difficult due to poor materials.

Genus *Rastellum* FAUJAS-SAINT-FOND, 1799

Rastellum? s. l. sp. ind.

Plate 2, Figure 7

Only a convex marginal part of strongly plicated shell is at hand. It is very difficult to determine even generically based on such fragmentary specimen. However, the characteristic plication of the shell margin reminds one of that seen in strongly plicated oysters, such as *Rastellum* s. s. or its subgenus *Arctostrea*, and the species is tentatively referred to *Rastellum* s. l.

Family Gryphaeidae VYALOV, 1936

Subfamily Exogyrinae VYALOV, 1936

Genus *Amphidonte* FISCHER DE
WALDHEIM, 1829

Subgenus *Amphidonte* FISCHER DE
WALDHEIM, 1829

Amphidonte (*Amphidonte*) sp. cf. *A.*
subhaliotoidea (NAGAO)

Plate 3, Figures 1-4

Compare:—

1934. *Exogyra subhaliotoidea* NAGAO, p. 203, pl. 30, figs. 1-4.
1965a. *Amphidonte* (*Amphidonte*) *subhaliotoidea*: HAYAMI, p. 343, pl. 50, figs. 6-9; pl. 51, figs. 1, 2.
1967. *Amphidonte* (*Amphidonte*) *subhaliotoidea*: HAYAMI and KAWASAWA, p. 78, pl. 9, fig. 5.
1972. *Amphidonte* (*Amphidonte*) *subhaliotoidea*: SHIKAMA and SUZUKI, pl. 5, figs. 10-14.

Description:—Shell relatively small, suboval, inaequivalve, inaequilateral, spirogyrate backward, higher than long, test fairly thick, provided with no radial ornament. Left valve moderately inflated having sharply rounded spiral keel along anterior margin which is broadly rounded; posterior margin nearly straight or a little arcuate with concave side backward, not raised; umbonal portion not well preserved, ligament area relatively short, elongated along dorsal margin forming shallow groove. Right valve a little inflated along weak, rounded spiral keel and nearly flat in posterior part; ligament area short and almost flat; anterior margin well rounded, posterior margin weakly curved with convex side backward; adductor scar being large and ovate lying a little posterior to the middle of shell.

Comparison:—The described species is

most allied to *Amphidonte* (*Amphidonte*) *subhalotoidea* (NAGAO) reported from the Miyako Group, the Inubo Formation of Choshi Group and from the Lower Cretaceous in Shikoku, which is only one known species of *Amphidonte* s. s. in Japan, but slightly differs from the latter in smaller size and absence of chomata along shell margin.

Order Veneroida ADAMS and
ADAMS, 1856

Superfamily Crassatellacea
FERUSSAC, 1882

Family Astartidae D'ORBIGNY, 1884

Genus *Astarte* SOWERBY, 1816

Astarte? sp. ind.

Plate 3, Figure 13

The present species is represented by a left internal mold which preserves impressions of a trigonal cardinal tooth and a socket. It is suboval in shape, 25.0 mm long, 21.0 mm high and 6.5 mm deep in the internal mold and has minute crenulation along the margin and a sub-circular posterior adductor muscle scar at posterodorsal position of the shell interior. It is difficult to determine even generically, because of poor preser-

vation of the hinge. However, this species may belong to the genus *Astarte* in general outline and marginal crenulation. It is similar to *Astarte* aff. *shinanoensis* YABE and NAGAO described by HAYAMI (1965b, p. 94, pl. 9, fig. 1; pl. 14, fig. 9) from the upper Neocomian Hanoura Formation in Shikoku and *A. akatsui* HAYAMI (1965b, p. 95, pl. 9, figs. 2-5; pl. 14, figs. 10, 11) of the Albian Yatsushiro Formation in Kyushu in transversely elongate form and mode of crenulation.

Systematic position uncertain

Bivalvia, gen. et sp. nov. ind.

Plate 3, Figure 11

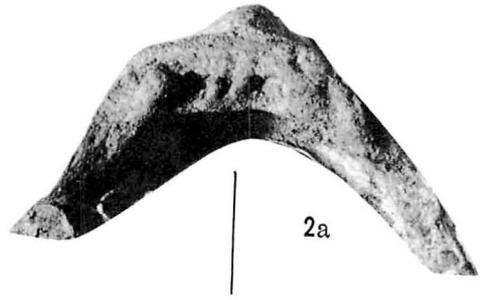
This unique bivalve is represented by a left internal mold with external mold of marginal part. Shell is suboval in shape, 37.0 mm long, 45.0 mm high and 14.0 mm deep with thick test reaching at least 10 mm near the margin. Surface is covered by relatively strong growth-lines of irregular strength. Hinge consists of two cardinal teeth, two cardinal sockets and a large socket-like depression along the posterodorsal margin. Anterior cardinal tooth is stout, trigonal and pointed; posterior one strong and elongate. Cardinal sockets are trigonal and deep, each situated anterior to the cardinal tooth respectively. Socket-like

Explanation of Plate 2

- 1-6. *Spondylus* sp. aff. *S. decoratus* NAGAO
 1. External gypsum cast of left valve, JM. 11294.
 2. Rubber-compound cast of left valve, 2a: hinge area, 2b: dorsal view, JM. 11295.
 3. External gypsum cast of left valve, 3a: side view, 3b: anterior view, JM. 11296.
 4. External rubber-compound cast of left valve, JM. 11297.
 5. External mold of left valve (5a) and the rubber-compound cast (5b), JM. 11298.
 6. External gypsum cast of marginal part of right valve, JM. 11296.
 7. *Rastellum?* s.l. sp. ind., external gypsum cast, JM. 11299.
 (All in natural size. Photo by K. NAKAZAWA.)



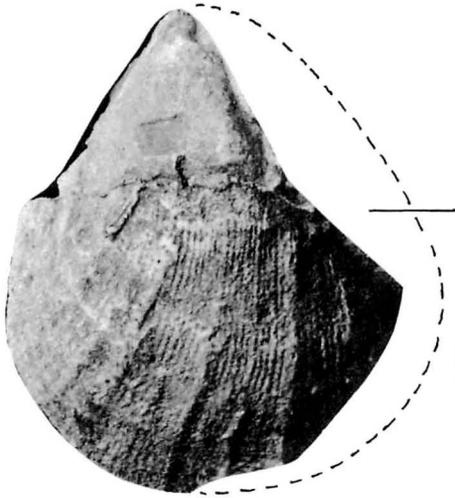
1



2a



2b



3a



3b



4



7a



7b



6



5a



5b

depression is large and elongate-oval, sculptured with vertical crenulation. It is not certain whether this is a real socket receiving a tooth of the opposite valve or not, because of its peculiar shape and serration. If this is a ligamental recess, ligament is internal. Lateral tooth or socket is seemingly lacking and, if present, completely reduced. Posterior adductor muscle scar is subcircular, large, situated at the middle of posterior half of the shell; anterior one is considered to be small, lying close to the anterior cardinal socket.

The thick and tall shell provided with robust cardinal teeth and sockets remind one of some megalodontid species, such as *Neomegalodon* GUEMBEL, 1863, and *Pachymegalodon* GUEMBEL, 1862, but the hinge characters and mode of muscle scar are different. *Megapraeonia* CHAVAN, 1952 of veneroids is somewhat similar to the present species in outline, thick shell, and strong dentition, but also distinguishable in musculature and dental formula. No comparable species could be found. More materials are required for full description and comparison.

