

日本古生物学会 報告・紀事

Transactions and Proceedings
of the
Palaeontological Society of Japan

New Series

No. 52



日本古生物学会

Palaeontological Society of Japan

Dec. 10th, 1963

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458. THE DIMORPHISM AND ONTOGENY OF
NORWOODELLA HALLI RESSER*

CHUNG-HUNG HU

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Norwoodella halli RESSER の異性型と発生：雄型と雌型の区別は性比、体形、武装の強弱による。動物の一生は早幼年期、中幼年期、晩幼年期、早中年期、晩中年期及び成年期の6時期に区分される。
胡忠恒

The material of this small report is light colored fine to medium grained dolomitic limestone, which was collected by Dr. C. L. BALK (1940), from the early Upper Cambrian Bonnetterre Dolomite of St. Francois County, southeastern Missouri. It contains an abundance of immature and mature forms of a late *Cedaria* fauna.

In this report the writer segregated *Norwoodella halli* into two different groups, recognizing the dimorphic phenomenon in the same genus and species. The form presumed male is characterized by a bigger body, a larger number of individuals, and heavier occipital spine, and the presumable female is characterized by a smaller number of individuals, smaller body, and slenderer occipital spine.

The author has recognized six developmental stages in the material, i. e. Anaprotaspid, Metaprotaspid, Paraprotaspid, Early Meraspid, Late Meraspid, and Holaspid periods.

Acknowledgements:—The writer expresses his deep appreciation to Dr. C. L.

* Received Nov. 14, 1962; read Nov. 10, 1963.

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BALK, New Mexico Institute of Mining and Technology, for her supervision and kind permission to me to described her excellent collection. Thanks are also to Dr. T. KOBAYASHI, Professor Emeritus of the University of Tokyo, Japan, for reading this paper.

Family Norwoodiidae WALCOTT, 1916

Genus *Norwoodella* RESSER, 1938

Norwoodella halli RESSER

Norwoodella halli RESSER, 1938. *Geol. Soc. Amer., sp. pap.* 15, p. 90, pl. 10, figs. 45, 46.
Norwoodella halli LOCHMAN, 1940. *Jour. Palcont., vol. 14, no. 1*, p. 47, pl. 5, figs. 31-36.

Diagnosis:—The cranium is triangular in outline, gently convex, with parial facial suture line. Surface is roundly smooth, fine impressed by dorsal furrows. Lateral lobe narrow and rather long (tr.), and with a medium sized, backward-directed genal spine. Palpebral lobe medium size. Occipital ring of medium size with a short and thick occipital spine. Librigena subquadrate, occupied by an anterior and posterior projections.

Pygidium narrow triangular in outline, gently convex, marked by three faint axial rings and a small terminal portion.

Outer surface smooth to fine granulation.

Norwoodella halli RESSER ♀

Pl. 19, figs. 1-25, 31-33.

Norwoodella halli RESSER, 1938, *Geol. Soc.*

Amer., sp. pap. 15, p. 90, pl. 10, figs. 45, 46.

Norwoodella halli LOCHMAN, 1940, *Jour. Paleont.*, vol. 14, no. 1, p. 47, pl. 5, figs. 31, 35.

Diagnosis:—The cranidium triangular in outline, gently convex, with proparial facial suture line and large backward-directed genal spine. Dorsal furrow rather fine marked. Glabella conical, tapering forward with three pairs of glabellar furrows on inner surface. Occipital ring crescentic with a short thick occipital spine and a minute median node. Anterior margin slightly down sloping and arching forward. Fixigena flat and very narrow. Palpebral lobe of medium size, located on the midline of cranidium.

Librigena subquadrate, with slender, sharply pointed anterior and posterior projections.

Pygidium semicircular in outline, gently convex. Axial lobe marked by two axial rings and a concave triangular terminal portion. Marginal border narrow has a faint inner marginal furrow.

Figured specimens:—Cranidia, U.S.N.M. 143466, 143466a.

Librigena, U.S.N.M. 143466p.

Pygidia, U.S.N.M. 143466q, r, s.

Norwoodella halli RESSER ♂

Pl. 19, figs. 26-30, 34-36.

Norwoodella halli LOCHMAN, 1940, *Jour. Paleont.*, vol. 14, no. 1, p. 47, pl. 5, figs. 31-33, 36.

Comparison:—The male specimens differ from the female in that (1) the anterior cranial margin has an obtuse angle, (2) the dorsal furrow is deeper, (3) occipital spine heavier, (4) pygidial terminal portion without depression, (5) axial lobe marked by more than two rings, (6) librigena with a broad flat anterior and shorter posterior projections.

Figured specimens:—Cranidia, U.S.N.M.

143466y, z.

Librigena, U.S.N.M. 143466t.

Pygidia, U. S. N. M. 143466u, v, w, x.

Norwoodella halli RESSER, ontogeny

Anaprotaspis period (pl. 19, figs. 18-24):

—The shield is subspherical in outline, strongly convex, with hypoparial facial suture line, about 0.30-0.40 mm. in length (sag.). Surface roundly smooth; no furrow or pit is observed. Posterior margin of the shield with a small hole in the smallest form, and a larger hole in bigger specimens, which may be a primitive anus. The under side of the shield shows the facial suture line well, which runs obliquely from the midline to the frontal margin of the shield.

Metaprotaspis period (pl. 19, figs. 16, 17):—The shield is about 0.42-0.46 mm. in length (sag.), subspherical in outline, strongly convex, surface is finely marked by six pairs of pits along the dorsal furrow and a median furrow. Facial suture line extends farther backward than in the early stage. The posterior marginal hole is broader than in early stage. Facial suture line is hypoparial form.

Paraprotaspis period (pl. 19, figs. 11-

15):—The shield is about 0.47-0.50 mm. in length (sag.), subspherical on outline, rather convex. Surface well impressed by shallow furrows. A small protopygidium is present, but not well separated from the cephalon. Facial suture line extends farther backward than in the early stages. Posterior lateral border and genal spine are well marked, and curve down to ventral side of the shield. Two short and strong spines are showed from the posterior (fig. 14). Facial suture line is hypoparial or proparial form.

Early Meraspid period (pl. 19, figs. 5-10):—The shield is about 0.55-1.2 mm. in length (sag.), ovate elongate in outline, rather convex. Dorsal furrow well marked. Glabella broadly conical with two pairs of shallow glabellar furrows. Occipital spine is short and slender. Posterior lateral border and furrow are rather finely marked. Pygidium divided into 4-5 axial rings, but the pleural furrows are not well separated. Facial suture line is hypoparial or proparial form.

Late Meraspid period (pl. 19, figs. 3, 4):—The cranidium without pygidium, thoracic segments and librigenae, gently convex, about 0.9-1.5 mm. long (sag.). Dorsal furrows are well define. Glabella broadly conical, and wider than the fixigena. Eye located far forward from the midline of glabella. Facial suture line represents proparial form.

Early Holaspid period (pl. 19, fig. 36):—The cranidium gently convex, about 1.8 mm. or more in length, triangular in outline. Palpebral lobe located backward, and fixigena narrower than early stages.

Figured specimens: Anaprotaspides, U. S. N. M. 143466o, n, m.
Metaprotaspides, U.S.N.M. 143466l, k.
Paraprotaspides, U.S.N.M. 143466j,

i, h.

Early Meraspides, U.S.N.M. 143466

g, f, e, d.

Late Meraspides, U.S.N.M. 143466c,

b.

Early Holaspid, U.S.N.M. 143466a.

Remarks

This species is represented by 80 specimens from early developmental stages to adult form which show well the successive embryonic stages. The mature specimens can be separated into two different groups by their different characteristics. 21 specimens represent the female, which is characterized by (1) rounded anterior border, (2) shallower dorsal furrows, (3) sharply pointed librigenal border, (4) less segmented pygidium, (5) smaller sized body and smaller number of individuals. The male is represented by 28 specimens, which are featured by (1) pointed angular anterior border, (2) deeper dorsal furrow, (3) broader librigenal border, (4) more segmented pygidium, (5) larger sized and larger number of individuals.

The early stages of the immature forms show a strongly convex shield, smooth or pitted dorsal furrow, smaller anal hole and hypoparial facial suture line. In the middle stages, the shield is rather convex, the surface marked by shallow dorsal furrow, the posterior margin of the shield with two vertical spines on the sides (fig. 14), and a hypoparial or proparial facial suture line. In the late stages, the shield is slightly convex, the surface is smooth or with faintly impressed furrows, the posterior margin flatter, with two shorter vertical spines on the sides, and a proparial facial suture line.

The guiding principle for the sexual identification is concern with some

modern arthropods, such as Stag-Beetles, Rhinoceros-Beetles, Hercales-Beetles etc. The male often has one or more large horns on the head, and a bigger body, whereas the female is without or with a smaller horn on the head, and has a smaller body. If these features are applied to this trilobite, *Norwoodella halli*, it is thought that the male body has a bigger occipital spine, and a larger size body, whereas the female has a slenderer occipital spine, and a smaller size body.

The sexual ratio in this material also conforms to that in some other kinds of modern animals, especially in arthropods.

The male is represented by a larger number of individuals than the female.

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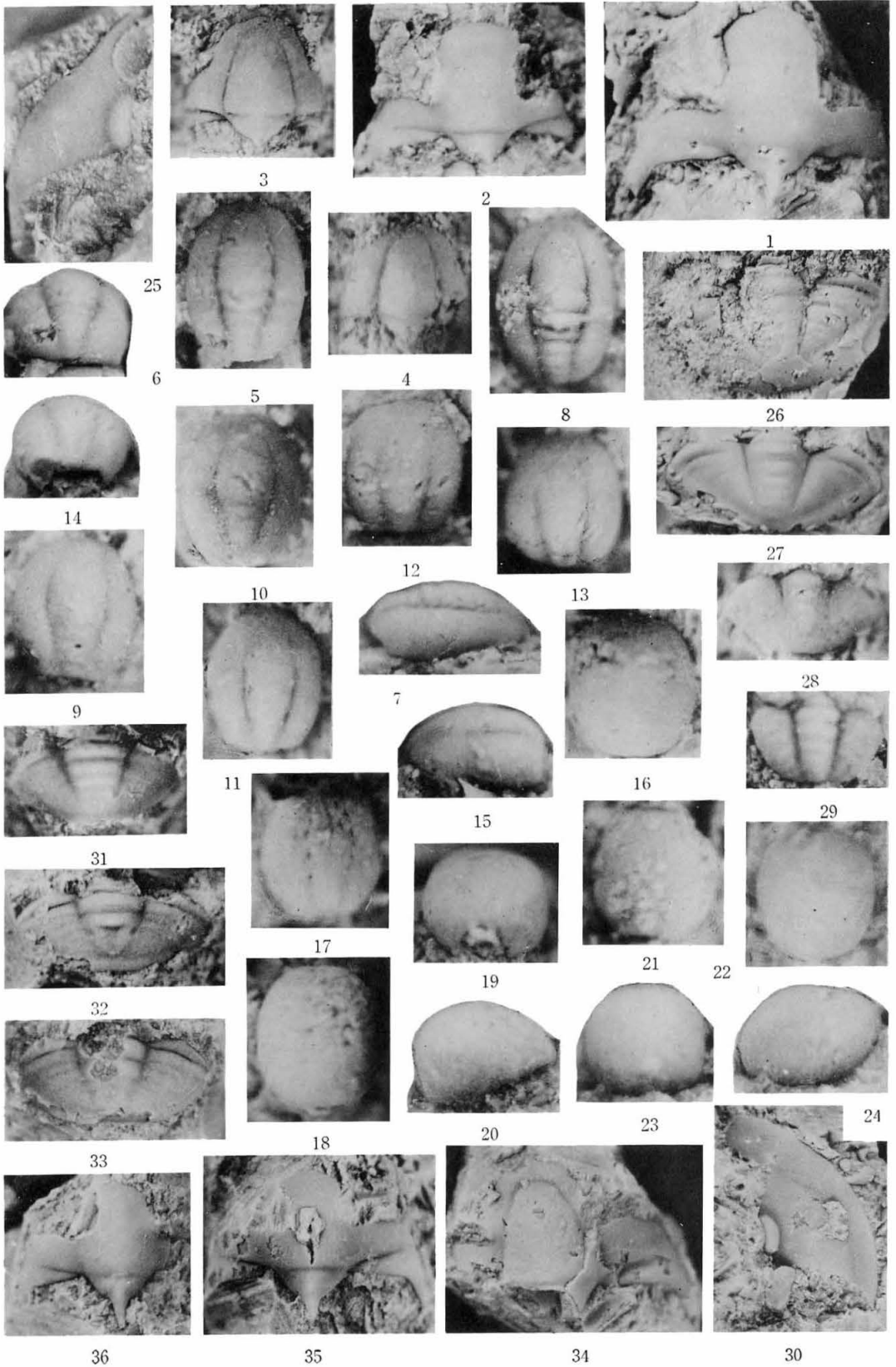
Explanation of plate 19

Figs. 1-25, 31-33: *Norwoodella halli* RESSER ♀

- 1, 2. Two large sized cranidia. (1) × 9, U. S. N. M. 143466
(2) × 11, U. S. N. M. 143466a
- 3, 4. Two late meraspides. (3) × 17, U. S. N. M. 143466b
(4) × 19, U. S. N. M. 143466c
- 5-10. Four early meraspides. (5, 6, 7) × 14, U. S. N. M. 143466d
(8) × 16, U. S. N. M. 143466e (9) × 48, U. S. N. M. 143466f
(10) × 32, U. S. N. M. 143466g
- 11-15. Three paraprotopaspides. (11) × 46, U. S. N. M. 143466h (12) × 45, U. S. N. M. 143466i
(13, 14, 15) × 46, U. S. N. M. 143466j
- 16, 17. Two metaprotopaspides. (16) × 50, U. S. N. M. 143466k (17) × 55, U. S. N. M. 143466l
- 18-24. Three anaprotaspides. (18, 19, 20) × 58, U. S. N. M. 143466m
(21) × 65, U. S. N. M. 143466n (22, 23, 24) × 70, U. S. N. M. 143466o
25. A librigena, × 16, U. S. N. M. 143466p
- 31-33. Three pygidia. (31) × 8.6, U. S. N. M. 143466q (32) × 8.3, U. S. N. M. 143466r
(33) × 8.0, U. S. N. M. 143466s
- 6, 14, 19, 23. Back view of figures 5, 13, 18, 22, showing the changes of posterior margin of the shield.
- 7, 15, 20, 24. Side view of figures 5, 13, 18, 22, showing the changes of facial suture line and convexity.

