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

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646. MIDDLE-LATE EARLY CRETACEOUS PLANTS NEWLY FOUND FROM THE UPPER COURSE OF THE KUZURYU RIVER AREA, FUKUI PREFECTURE, JAPAN*

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福井県九頭竜上流域に発見された前期白亜紀中～後期植物群：私と林 良和は，福井県大野郡和泉村九頭竜川の支谷，田茂谷および林谷上流に露出する赤岩層群相当層およびその上位の凝灰岩をはさむ地層から保存不良の植物化石を採集した。また最近，関戸信次，山崎慶寿らとともに白山中腹部および大杉谷の赤岩層群から多量の植物化石を発見，採集した。これら植物化石の研究ならびに従来の“手取植物群”に関する知見を総合すると，“手取植物群”は層位的に，ジュラ紀後期の九頭竜植物群，Neocomian 初期および後期と考えられる尾口植物群（石徹白層群桑島砂岩頁岩互層の植物群）および赤岩植物群，および Aptian と考えられる田茂谷植物群に区分される。これらの植物群は内帯（飛騨）植物区（木村，1961，1963）の構成員であることはもちろんであるが，それぞれについてかなりの組成上の特長が認められ，またそれぞれ，ほぼ同時期の外帯植物区の植物群とは組成が異なる。外帯植物区の前期白亜紀植物群は Wealden 型で，その代表者は“領石植物群”であり，沿海州の前期白亜紀植物群とともに，VAKHRAMEEV のいうインド，ヨーロッパ植物区に属し，概して乾燥卓越条件下の植物群である。また尾口植物群を代表者とする内帯植物区の植物群は，同時期のシベリア植物区の植物群にそれぞれ近縁であり，概して温暖，適湿条件下の植物群と考えられる。したがって内帯植物区は，インド，ヨーロッパ植物区域中に孤立しているようにみえる。

田茂谷植物群は，赤岩層群に整合に重なる北谷層相当層に産し，北極圏の前期白亜紀植物群の諸要素，たとえば，*Arctopteris*, *Jacutopteris* などを含む。本稿では，赤岩植物群の一部および田茂谷植物群について識別し得た属種について記載するとともに，前期白亜紀の外帯および内帯植物群の概要について述べた。*Birisia onychioides* はシベリア植物区前期白亜紀植物群の重要構成要素の一種である。

木 村 達 明

Introduction and Acknowledgement

In 1953, the writer and Y. HAYASHI who was a student of the Tokyo University of Education, studied the stratigraphy of the little known Mesozoic for mation exposed along the upper course of the Kuzuryu, Kami-Anama-mura (now Izumi-mura), Ono-gun, Fukui Prefecture, and collected many fossil plant fragments mainly from the Tamodani valley, a right tributary of the Kuzuryu.

This paper deals with the first palaeobotanical study of the middle to late Early Cretaceous floras in the Hida (Inner side) Palaeofloristic Province formerly proposed by the writer (1961, 1963).

The present writer is deeply indebted to Dr. THOMAS M. HARRIS, Professor Emeritus of the University of Reading for his very helpful suggestions and criticism during the writer's stay in England. Financial support of this study was in part defrayed by the Grant-in-Aid for

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Geology and Occurrence of fossil plants

HAYASHI named the Mesozoic formation in this area the Tamodani Formation. This formation is monoclinic in structure, inclined gently to north, and is divisible into the following four members which are conformably set each other:

Uppermost tuff, shale and sandstone alternation
Upper sandstone
Middle sandstone and shale alternation
Lower conglomerate

The Lower Member overlies the Permian Group and semi-schist with unconformity, and the Uppermost Member is characterised by the association of two tuff beds, greyish in colour, 30-50 cm thick, and covered unconformably with quartz-porphyry and andesite flows of later ages.

As shown in Fig. 2, fossil plants occur in several horizons, A-H but not the Lower and the Upper Members. Nonmarine or brackish shells, though they are of little use as stratigraphical indicators, are obtained from the lower part of the Middle Member.

In the Tetori (Tedori) Basin, the following tuff-bearing Early Cretaceous deposits have only been known:

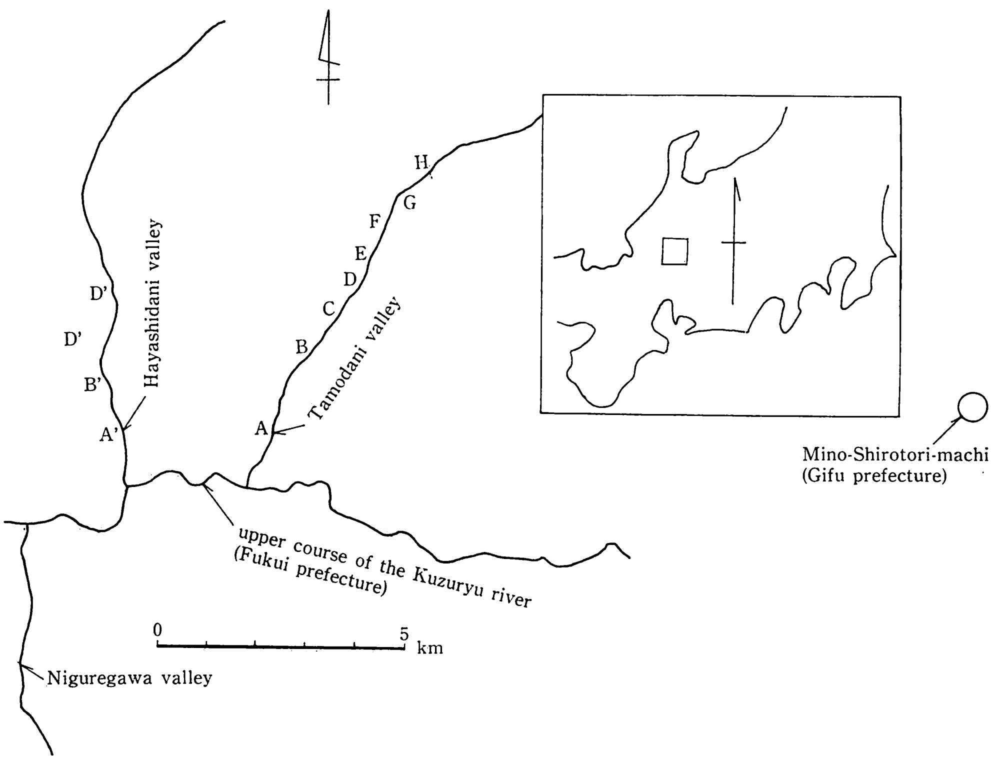

Fig. 1. Map shows fossil localities (A-H, A′, B′, D′) along the Tamodani and the Hayashidani valleys, Izumi-mura, Ono-gun, Fukui prefecture.

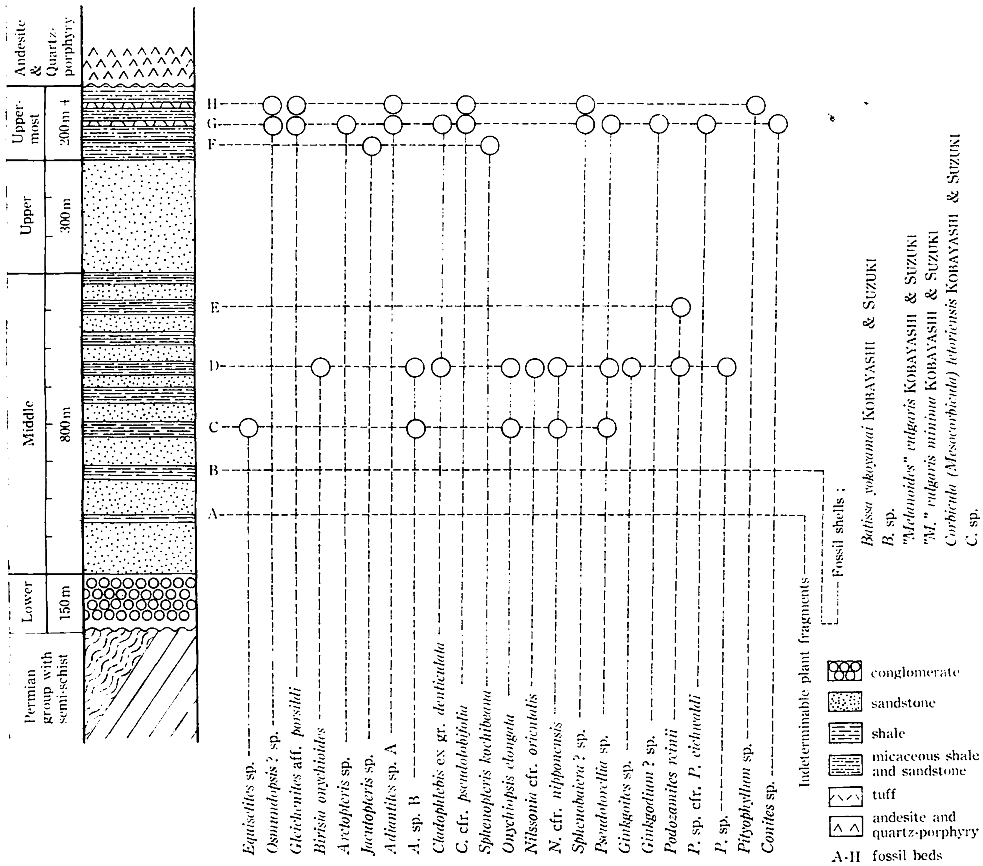

Fig. 2. Columnar section of the Lower Cretaceous formation exposed along the Tamodani valley, and the occurrence of fossils (T. KIMURA, 1974).