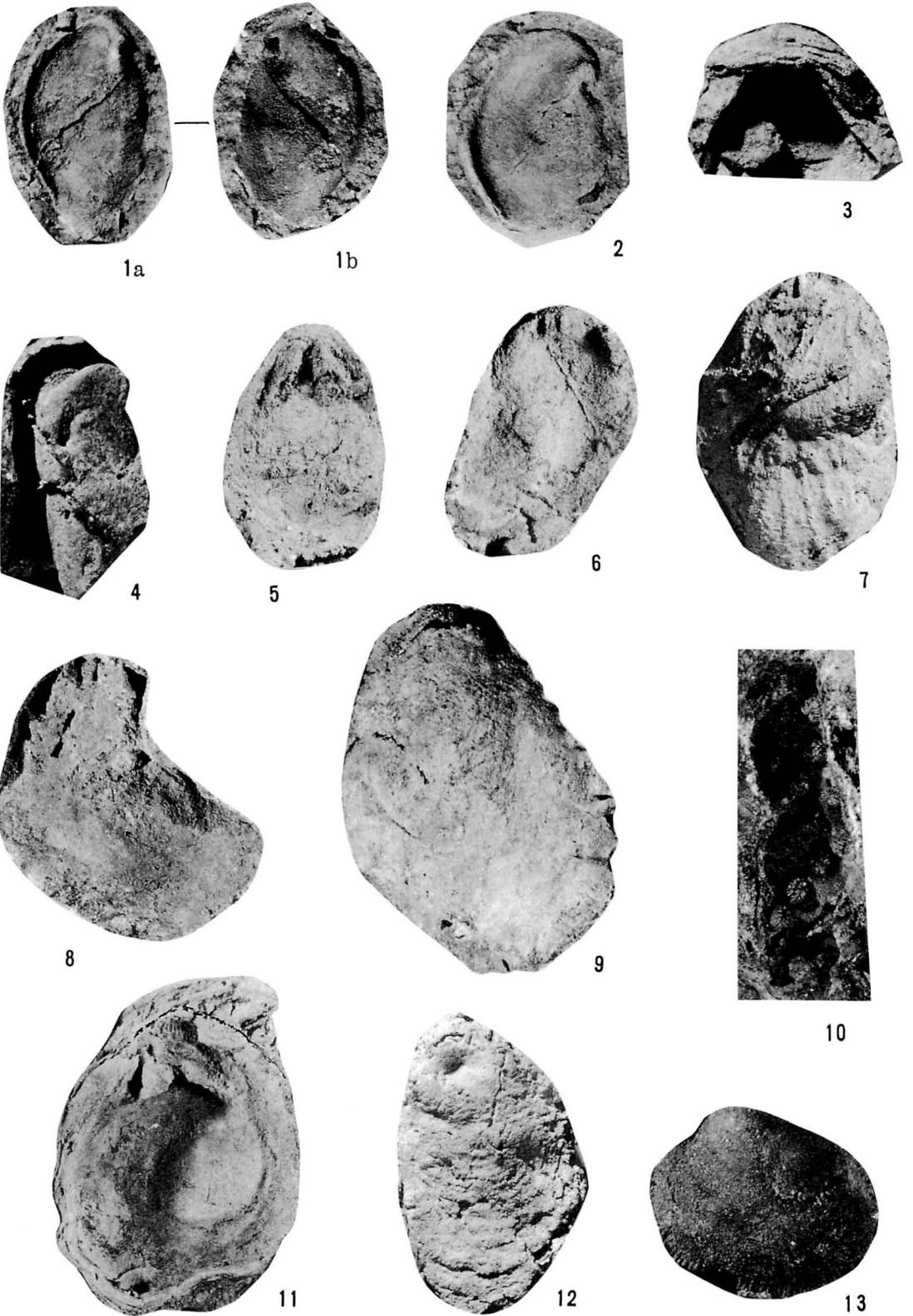
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Explanation of Plate 3

- 1-4. *Amphidonte* (*Amphidonte*) sp. cf. *A. subhalioidea* (NAGAO)
 1. Internal mold (1a) and the gypsum cast (1b), JM. 11300.
 2. Internal gypsum cast of right valve JM. 11301.
 3. Rubber-compound cast of right valve, showing umbonal part, $\times 1.5$, JM. 11302.
 4. Internal mold of right valve, $\times 1.5$, JM. 11303.
 - 5-7. *Plicatula* sp. aff. *P. hanaii* HAYAMI
 5. Internal gypsum cast of right valve, JM. 11304.
 6. Internal rubber-compound cast of left valve, JM. 11305.
 7. External rubber-compound cast of right valve, JM. 11306.
 8. *Plicatula* sp. ind., left internal mold, JM. 11307.
 - 9, 12. *Ostrea* sp. ind.
 9. Left internal mold, JM. 11308.
 12. External rubber-compound cast of right valve, JM. 11309.
 10. *Calamophyllia* sp. ind., internal and external molds, $\times 1.5$.
 11. *Bivalvia*, gen. et sp. nov. ind., internal rubber-compound cast of right valve with other shell, JM. 11310.
 13. *Astarte*? sp. ind., right internal mold, $\times 1.5$ JM. 11311.
- (All in natural size excepting Figs. 3, 4, 10 and 13. Photo by K. NAKAZAWA)



Doganaro 堂々奈路, Nonoshiri 野々尻, Kanaya 金屋, Kuratani 倉谷, Shimizu 清水,
Yuasa 湯浅, Yukawa 湯川, Yungawa 湯子川

西南日本, 紀伊半島四万十帯北縁より白亜紀浅海性二枚貝の産出: 和歌山県清水町の湯川川下流, 湯川層砂岩より *Spondylus* aff. *decoratus*, *Plicatula* aff. *hanaii*, *Amphidonte* cf. *subhaliotoidea*, *Ostrea* sp. などの二枚貝や, さんご *Camalophyllia* sp. が発見された。二枚貝は宮古統のものに類似し, 時代は古白亜紀とみなされる。厚殻, 付着, 固着性の二枚貝を主体とし, ごく浅い海的环境を示している。これは砂岩の堆積学的研究からも支持される。周囲はやや深い地向斜性の堆積層であるが, このような浅海性の地層の存在は, 海底地送りによるものではなく, 海水準の相対的变化によるものと結論した。

中沢圭二・公文富士夫・木村克己

700. NOTES ON *LEWESICERAS* AND *NOWAKITES* (PACHYDISCID AMMONITES) FROM THE CRETACEOUS OF HOKKAIDO*
(STUDIES OF THE CRETACEOUS AMMONITES FROM HOKKAIDO AND SAGHALIEN—XXXVI)

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Abstract. This is the first description of *Lewesiceras* and *Nowakites* from the Cretaceous of Hokkaido. It comprises four new species which are allied to *L. rhodanicum* (ROMAN and MAZELAN), *L. elmii* COLLIGNON, *N. lemarchandi* (DE GROS-SOUVRE) and *N. tallavignesi* (D'ORBIGNY), respectively. The reasons why these two genera are rare in Hokkaido are discussed in connexion with the evolutionary history of the family.

Introduction

Fossils belonging to the Pachydiscidae occur fairly commonly in the Upper Cretaceous of Japan and South Saghalien. They belong to the genera *Anapachydiscus*, *Eupachydiscus*, *Canadoceras*, *Patagiosites*, *Pachydiscus* and some bituberculate offshoots, *Menuites*, *Urakawites*, and *Teshioites* (MATSUMOTO, 1954a, 1955). They came mainly from the strata of Santonian to Maastrichtian ages. For some reasons little has been known from the Coniacian and older rocks. It was strange that no examples of *Lewesiceras* and *Nowakites* were reported from Japan, while they are fairly common in Europe and some other regions.

For years, I sought them in vain from the Cretaceous of Hokkaido. The present discovery happened unexpectedly, while I was collecting vascoceratid ammonites. Mr. Tsutomu SATO of Yubari kindly sent

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me, through Mr. Y. FUJISHIMA, an interesting vascoceratid ammonite from the Hobetsu area (MATSUMOTO and MURAMOTO, 1978) and, furthermore, gave an information to my inquiry by sending several associated specimens, in which I noticed an example of *Lewesiceras*. Mr. Yoshitaro KAWASHITA of Mikasa also kindly sent me an ammonite from the Ashibetsu area which he thought possibly a *Fagesia*. Actually this was not a vascoceratid but is another example of *Lewesiceras*.

An example of *Nowakites* has long been in Mr. Tatsuo MURAMOTO's collection, but is incompletely preserved. Another example of the same genus was in my own collection from the Yubari area, which was, however, erroneously listed as a species of *Mesopuzosia* (MATSUMOTO and HARADA, 1965, table 3).

On the basis of these specimens a systematic description is given below, with some remarks on the two genera.

Repositories of the described specimens

are Geological Survey, Hokkaido Colliery and Steamship Co., Yubari [HCS], Department of Geology, Kyushu University [GK], and other private collections which would eventually enter into certain museums.

Before going further, I thank Messrs. T. SATO, Y. KAWASHITA and T. MURAMOTO, who provided me with interesting specimens for this study. Drs. I. HAYAMI, H. HIRANO, K. TANABE, Messrs. H. HONDA, Y. FUJISHIMA and K. MURAMOTO helped me in various ways.

This is a contribution to the IGCP Project Mid-Cretaceous Events.

Systematic Description

Family Pachydiscidae SPATH, 1922

Genus *Lewesiceras* SPATH, 1939

Type-species:—*Ammonites peramplus* MANTELL, 1822

Diagnosis:—Shell moderate-sized to large, variably involute, with rounded or depressed whorl-section, but may be higher whorled in later stages. Periodic constrictions better marked on inner whorls, associated with major ribs and strong umbilical tubercles. Ribs of various length and strength, more or less projected on the venter, generally becoming weaker on the last part. Suture typically less deeply incised than in *Anapachydiscus*,

with rather massive elements; E of moderate length, tripartite long L, bipartite lateral saddles, small but erect U₂, descending auxiliaries, and narrow internal elements.

Discussion:—As WRIGHT (1957, p. L 377) has suggested, *Lewesiceras* is presumably a descendant of *Eopachydiscus*. I have seen a probable example of *Eopachydiscus* in Dr. SARKAR's collection from the Cenomanian of India, which can connect the range of the two genera.