Figs. 26-30, 34-36: *Norwoodella halli* RESSER ♂

- 26-29. Four small and large sized pygidia. (26) × 5, U. S. N. M. 143466u
(27) × 8, U. S. N. M. 143466v (28) × 16.2, U. S. N. M. 143466w
(29) × 26, U. S. N. M. 143466x
30. A librigena, × 4.8, U. S. N. M. 143466t
- 34, 35. Two cranidia. (34) × 6.5, U. S. N. M. 143466y (35) × 8.1, 143466z
36. An holaspis, × 9.5, U. S. N. M. 143466a'



459. ON THE GENUS *PLATANUS* FROM HOKKAIDO, JAPAN*

SEIDO ENDO

北海道産プラタナス属について：属プラタナスには現生種 6 種あり、悉く北半球に分布して居る。化石種は約 40 種、白堊紀から新生代の地層に発見されて居るが、古第三紀層に多い。クレドネリアに似たものもあるがプラタナス属と是とは近縁であろう。北海道産プラタナス・アセロイデスは通常三葉のものと同葉のものがある。単葉のものを其亜種とした。

遠藤 誠道

The genu *Platanus* comprises the following six existing species which are all distributed within the Northern Hemisphere:

- P. orientalis* L.
From Eastern Europe to Himalaya
- P. occidentalis* L.
From Mexico to Canada. (Eastern side)
- P. racemosa* NUTT.California
- P. Wrightii* S. WATS.
From Mexico to Arizona (U. S. A.)
- P. Lindeniana* MART. et GAL.
From Mexico to Central America
- P. acerifolia* AIT.
Hybrid between *P. orientalis* and *P. occidentalis*.

The fossil species of the genus attain about 40 which are reported from various formations from Cretaceous to Cenozoic.

The genus however, has most flourished in the Palaeogene period. Its occurrences become scarce in the Neogene formations. In the general shape and nervation its leaves remind one of maple leaves. The former, however, can be distinguished from the latter by the arrangement not being opposite in pairs

and by the funnel-like terminus of the leaf-stalk. Another resembling genus is Cretaceous *Credneria*, some species of which look almost diagnostic of *Platanus* and indeed *Credneria rhomboidea* VEL. may be a *Platanus*.

Platanus aceroides GOEPPERT,
subspecies *yubariensis* ENDO,
n. subsp.

Pl. 20, fig. 3

Description:—Leaves simple and not lobed, broad ovate in outline, palmately suprabasililar 3 veined and craspedodrome; base somewhat cordate; apex acuminate; margins irregularly dentate or more or less dupleately dentate; midrib stout and straight; alternate secondaries in 4 or 5 pairs, issuing from midrib with angle of about 30 degrees, all strong and straight to the apex of a dentation. Lateral pair of primaries, also prominent and stout, forming an angles of 30 to 35 degrees with midrib and bearing 5 to 7 abaxial secondaries. Tertiary venation somewhat parallel, irregularly percurrent. Texture coriaceous.

* Received Nov. 26, 1962; read Sept. 29, 1962

Maximum length and breadth of the leaf about 10 cm. and 9 cm. respectively.

Comparison.—The present form is almost identical with *Platanus aceroides* GOEPP., which was described by HEER (1856, p. 71, pl. 87, fig. 4). But the present form is not lobed. Therefore it is considered a new subspecies of the species. As already stated, the Genus *Platanus* includes six existing species and numerous fossil species in the range from Cretaceous to Tertiary (KNOWLTON, 1919; LAMOTTE, 1952). The Cretaceous genus, *Credneria*, may be a near relation to *Platanus*. Generally *Credneria* has the obovate or orbicular leaves with roughly dentate margins. Some leaves of *Platanus*, however, have simple and entire margins. It is presumed that remote ancestors had simple and entire margins.

The present species is most common in the Palaeogene formations of East Asia. In Japan it was described by OISHI and HUZIOKA (1943, p. 106, pls.

15-16) from the *Woodwardia* formation of the Ishikari group.

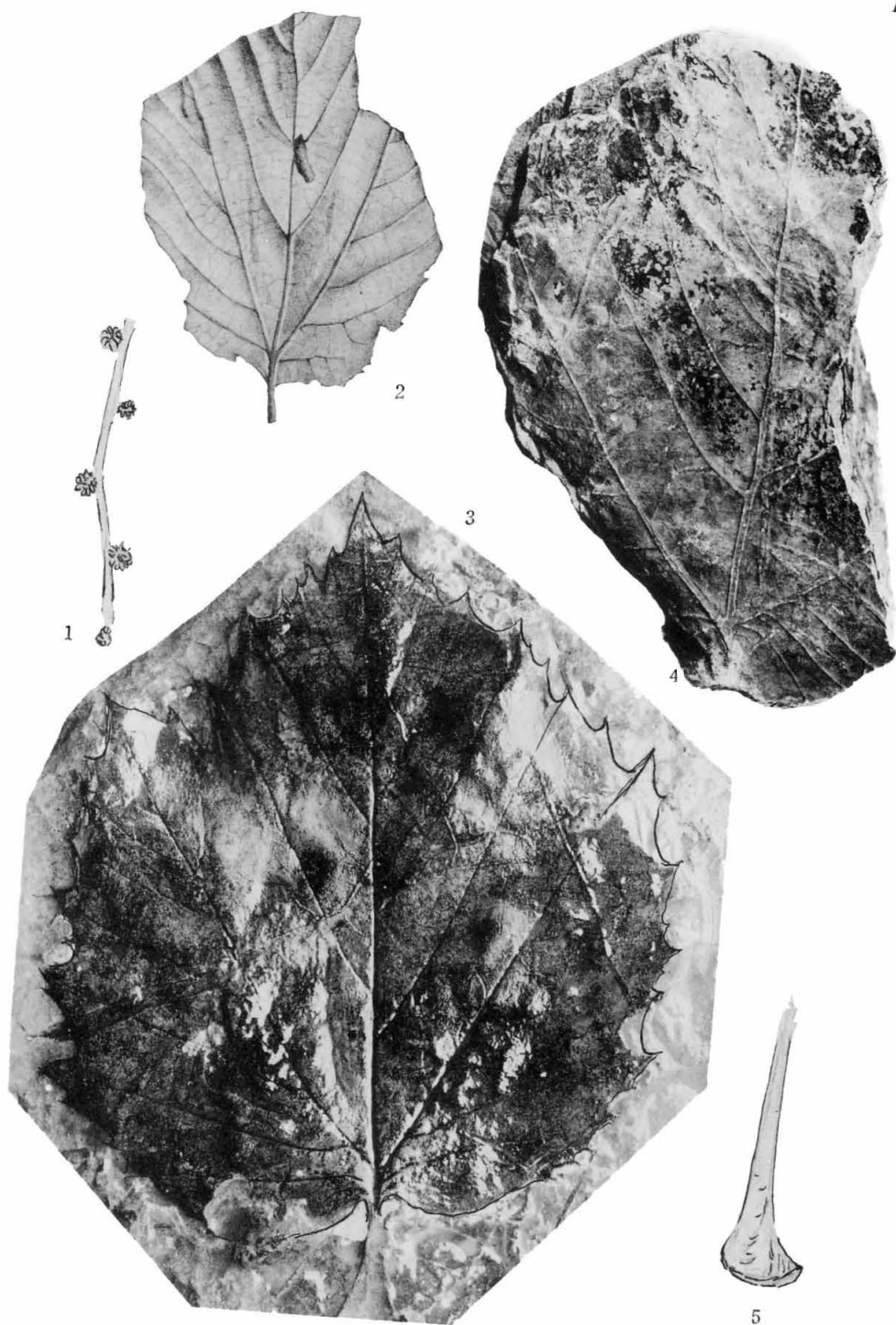
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Kakuta	角 田	Shimizu-sawa	清水沢
Kumano-sawa	熊ノ沢		

Explanation of Plate 20

1. Male catkins of *Platanus*. \times ca. 1.5
Occurrence: Kakuta Coal-Mine, Yubari-gun, Hokkaido; *Woodwardia* formation.
2. *Platanus* sp. \times 1
Occurrence: Kumano-sawa, Yubari-gun, Hokkaido; *Woodwardia* formation.
3. *Platanus aceroides* GOEPP. subsp., *yubariensis* ENDO, n. subsp. \times ca. 1
Occurrence: Shimizu-sawa, Yubari-City, Hokkaido; *Woodwardia* formation.
4. *Platanus* sp. \times ca. 1
Occurrence: Shimizu-sawa, Yubari-City, Hokkaido; *Woodwardia* formation.
5. Basal part of leaf-stalk of *Platanus*. \times ca. 1.3
Occurrence: Kakuta Coal-Mine, Yubari-gun, Hokkaido; *Woodwardia* formation.



460. ON THE GENUS *AILANTHUS* FROM THE
TERTIARY OF JAPAN*

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日本産の第三紀ニワウルシ属について：ニワウルシ属 (*Ailanthus*) は中国の中部から南部にのみ現在自生している植物であるが、その化石は北半球の各地の第三系から発見されている。筆者らはこのたび北海道東北部における中新統上部から、極めて保存のよい *Ailanthus* の小葉と翅果化石を発見した。これらと他の本邦産の本属の化石を併せて検討し、*Ailanthus yezoense* に同定することができた。なお、従来報告された世界におけるニワウルシ属化石を検討して、第三紀における本属の分布変遷について簡単に考察した。

棚井敏雅・鈴木順雄

Introduction

Study of Tertiary Geofloras provides important evidence, if one wishes to investigate the historical development of modern plant distribution. There are widely-spread plants and narrow endemics in the modern plant distribution, whether at the level of genus or family. With respect to genera, most of those in the Arcto-Tertiary Geoflora had a wide distribution in the northern hemisphere, and many of them still exist there; they are typically temperate or cool temperate genera such as pine, spruce, fir, alder, birch, poplar, hazelnut, willow, deciduous oak, maple, hawthorn, rose sumach, and a host of other. On the other hand, there are many relict endemics which formerly had wide distribution, for instance, *Sequoia* (redwood), *Metasequoia*, *Glyptostrobus* (water-pine), *Taxodium* (bald cypress), *Keteleeria*, *Pseudolarix* (golden larch), *Cunninghamia* (Chinese fir), *Comptonia* (sweetfern), *Pterocarya*, *Cercidiphyllum*, *Ailanthus* (tree

of heaven), *Eucommia*, *Engelhardtia* and many others. Furthermore, some are discontinuous, as between Europe-Asia-North America for *Aesculus* (horse-chestnut), *Castanea* (chestnut), *Fagus* (beech), *Ostrya* (hop-hornbeam), and *Ulmus* (elm), or between eastern Asia and eastern North America in the case of *Berchemia*, *Cladrastis* (yellow-wood), *Sassafras* (sassafras), *Nyssa* (tupelo), *Cedrela* (Chinese mahogany), *Liquidambar* (sweet gum), and *Catalpa* (catalpa). The authors undertook to investigate Tertiary fossils of such relict endemic genera, which are restricted in their modern distribution, but were widely distributed in the world during the Tertiary.

The fossil *Ailanthus* has been widely recorded from the Tertiary of the northern hemisphere, though there is not an abundant number of specimens. In eastern Asia 4 species have been reported; they are *A. yungi* HU and CHANEY, *A. yezoense* OISHI and HUZIOKA, *A. confucii* UNGER, and *A. altissima* (MILL.) SWINGLE. Recently, several fruits and leaflets of *Ailanthus* have

Received Jan. 21, 1963; read May 13, 1961.

been found from a Late Miocene flora of northeastern Hokkaido, Japan by the authors, and also 3 fruit specimens were collected from the Middle Miocene of Honshu by HUZIOKA and ISHIDA. The authors investigated these specimens, comparing them with the previously recorded species of the world, and offer a consideration of the past distribution of this genus.

The authors take this opportunity to express their deep gratitude to Professor Kazuo HUZIOKA of Akita University and Dr. Shirō ISHIDA of Kyoto University for kind permission to study some of their collections.

Fossil Remains from Japan

Tertiary fossils of *Ailanthus* in Japan have been identified first from the Middle Miocene of southwestern Hokkaido by OISHI and HUZIOKA (1942); lately the present authors add their findings in several localities of Hokkaido and Honshu. Also, only seeds of *Ailanthus* with no wing have been reported from the Pleistocene of western Honshu by MIKI (1948). These fossil localities and the general features of the floras found in company with *Ailanthus* are as follows:

1) Abura, Setana-machi, southwestern Hokkaido (Middle Miocene).

On the basis of an incomplete samara and its counterpart from the Middle Miocene Kunnui formation, *Ailanthus yezoense* was established by OISHI and HUZIOKA (1942). Lately, the authors have investigated the Abura flora in detail, collecting a number of fossils. This flora consists mainly of temperate plants such as Pinaceae, Betulaceae, Ulmaceae, and Aceraceae; of 50 Abura species, *Fagus antipofi*, *Metasequoia occidentalis*, *Picea ugoana*, *Acer ezoanum*, *Glyptostrobus europaeus*, *Abies aburaensis*,

Castanea miomollissima and *Carpinus subcordata* occupy about 90 per cent of the total 1,169 specimens collected by the authors. As already discussed in detail (TANAI, 1963, in press), the Abura flora is concluded to have been both a slope and a montane association in temperate region during Middle Miocene time.

2) Kamishanabuchi, Engaru-machi, northeastern Hokkaido (Late Miocene).

Several well-preserved leaflets and samaras referable to *Ailanthus yezoense*, have been collected from the Late Miocene Shanabuchi formation of northeastern Hokkaido by the authors. The Shanabuchi flora comprises mainly typically temperate families such as Pinaceae, Salicaceae, Betulaceae, Fagaceae, Ulmaceae, Rosaceae, and Aceraceae; of Shanabuchi 71 species, *Fagus protojaponica*, *Cladrastis chaneyi*, *Ulmus protojaponica*, *Betula protoermani*, *Cercidiphyllum crenatum*, *Juglans japonica*, *Carpinus subcordata*, *Magnolia elliptica*, *Acer protojaponicum*, *Picea kaneharai*, *Salix lanceolata*, *Celtis miobungeana*, and *C. nordenskiöldii*, make up about 77 per cent of the total 993 specimens collected by the authors. This flora is largely composed of temperate broad-leaved trees, accompanied by several southern elements such as *Taiwania*, *Liquidambar*, *Cinnamomum*, and *Zizyphus*; it belongs indubitably to the so-called Mitoku-type flora of Late Miocene time (TANAI, 1961, pp. 169-184).