The type-species and its allies are characterized by a comparatively less complex suture, as exemplified by that of *Lewesiceras sharpei* (SPATH) (see BILLINGHURST, 1927, fig. 2) (here drawn, Fig. 1) and that of *L. mantelli* WRIGHT and WRIGHT. These are undoubtedly distinguished from a finely and deeply incised suture of *Pachydiscus* ZITTEL (see REDTENBACHER, 1873, pl. 27, fig. 5a-c) or that of *Anapachydiscus* YABE and SHIMIZU (see YABE and SHIMIZU, 1921, pl. 9, fig. 2) or that of *Eupachydiscus* SPATH (see REDTENBACHER, 1873, pl. 29, fig. 1b). The stems of L and other elements are much narrowed in the latter group, whereas they are moderately broad in the former. There is, however, gradation in the degree of incisions between typical patterns. Certain species which have been assigned to *Lewesiceras*, such as "*L.*" *anapadense* (KOSSMAT) (1898, pl. 14, fig. 2) and *L. beantalyense* COLLIGNON

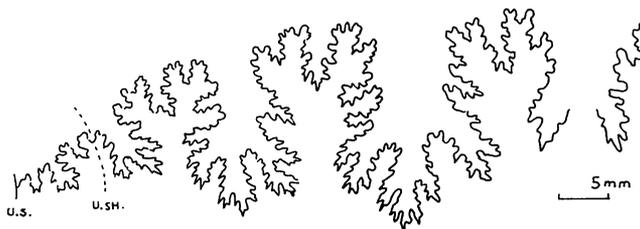


Fig. 1. External suture of *Lewesiceras sharpei* (SPATH). BM. C 32290 from Chalk Rock of England. (T. M. delin.)

(1955, pl. 2, fig. 3), have moderately deeply incised sutures.

The ribbing also varies between species. The type and the allied species of *Anapachydiscus* [*A. fascicostatus* (YABE and SHIMIZU), *A. sutneri* (YOKOYAMA) etc.] have finer and weaker ribs than those of *Lewesiceras*, but there is no remarkable difference in the degree of fineness or coarseness of the ribbing between some species. For example, *L. koluturense* (STOLICZKA) (1865, pl. 64, fig. 3) has nearly as fine and numerous ribs as those of *A. fascicostatus* and is only distinguished by its sharper ribs and less complex suture. *Anapachydiscus arrialoorensis* (STOLICZKA) (1865, pl. 64, fig. 1), on the other hand, has as coarse ribs as those of *L. rhodanicum* (ROMAN and MAZERAN) (1913, pl. 1, fig. 10), but its suture is as complex as that of *A. fascicostatus*.

I presume that *Anapachydiscus* and probably also *Eupachydiscus* may have been derived from *Lewesiceras*, as is strongly suggested by the species to be described below. Furthermore, *Pseudojacobites* SPATH, 1922 and *Pachydiscoides* SPATH, 1922 are regarded as offshoots of *Lewesiceras* (see WRIGHT, 1957, p. L 377). Therefore, *Lewesiceras* probably represents a fundamental stock of the Pachydiscidae. Incidentally, "*Lewesiceras*" *anapadense* (KOSSMAT) has ventrolateral tubercles but no median ventral ones on the preserved last half whorl. As the body-whorl is incompletely preserved even in its lectotype (here designated, GSI. 260, STOLICZKA, 1865, pl. 65, fig. 1; KOSSMAT, 1898, pl. 20, fig. 2), I think it better to assign this species temporarily to *Pseudojacobites* than to establish a new genus for it at this moment. This species is closely allied to *Lewesiceras mantelli* at an immature stage and can be regarded as representing a transition from *Lewesiceras* to *Pseudojacobites*.

Lewesiceras kawashitai sp. nov.

Pl. 4, Fig. 1; Text-fig. 2

Material.—Holotype, M. KAWASHITA's Collection, a well preserved fossil, from Kami-Ashibetsu of central Hokkaido. Another small specimen in T. MURAMOTO's Collection from the Ikushumbetsu area (central Hokkaido), may be an immature example of the present species.

Specific characters.—Shell of moderate size, globose in aspects, moderately involute, overlapping about a half of the inner whorl immediately outside the row of tubercles, with an umbilicus of moderate size (35 percent of diameter). Whorl coronate in section, much broader than high, with steeply inclined, high umbilical wall, subrounded shoulder and broadly rounded venter. The shoulder combines the umbilical one concurrently with the ventrolateral one.

Numerous ribs of unequal length and strength. Every fourth or fifth is the major rib, which is provided with a strong tubercle at the shoulder and accompanied behind with an indistinct constriction on the septate whorl. Secondary ribs are intercalated or branched from the major ones near the tubercle. Some of them are long enough to reach the shoulder where they may be slightly elevated or not. Ribs are as a whole rather crowded with somewhat irregular distance. They are nearly rectiradiate or show a very gently forward curvature on the venter. The major rib is slightly rursiradiate on the umbilical wall. On the body chamber the ribs are somewhat strengthened and becoming slightly more distant. Some of the ribs are somewhat narrowed and lowered on crossing the median line of the venter. There are 12 major ribs on the preserved last whorl, of which 4 are on the preserved part (about 90°) of the

body chamber. The major ribs are somewhat more numerous on the inner whorl than on the outer one, but the change is gradual.

The suture is moderately deeply incised.

The stems of L and U 2 are not so much narrowed as in those of *Anapachydiscus* but those of the first and the second lateral saddles are considerably narrowed.

Measurements (in mm) of *L. kawashitai* sp. nov.

Specimen	Diameter	Umbilicus	Height	Breadth	B./H.
Holotype	89.0(1)	30.0(.34)	34.0(.38)	64.0(.72)	1.88
"	(intercostal)		32.0	58.3	1.82
For comparison					
<i>L. elmii</i> (holotype)*	67.0(1)	20.0(.30)	28.0(.42)	48.0(.73)	1.75

[* measured from COLLIGNON, 1965b, pl. 429, fig. 1778; H: 0.038(0.57) in his explanation of plate was probably misprinted.]

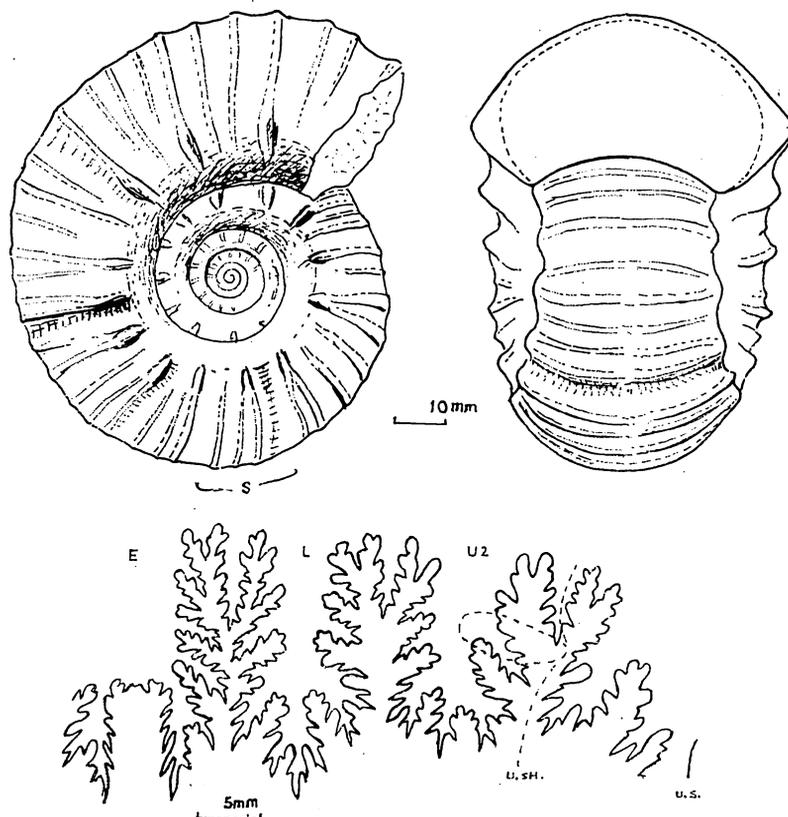


Fig. 2. *Lewesiceras kawashitai* sp. nov.

Diagrammatic sketch of holotype. a: lateral view, b: frontal view, c: external suture at S. (T.M. delin.)

Comparison.—Although only a single specimen (holotype) and a comparable smaller one are available at present, the observed characters are distinct enough to establish a new species.

This species resembles *Lewesiceras elmii* COLLIGNON (1965b, p. 36, pl. 429, figs. 1777–1778), from the middle part of the Coniacian in Madagascar, in the depressed whorl, broadly rounded venter and general aspects of ornamentation, but differs in its still broader whorl with a coronate, rather than a semi-lunate section, and the less projected curvature of the ribs. The holotype of *L. kawashitai* has a broader umbilicus than that of *L. elmii*. The largest of the three illustrated specimens from Madagascar (COLLIGNON, 1965b, pl. 429, fig. 1779) has an umbilicus as wide as the Hokkaido specimen, but its ribs are coarser and more distant with fewer secondaries than *L. kawashitai* and also typical *L. elmii*.

As the suture was neither well illustrated nor described in COLLIGNON's atlas (1965b), the exact comparison is difficult.

If a sufficient number of specimens were available in both Japan and Madagascar, whether the distinction is specific or subspecific could be decided. In the present knowledge it is better to treat the present species as distinct, because of its olcostephanitoid aspect and its diagnostic suture.

In the appearance of the shell-form and ornamentation, this species looks to be somewhat similar to *Polyptychites polyptychus* (KEYSERLING) of the Olcostephanidae and *Teloceras blagdeni* (J. SOWERBY) of the Stephanoceratidae and *Fagesia superstes* (KOSSMAT) of the Vascoceratidae. This is of course superficial similarity or homoeomorphy and the difference of families is clearly shown by the sutures. Also some difference in the mode of branching or intercalation of the

ribs is noticed, if carefully examined.

The suture of *L. kawashitai* is more deeply incised with narrower stems of the elements than in typical species of *Lewesiceras* (e.g. *L. peramplus* or *L. sharpei*), but is less so than in typical *Anapachydiscus*.

Occurrence.—The holotype was obtained by Y. KAWASHITA at a point about 2 km downstream from the Kami-Ashibetsu dam on the floor of the River Ashibetsu from a rolled or fallen calcareous nodule. At and near this point along the valley of the Ashibetsu River the Coniacian part of the Upper Yezo Group is extensively exposed, forming a synclinorium (see YOSHIDA and KAMBE, 1955).

Another comparable smaller specimen was obtained by T. MURAMOTO in a floated calcareous nodule of the Ikushumbetsu River in an area adjacent to the south of the Kami-Ashibetsu area. It is presumed to have been derived from somewhere in the Upper Yezo Group (Upper Turonian-Santonian). Thus the precise stratigraphic position of the present species is uncertain, but the derivation of its holotype from the Coniacian is the most probable.

Lewesiceras satoi sp. nov.

Pl. 5, Fig. 1; Text-fig. 3

Material.—Holotype, HCS. No. 187, from Osawa, paratype, HCS. No. 3, from Nutapomanai, both Tsutomu SATO's Collection from the Hobetsu area, Hokkaido.

Specific characters.—Shell of moderate size and moderately involute, about a half of the inner whorl being overlapped by the outer one; umbilicus of moderate width (about 30% of diameter). Whorls rounded, somewhat broader than high, and broadest in the lower part slightly outside the rounded umbilical shoulder.

Ribs numerous, of various length, becoming coarser on the adult body-chamber, gently concave on the flank and gently to moderately projected on the venter. On the outer whorl every fifth or fourth rib is longer and slightly stronger than others and provided with an umbilical tubercle, which is generally of moderate intensity and rounded at the base but on the preserved last part bullate. The major rib is accompanied with a weak constriction in front of it. On the early half of the last whorl (i. e. the late part of the septate whorl), another rib starts from the umbilical tubercle behind the

major one. On the inner whorl every second or third rib is longer and provided with a bullate umbilical tubercle. There are 10 or 11 umbilical tubercles on the outer whorl and more numerous ones on the inner whorl.

Suture of general pachydiscid pattern. L and the saddles on both sides of L have narrower stems than in *Lewesiceras sharpei* (SPATH) (see BILLINGHURST, 1927, text-fig. 2; also Fig. 1 in this paper), but the stems of L and U2 are not so narrowed as in *Anapachydiscus fascicostatus* (YABE) (YABE and SHIMIZU, 1921, pl. 9, fig. 2).

Measurements (in mm) of *L. satoi* sp. nov.

Specimen	Diameter	Umbilicus	Height	Breadth	B./H.
Holotype	124.0(1)	39.6(.32)	52.0(.42)	$\sim 30.5 \times 2 = 61(.48)$	1.17
" (-180°)	—	—	35.0	44.5	1.27
Paratype	57.0	16.6(.29)	25.2(.44)	$\sim 15.0 \times 2 = 30(.53)$	1.20
<i>L. rhodanicum</i>	75	17.5(.23)	32.5(.43)	46(.61)	1.38

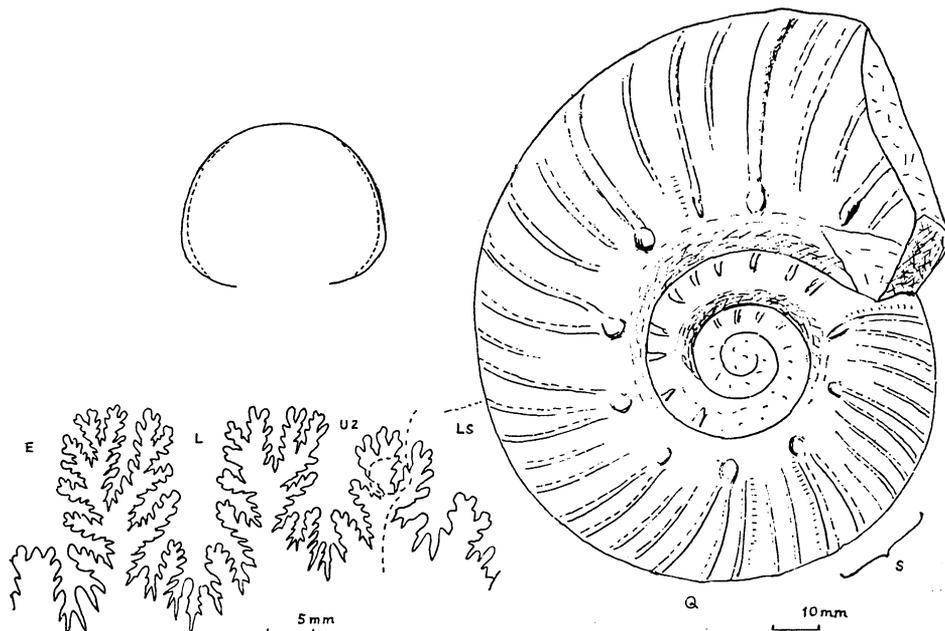


Fig. 3. *Lewesiceras satoi* sp. nov.

Diagrammatic sketch of holotype. a: lateral view, b: costal whorl-section at Q, c: external suture at S. (T. M. delin.)

Remarks.—The holotype is represented by an internal mould, without shell layers in most parts. Only an inner shell layer is preserved on some portions of the living chamber. It shows minor wrinkled structure and also minute dotted structure. The last suture is seen at about 95 mm in diameter and the living chamber occupies at least a half whorl. At about the middle of the living chamber a weak umbilical bulla is exceptionally discernible at the end of one of the three ribs inserted between the major ribs (see Text-fig. 3).

As the umbilical tubercles on the outer whorl of the holotype have a rounded base and are fairly strong even on the internal mould, the tubercles must have been prominent at the top, when the outer shell layer was preserved.

Comparison.—The present species is somewhat similar to *Lewesiceras rhodanicum* (ROMAN and MAZERAN) (1913, p. 18, pl. 1, fig. 10), from the Turonian of the Uchaux basin, France, but it has less inflated whorls, more numerous and finer ribs than that French species. In *L. rhodanicum* the tubercles are bullate at every stage but in *L. satoi* they have a rounded base and probably a prominent top. The suture was not well described in *L. rhodanicum* but the photograph of the holotype suggests a less deeply incised suture.

This species closely resembles *Anapachydiscus deccanensis yezoensis* MATSUMOTO (1955, p. 179) (see Pl. 7 of this paper), from the Santonian of Hokkaido and Saghalien, in the shell-form, ribbing and tuberculation. The distinction is that in the latter species the prominent umbilical tubercles (of *deccanensis* type) appear earlier and the suture is much more deeply and finely incised with more narrowed stems of L and U₂ as well as saddles, as in other species of *Anapachy-*

discus, e. g. *A. fascicostatus* (YABE) (YABE and SHIMIZU, 1921, p. 57, pl. 8, fig. 5; pl. 9, fig. 2) or *A. sutneri* (YOKOYAMA) (1890, p. 187, pl. 23, fig. 1). It is possibly considered that *A. deccanensis yezoensis* may have descended from *Lewesiceras satoi* by developing the strong umbilical tubercles and increase in the complexity of sutures. More specimens from successive stratigraphic levels, including Coniacian ones, are needed to examine this possibility.