3) Kamigo, Tsuruoka City, northeastern Honshu (Middle Miocene).

A single samara referable to *A. yezoense* was collected by HUZIOKA from the Middle Miocene Kamigo formation of northeastern Honshu. On the basis of the senior author's investigation (TANAI, 1961, pp. 154-155), the Kamigo flora consists mainly of temperate and rather warm temperate families such as Faga-

ceae, Lauraceae, Leguminosae, Anacardiaceae: of 35 Kamigo species, *Castanea miomollissima*, *Quercus mandraliscae*, *Q. nathorsti*, *Zelkova ungeri*, *Comptonia nannmanni*, *Liquidambar miosinica*, *Cinnamomum miocenum*, *Parabenzoin protopraecox* and *Carpinus shimizui* make up over 60 per cent of the total specimens collected by the senior author. This flora consists largely of rather warm temperate broad-leaved trees, including several subtropical trees, and seems likely to have been a lowland to lower slope association, influenced by rather warm sea current.

4) Takaya, Suzu City, Ishikawa Prefecture, north-central Honshu (Middle Miocene).

Two well-preserved samaras collected by ISHIDA from the Middle Miocene Anamizu formation of Noto peninsula, central Honshu, are referable to *A. yezoense*. According to Dr. ISHIDA's investigation, the Suzu flora consists mainly of Taxodiaceae, Pinaceae, Betulaceae, Fagaceae, Hamamelidaceae, Lauraceae, Leguminosae, and Anacardiaceae; the dominant species are *Pinus miocenica*, *Fookienia* sp. nov., *Metasequoia occidentalis*, *Comptonia nannmanni*, *Castanea miomollissima*, *Quercus nathorsti*, *Q. mandraliscae*, *Carpinus shimizui*, *Zelkova ungeri*, *Liquidambar miosinica*, *Machilus ugoana*, *Cladrastis anisensis*, *Podogonium knorri*, *Rhus miosuccedanea*, "*Dodonaea*" *japonica*, and *Acer palaeodiabolicum*. This flora includes a number of ever-green broad-leaved trees, associating southern conifers, and seems to have been lowland and slope vegetation during the Middle Miocene.

5) Higashiyama, Kyoto City, western Honshu (Pleistocene).

6) Minoo-machi, Toyonaka City, Osaka Prefecture, western Honshu (Pleistocene).

Several fossil seeds with no wings referred to *A. altissima* were reported

by MIKI (1948, pp. 108-109, pl. 5, fig. II) from the Pleistocene of western Honshu. These fossils offer the latest fossil record of *Ailanthus* in the world, and probably have a very close relationship with the living species which has survived only in China.

Fossil Remains from East Asia except Japan

Fossils of *Ailanthus* from East Asia, excluding Japan, are known from the following 4 localities, but they are not common.

7) Kungsing coal mine, North Hamgyōng-do, northeastern Korea (Middle Miocene).

An incomplete winged seed was figured as *A. kyushinensis* from the Middle Miocene Ham-gyōng-do formation of north-eastern Korea by ENDO (1955, pl. 32, fig. 2). According to ENDO (1938), this flora consists mainly of Juglandaceae, Betulaceae, Fagaceae, Lauraceae, Hamamelidaceae and Aceraceae, and is closely similar to the Daijima-type flora of Middle Miocene age, considering from its floristic composition and components. As discussed later, *A. kyushinensis* is placed in synonymy with *A. yezoense* by the present authors.

8) Shanwang, Shantung Province, northern China (Middle Miocene).

On the basis of a single samara and 3 leaflets, *A. yungi* was described from the Middle Miocene Shanwang flora of northern China by HU and CHANEY (1938, pp. 54-55, pl. 30, figs. 4, 5, 8, 9). These leaflets as discussed later, are somewhat doubtfully referable to *Ailanthus*, but the samara is apparently referable to this genus. The Shanwang flora consists mainly of Betulaceae, Fagaceae, Ulmaceae, Hamamelidaceae, Leguminosae, Magnoliaceae, Anacardiaceae, Rosaceae, and Aceraceae, and in-

cludes a number of southern ever-green broad-leafed trees. This flora was concluded by CHANEY (1938) to have represented the vegetation surrounding an upland lake during Middle Miocene time.

9) Bureinski Plain, Khavarovskaya, eastern USSR (Paleocene).

Two incomplete samara referred to *A. confucii* were described from a Paleocene flora of Khavarovskaya, eastern USSR by BAIKOVSKAYA (1950, p. 372, pl. 3, figs. 10, 11). This flora consists mainly of temperate or warm temperate trees such as Salicaceae, Moraceae, Lauraceae, Rhamnaceae, and Ebenaceae, associated with several aquatic plants such as *Salvinia*, *Potamogeton*, *Arundo*, *Cyperites*, *Nelumbo*, and *Ceratophyllum*. If this flora is acceptable to be Paleocene in age as considered by BAIKOVSKAYA, the fossils of *Ailanthus* from Khavarovskaya are the oldest in the world.

10) Fushun coal field, Fengtien province, southern Manchuria (Oligocene or Late Eocene).

A number of well-preserved plant fossils have been reported from the Late Fushun Group of southern Manchuria by FLORIN (1922) and ENDO (1934, 1942). ENDO listed *A. asiatica* in the Fushun flora, but no description and figure were given for its species. The Fushun flora is composed mainly of Taxodiaceae, Salicaceae, Betulaceae, Fagaceae, Moraceae, Platanaceae, *Sabalites*, and *Nelumbo*; it is closely similar to the Ikushunbetsu flora of Hokkaido, Japan, and is considered to be Oligocene or Late Eocene in age.

11) Ashutas, eastern Kazakh region, USSR. (Oligocene).

Two winged seeds of *A. confucii* were described from the Oligocene flora of the eastern Kazakh region, Central Asia by KRYSITOVICH (1956, p. 132, pl. 50, figs. 4, 5). The Ashutas flora consists

mainly of temperate broad-leafed trees such as Salicaceae, Juglandaceae, Betulaceae, Fagaceae, Ulmaceae, Magnoliaceae, Hamamelidaceae, Rosaceae, Aceraceae, Vitaceae, and Nyssaceae, being associated with conifers such as *Pseudolarix*, *Taxodium*, *Metasequoia*, and *Glyptostrobus*; all of these fossils show a very close resemblance to the Middle Miocene species of Japan.

Fossil Remains from North America

From the Tertiary of North America have been known 2 species of *Ailanthus*, *A. indiana* and *A. americana*, on the basis largely of winged seeds and occasionally of leaflets. These fossils ranged from the Middle Eocene to the Middle Miocene; no fossil of *Ailanthus* since the Late Miocene has been recorded. The localities of *Ailanthus* in North America are as follows:

Ailanthus indiana (MACGINITIE) BROWN

12) Upper Cedarville, Nevada (Middle Miocene): CHANEY and AXELROD (1959), p. 189.

13) Blue Mountains, Oregon (Middle Miocene): CHANEY and AXELROD (1959), p. 189, pl. 38, fig. 2.

14) Stinking Water, Oregon (Middle Miocene): CHANEY and AXELROD (1959), p. 189, pl. 38, fig. 1.

15) Sucker Creek, Oregon (Middle Miocene): SMITH (1939), p. 117, pl. 6, fig. 1; pl. 7, fig. 2; ARNOLD (1937), p. 95, pl. 8, figs. 3, 4.

16) Trout Creek, Oregon (Middle Miocene): MACGINITIE (1933), pl. 12, fig. 1 (Original specimen based on leaflet); ARNOLD (1937), p. 35.

17) Tipton, Oregon (Middle Miocene): OLIVER (1934), p. 23.

Ailanthus americana COCKERELL

18) Florissant, Colorado (Early Oligocene): MACGINITIE (1953), p. 129, pl. 37,

figs. 7, 8; COCKERELL (1908), p. 539, text-fig. 3 (original specimen on the basis of winged seed).

19) Ruby, Montana (Late Oligocene): BECKER (1961), p. 77, pl. 24, figs. 13-17.

20) Chalk Bluff, California (Middle Eocene): MACGINITIE (1941), p. 136, pl. 32, fig. 5.

21) Green River, Wyoming (Eocene): COCKERELL (1927), p. 95; BROWN (1934), p. 59.

Fossil Remains from Europe

Fossils of *Ailanthus* have commonly known from the Tertiary of Europe; they range from the Lower Oligocene to the Lower Pliocene. These fossils are largely of winged seeds, partly of leaflets, and are described under various specific names. Principal fossils and their localities are as follows:

Ailanthus confucii UNGER

This species is most widely distributed and most widely ranged in the Tertiary vegetation of Europe; it was originally established on the basis of winged seeds by UNGER (1850), thereafter was redesignated by WEYLAND (1937), on the basis of both fruits and leaflets. *A. confucii* has been recorded from the following 6 localities in Europe.

22) Brunn-vösendorf, near Wien, Austria (Early Pliocene): BERGER (1955), p. 78, abb. 18.

23) Rott, northern Rhineland, Germany (Late or Middle Oligocene): WEYLAND (1937), p. 100, abb. 40, pl. 2, fig. 14; WESSEL (1856), p. 147, pl. 26, fig. 3; SCHLECHTENDAL (1789), p. 384, pl. 2, fig. 1; GOTHAN and ZIMMERMANN (1919), p. 116, abb. 73c.

24) Randeck, near Kelheim, Württemberg, Germany (Late Miocene): UNGER (1850), p. 23; UNGER (1866), p. 54, pl. 17, figs. 6, 7 (Original specimens based on

winged seeds).

25) Erdöbénye, near Tokaj, north-eastern Hungary (Late Oligocene): ANDREANSZKY (1959), p. 155, abb. 181, pl. 67, fig. 2.

26) Krynka River area, Rostov region, southwestern USSR (Late Miocene): KRYSHTOFOVICH (1916), p. 1285, fig. 7.

The following species based on winged seeds are nearly indistinguishable from *A. confucii* in character of fruit, although they are different in size.

27) *Ailanthus microsperma* HEER. Hoheronen, near Zug, Switzerland (Early Miocene): HEER (1859), p. 87, pl. 127, fig. 35.

28) *Ailanthus oxicarpa* SAPORTA. Berand, near Suloditz, Czechoslovakia (Late Oligocene): ENGELHARDT (1898), p. 110, pl. 11, figs. 15, 16.

29) *Ailanthus foersteri* LAKOWITZ. Brunsatt, Alsace, France (Early Miocene): LAKOWITZ (1895), p. 275, pl. 9, fig. 14.

30) *Ailanthus* sp. Valea Neagra, near Oradea, northwestern Rumania (Early Pliocene): GIVULESCU (1962), p. 156, abb. 129.

In addition to the above-noted localities, several species of *Ailanthus* have been reported from many localities by various authors. Of these fossils leaflets or fruits surely belonging to *Ailanthus* are as follows:

31) *Ailanthus ailanthifolia* (WEBER) WEYLAND. Rott, north Rhineland, Germany (Late or Middle Oligocene): WEYLAND (1937), p. 100, pl. 12, fig. 15.

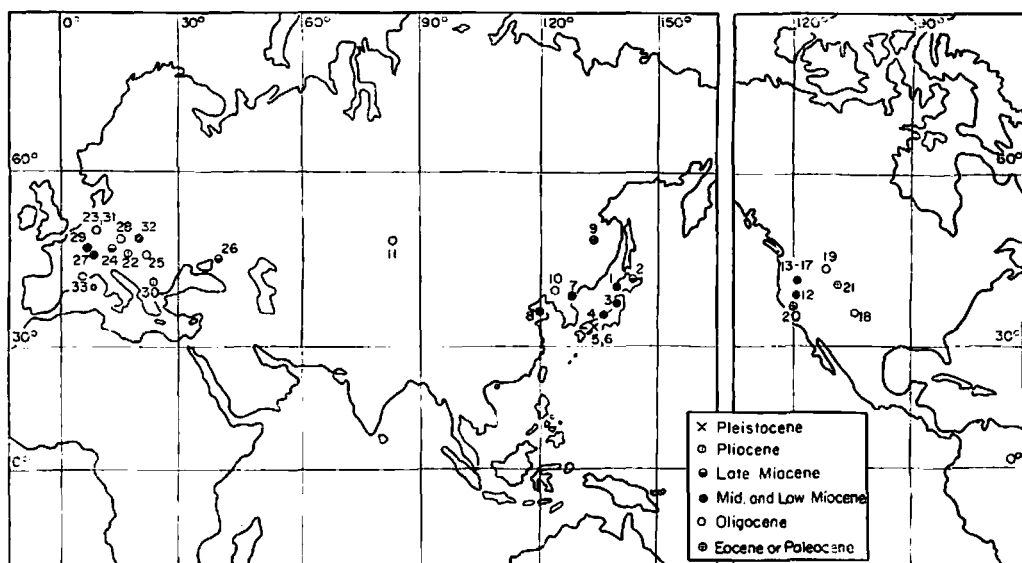
32) *Ailanthus altissima* (MILL.) SWINGLE. Stare Gliwice, Upper Silesia, Poland (Miocene): SZAFER (1961), p. 71, pl. 19, figs. 1, 2.

33) *Ailanthus recognita* SAPORTA. Aix, Bouches du Rhône, southeastern France (Early Oligocene): SAPORTA (1862), pl. 8, fig. 7.

Consideration of Distribution

The living species of the genus *Ailanthus* grows in a limited area of the northern hemisphere; it is native only in central and southern China. This living tree, *Ailanthus altissima*, seems to show a warm temperate or subtropical appearance; it is very luxuriantly growing in such warm or tropical regions of low latitudes as Malaysia, India, the Philip-

pines, New Zealand, and northern Australia, though it is not native there. On the one hand, it is also a hardy tree of very rapid growth and little affected by the dust and smoke of cities in temperate regions of middle latitudes in the northern hemisphere; it shows a luxuriant growth even in cool-temperate regions of North America, Europe, and East Asia. Thus, the living species seems to be well adaptable to various climatic conditions.



Text-fig. 1. Past distribution of the genus *Ailanthus*. Numbers of fossil localities correspond to those written in text.

On the basis of fossil leaflets and fruits surely referred to *Ailanthus*, the genus was widely distributed in the middle latitudes of the northern hemisphere during the Tertiary Period as shown in text-fig. 1; it ranged from about 35 to about 50 degrees of north latitudes. Most of its fossil localities are, however, nearly concentrated into the following 3 regions: Middle Europe, East Asia, and western United States. It is noteworthy that no fossil *Ailanthus*,

on the basis of both macrofossils and pollens, has been recorded from eastern United States, where many trees of such Tertiary world-widely distributed genera as *Comptonia*, *Taxodium*, *Liquidambar*, *Sassafras*, *Nyssa*, *Liriodendron*, *Diospyros*, and *Cercis*, have survived similarly to the case in China. Many fossils of Asiatic genera such as *Metasequoia*, *Glyptostrobus*, *Pterocarya*, *Engelhardtia*, *Zelkova*, *Cercidiphyllum*, *Phellodendron*, *Camellia*, and *Acer* (Asiatic type), have

been recorded from the Tertiary of eastern United States, and also most of these genera were common members in all of the Tertiary floras of the world which include fossils of *Ailanthus*. Furthermore, the living species, *A. altissima*, is widely naturalized in eastern United States and eastern Canada. Accordingly, it is unsolved why *Ailanthus* has been not recorded from the Tertiary of eastern North America. Most of Tertiary floras including *Ailanthus* show, in general, typically temperate or warm temperate aspects, considering their floristic composition. But, some of Paleogene floras such as the Chalk Bluff and Green River floras of western United States, have rather subtropical aspect, and in these floras *Ailanthus* was associated with many tropical or subtropical ever-green trees such as *Lygodium*, *Sabalites*, *Castanopsis*, *Ficus*, *Persea*, *Cinnamomum*, *Artocarpus*, *Terminalia*, *Phytocrene*, and *Canarium*. Due to lowering temperate, Paleogene *Ailanthus* in subtropical forest seems to have adapted to temperate climate during Oligocene and Miocene time. Thus, wide adaptation to various climatic conditions in the past is quite similar to that of the living species as shown in the present cultivation.

As to geologic distribution, in North America *Ailanthus* ranged from the Middle Eocene to the Middle Miocene, in Europe from the Lower Oligocene to the Lower Pliocene, and in East Asia from the Paleocene to the Pleistocene. It is rather natural that fossil seeds of *Ailanthus* occurred from the Pleistocene of Japan, because its relict is now found in China. Considering their distribution, Paleogene floras with *Ailanthus* somewhat shifted southward during Miocene time in Eurasia, while *Ailanthus* disappeared in interior regions of North

America. The gradual reduction and narrowing distribution of *Ailanthus* in the world during the Late Miocene and the Pliocene has been, of course, ascribed to lowering temperature. However, these problems must be left for later discussion after research on many other relict plants, which flourished widely in the Tertiary.

Description of Species

Ailanthus yezoense OISHI et HUZIOKA

Pl. 21, figs. 1, 3-6, 12, 13.

1942. *Ailanthus yezoense* OISHI et HUZIOKA. *Jour. Geol. Soc. Japan*, vol. 49, p. 181, text-fig. 2-4.
 1955. *Ailanthus kyushinensis* ENDO. *Icon. Foss. Plants Japan*, Isl., pl. 32, fig. 2.
 1963. *Ailanthus yezoense* OISHI et HUZIOKA. TANAI et N. SUZUKI. *Geol. Surv. Japan. Spec. Rep.*, pl. 16, figs. 4, 5. (in press).

Supplementary description.— Leaflets lanceolate, 14 cm. (estimated) long and 4 to 6.7 cm. wide; apex gradually narrowed, with an acuminate tip, somewhat arcuate; base broadly rounded to asymmetrically truncate; midrib stout, very thick below, gradually thin distally, nearly straight but somewhat arcuate in apical part; secondary nerves about 13 pairs, opposite to subalternate, leaving midrib at angles of 70 to 90 degrees in lower part of blade, and of 45 to 55 degrees in upper part, gently curving upward, near margin arising upward, forming loops; slender subsecondary nerves sometimes leaving midrib in intersecondary spaces; a few branches from secondaries near margin forming small loops; tertiaries thin, irregularly percurrent; nervilles indistinct, finely and irregularly reticulate; margin entire but irregularly waved, having a pair of

glands in basal margin; texture thin; petiole missing.

Samaras 2.5 to 3.2 cm. long and 0.8 to 1 cm. wide in the middle part; wing linear-oblong in shape, obtuse and twisted apex, acute at base, petiolate; nerves thin and numerous, indistinct; seeds occupying a central part of wing, compressed, orbicular in shape.

Remarks.—These well-preserved samaras from several localities in Japan are referred to *A. yezoense* in their characteristic features, though the original specimen is incomplete. They well match those produced by the modern *A. altissima* (MILL.) SWINGLE of China. An incomplete samara figured as *A. kyushinensis* from the Middle Miocene Kungsing flora of northern Korea (ENDO, 1955) is essentially indistinguishable from our species, and is therefore included in *A. yezoense*. Several well-preserved leaflets from the Upper Miocene Shanabuchi flora of Hokkaido are closely similar to those of the modern *A. altissima* in their shape, secondary nervation, and glands of basal margin. These leaflets are associated with fossil samara of *A. yezoense* from the same locality, and so they are referable to this species.

Samaras of *A. yezoense* are closely similar to those of *A. confucii* UNGER which has been commonly reported from the Pliocene to Oligocene floras of Europe. They also resemble samaras of *A. indiana* (MACGINITIE) BROWN from Miocene floras of western United States in all characters, but leaflets referred to this American species (*Apocynum indiana* MACGINITIE, 1933, and *Sapindus oregoniana* KNOWLTON, LAMOTTE, 1935), having no glands which characterize the genus *Ailanthus*, do not appear to the present authors like those of *Ailanthus*. Foliages figured as *A. yungi* by HU and CHANEY (1938) from the Miocene Shanwang flora

of China seem doubtfully referable to this genus, though the seed appears to represent *Ailanthus*. A single leaflet figured as *A. ailanthifolia* (WEB.) WEYLAND from an Oligocene flora of Germany (WEYLAND, 1938: pl. 12, fig. 15) represents surely that of this genus, having a few pairs of distinctive glands in its lower margin, but it does not resemble our leaflets in shape and secondary nervation. No fossil leaflets in the world are similar to our species.

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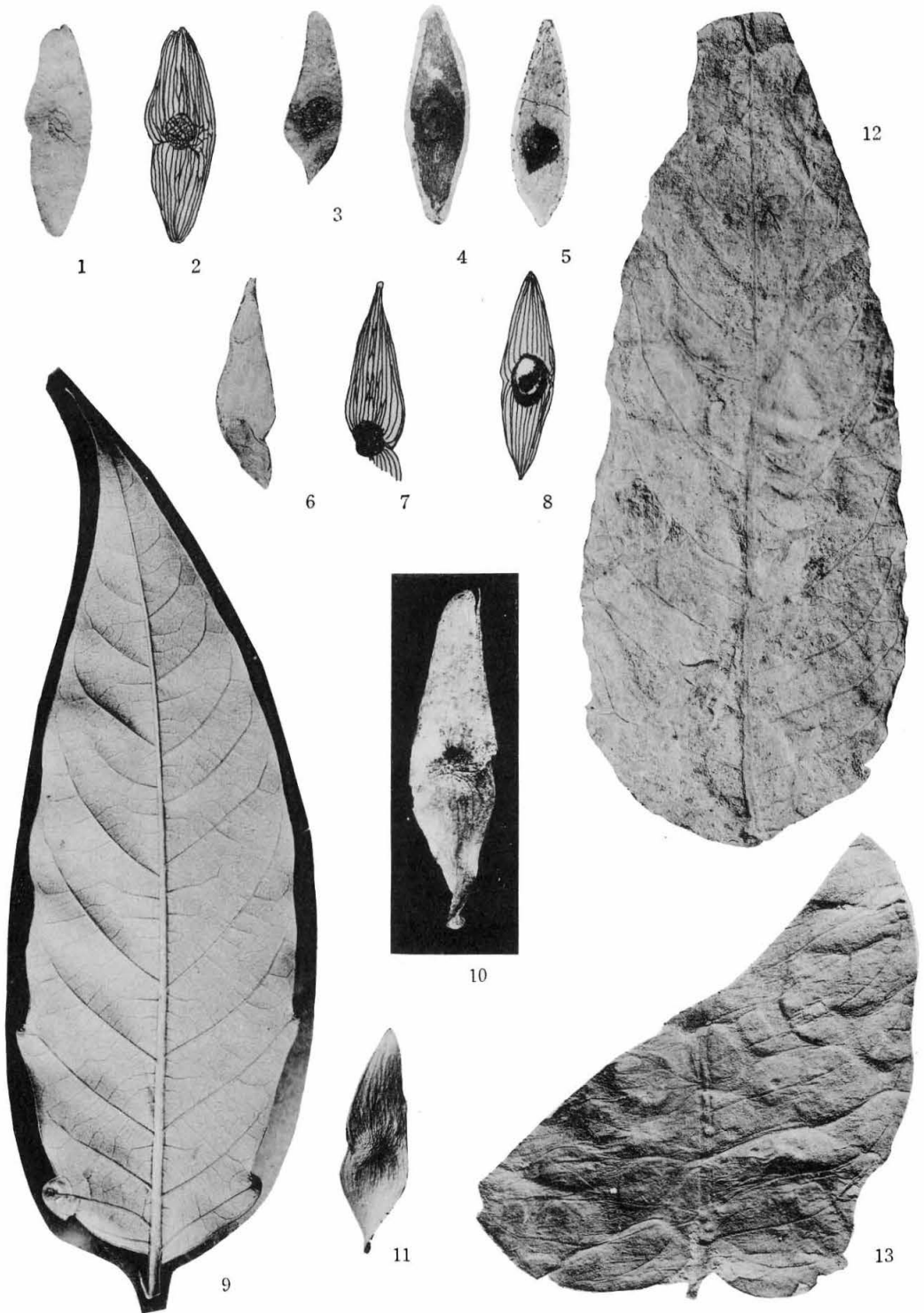
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Abura	虻 羅	Kamishanabuchi	上社名淵
Engaru-machi	遠 輕 町	Minoo	箕 面
Higashiyama	東 山	Setana-machi	瀬 棚 町
Kamigo	上 郷	Takaya	高 屋

Explanation of Plate 21

(All natural size)

- Figs. 1, 3. *Ailanthus yezoense* OISHI et HUZIOKA. Kami-shanabuchi, Engaru-machi, north-eastern Hokkaido. Shanabuchi formation (Late Miocene). Paratype H. U. M. P. No. 25750 (fig. 1), Hypotype No. 25751 (fig. 3).
- Fig. 2. Sketch of fig. 1.
- Fig. 4. *Ailanthus yezoense* OISHI et HUZIOKA. Takaya, Suzu City, Ishikawa Prefecture. Anamizu formation (Middle Miocene).
- Fig. 5. *Ailanthus yezoense* OISHI et HUZIOKA. Kamigo, Tsuruoka City, Yamagata Prefecture. Kamigo formation (Middle Miocene).
- Fig. 6. *Ailanthus yezoense* OISHI et HUZIOKA. Abura, Setana-machi, southwestern Hokkaido. Kunnui formation (Middle Miocene). H. U. M. P. No. 9313.
- Fig. 7. Sketch of fig. 6.
- Fig. 8. Sketch of fig. 4.
- Figs. 9-11. *Ailanthus altissima* (MILL.) SWINGLE. The living leaflet and winged seeds for comparison (cultivated in the campus of the Hokkaido University).
- Figs. 12, 13. *Ailanthus yezoense* OISHI et HUZIOKA. Kami-shanabuchi. Paratype H. U. M. P. No. 25749 (fig. 12), Hypotype No. 25752.



461. THE SO-CALLED *PATINOPECTEN* OF JAPAN*

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本邦産いわゆる *Patinopecten* について：本邦産の *Patinopecten* と北米産の *Patinopecten* を比較検討した結果、従来日本から報告されたいわゆる *Patinopecten* は、その殆どが北米の *Patinopecten* とは別系統のものであることが明らかになった。唯 *Pecten tokunagai* YOKOYAMA は *Patinopecten* のグループに属するものであると考えられ、これに対して *Yabepecten* なる新属名を与えた。更にいわゆる *Patinopecten* に対しては *Fortipectininae* なる新亜科を設定し、従来 *Patinopecten* (s. s.) と考えられていたものに対して *Mizuhopecten* なる新属名を与え、本邦産 *Patinopecten* の再分類を行った。

増田孝一郎

Introduction

Patinopecten was established by DALL in 1898 as a section of the genus *Pecten* based upon a Northern Californian scallop, *Pecten caurinus* GOULD. Thence *Patinopecten* has frequently been recorded from the Recent seas of the Northern Pacific, Tertiary and Pleistocene deposits of Japan and of the West Coast of North America. *Patinopecten* has not been recorded from other regions.

In Japan *Patinopecten* was first used by KURODA (1932) as a subgenus of *Pecten* based upon a Recent scallop, *Pecten yessoensis* JAY and also for about ten fossil species such as *Pecten tokyoensis* TOKUNAGA, *Pecten kagamianus* YOKOYAMA, *Pecten takahashii* YOKOYAMA, etc. Thenceforth, there have been published many works in which descriptions, illustrations or only lists of *Patinopecten*, Recent or fossil, are

given from various localities distributed throughout Japan and Korea. Among the Tertiary or Pleistocene Pectinidae of Japan *Patinopecten* has been considered to be one of the important and interesting scallops, particularly from the view point of geographical distribution, restricted geological range and intimate relationship with the Californian scallops. Lately AKIYAMA (1962) has discussed on the phylogenetical relationship between the North American *Patinopecten* and the Japanese *Patinopecten*, and concluded that some American species of *Patinopecten* migrated from Japan during the Miocene to Pliocene age. But from the study of the Tertiary Pectinidae of Japan the present writer (1962a) doubted whether the genus *Patinopecten* in usage in Japan can be identified exactly with the *Patinopecten* of Western North America, though the genus *Patinopecten* was employed for the Japanese Tertiary scallops at that time.

Many specimens of fossil and Recent species of *Patinopecten* from the West Coast of North America and numerous

* Received Feb. 1, 1963; read at the annual meeting of the Society at Tokyo, Jan. 19, 1963.

specimens of all known species of the so-called *Patinopecten* in Japan were studied with regard to the above mentioned problem. The specimens studied included those now preserved in the collections of the Department of Geology, Faculty of Education, of the Institute of Geology and Paleontology, Faculty of Science, both of the Tohoku University, and of the Saito Ho-on Kai Museum, all in Sendai City, and the collections of the National Science Museum and of the Geological and Mineralogical Institute, Faculty of Science, Tokyo University of Education, all in Tokyo.