It is also noted that the present species looks somewhat similar to *Eupachydiscus haradai* (JIMBO) (see MATSUMOTO, 1954a, p. 281, pl. 8, fig. 2; pl. 9, figs. 1-3; pl. 10, figs. 1-3; text-figs. 14-17) from the Santonian and the lowest part of the Campanian of Hokkaido and other regions, but the latter has much coarser and stronger ribs and more complex sutures in the middle and late growth-stages.

Occurrence.—Holotype was obtained by T. SATO in a floated calcareous nodule at a point about 100 m downstream from the confluence with a branch called the Nutapomanai in the main course of the River Hobetsu. Paratype was obtained also by T. SATO at loc. H2074p, in the lower course of the Nutapomanai of the same Hobetsu area, central Hokkaido. As the Turonian rocks are exposed well along the stream of the Nutapomanai, the two specimens were probably derived from somewhere within the Turonian.

Genus *Nowakites* SPATH, 1922

Type-species.—*Pachydiscus carezei* DE GROSSOUVRE, 1894

Diagnosis.—Shell small to moderate in size, moderately involute, with umbilicus of moderate width; whorl-section circular to suboval, nearly as high as broad or somewhat higher than broad. Periodic constrictions moderate or shallow on

inner whorls, becoming less distinct on outer whorl. Major ribs behind the constriction start from weak umbilical bullae; several ribs of unequal length between major ones; constrictions and ribs gently to moderately projected on venter. Ribs may be coarsened on outer whorl. Suture similar to that of *Lewesiceras*.

Remarks:—To this genus I refer, besides the type-species, *Puzosia lemarchandi* DE GROSSOUVRE, 1894, *Sonneratia savini* DE GROSSOUVRE, 1894, *Ammonites tallavignesii* D'ORBIGNY, 1850, and probably *Ammonites paillettei* D'ORBIGNY, 1841. These are from the Coniacian or Santonian of France and other areas.

Pachydiscus jimboi KOSSMAT, 1898 (holotype GSI. 263, from the Trichinopoly Group of southern India), is better referred to *Nowakites* than to *Lewesiceras*, because its whorl is less inflated and frequently constricted.

Whether *Ammonites draschei* REDTENBACHER, 1873, from the Alpine Gosau beds is *Nowakites* or *Canadoceras* is a question to be worked out. COLLIGNON (1955, 1966) referred it to *Nowakites* and described another allied species, *N. mangoldi* COLLIGNON, 1966, from the Middle Santonian of Madagascar.

Through the study of two syntypes of *Ammonites flaccidicosta* RÖMER, 1852, from Texas, I have noticed that one of them (lectotype) belongs to *Nowakites flaccidicostus* (RÖMER) and the other a new species of *Pseudojacobites* [*P. texanus* MATSUMOTO] (see MATSUMOTO, 1966). The holotype (GIB. 27), by monotypy, of *Ammonites hernensis* SCHLÜTER, 1867, from Grauer Mergel of Westphalia (Germany), is secondarily deformed, but is probably an example of *Nowakites*, which is fairly close to *N. lemarchandi* but still more finely ribbed. Unfortunately the suture is not observable on this specimen.

In this paper two new species are added

from Hokkaido, of which one is from the Coniacian and the other from the middle part of the Turonian. On this evidence the range of *Nowakites* extends down to the mid-Turonian.

Discussion:—I suggested once (1954b, p. 113) that *Pseudopuzosia* SPATH, 1926 of Turonian age could be an ancestor of *Anapachydiscus* and *Nowakites*. That genus is yet little known, represented only by *P. marlowense* (NOBLE), from the Upper Turonian of England, and *P. sp.* from a boulder of phosphatised rock at Sardal (BIRKELUND, 1973), presumably derived from Upper Cenomanian or Turonian beds. This Scandinavian species is more involute and less inflated than *P. marlowense* and shows some similarity to *Eopachydiscus marcianus* (SHUMARD, 1854), from the Upper Albian of Texas, if it is not so much involute and compressed as SHUMARD's species. Its suture, illustrated by BIRKELUND (1973, fig. 10), is fairly similar to that of *Eopachydiscus laevicaniculatus* RÖMER in LASSWITZ, 1904. This suggests me that *Pseudopuzosia* may be a smoothing derivative of *Eopachydiscus* or possibly a smoothed offshoot of *Lewesiceras*.

Meanwhile, as I discussed in the preceding genus, *Anapachydiscus* can now be interpreted to have been derived from a certain subgroup of *Lewesiceras*. Since *Lewesiceras* includes so various species that a certain other subgroup (e. g., represented by *L. donovani* COLLIGNON, 1965) may have given rise to *Nowakites*, acquiring multicostation and reducing inflation of whorls.

Canadoceras was probably derived from *Nowakites*, with enlarging shell, more distinct multicostation, more distinct constrictions with strongly tuberculate major ribs and more complex sutures, with much narrowed stems of the elements by deep incisions.

Nowakites yubarensis sp. nov.

Pl. 5, Figs. 2-3; Text-fig. 4.

Material.—Holotype, GK. H5872, collected by myself in 1960, from loc. Yb 15, Yubari, Hokkaido.

Specific characters.—Shell of moderate size, with the last septum at about 80 mm in diameter. Whorl moderately involute, with moderately narrow umbilicus, growing rather slowly; whorl-section subelliptical, somewhat higher than broad, with B./H.=0.85 or so at the septate stage; flanks gently inflated passing to moderately arched venter; umbilical shoulder subrounded; umbilical wall steep but low.

Periodic constrictions well-marked on the internal mould of the middle growth-stage, bordered in front by a major rib which is distinctly elevated at the umbilical shoulder, forming a bullate tubercle. There are four or five constrictions per whorl, and on the intervening parts between the constrictions there are numerous ribs, which normally consist of alternating longer and shorter ones. Some of the longer ribs look to be slightly thickened at the umbilical shoulder but not so distinctly elevated as the tubercles of the periodic major ribs. The ribs and the constrictions are nearly

parallel, gently to moderately sigmoidal on the flank and considerably projected on the venter. The ribs are fairly fine and dense in early growth-stages, becoming to be of moderate intensity and density later.

Suture is of pachydiscid type, with moderate degree of incision. Lobes and saddles are moderately narrowed at their stem.

Remarks.—Only a posterior portion of the living chamber is preserved. Its ribbing is not much different from that of the late part of the septate whorl. The measurements (below) are on the whorl of the middle growth-stage.

Comparison.—This species closely resembles *Nowakites lemarchandi* (DE GROS-SOUVRE) (1894, p. 173, pl. 22, fig. 5), from the Lower Coniacian of Aude (France), but its ribs are gently to moderately sigmoidal on the flank, unlike simply

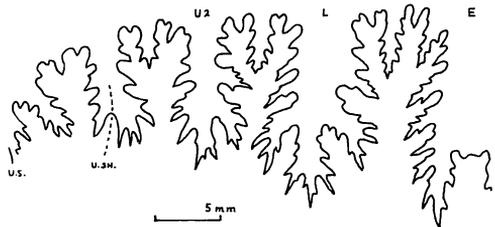


Fig. 4. External suture of *Nowakites yubarensis* sp. nov.

Measurements (in mm) of *N. yubarensis* sp. nov.

Diameter	Umbilicus	Height	Breadth	B./H.
76.0(1)	20.0(.26)	26(.34)	~22(.29)	0.85
(-90°)	—	24	20.5	0.85

Explanation of Plate 4

Fig. 1. *Lewesiceras kawashitai* sp. nov. Page 32
 Holotype, from the Ashibetsu area, collected by Y. KAWASHITA. Two lateral (a, b), ventral (c) and frontal (d) views, ×1. Kyushu University (H. HIRANO) photos without whitening.



1a



1c



1b



1d

projected ribs of the latter. As far as the holotypes of the two species are concerned, the constrictions are less frequent in ours than in the French species, but this character could be variable, if numerous specimens were examined. Unfortunately the suture is not known in that French species, which was assigned to *Puzosia* by DE GROSSOUVRE (1894, p. 173).

The holotype of this species was once (MATSUMOTO and HARADA, 1964, table 3) misidentified with *Mesopuzosia pacifica* MATSUMOTO (1954b, p. 82, pl. 14, fig. 1; pl. 15, figs. 1-2; pl. 16, figs. 1-3), but the similarity is superficial. It has tuberculate major ribs and pachydiscid type suture. The suture of *M. pacifica* is of *Puzosia* type (as represented by the fine illustration of KOSSMAT, 1898, pl. 16, fig. 4), having an enlarged and extremely asymmetrically trifid L.

In view of the similarity in suture and other respects, this species should be brought in comparison with *Kossmaticeras theobaldianum* (STOLICZKA), which is widespread in the Coniacian of the Indo-Pacific region. In the latter species the ribs are less flexuous and more prorsiradial, the constrictions are more prominently projected on the venter, cutting obliquely several ribs behind them, the longer ribs are more frequently elevated forming bullae at the umbilical end and the shorter ribs are often so disposed as being bifurcated from the longer ones.