The results of examination of those specimens show that almost all of the species of the so-called *Patinopecten* in Japan differ from the true *Patinopecten* of North America and that the so-called *Patinopecten* group in Japan may be classified into five genera and be included into a subfamily different from the Pectininae which includes such genera as *Pecten* and *Patinopecten*. However, only one species, the so-called *Patinopecten tokunagai* (YOKOYAMA), a Pliocene species of Northern Japan, can be considered to represent an undescribed genus of the *Patinopecten* group.

In the present article the writer describes the morphological characters of the true *Patinopecten* of North America and the so-called *Patinopecten* of Japan, proposes a new classification of the *Patinopecten* group in usage in Japan, and discusses on the paleontological significance of the so-called *Patinopecten* of Japan.

Acknowledgements

The writer wishes to express his deep gratitude to Professor Kotora HATAI of the Institute of Geology and Paleontology, Faculty of Science, Tohoku Uni-

versity, for his contiguous encouragement and supervision during the course of the present work and to Dr. Edwin C. ALLISON of the Department of Geology, San Diego State College, for his kind offer of the Californian specimens. Acknowledgements are due to Dr. Tada-shige HABE of the National Science Museum, Tokyo, for his encouragement and to Dr. Shozo HAYASAKA of the Institute of Geology and Paleontology, Faculty of Science, Tohoku University, for his discussion on paleontology problems.

Thanks are due to the Saito Ho-on Kai Museum, Institute of Geology and Paleontology, Faculty of Science, Tohoku University, both of Sendai City and to the National Science Museum and the Geological and Mineralogical Institute, Faculty of Science, Tokyo University of Education, both in Tokyo, for permission to study their collections.

Notes on the genus *Patinopecten*

In 1898 DALL (p. 695) established *Patinopecten* as a section of the genus *Pecten* and gave the following diagnosis:

"Valves with small ribs, flat on the right valve and sometimes dichotomous; smaller and more rounded on the left valve; concentric sculpture inconspicuous; radial striae absent or obsolete; ears subequal; valves nearly equilateral".

At that time he designated *Pecten caurinus* GOULD, a Recent scallop of Northern California, as the type species and included into this section such fossil species as *Pecten meekii* CONRAD and *Pecten expansus* DALL.

Subsequently ARNOLD (1906) raised *Patinopecten* to subgeneric ranking and included the following scallops, *Pecten caurinus* GOULD, *Pecten coosensis* SHUMARD, *Pecten dilleri* DALL, *Pecten healeyi*

ARNOLD, *Pecten oweni* ARNOLD, *Pecten purisimaensis* ARNOLD, *Pecten propatulus* CONRAD and *Pecten turneri* ARNOLD. Subsequently, GRANT and GALE (1931) gave the following diagnosis to the subgenus *Patinopecten*.

"Shell large, thin, sometimes of a somewhat pearly texture, having a circular outline and very low convexity, valves usually equal, although at times one or the other may become nearly flat: radial sculpture consisting of distinct ribs without minor striation, sometimes with microscopic cross-hatching, ribs of the right valve comparatively broad and squarish, sometimes with a medial sulcus, those of the left valve narrow, often sharp, with intercalaries if the ribs of the right valve are sulcated; hinge line usually short, ears of almost equal length, byssal notch deep in the older species, more shallow in Recent species".

At that time they included several fossil or Recent species distributed from Alaska to Oregon into the subgenus *Patinopecten*. Moreover, they questionably referred the Japanese *Pecten yamasakii* YOKOYAMA and *Pecten tryblium* YOKOYAMA to *Pecten (Patinopecten) healevi* ARNOLD, a Pliocene species of California.

From the study of the Recent and fossil Californian scallops referable to *Patinopecten caurinus* (GOULD), the type species of the genus *Patinopecten*, the following features must be added to the descriptions by DALL. and GRANT and GALE:

Rather thick, conspicuous auricular crurae along inner margin of auricles with a conspicuous, rounded, oblong distal denticle at extremity of posterior part, that at anterior part extends ventrally and terminates distally in an oblong, rather obscure denticle in right valve: left valve with distal denticle

at each extremity of hinge more conspicuous than that of right valve.

These characteristic features can be observed in *Patinopecten healevi* (ARNOLD) at hand from the Pliocene formations in California. But the auricular crurae of the inner margin of the auricles in *Patinopecten caurinus* (GOULD) and *Patinopecten healevi* (ARNOLD) are not so conspicuous compared with those of the Amusiinae.

Recently MACNEIL (1961) distinguished the subgenus *Lituyapecten* from the genus *Patinopecten* based upon the fossil specimens from Alaska and California. At that time he designated *Patinopecten (Lituyapecten) lituyaensis* MACNEIL as the type species and included several known and new species into *Lituyapecten*. According to the original description and figures the subgenus *Lituyapecten* seems to have the same characteristic features of the hinge area as of *Patinopecten*.

Under the genus *Patinopecten* (or subgenus *Patinopecten* of some authors) many species have been described from the Tertiary and Quaternary formations in the West Coast of North America, but whether all of these species can be referred to *Patinopecten* or *Lituyapecten* may be open to question. Judging from the published descriptions and figures of the species hitherto referred to the genus *Patinopecten* from the West Coast of North America it seems that all may be identified with the genus, but further study on the problem appears to be desirable.

The genus *Pecten* has nearly the same characteristic features in the hinge area as those of the *Patinopecten*, but the former can be distinguished from the latter by its greatly inflated right valve, concave or flat left valve, distinct internal ribs and much less conspicuous byssal notch. The auricular crurae in

Pecten are rather obscure and very slender in the right valve but in the left valve they terminate distally in a distinct, rounded, rather oblong denticle at each extremity of the hinge. From the morphological characters it is evident that *Patinopecten* should be included into the same subfamily Pectininae as the genus *Pecten*.

In the genera of Amusiinae the auricular crurae terminate distally in a very much conspicuous, rounded, rather oblong denticle at each extremity of hinge and they are considered to be one of the most important characters in the classification of them besides the internal ribs (VERRILL, 1897).

Considering from the morphological characters of the auricular crurae above described it is evident that they enable the valves to resist the powerful action of the adductor muscle when suddenly closed and may serve to strengthen the valves. This consideration may be supported by the abraded distal denticle of the auricular crurae in the left valve of full grown specimens of the genus *Pecten*, because this was probably produced by the friction of the valves when suddenly closed for swimming or for self-protection. Thus the above noticed features of hinge area are important criteria in the classification of the Pectinidae.

The genus *Patinopecten* in usage in Japan very much resembles the true *Patinopecten* in general exterior features. However, almost all species of the so-called *Patinopecten* of Japan can be distinguished from the true *Patinopecten* by lacking the auricular crurae with conspicuous distal denticle, rounded radial ribs in the right valve, very shallow byssal notch and large auricles. Therefore, the Japanese species of *Patinopecten* are in need of a new classification.

cation.

Among the numerous Cenozoic species of the so-called *Patinopecten* of Japan only one Pliocene species, the so-called *Patinopecten tokunagai* (YOKOYAMA), has the same characteristic auricular crurae as the true *Patinopecten*, though it is more obscure. The other morphological characters of *tokunagai* are so different from the *Patinopecten* of North America that it can be regarded as an undescribed genus of the *Patinopecten* group as mentioned later.

In other species of the so-called *Patinopecten* of Japan the characteristic features of hinge area as *tokunagai* have not been observed. The other genera or subgenera of the Japanese *Patinopecten* group in broad sense, that is to say, *Fortipecten*, *Masudapecten* and *Kotorapecten* are lacking in the characteristic features of hinge area above mentioned.

Revision of the Japanese *Patinopecten* in usage

As noticed in the earlier pages, among the species hitherto referred to *Patinopecten* in Japan the true *Patinopecten* group is represented only by the so-called *Patinopecten tokunagai* (YOKOYAMA), whereas the other scallops of the group should be referred to some genus other than *Patinopecten*. From the morphological features, among the Cenozoic Pectinidae of Japan only *Pecten albicans* (SCHRÖTER), *Pecten excavatus* ANTON, *Pecten puncticulatus* DUNKER and the so-called *Patinopecten tokunagai* (YOKOYAMA) can be included into the subfamily Pectininae.

Since publication of a monograph of the Pectinidae of Japan (MASUDA, 1962a), the writer, from the evidence accumulated to date, finds that the *Patinopecten*

group must be revised and proposes in this work the following classification of the Japanese *Patinopecten* group.

Family Pectinidae

Subfamily Pectininae

Genus *Pecten* MÜLLER, 1776

Pecten albicans (SCHROTER), 1802

Pecten naganumanus YOKOYAMA, 1920

Genus *Yabepecten* MASUDA, n. gen.

Yabepecten tokunagai (YOKOYAMA), 1911

Subfamily Fortipectininae MASUDA, n. subfam.

Genus *Fortipecten* YABE and HATAI, 1940

Fortipecten kenyoshiensis (CHINZEI), 1960

Fortipecten takahashii (YOKOYAMA), 1930

Genus *Masudapecten* AKIYAMA, 1962

Masudapecten iwasakiensis (NOMURA), 1935

Masudapecten kintaichiensis (MASUDA), 1958

Masudapecten masudai (AKIYAMA), 1962

Genus *Kotorapecten* MASUDA, 1962

Kotorapecten egregius (ITOIGAWA), 1955

Kotorapecten kagamianus (YOKOYAMA), 1923

Kotorapecten kagamianus moniwaensis
(MASUDA), 1958

Kotorapecten kagamianus nimaensis
(MASUDA), 1958

Kotorapecten kagamianus permirus
(YOKOYAMA), 1926

Kotorapecten naganoensis (MASUDA), 1962

Kotorapecten nakajimai (MASUDA), 1954

Kotorapecten sannohensis (CHINZEI), 1961

Kotorapecten tryblium (YOKOYAMA), 1925

Kotorapecten tryblium shinshuensis
(AKIYAMA), 1962

Kotorapecten yamasakii (YOKOYAMA), 1925

Kotorapecten yamasakii ninohensis (MASUDA),
1954

Genus *Mizuhopecten* MASUDA, n. gen.

Mizuhopecten chichibuensis (KANNO), 1958

Mizuhopecten hashimotoi (AKIYAMA), 1962

Mizuhopecten ibaragiensis (MASUDA), 1953

Mizuhopecten imamurai (MASUDA), 1959

Mizuhopecten kanbaraensis (OTUKA), 1938

Mizuhopecten kimurai (YOKOYAMA), 1925

Mizuhopecten kimurai murayamai

(YOKOYAMA), 1926

Mizuhopecten kimurai nakosoensis (MASUDA),
1960

Mizuhopecten kimurai tigonouraensis
(NAKAMURA), 1940

Mizuhopecten kimurai ugoensis (HATAI and
NISIYAMA), 1939

Mizuhopecten kimurai yudaensis (MASUDA),
1960

Mizuhopecten kobiyamai (KAMADA), 1954

Mizuhopecten kudoii (NOMURA), 1935

Mizuhopecten paraplebejus (NOMURA and
HATAI), 1936

Mizuhopecten planicostulatus (NOMURA and
NINO), 1932

Mizuhopecten poculum (YOKOYAMA), 1926

Mizuhopecten poculum tsudae (NODA), 1962

Mizuhopecten togeshitensis (AKIYAMA), 1962

Mizuhopecten tokyoensis (TOKUNAGA), 1906

Mizuhopecten tokyoensis hokurikuensis
(AKIYAMA), 1962

Mizuhopecten tokyoensis sematensis
(AKIYAMA), 1962

Mizuhopecten yessoensis (JAY), 1857

Mizuhopecten yessoensis nakatombetsuensis
(AKIYAMA), 1962

Mizuhopecten yessoensis pseudoyessoensis
(AKIYAMA and MIYAJIMA), 1960

Mizuhopecten yessoensis yokoyamae (MASUDA),
1962

Genus *Nipponopecten* MASUDA, 1962

Nipponopecten akihoensis (MATSUMOTO), 1930

Nipponopecten wakuyaensis (MASUDA), 1956

Masudapecten, *Kotorapecten* and *Nipponopecten* which are previously described as subgenera (AKIYAMA, 1962; MASUDA, 1962a) are raised to generic rank because of their morphological characters which bring them to the level of genus.

Description

Genus *Yabepecten* MASUDA, n. gen.

Type-species:— *Pecten tokunagai* YOKOYAMA, 1911. Pliocene Koshiba forma-

tion of Kanagawa Prefecture.

Geological range.—Pliocene.

Diagnosis.—Shell large, rather thin, compressed, suborbicular, inequivalve, right valve more convex than nearly flat or slightly inflated left valve; right valve with numerous, very low, round-topped radial ribs which are obscure in younger stage but tend to become distinct with growth; left valve with rather distinct, very slender, low radial ribs which tend to become obscure with growth and characteristic, conspicuous network; anterior auricle larger than posterior, with very shallow byssal notch; hinge with simple cardinal crura, wide and shallow resilial pit with rather distinct lateral ridges which tend to become obscure lowards and auricular crurae which terminate distally in a rounded, rather obscure, oblong denticle; interior surface slightly folded corresponding to external sculpture.

Remarks.—The present new genus is named in honor of Dr. Hisakatsu YABE, Emeritus Professor of the Tohoku University, who founded the Institute of Geology and Paleontology, Tohoku University.

The present new genus is based upon the Pliocene *Pecten tokunagai* YOKOYAMA. The genus *Patinopecten* can be distinguished from the present one by its distinct, squarish radial ribs in the right valve, deep byssal notch and

much more conspicuous auricular crurae. *Fortipecten*, *Masudapecten*, *Nipponopecten* and *Kotorapecten* also can be distinguished from the present one by their lacking auricular crurae with distinct distal denticle.

Subfamily Fortipectininae

MASUDA, n. subfam.

Definition.—Shell large to very large, suborbicular; inequivalve, right valve more inflated than nearly flat or somewhat inflated left valve; cardinal crura rather distinct but simple; ctenolium usually not observed in adult shell but sometimes observed in younger shell; auricles nearly equal, moderate to large; byssal notch wide and shallow; interior surface somewhat folded corresponding to external sculpture.