Occurrence.—Loc. Yb 15, exposure on left wall of the creek of Ponhorokabetsu, about 400m below the dam from the source of water supply to Yubari City, in green, fine to medium-grained sandstone of Member Mk3, Mikasa Formation, slightly above the prolific part of *Inoceramus hobetsensis* NAGAO and MATSUMOTO but distinctly below that of *Inoceramus*

teshioensis NAGAO and MATSUMOTO (see MATSUMOTO and HARADA, 1964), "middle part of the Turonian" as defined in Japan (MATSUMOTO, in press).

Nowakites mikasaensis sp. nov.

Pl. 6, Fig. 1

Material.—Holotype, T. MURAMOTO Collection M-1709, from Ban-no-sawa A, Ikushumbetsu, central Hokkaido.

Specific characters.—Shell fairly large for the genus, about 140 mm in diameter at the last septum; umbilicus about one third of the entire diameter. Whorl subelliptical in section, higher than broad in late growth-stages but probably sub-circular and nearly as high as broad in earlier stages, with steep but low umbilical walls, rounded umbilical shoulders, moderately inflated to very gently convex flanks and rounded venter.

Ribs numerous, weak and of unequal length on the main part of the septate whorl; every sixth rib is somewhat stronger than others, provided with umbilical tubercles, and accompanied by a weak constriction in front of it. On the last part (about 60°) of the septate whorl and probably on the living chamber (which is mostly missing in the holotype), the ribs become coarser and more distant, showing a moderate projection on the venter. Every third rib is major, and provided with moderately strong tubercles at the umbilical shoulder.

Sutures, as partly observed, fairly finely and deeply incised for the genus.

Remarks.—The holotype is imperfectly preserved, especially its whorls of early stages are badly squashed; also only a posterior portion of its living chamber is preserved. For a long time I sought in vain better preserved specimens. Despite some deficiency, however, the holotype

Measurements (in mm) of *N. mikasaensis* sp. nov.

Diameter	Umbilicus	Height	Breadth	B./H.
140.0(1)	45.0(.32)	60.0(.43)	51.0(.36)	0.85

shows distinct characters. It would be better to describe a new species on this occasion than to postpone the description.

Comparison:—The holotype of this species is larger than any of the previously described examples of *Nowakites* and the suture is deeply and finely incised, resulting in narrowed stems of the lobes and saddles, though it is partly observed. Accordingly someone might consider this species as *Canadoceras*. However, I refer it at least tentatively to *Nowakites*, because the constrictions are less well-marked and the umbilical tubercles on major ribs are less prominent than in *Canadoceras*.

The mode of ribbing on the whorl of the late growth-stage of this species is somewhat similar to that of *Nowakites tallavignesi* (D'ORBIGNY) (1850, p. 190) (holotype figured by COLLIGNON, 1955, pl. 9, fig. 3), from the Coniacian of south-western France, but the holotype of that species is much smaller and has more rounded whorl than that of the present species. Again the suture is not clearly described in *N. tallavignesi*.

Occurrence:—Holotype is from an exposure on a small branch A of the Ban-

no-sawa a tributary of the River Iku-shumbetsu, from a calcareous concretion in sandy siltstone of the Zone of *Inoceramus uwajimensis*, which is probably correlated with the Lower Coniacian in terms of the international scale.

Concluding Remarks

In this paper I have described two species of *Lewesiceras* and two species of *Nowakites*, which are somewhat allied to certain hitherto known species from France, Madagascar and other areas. At present every species is represented by only one or a few specimens and the impression that the two genera occur rather rarely in Hokkaido cannot be denied. The rarity may partly due to our collection failure but there may be some other reasons

I once attempted to draw a tentative diagram to show the vertical ranges of the genera and subgenera of the Pachydiscidae, with presumed phylogenetic relationships (MATSUMOTO, 1964). Its revised diagram is presented here (Fig. 5), though this is still tentative.

Explanation of Plate 5

- Fig. 1. *Lewesiceras satoi* sp. nov. Page 34
 Holotype, from the Hobetsu area, collected by T. SATO. Lateral (a) and frontal (b) views, $\times 2/3$.
- Figs. 2-3 *Nowakites yubarensis* sp. nov. Page 38
 Holotype, GK. H 5872, from the Yubari area, collected by T. MATSUMOTO.
 2. Lateral view of the whole specimen, with much destroyed outer whorl, $\times 1$
 3. Lateral (a) and ventral (b) views of the inner whorl, $\times 1$
 Kyushu University (K. TANABE) photos without whitening.



1a



1b



2



3a



3b

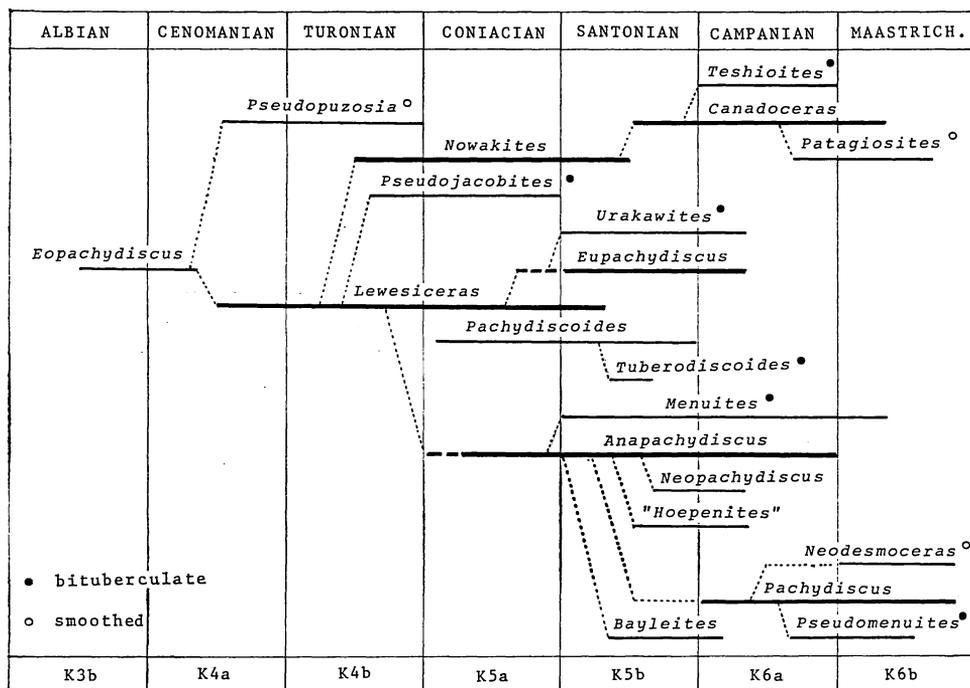


Fig. 5. Diagram showing stratigraphic ranges and phylogenetic relationships of pachydiscid genera and subgenera.

The origin of the Pachydiscidae is probably in *Desmoceras* of Albian age. Compared with *Desmoceras* and other genera of the Desmoceratinae, most of the Pachydiscidae have larger size, more or less wider umbilicus, coarser or stronger ribs, which are less or non-sigmoidal, and distinct tubercles. Some of these characters suggest the adaptation to somewhat shallower seas than the Desmoceratinae. In fact, *Lewesiceras*, *Nowakites* and *Pachydiscoides* occur commonly in the sediments of the shelf or epicontinental shallow sea facies. These genera, and also *Eopachydiscus* and *Pseudopuzosia* have comparatively less deeply incised, broader lobes and/or saddles of the septal suture, which again suggest that their habitats were comparatively shallow. Pachydiscid genera of later ages, such as *Anapachy-*

discus, *Eupachydiscus*, *Canadoceras*, and *Pachydiscus*, have more deeply and finely incised, complex sutures, with narrowed stems of lobes and saddles. This suggests that these genera of later ages may have again acquired the ability of better swimming in the off-shore seas or that of going down to moderate depths. In view of various shell-forms and mode of ornamentation, the habitats of these genera must have been diverse, with multiple ways of adaptation. Speaking broadly, however, these genera occur commonly in the regions facing the oceans, although in various kinds of facies.

The above mentioned major aspect in the evolutionary history of the Pachydiscidae is an answer why *Lewesiceras* and *Nowakites* are rare and no example

of *Pachydiscoides* has been found in the Cretaceous of Hokkaido and other areas in the Japanese province where shallow shelf seas were lacking or limited.

Another interesting aspect in the evolutionary history of the Pachydiscidae in the development of ventrolateral tubercles (and also median ventral ones in certain genera) on the outer whorl of several genera. They are respectively allied to but usually smaller than certain normal pachydiscid genera of a nearly contemporary age. The counterparts are, for example, *Pseudojacobites*: *Lewesiceras*, *Tuberodiscoides*: *Pachydiscoides*, *Menuites*: *Anapachydiscus*, *Pseudomenuites*: *Pachydiscus*, *Urakawites*: *Eupachydiscus*, and *Teshioites*: *Canadoceras*. This gives us an idea that they might represent the dimorphism, with bituberculate form as microconch, as I have already notified with rather negative suggestion (MATSUMOTO, 1955, p. 155). In our present knowledge, bituberculate forms are generally found with much less frequency than the normal counterparts. Their exact stratigraphic ranges do not strictly coincide with those of normal ones. There are a few genera for which no bituberculate counterparts are found. *Nowakites* is an example of such a case, although the relationship of *Nowakites flaccidicostus* (RÖMER) and *Pseudojacobites texanus* MATSUMOTO could still provoke a debate (see MATSUMOTO, 1966). So far as I have seen, certain species of bituberculate pachydiscids are collared or constricted near the apertural end of the shell but no lappets have been confirmed. In some

species bituberculation begins to appear already on a probably immature shell. I am, thus, still kept to hold my previous view that the bi- or trituberculation in pachydiscids is evolutionary—i. e. adaptation for certain modes of life, rather than dimorphism, although I would not decidedly deny a possibility of the latter interpretation.

Lastly, another evolutionary aspect is the smoothing of the shell or reduction of ornaments, as exemplified by *Neodesmoceras* and *Patagiosites*. In this paper, *Pseudopuzosia* is also interpreted in such a way, and not considered as ancestral weakly ornamented form to give rise to *Nowakites*.

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Explanation of Plate 6

- Fig. 1. *Nowakites mikasaensis* sp. nov. Page 39
 Holotype, from the Ikushumbetsu area, collected by T. MURAMOTO. Two lateral (a, b) and ventral (c) views, $\times 2/3$. Kyushu University (K. TANABE) photos without whitening.

MATSUMOTO: Lewesiceras and Nowakites

Plate 6



- pls. 455-513.
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Ashibetsu 芦別, Ban-no-sawa 盤の沢, Hobetsu 穂別, Ikushumbetsu 幾春別, Kami-Ashibetsu 上芦別, Mikasa 三笠, Nutapomanai スタポマナイ, Osawa 長和, Ponhorokabetsu ポンホロカベツ, Sanushibe サヌシベ, Yezo エゾ (蝦夷), Yubari 夕張

北海道白亜系産パッキディスカス科アンモナイトの *Lewesiceras* と *Nowakites* について: 日本の上部白亜系には *Pachydiscidae* に属するアンモナイトは, かなり多産するが, この両属は今まで報告されていなかった。最近北海道のチューロニアンとコニアシアンから, 現地の方の助力もあって, 若干の実例を得ることができた。ここには4種を記載した。それらは, (1) *L. elmii* COLLIGNON, (2) *L. rhodanicum* (ROMAN and MAZERAN), (3) *N. lemarchandi* (DE GROSSOUVRE), (4) *N. tallavigneii* (D'ORBIGNY) に類似するが, 明確に識別されるので新種とした。記載に当たり, 両属の特性, 他属との関係などについて言及した。結章には, *Pachydiscidae* 科の進化史の概要を, 系統樹式図表を添えて記し, これに関連して, 海外でかなりよく産する *Lewesiceras* と *Nowakites* が日本では比較的まれにしか産しない理由の説明を試みた。 松本達郎

P. S. A part of the expenditure for this study was defrayed through the grant (No. 334043) from the Ministry of Education, Science and Culture [*Monbusho*].

Explanation of Plate 7

- Fig. 1. *Anapachydiscus deccanensis yezoensis* MATSUMOTO Page 36
 Holotype, UMUT. MM 5645 [=GT. I-2742], from Sanushibe, *Anapachydiscus* beds of the Upper Yezo Group in the Hobetsu area, central Hokkaido (H. YABE Coll.) (see MATSUMOTO, 1955, p. 179). Two lateral (a, b), ventral (c) and frontal (d) views, $\times 5/8$ (Bar at the center indicates 10 mm). Early portion of the last whorl is taken out in Fig. 1a and Fig. 1d to show the inner whorls. University of Tokyo (I. HAYAMI) photos, with whitening.



PROCEEDINGS OF THE PALAEOONTOLOGICAL
SOCIETY OF JAPAN

学 会 記 事

- 1978年6月2日に筑波大学で行なわれた定例評議員会において、次の諸君の入・退会が承認された(敬称略)。
〔入会〕大崎康吉、久保親弘、菊池芳文、安藤寿男、鈴木保宏、石川 享、杉本次郎、白木孝佳、平川昌登、立松泰夫、井口休夫、谷村好洋、安田尚登(13名)
〔退会〕片山貞昭、丸山文男(2名)
- 1978年9月に行なわれた関連5学会の協議の結果、昭和54・55年度科学研究費配分委員に本会推薦の猪郷久義が候補となった。その結果、54年度配分委員は地質学2段が大久保雅弘、地質学一般1段が、中島和一(留任)、石崎国熙(留任、本会推薦)、赤木三郎、層位古生物学1段が、速水 格(留任、本会推薦)、中村耕二、猪郷久義(本会推薦)となった(敬称略)。
- 1978年11月に行なわれた評議員選挙の結果、1979・80年度の本会評議員は次のようにきまった(敬称略、ABC順)。浅間一男、鎮西清高、浜田隆士、花井哲郎、速水 格、猪郷久義、勘米良亀齡、小高民夫、松本達郎、小島郁生、斎藤常正、首藤次男、高柳洋吉、棚井敏雅、鳥山隆三(15名)
- 1979年1月20日に福岡大学で行なわれた新評議員会で、会長に花井哲郎、常務委員として庶務委員に鎮西清高、外国庶務委員に猪郷久義、会計委員に浅間一男、編集委員に速水格・斎藤常正、会員委員に小島郁生、行事委員に浜田隆士、特別号編集委員に首藤次男、“化石”編集委員に高柳洋吉、また幹事として庶務幹事に山口寿之の各君がきまった。他の幹事は追って決定される。
- 同評議員会で賞の委員の半数改選を行ない、首藤次男・棚井敏雅の両君にきまった。1979年度賞の委員会は上記2名のほか、会長、猪郷久義、亀井節夫の5名で構成される。
- 1979・80年度の会計監査を坂上澄夫君に依頼した。
- 上記評議員会において、次の諸君の特別会員への推薦および入退会が承認された(敬称略)
〔特別会員〕鹿島愛彦、三上貴彦、内藤源太郎、押手 敬、関戸信次(5名)

〔入会〕石田啓祐、佐藤昌人、吉田俊秀、門田真人、加藤法彦、森 群平、小田 博、丸山俊明、大石 朗、坂本省吾(10名)
〔退会〕坂倉勝彦(1名)
〔逝去〕鹿間時夫(名誉会員)、江口元起(特別会員)、岡藤五郎、鈴木達夫(普通会員)
なお、現会員数は次の通りである。賛助会員8、名誉会員7、特別会員170、普通会員325、在外会員51、計561名。

日本古生物学会1979年総会・年会は1979年1月21日(日)・22日(月)に福岡大学理学部において開催された(参加者121名)。

特 別 講 演

秋吉石灰岩層群の堆積環境と構造 太田正道
被子植物の起源にまつわる諸問題 浅間一男
会長講演 鳥山隆三

コ ロ キ ュ ウ ム

「国際対比の見地からみた日本および近接地の白亜紀化石」
序 言 世話人代表 松本達郎
石灰質微化石による白亜系層位学の進歩
..... 高柳洋吉・斎藤常正
(石灰質微化石関係)指名討論..岡田尚武・岡村貞本邦白亜系放散虫群集と国際対比の可能性
..... 中世古幸次郎
(珪質微化石関係)指名討論...小泉 格
本邦海成白亜系産化石についての国際対比の評価
..... 松本達郎・小島郁生
(同上)指名討論...速水 格
非海成～汽水成層産化石と国際対比 ... 梁 承栄
(同上)指名討論...田村 実・太田喜久
(同上)指名討論.....上野輝弥
東亜における白亜紀の植物地理区について
..... 木村達明
(同上)指名討論.....棚井敏雅
総合討論と結語 世話人 高柳洋吉