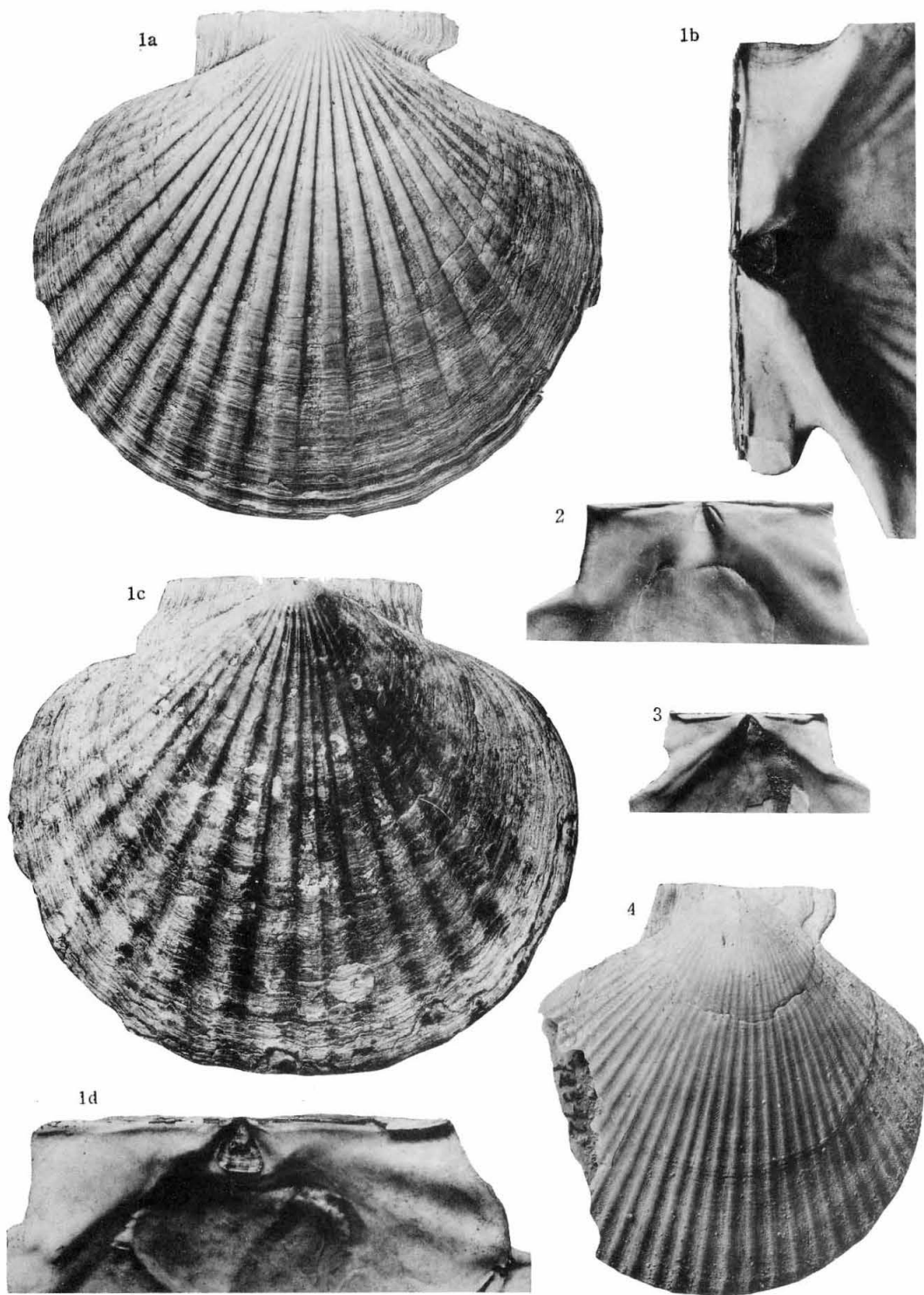
Remarks.—The present new subfamily now includes such genera as *Fortipecten* YABE and HATAI, *Masudapecten* AKIYAMA, *Kotorapecten* MASUDA, *Nipponopecten* MASUDA, and *Mizuhopecten* MASUDA n. gen. among the Japanese Pectinidae.

The present group can be distinguished from the Pectininae or Amusiinae by the inequivalved shell with rounded smooth radial ribs, nearly equal auricles with wide and shallow byssal notch, no auricular crurae with distal denticle and folded interior surface corresponding to external sculpture.

Explanation of Plate 22

Figs. 1a-d. *Patinopecten caurinus* (GOULD). 1a, Right valve, \times ca. 4/9. 1b, Hinge area of 1a, \times 1. 1c, Left valve, \times ca. 4/9. 1d, Hinge area of 1b, \times 1. SM, Reg. No. 10885. Loc. Puget Sound, Washington, U. S. A. Recent.

Figs. 2-4. *Yabepecten tokunagai* (YOKOYAMA). 2, Hinge area of left valve, \times 1. 3, Hinge area of right valve, \times 1. DGS, Reg. No. 3714. 4, Right valve, \times ca. 1. IGPS, coll. cat. no. 72542. Loc. Right river cliff of the Chikagawa stream, about 700 m. from the sea shore, Chikagawa, Mutsu City, Aomori Prefecture. Pliocene Hamada formation.



Genus *Mizuhopecten* MASUDA, n. gen.

Remarks

Type-species:— *Pecten yessoensis* JAY, 1857. Recent, Northern Japan.

Geological and geographical distributions:—Oligocene to Recent. Northern Japan.

Diagnosis:—Shell large, rather thick, suborbicular, inequivalve, right valve more inflated than nearly flat or slightly inflated left valve; right valve usually with rather distinct, broad, rounded radial ribs, rarely dichotomous; left valve with distinct but low, rounded, narrow radial ribs and fine network; anterior auricle nearly equal to posterior one, with wide and shallow byssal notch; hinge with distinct but simple cardinal crura, wide and shallow resilial pit with distinct lateral ridges; interior surface somewhat folded corresponding to external sculpture.

Remarks:—This new genus is named based upon the old name of Japan.

Mizuhopecten can be distinguished from *Patinopecten* by its having no auricular crurae with distal denticle, rounded, broad radial ribs and large auricles with wide and shallow byssal notch. From *Yabepecten* it differs by its having no auricular crurae and broad, rather distinct radial ribs. *Fortipecten* also can be distinguished from the present one by its greatly inflated right valve, nearly flat left valve, very large auricles and narrow radial ribs.

Judged from the figures and description of *Pecten (Aequipecten) pseuduloa* EAMES and COX (1956) from the Upper Miocene to Pliocene of Persia, it can be distinguished from the present one by its left valve being slightly more inflated than the right valve. Whether their specimen can be referred to *Aequipecten* and *Pecten* may be in need of a re-examination.

With regard to the development of the so-called *Patinopecten* of Japan the writer previously noticed that *Patinopecten* (s. s.) which is newly proposed in the present article as *Mizuhopecten*, is very abundant in specific and individual numbers during the Tertiary period, but only two species are known in the Pleistocene and only one species, *Patinopecten* (s. s.) *yessoensis* (JAY) is known from the Recent sea of Northern Japan.

Mizuhopecten chichibuensis (KANNO) from the Nenokami sandstone of the Hikokubo group, Chichibu Basin, Saitama Prefecture (KANNO, 1957) and also questionably from the Taishu formation, Tsushima Island, Nagasaki Prefecture (KANNO, 1955) is the earliest known species of the genus *Mizuhopecten* in Japan. Judging from its associated fauna the Nenokami sandstone is considered to have been deposited under the influence of warm thermal conditions. Therefore, the ancestral stock of *Mizuhopecten* may be found in the Early Tertiary formations of a Southern region. In general, the changes in the marine environmental conditions from the Early Neogene to the Recent are well reflected in the mega fauna. The water temperature generally became gradually lower from the Early to latest Neogene and showed fluctuation during the Pleistocene. The decreasing in the number of species of *Mizuhopecten* besides other pectinids from during the Tertiary to the Recent may coincide with the gradual lowering of the water temperature associated with physical and nutrient changes in Japan, especially in Northern Japan. The decreasing of pectinids in general with the advance of geological time can be explained by the changes of environmental conditions.

The earliest occurrence of the common Recent species of Northern Japan, *Mizuhopecten yessoensis* (JAY), is from the Early Pliocene formations of the Japan Sea borderland province (MASUDA, 1962b) in association with several species of *Mizuhopecten* and *Yabepecten tokunagai* (YOKOYAMA). Although *Mizuhopecten yessoensis* (JAY) survived to the present, almost all other species of *Mizuhopecten* and *Yabepecten tokunagai* (YOKOYAMA) became extinct at the end of the Early Pliocene. *Mizuhopecten tokyoensis hokurikuensis* (AKIYAMA) appeared in the Early Pliocene but it became extinct at the end of the Early Pliocene and *Mizuhopecten tokyoensis* (s. s.) (TOKUNAGA) which may be derived from *tokyoensis hokurikuensis*, appeared in the Late Pliocene and survived to the Pleistocene. *Mizuhopecten tokyoensis sematensis* (AKIYAMA) appeared in the Pleistocene and became extinct before the close of the age. The development and extinction of the species *Mizuhopecten* may have had intimate relation with the changes of the environmental conditions.

The genus *Patinopecten* distributed in the Northern Pacific region may be closely related to *Pecten* or *Amusiinae* considering from the presence of the auricular crurae with distal denticle.

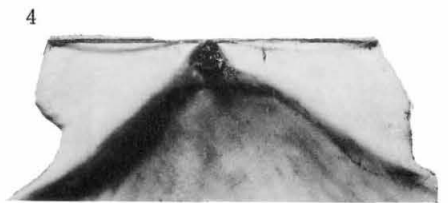
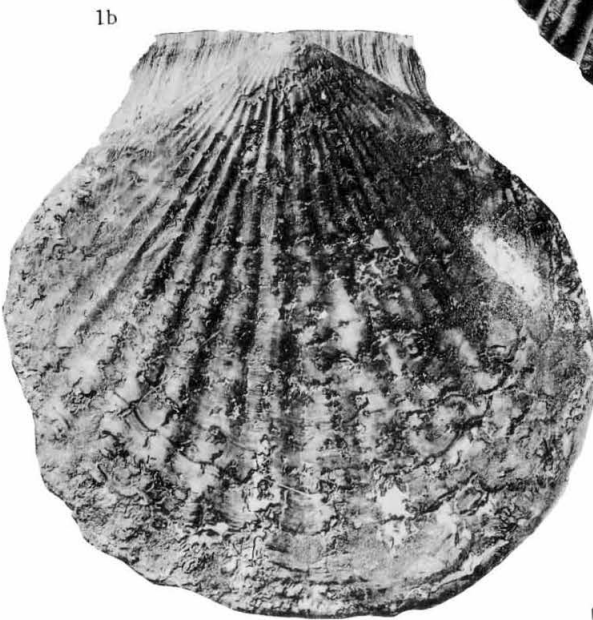
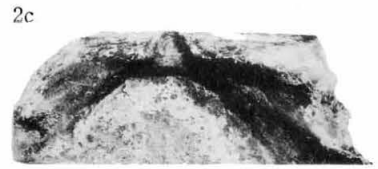
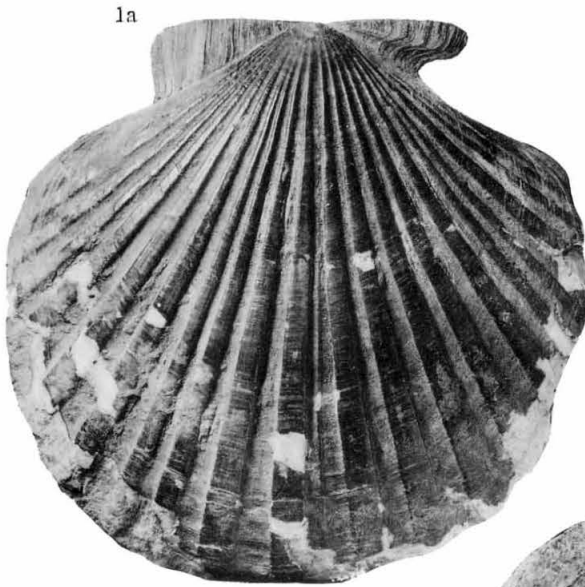
The occurrence of the genus *Patinopecten* is unknown from the Japanese Miocene or from the Miocene of South-eastern Asia. Therefore, its ancestral stock may not be a migrant from Asia but from some other regions, probably from the Mediterranean region. *Yabepecten tokunagai* (YOKOYAMA) which appeared in the Early Pliocene of Northern Japan probably branched off from the *Patinopecten* group of the Northern Pacific region of North America as a result of its westward migration from North America in the Early Pliocene. It became extinct during that time.

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Explanation of Plate 23

- Figs. 1a-b. *Patinopecten caurinus* (GOULD). 1a, Right valve, $\times ca. 1/2$. 1b, Left valve, $\times ca. 1/2$. DGS, Reg. No. 1576. Loc. Eel River, Scotia Bluffs, Scotia, Humboldt County, California, U. S. A. Pliocene Wildcat formation.
- Figs. 2a-c. *Patinopecten healeyi* (ARNOLD). 2a, Right valve, $\times ca. 2/3$. 2b, Hinge area of 2a, $\times ca. 2/3$. 2c, Hinge area of left valve, $\times ca. 2/3$. DGS, Reg. No. 1128. Loc. Rose Canyon, La Jolla Quadr., San Diego, California, U. S. A. Pliocene.
- Fig. 3. *Yabepecten tokunagai* (YOKOYAMA). Hinge area of left valve, $\times 1$. DGS, Reg. No. 3714. Loc. Right river cliff of the Chikagawa stream, about 700 m. from the sea shore, Chikagawa, Mutsu City, Aomori Prefecture. Pliocene Hamada formation.
- Figs. 4-5. *Mizuhopecten yessoensis* (JAY). 4, Hinge area of right valve, $\times 1$. 5, Hinge area of left valve, $\times 1$. DGS, Reg. No. 4488. Loc. Asamushi, Nonai-mura, Higashi-Tsugaru-gun, Aomori Prefecture. Recent.