個人講演

- 天草下島産の三角貝 (*Steinmanella*) について ..
田代正之
Inoceramus balticus BÖHM 及び関連種の命名に
 ついての検討.....野田雅之
 Notes on *Inoceramus japonicus* from the
 Upper Santonian of Japan.....
NODA, M. and MATSUMOTO, T.
 Some new bivalve species from the lower
 Gyeongsang Group, Korea.....
Seong Young YANG
 “*Ostrea*” *konbo* (白亜紀) の生長様式と殻の開閉
 機構.....鎮西清高
 A list of Recent Indo-Western Pacific glycy-
 meridids, with description of a new species
 from Miyako Island, south Kyushu
MATSUKUMA, A.
 Notes on the ecology of the sand snail
Umbonium (Suchium) moniliferum (LAMARCK)
OZAWA, T. and SHIMOYAMA, S.
 Deep burrowing mollusks と shallow burrow-
 ing mollusks の遺骸集団に保存される古生物学
 的資料.....下山正一
 Turritellid Dimorphism.....KOTAKA, T.
 Taxonomic relation of *Turritella karatsuensis*
 NAGAO and *T. infralirata* NAGAO.....
SHUTO, T.
 白亜紀アンモナイト類の殻の初期成長の特徴とそ
 の分類学的意義.....棚部一成・小島郁生
 オーストラリア北西沖海底堆積物中のアンモナイ
 トについて.....松本達郎
 An interesting mode of occurrence of *Polypty-*
choceras (Cretaceous heteromorph ammonoid)
MATSUMOTO, T. and NIHONGI, M.
 秋吉石灰岩層群産の大型ストロホメナ目腕足類に
 ついて.....柳田寿一
 Permian bryozoans from the Abadeh region,
 central Iran.....SAKAGAMI, S.
 北海道日高累層群中のこけ虫化石について.....
坂上澄夫・酒井 彰
 秋吉石灰岩のこけ虫化石による石炭系生層序 (予
 報)坂上澄夫・杉村昭弘
 Carboniferous ostracodes from the lower part
 of the Ichinotani Formation, Fukuji, Hida
 Massif, central Japan
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小西健二・後藤十志朗

1978年度日本古生物学会学術奨励金推薦文

棚井敏雅君：新生代古植物の研究

東アジアの亜熱帯～温帯は世界のどの地域よりも第三紀からの残存植物が多く、第三紀森林の面影をとどめた地域であり、それと同時に新生代の各時代における豊富な化石の産出と相まって、北半球における第三紀森林変遷を調べる上で最も重要な地域である。棚井君は石炭地質学的研究から古植物研究を志し、長年にわたって第三紀植物を中心とした精力的な研究を続けてきた。

同君は1961年日本の新第三紀植物群をそれまでの多くの層位、古生物資料を整理した上で、各地の植物化石群の組成・構成種を検討し、これらを下位より相の浦・阿仁合・台島・三徳・新庄および明石の6植物群型に区分した。この研究は当時研究の立遅れていた陸成新第三系の層位学的位置を日本全体にわたって体系づけたものとして、国内、外でも広く認められており、高く評価される。同君および協同研究者は、その後も北海道の新第三紀植物群、釧路炭田の漸新世植物群、長崎県茂木の鮮新世植物群などについて詳細な分類学的検討をし、日本の第三紀植物群の基礎資料の充実に貢献すると共に、植物群の群落解析による古生態、古地理的検討を加えた。

同君の研究は一貫して北半球の森林変遷史、とくにブナ属、シデ属、カエデ属など温帯林の重要な構成要素を分類群ごとにそれらの系統と分布変遷を論じた。さらに最近では、多量の現生種の葉

脈参照標本を作製し、それらの比較検討から現生および化石の微細脈系による分類基準を吟味し、世界の現生カエデ科や北米のニレ科化石について注目すべき成果をあげている。

以上のように棚井君は分類記載という基礎的研究の蓄積と、それに平行して系統進化、古生態、植物地理、古気候並びに生層位など多方面の古植物研究に著しい貢献をした。よって日本古生物学会はここに学術奨励金を贈り、今後いっそうの発展を期待するものである。

石崎国熙君：貝形虫による古環境の多変量解析

石崎君の化石オストラコーダの分類学的研究は1963年に始まり、日本より131新種と4新属を提唱した。これは日本から現在までに知られている種の約1/4にあたり、日本で現在行なわれつつあるオストラコーダに関する種々の研究が出発するための素材となっている。石崎君の研究は地方的動物群の記載より始まり、古生代のものについては、時代の決定に、新生代のものについては、古水温変化の推定に進んだが、1968年よりは、現生や第四紀のオストラコーダ群集についてQマトリックスおよびRマトリックスに基づくクラスタリングを行ないバイオトープと生相を識別し、又、元村の多様度指数を計算し、これに調査によって得られた環境要因を加えてオストラコーダの分布を論じた。更に最近にはQマトリックスとRマトリックスについて主因子分析を行ない、分布や種の随伴関係を決定している要因について解析をこころみた。例えば東支那海では第一因子動物群はオーストラリア北方から日本南縁に分布する浅海種、第二因子動物群はニュージーランド北方の比較的深い海域より知られる種、第三因子動物群は日本近海の固有種であった。更に1975年には主因子分析を所謂“*Hermanites*”属の形態の中新世より現在に至る変化の解析に利用した。殻の後背部にあるループ形の隆起の形態をフーリエ級数としてとらえて得た10の形質間の相関に関する主因子分析を行ない、初めの4番目までの因子で分散の95%以上が説明されることを示し、それらの因子に関係あると考えられる形質の時代による変化を論じた。また“*Leguminocythereis hodgii*”についてはMANN-WHITNEYのu検定を使って幼生に見られる網目状装飾の発達しない個体の頻度は海水温に影響されているとの結論を出した。これを要するに石崎君はオストラコーダを材料にして種々の数量的解析を試みオストラコーダの理解とオストラコーダによる古環境解析の基礎作りに貢献した。よって日本古生物学会はここに学術奨励金を贈り、今後一層の発展を期待するものである。

編集係より

○1978年度に投稿原稿の校閲者として尽力された諸兄に感謝いたします（御氏名は申し合わせにより公表いたしません）。

会員名簿訂正

本誌新篇112号に掲載した Members of Palaeontological Society of Japan に次の誤りがありましたのでおわびして訂正します。

会員係・編集係

○KURODA, Tokubei (黒田徳米) D. Sc., c/o Nishinomiya Kaisei Hospital, 1-4, Ohama-cho, Nishinomiya (662) を名誉会員の項に加える。

○IWAI, Takehiko (岩井武彦), TSUDA, Karyu (津田禾粒) の両君に特別会員のマーク(*)をつける。

行 事 予 定

	開 催 地	開 催 日	講演申込締切
第 123 回 例 会	辰口町総合福祉会館	1979年 6 月 9 日～11日	1979年 4 月 5 日
第 124 回 例 会	名 古 屋 大 学	1979年10月20日	1979年 8 月20日

第 123 回例会の会場は前号に金沢大学とお知らせしましたが、上記の小松市に近い辰口（たつのくち）町の総合福祉会館に変更いたします。詳しくはプログラムでお知らせいたしますが、宿泊施設は地元でお世話する下記のを御利用さい。

①加賀白山荘 ②金沢大学辰口共同研修センター。なお、6月9日に個人講演、6月10日にコロキウム「地質時計としての化石—その分解能」（世話人代表：小西健二）、6月11日に手取川白峰村桑島化石壁および手取ダムへの巡検（案内者：松尾秀邦）が予定されています。

お 知 ら せ

本号の学会記事にありますように、今春から常務委員などの役割分担が一部変更になりました。会務の円滑を期するため、1979—80 年度の本会関係の連絡先を用務別に記しておきますのでよろしく御協力下さい。

- 会費の払込 お送りしている銀行振込用紙で日本学会事務センター
- 会費に関する問合せ 会計係：浅間一男（科学博物館分館地学部）
- 本会の常務委員会への連絡一般 庶務係：鎮西清高・山口寿之（東京大学・理学部・地質学教室）
- 住所変更・入退会申込・報告記事バックナンバー購入申込 日本学会事務センター内日本古生物学会
- 講演申込 日本学会事務センター日本古生物学会行事係、または行事係：浜田隆士（東京大学・教養学部・宇宙地球科学教室）
- 報告記事への投稿 なるべく書留便で日本学会事務センター内日本古生物学会、または編集係：速水格（東京大学・総合研究資料館）（原稿コピーと投稿カードを同封または別送して下さい）
- 報告記事編集に関する問合せ 編集委員会：速水格（同上）、斎藤常正（山形大学・理学部・地学教室）、小沢智生（東京大学・理学部・地質学教室）
- 特別号に関する問合せ・購入申込 特別号編集委員会：首藤次男・柳田寿一（九州大学・理学部・地質学教室）（郵送によらない直接販売は東大・総合研究資料館、科学博物館でも取扱います）
- “化石”に関する問合せ・投稿・購入申込 化石編集部：高柳洋吉・石崎国熙（東北大学・理学部・地質学古生物学教室）
- 各種の賞に関する問合せ、推薦依頼 賞の委員会：猪郷久義（筑波大学・地球科学系）（79年度のみ）

行 事 係 よ り

- プログラム編成の必要上講演の内容についてあらかじめお訊ねすることがありますので御了承下さい。

◎ 文部省科学研究費補助金（研究成果刊行費）による。

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