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 Nonai-mura 野 内 村

SHORT NOTE

11. *ORTHOTICHIA JAPONICA* HAYASAKA (1933) AND *ORTHOTICHIA MAGNIFICA* GRABAU (1936)*

ICHIRO HAYASAKA

A. D. GRABAU, in his bulky volume, fauna of the Maping Limestone of Kwangsi and Kweichow²⁾, described a new species *Orthotichia magnifica*, and remarked that it "is by far the largest shell, not only of this species but of the genus so far found in China....", with a comment in a foot-note, p. 59, reading "Recently HAYASAKA has described a still larger species *O. japonica* HAYASAKA³⁾ from Nabeyama region." He gave a table of measurements of three specimens of *O. magnifica*, including, in an additional column, those of the largest specimen of *O. japonica*. This implies that GRABAU recognized the identity of the Chinese and Japanese species: to this idea I flatly consent. In other words, *O. magnifica* was recognized as a synonym of *O. japonica*, although the former name expresses the conspicuous feature of the species.

GRABAU's work being voluminous, much time must have been necessary for editing and printing, so that when

HAYASAKA's paper caught his attention the whole of his text might have been nearly ready for publication. He could not but take an expedient measure of referring to it in the foot-note, and of adding a column of measurements of the largest Japanese specimen to the table.

Notes

1. GRABAU, A. W. (1936):—Early Permian Fossils of China, II, *Palaeont. Sinica, ser. B, vol. VIII, fasc. 4*, pp. 57-60, pl. IV, figs. 1-3.
2. HAYASAKA, I. (1933):—On the Up. Carb. Brachiopod Fauna from the Nabeyama Region, etc. *Mem. Fac. Sci. & Agric., Taihoku Imp. Univ., vol. VI, no. 2*, pp. 20-22, pl. III, fig. 1; pl. IV; pl. V; pl. VI, fig. 1; text-fig. 3. The fossiliferous black bituminous limestone is now considered Permian in age on account of the stratigraphical relation with fusulinid bed.

* Received July. 23, 1962

462. SOME PERMIAN BRYOZOA FROM THE YAMANBA
LIMESTONE, IN THE SAKAWA BASIN,
SHIKOKU, JAPAN

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四国山姥石灰岩産二疊紀群虫: 山姥石灰岩から5種(新種1, 既知種2, 未定種2)を識別, 記載した。そのうち既知2種はいつも筆者が岩井崎石灰岩からはじめて記載したもので, この結果からも小林貞一の指摘したように山姥フォーナと岩井崎フォーナの間には著しい近似性が認められる。
坂上澄夫

Introduction and Acknowledgements

At the suggestion of Professor KOBAYASHI, the writer visited the Yamanba limestone in the Sakawa Basin, Shikoku to collect bryozoan specimens in April, 1962 and was fortunate in obtaining some relatively well-preserved specimens. These bryozoans are described in the present paper.

Before entering into the description, the writer expresses his sincere thanks to Professor Teiichi KOBAYASHI of the University of Tokyo for his kind guidance and encouragement, to Professor Kitora HATAI of the Tohoku University for his kindness in reading this manuscript, and to Mr. Naoji NONAKA of Sakawa-machi for his kind guidance to the Yamanba limestone.

Historical Review of Paleontology of the Yamanba Limestone

The Paleontology of the Yamanba limestone in the Sakawa basin, Kochi Prefecture, Shikoku has been discussed by KOBAYASHI (1931, 1935, 1951), YABE

and SUGIYAMA (1933), NONAKA (1946) and MINATO (1949, 1955).

KOBAYASHI (1931) reported *Spiriferina sakawana* (nom. nud.), crinoid stems and bryozoa gen. et sp. indet. from the Yamanba limestone and considered that its geological age may correspond to the Carnic. Successively YABE and SUGIYAMA (1933) described one species of hexacoral *Omphalophyllia yamanbaensis*, and it was also considered to be Carnic in age. A few years later, KOBAYASHI (1935) restudied the Yamanba fauna and claimed its geological age to be Permian from the following fossils, namely, Bryozoa (*Coscinium*), Brachiopods (*Martinia* 2 spp., *Squamularia*, *Schizophoria*, *Spiriferina*, *Streptorhynchus*, Productid (2 spp.), and Foraminifera (*Parafusulina*). Of these fossils the brachiopods were restudied by J. NONAKA (1946) who discriminated *Schizophoria* sp. nov., *S. indica* (WAAGEN), *Orthotichia derbyi* (WAAGEN), *Camarophoria mutabilis* TSCHERNYSCHEW, *Streptorhynchus pseudopelargenatus* (BREILI), *Meekeella?* sp., *Aulosteges poyangensis* (KEYSER), *Squamularia rostrata* (KUTORGA) var. nov., *S. asiatica* CHAO, *Martinia orbicularis* GEMMELLARE, *M.* sp.

nov., *Spiriferina multiplicata* SOWERBY, *S. masuta* (WAAGEN) var. nov. and *S. sp.* NONAKA placed the Yamanba limestone in the Artinskian to Kungurian from the brachiopod fauna. MINATO (1949) described *Lonsdaleiastraea yamanbaensis* MINATO from the limestone and he (1955) considered this coral to indicate the *Neoschwagerina* or *Parafusulina* zone. At the same time, MINATO stated that *Omphalophyllia yamanbaensis* should be subjected to further investigation. In 1951, KOBAYASHI stated that the Yamanba fauna is of the middle to late Permian in age and its fauna is very similar to that from the Iwaizaki limestone of the Kitakami massif.

Remarks on Bryozoan Fauna

Five bryozoan species were discriminated in the collection as follows:

Meekopora? sp. indet.

Leioclema nonakae SAKAGAMI, n. sp.

Rhabdomeson sp. indet.

Hayasakapora erectoradiata SAKAGAMI

Sulcoretepora nipponica SAKAGAMI

Of these species, *Hayasakapora erectoradiata* and *Sulcoretepora nipponica* coincide with their holotypes. *Hayasakapora erectoradiata* was described by SAKAGAMI (1961) from the h member of the Iwaizaki limestone. At that time, he also described *H. matsudae* from the d member of the Iwaizaki limestone. *H. erecto-*

radiata and *H. matsudae* were separated from one another only by the differences of their zoarial diameters. In view of variability of the diameter of zoaria among the specimens from the Yamanba limestone, the writer now considers that *H. matsudae* and *H. erectoradiata* may be synonymous. *Sulcoretepora nipponica* was originally described by SAKAGAMI (1961) from Kamiyatsuse (*Parafusulina* zone) and the same species was found in the d member of the Iwaizaki limestone. The present specimen is nearest to the Iwaizaki specimen. *Leioclema nonakae* may be close to *Leioclema globosa* CROCKFORD which was originally described from Western Australia, and was reported recently by SAKAGAMI (1961) from Kamiyatsuse, Kitakami massif, Japan. Of the two indeterminate species, *Meekopora?* sp. is common at the present locality, but its internal structures are not well preserved. *Rhabdomeson* sp. indet. is represented by only one oblique section. This form seems to be nearest to *Rhabdomeson mammilatum* (BRETNALL), which was recorded from the Noonkanbah series in Western Australia.

In the thin section of the Yamanba limestone, the writer found a specimen of *Chusenella* cf. *conico cylindrica* CHEN (Text-figure 1). This species was originally described from the Chinghsichung limestone, Hunan, China and also recorded by MORIKAWA (1930) from the c



Text-fig. 1. *Chusenella* cf. *conico cylindrica* CHEN $\times 10$ Reg. no. 9518.

member of the Iwaizaki limestone.

From the above mentioned facts, the present bryozoan fauna can be referred to the *Parafusulina* zone. It is very interesting that the Yamanba fauna shows close resemblance with the Iwaizaki fauna as already mentioned by KOBAYASHI (1951). This conclusion is now confirmed by the bryozoans.

Description of Species

Meekopora ? sp. indet.

Pl. 24, fig. 1.

Zoarium bifoliate, variable in thickness. Mesotheca apparently closely joined double layers, reaching at edge consisting of acute periphery, but occasionally separated by individual single layer. Zoecium tubular, proximally parallel to mesotheca making large angle in mature stage. Zoecial tube circular, its diameter 0.24 mm to 0.27 mm. Usually 5 zoecia per 2 mm. Interspaces between zoecial tubes filled by vesicular tissue which is triangular to hexagonal in tangential section, regularly arranged in longitudinal series, and quadrate in longitudinal section. Two or three, occasionally five rows of vesicles in an interspace between zoecial tubes. Vesicular tissue becoming gradually coarse (in thickness) towards surface, and then, becoming fine rapidly at two or three layers of vesicles near surface. Diaphragms usually observed, 1 to 2 in a tube. No stereom covering vesicular tissue. Lunarium lacking.

Remarks:—Because of the badly oriented specimens and insufficiency of the material at hand, the species was left unnamed.

Reg. nos. 9501-A, 9502, 9503, 9504.

Leioclema nonakae SAKAGAMI, n. sp.

Pl. 24, figs. 2-5.

Two sections were obtained from the same zoarium. Zoarium encrusting, but in part, consisting of cylindrical stem. Diameter of cylindrical stem about 3 mm, zoecial tube bending gradually outward in longitudinal section. Encrusting part of zoarium 1.4 mm to 1.6 mm thick, zoecial tube parallel to coenelasma (epithea) for very short distance, then rapidly making large angle and nearly straight in mature zone. In tangential section, zoecial tube circular near surface, rounded polygonal in immature zone. Diameter of zoecial tube in mature zone 0.16 mm to 0.22 mm, and about 4 to 5 zoecia per 2 mm. Zoecial wall thin in immature zone, becoming as thick as 0.05 mm to 0.11 mm in mature zone. No moniliform developed but wall formed irregularly. Mesopore relatively numerous, 0.06 mm to 0.10 mm in diameter. One acanthopore usually present at each intersection of zoecial walls, 0.008 mm to 0.020 mm in diameter, surrounded by dark excentric fibrous tissue. Outside diameter of excentric fibrous tissue about 0.08 mm. Diaphragms numerous, very closely spaced in both zoecial tubes and mesopores, usually spaced about 0.16 mm, occasionally less spaced near surface, somewhat concave to aperture.

Remarks:—The present species is most similar to *Leioclema globosa* which CROCKFORD (1957) originally described from the Nura Nura member of the Poole Sandstone, Fitzroy basin, Western Australia and SAKAGAMI (1961) recorded it from the *Parafusulina* zone of Kamiyatsuse, Kitakami massif, Japan. This species is, however, distinguished from

L. globosa by the smaller diameter of zoecium and larger diameter of acanthopore.

The specific name is dedicated to Mr. Naoji NONAKA who kindly guided me to the Yamanba limestone.

Reg. no. 9505 (holotype), 9506.

Rhabdomeson sp. indet.

Pl. 24, fig. 8.

A single oblique section. Zoarium 1.0 mm in diameter. Central tubes about 0.2 mm in diameter. Zoecial tubes circular, 0.11 mm to 0.13 mm in diameter at mature zone, but rhomboidal in immature zone. Wall thin and separated by a dark line in immature zone, about 0.02 mm in thickness, but gradually thickened about 0.08 mm to 0.13 mm in mature zone. One kind of acanthopore disposed at distal edge of each zoecium. Neither hemisepta nor diaphragms present.

Remarks:—The present form is most similar to *Rhabdomeson mammilatum* (BRETNALI). As its internal structures were described by CROCKFORD (1944), one kind of large acanthopore is disposed at each intersection of the ridges and small acanthopores, diaphragms and hemisepta are all undeveloped. The present form differs from *R. mammilatum* simply in the smaller diameter of zoarium, being about 1 mm instead of about 2 mm.

Reg. no. 9516-A.

Hayasakapora erectoradiata SAKAGAMI

Pl. 24, figs. 6, 7.

1960. *Hayasakapora erectoradiata* SAKAGAMI. *Trans. Proc. Pal. Soc. Japan, N.S., No. 39*, p. 323, pl. 37, figs. 1-8.

1961. *Hayasakapora matsudae* SAKAGAMI. *Pal.*

Soc. Japan. Spec. Paper No. 7, pp. 53, 54, pl. 27, figs. 15, 16.

Zoarium a cylindrical branch, varying in diameter from 1.6 mm to 2.4 mm or 1.8 mm on an average. Zoecial tube straight and arise radially at right angle from linear axis. Arrangement of zoecial aperture not observed, but zoecial tubes seem to be regular in longitudinally intersecting rows and surrounded by dense fibrous tissue. Fibrous tissue 0.24 mm to 0.32 mm thick. Length and width of zoecial tube 0.7 mm to 1.1 mm and about 0.16 mm, respectively. Numerous very minute pores occur at fibrous tissue near surface. Seven acanthopore-like substances disposed in one specimen on apertural margin of zoecium (Reg. no. 9516-B) but unobservable in other specimens, about 0.06 mm in diameter.

Remarks:—Previously the writer (1960, 1961) described four species of *Hayasakapora* from the Permian rocks of Japan. *Hayasakapora erectoradiata*, the type species of the genus, from the h member (upper part of the *Yabeina-Lepidolina* zone) of the Iwaizaki limestone and *H. matsudae* from the d member (upper part of the *Parafusulina* zone) of the same limestone were distinguished by their diameter of zoarium. Namely, *H. matsudae* has a larger diameter than that of *H. erectoradiata*.

In the Yamanba limestone, several specimens of *Hayasakapora* were found in the same horizon, they show no difference in their inner structures, but the diameter of zoarium is found to range from 1.6 mm to 2.4 mm. By this reason the writer considers that *H. erectoradiata* and *H. matsudae* may belong to one and the same species, and accordingly the geological range of this species extends from the upper part of the *Parafusulina* zone to the upper

part of the *Lepidolina-Yabeina* zone.

Reg. nos. 9501-B, 9509, 9510-A, 9510-B, 9516-B.

Sulcoretopora nipponica SAKAGAMI

Pl. 24, fig. 9.

1961. *Sulcoretopora nipponica* SAKAGAMI. *Pal. Soc. Japan. Spec. Paper No. 7*, p. 55, pl. 28, figs. 5-8, pl. 29, figs. 1-3, pl. 30, figs. 1-7.

Zoarium bifoliate, branching in plane of mesotheca and elongated oval in transverse section. Mesotheca straight, apparently closely joined double layers reaching to surface at acute edges of zoarium. Width and thickness of zoarium about 3.4 mm and 1.3 mm, respectively, based on measurements from random sections. Zoecial tubes parallel to mesotheca for a very short distance, then rapidly or more gradually making large angles in mature region. Zoecial tubes near surface circular in tangential section, about 0.19 mm in diameter, and probably arranged longitudinally. Number of rows of zoecial apertures and of zoecia in 2 mm of one row cannot be counted. Vesicular tissue regularly arranged, usually consisting of one or two rows of vesicles between longitudinal series of zoecia and two or three rows of vesicles composed of two or three vesicles in one row between zoecia in one zoecial series; arrangements become indistinct near surface. Shape of vesicles rectangular in both tangential and longitudinal sections. About one half to two thirds of them near surface covered by dense fibrous tissue.

Remarks:—In spite of a small number and ill-preservation of the specimens at hand, they coincide with the original description and illustration of the specimens from the *Parafusulina* zone of

Kamiyatsuse and from the d member of the Iwaizaki limestone (SAKAGAMI, 1961). Reg. nos. 9508, 9512, 9513, 9514.

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Iwaizaki
Kamiyatsuse

岩井崎
上八瀬

Sakawa basin
Yamanba

佐川盆地
山 姥

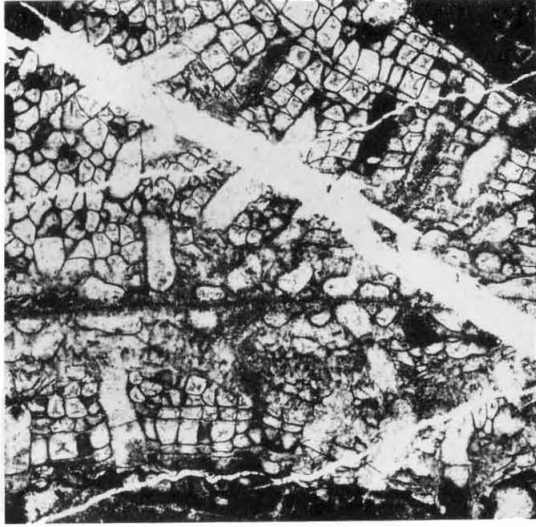
Explanation of Plate 24

- Fig. 1. *Aleekopora* ? sp. indet.
Longitudinal section. $\times 20$, Reg. no. 9502.
- Figs. 2-5. *Leioclema nonakae* SAKAGAMI, n. sp.
2. Longitudinal section of encrusting part of zoarium. $\times 20$. 3. Tangential section of cylindrical part of the same zoarium. $\times 20$. 4. 5. Enlarged part of Fig. 3 and 2, respectively. $\times 40$, Reg. no. 9505.
- Figs. 6, 7. *Hayasakopora erectoradiata* SAKAGAMI
6. Longitudinal section of distal part of zoarium, $\times 20$. 7. Longitudinal but slightly tangential section of proximal part of the same specimen. $\times 20$. Reg. no. 9501.
- Fig. 8. *Rhabdomeson* sp. indet.
Obliquely transverse section. $\times 20$. Reg. no. 9516-A.
- Fig. 9. *Sulcoretopora nipponica* SAKAGAMI
Longitudinal section. $\times 20$. Reg. no. 9513.

All of specimens described in this paper are preserved in the collection of the Hakodate School, Hokkaido Gakugei University.



6



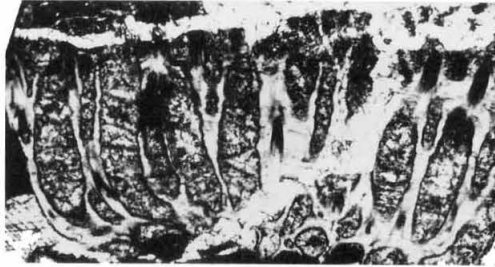
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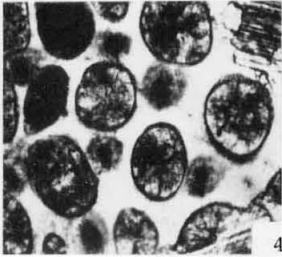
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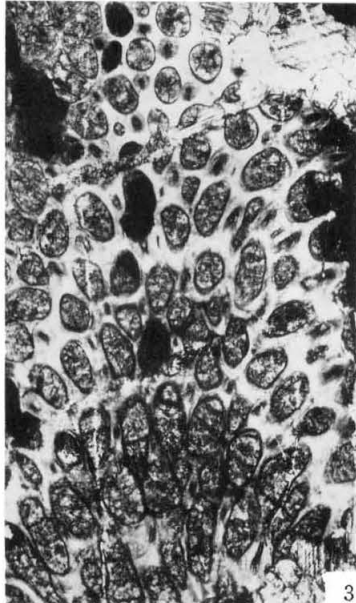
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PROCEEDINGS ON THE PALAEOONTOLOGICAL SOCIETY
OF JAPAN

日本古生物学会第 85 回例会および応用古生物学シンポジウムは、1963 年 9 月 6, 7 日工業技術院地質調査所において開催された (参加者 35 名)。

個人講演

- On the Occurrence of an Upper Cretaceous Plant in Central Thailand Seido ENDO
On Some Fossil Plants from the Mae Sot Basin, West Thailand Seido ENDO
浜松市伊佐地の佐度層産 *Pediastrum* の化石 島倉巳三郎
Kisseriells carina SHESH の北日本における産出層準について 沢村孝之助
Two Foraminiferal Sequences in the Yûraku-chô Formation Hiroshi UJIE
関東山地後期古生界産 *Polythecalis* について (代読) 山際延夫・藤山家徳
志摩後期古生界産サンゴ化石の研究 (その 1) (代読) 山際延夫
On the Lower Silurian Shelly Fauna in the Langkawi Islands, Northwest Malaya Takashi HAMADA, C. R. JONES & Teiichi KOBAYASHI
Some Jurassic Pelecypods from Viet-Nam. Donated by Dr. H. FONTAINE Itaru HAYAMI
Hanaia, a New Subgenus of *Glycymeris*, from the Miyako Group of Northeast Japan Itaru HAYAMI
タイ産淡水椎貝化石について 大山 桂
Permian Fossils from Northern Pahang, Malaya Hisayoshi IGO
On a New Malayan Species of *Dalmanitina*. Teiichi KOBAYASHI & Takashi HAMADA
Conodonts from the Omi Limestone Hisayoshi IGO & Toshio KOIKE
Conodonts from South Kelantan, Malaya Hisayoshi IGO & Toshio KOIKE

応用古生物学シンポジウム

- 石灰質岩石の層位、および堆積環境と化学成分との関係について 河田茂磨
化石層序学の基本的考察 内尾高保
有孔虫化石による古地理学的考察 (新潟油田地域) 岩本寿一
応用古生態学における 2, 3 の問題点 大山 桂
花粉化石鑑定の一方法 (ホールソートシステム) 徳永重元

日本古生物学会第 86 回例会および「古生物を中心として見た西日本の第四紀」についてのシンポジウム (日本第四紀学会と共催) は 1963 年 11 月 10 日大阪市立自然科学博物館において開催された (参加者 42 名)。

個人講演

- 大洗植物群 (上部白亜系) に産出したヤシ科の葉片について 松尾秀邦・大山年次
On the Type Species of *Lepidolina* from Cambodia Kenichi ISHII & Yasuo NOGAMI
Neogene Cyrtosidea (Radiolaria) from the Isozaki Formation in Ibaragi Prefecture, Japan Kojiro NAKASEKO
On the Occurrence of Middle Ordovician Fossils from Satun in Thailand near the Malayan Frontier Teiichi KOBAYASHI & Takashi HAMADA
Some Middle Ordovician Brachiopods from Satun, Southern Thailand (代読) Takashi HAMADA
Late Cretaceous Pelecypods from the Izumi Group. Part IV. Koichiro ICHIKAWA & Yasuo MAEDA
Note on a Cretaceous Nautiloid from Kyushu (代読) Tatsuro MATSUMOTO & Masahisa AMANO
On Some Pleistocene Mammals from Yamaguchi Prefecture, Japan Yoshikazu HASEGAWA & Tokuro HARA
The Dimorphism and Ontogeny of *Norwoodella halli* RESSER (代読) Chung-Hung HU
On the Occurrence of Graptolites Shale in North Thailand Teiichi KOBAYASHI & Hisayoshi IGO

特別講演

古植物研究 30 年を迎えて 三木 茂

- シンポジウム: 古生物上から見た西日本の第四紀
近畿地方のフウ化石 千地万造・池辺展生・石田志朗
花粉分析から見た西日本の第四紀 島倉巳三郎・田井昭子
大阪市の新しいボーリング (907 m) よりえられた古生物学的資料 (中間報告) 池辺展生・原 実・田井昭子・千地万造・中世古幸次郎

日本古生物学会特別号の原稿募集

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 - (g) 他よりの経費支出の見込有無、その予算額、支出源[1964 年度の文部省の刊行助成金を申請希望の場合も、その旨を上記に準じて添書して下さい]。
 - (h) その他参考事項を記入、申込年月日、氏名捺印(または署名)。
- (4) 申込〆切 1963 年 12 月 31 日(消印有効)；採否は 1964 年 1 月の評議員会で審議決定の上申込者に回答の予定。場合によっては申込者との話し合いを求めることがあるかもしれません。

学 会 記 事

- 本会誌の出版は一部文部省研究成果刊行費補助金による。

例 会 ・ 年 会 通 知

	開 催 地	開 催 日	講 演 申 込 締 切 日
1964年総会年会	九 州 大 学	1964年1月18・19日	1963年12月1日
第90回例会	京 都 大 学	1964年6月7日	1964年5月5日

1964年総会年会(九州大学):「進化と個体発生」(Ontogeny and Evolution)に関するシンポジウム(世話人,九州大学 松本達郎・首藤次男)
参加を希望する人は早目に世話人まで連絡されたい。

会 員 消 息

- 会長小林真一君は10月中旬ローマで開かれた国際地質学連合(International Union of Geological Sciences)の執行委員会に出席したのち、イラン、タイ両国を経て帰国した。
- 会員堀越増興君はデンマークのエルシノー(Elsinore)臨海実験所に留学のため10月中旬出発した。
- 会員今泉力蔵君は米国コロラド鉱山学校(Colorado School of Mines)に留学中であったが10月下旬帰国した。
- 会員土隆一君はユネスコの国際インド洋調査に参加10月下旬出航した。
- 会員徳山明君はドイツ、ボン大学(Universität Bonn)に留学中であったが11月下旬帰国した。
- 会長小林真一君および会員浅間一男・浜田隆士・猪郷久義・岩井淳一・木村敏雄・佐藤正・鳥山隆三の諸君はコロポ計画によるタイ・マライ古生物学調査に12月上旬出発した。

News

- 国際古生物学連合(International Paleontological Union)より次の内容の仏文の回覧があった:
 - 1) 会則 構成
 - 2) 回覧 1. 前がき 2. 1956年以來の連合の活動 3. 連合の事業:「Palaeontologia Universalis」の刊行:世界の古生物学者の名簿の刊行:化石標本のカタログの作製 4. 現状と計画
 回覧希望者は本会事務局および本会評議員に配布してあるので問合せられたい。
- 本会創立25周年記念出版として
A Survey of the Fossils from Japan Illustrated in Classical Monographs—(Primarily A Nomenclatorial Revision) Edited by Tatsuro MATSUMOTO が出版された。
定価一部 送料共 4500円(特別製本 5500円)である。
- 本会より推薦した、会員西山省三君の「日本および近接地産海胆類動物群」の研究に毎日学術奨励金がおくられた。
- 「化石」は年二冊出版し、下記の様に配布しますから御購読下さい。
「化石」購読費(年二冊)会員550円、非会員660円。
但し購読費は一年分御払い下さい。一冊売りは一冊350円です。

購読御希望の方は本会宛御申込下さい

1963年12月5日	印	刷	東京大学理学部地質学教室内
1963年12月10日	発	行	日本古生物学会
日本古生物学会報告・紀事	編	集	高 井 冬 二
新 篇 第 52 号	発	行	市 川 健 雄
350 円	印	刷	(振替口座東京84780番)
	学	術	東 京 都 港 区 芝 片 門 前 2 / 13
	図	書	学 術 図 書 印 刷 株 式 会 社 富 田 元

Regulations for Publication in Transactions and Proceedings of the Palaeontological Society of Japan

(Jan. 15, 1961)

1. Manuscripts considered for publication should have been read at the General Meeting or the Ordinary meeting of the Palaeontological Society of Japan.
2. Manuscripts shall be written in European language, they should be typed (Pica) on one of standard-size (22.5×27.5 cm) paper and double-spaced throughout. Biological names should be in italics and be underlined by the author.
3. Manuscripts (including of text-figures, maps and tables) will be limited to 12 printed pages (less than 27 type-written pages).
4. Illustrations will be limited to one plate (14.2×20.0 cm).
5. Text-figures (2 if less than 6 (subo, 1 subo is 1 square sun) should be drawn carefully on white paper with drawing or Indian ink, letters used in the figures should be either printed or typed letters pasted-in. Figures may be reduced, so authors are requested to carefully select the size and thickness of the lines or letter used.
6. Maps should be accompanied with scale, fractions should not be used.
7. The author is requested to pay for any cost extending beyond the above stated regulations. One additional plate can be added in place of 4 printed pages, with the editor's approval.
8. Manuscripts should have the title and a brief abstract in Japanese, (such will be added for persons not familiar with Japanese language).
9. Literature cited or referred to should be listed at the end of the manuscript in the form of bibliography. Bibliography should be arranged in alphabetic order of author and by year. The order will be, Author, Year, Title of Paper, Name of Journal, Volume, Page, Plate, Figure, Map, Table.
10. The author's official address should be given below his name, under the title.
11. Palaeontological notes which can be fitted into less than one printed page (including figures, maps, tables) will be published in the order received as space becomes available.
12. The desired number of reprints should be indicated on the right corner of the front page of the manuscript. 100 reprints without cover, but will reference to volume, number and year will be furnished free of charge to the author (if more than one author is involved they shall be divided). Additional reprints will be furnished at the printers rate.

Editorial Regulations

1. The Editorial Staff will transact, preserve and edit the manuscripts.
2. When the Editorial Staff transacts a manuscript, a notification with date of acceptance will be sent to the author, if the manuscript is clear, and abides with the regulations.
3. Acceptance or non-acceptance of manuscripts will be decided by the Editorial Council.
4. Manuscripts not accepted for publication will be returned to the author with notification from the Editor of the reason(s) for its rejection.
5. Manuscripts accepted will be published in the order received with the date of acceptance indicated thereon.
6. Manuscripts whose contents are altered by the author after being accepted for publication, will have their date of acceptance changed.
7. The printing style will be as Journal of Palaeontology.
8. Proof reading will be done under the responsibility of the Publication Committee.