Kitadani alternation of sandstone, shale and tuff (MAÊDA, 1958);

Distributed along the Omichidani valley, a tributary of the Tetori and the Takinami River, a tributary of the Kuzuryu, overlying the thick Akaiwa sandstone, characterised by the presence of reddish or greenish tuffaceous layers above (see Fig. 3) and by the existence of the non-marine shells as *Trigonioides suzukii* MAÊDA, *T. kodairai* KOBAYASHI & SUZUKI, *Plicatounio kobayashii* MAÊDA, *P. tetoriensis* MAÊDA, *Nakamuranaia chingshanensis* (GRABAU), etc. below. According to MAÊDA (1958), these shells (Kitadani Fauna) were said to differ from the so-called Tetori non-marine shells described by KOBAYASHI & SUZUKI (1936) and to be close to those of the Nagdong Series, Southern Korea and the late Neocomian Wakino Subgroup, the Kwanmon Group, Northeastern Kyushu.

Chinaboradani alternation of tuff, shale and sandstone (MAÊDA, 1957);

About 100 m thick, overlying conformably the Nochino conglomerate and sandstone, the Akaiwa sandstone equivalent, distributed at the upper

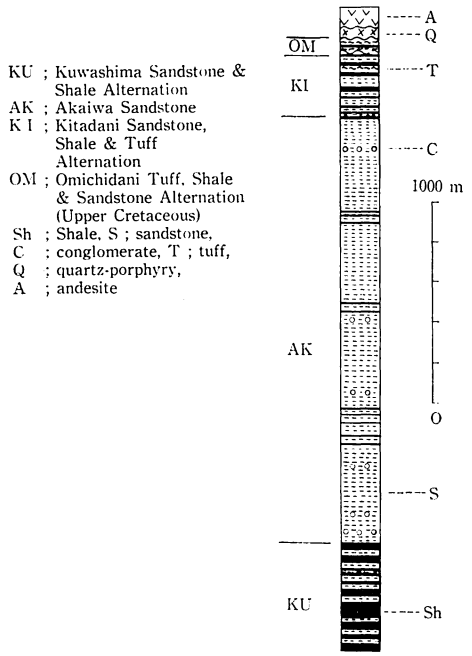

Fig. 3. Columnar section along the Omichidani valley, Ishikawa Prefecture (after S. MAEDA, 1958).

course of the Uchinami and the Itoshiro Rivers, both tributaries of the Kuzuryu, characterised by the presence of reddish or dark greenish tuffaceous layers.

Oyama Formation (MAÉDA, 1957);

Distributed along the upper course of the Itoshiro River, consisting of the Upper alternation of tuff, shale and sandstone Member of 30 m thick, and the Lower sandstone and tuff Member of 47 m thick, conformably overlying the thin Nobudani conglomerate which overlies the Palaeozoic Group with unconformity and is characterised by the presence of reddish or dark greenish tuffaceous layers.

Judging from the lithic characters, the Uppermost Member may correspond to the tuff-bearing formations mentioned above, though the colour of the tuff in the former is not reddish or dark greenish but rather greyish.

The geological age of the Uppermost Member is presumed to be Aptian, because in the Kitadani Formation, the Kitadani Fauna below is similar to that of the late Neocomian Wakino Subgroup (A. HASE, 1960; Y. OTA, 1960) and the coloured tuffaceous layers above are similar in colour to the coloured pyroclastic layers of the Shimonoseki Subgroup (so-called the Inkstone) overlying the Wakino Subgroup, and of Silla (Shiragi in Japanese) Series overlying the Neocomian Nagdong Group.

If the above chronological assumption for the Uppermost Member is accepted, the Lower to Upper Member are rightly correlated with the late Neocomian Akaiwa sandstone widely distributed in the Tetori Basin.

Subdivision of the so-called "Tetori Flora"

The fossil plants including *Arctopteris* and *Jacutopteris*, of the Uppermost Member, are quite different in composition from those of the Akaiwa and the early Neocomian Oguchi Formations and that of the late Jurassic Kuzuryu Group. Accordingly it is appropriate to treat them as a flora, the Tamodani Flora.

Recently, from several new localities of the Akaiwa Formation, the writer and his cooporators found a new fossil flora, the Akaiwa Flora which was fairly different from the Oguchi Flora both in morphological characters of cycadophytes and ginkgos and in composition.

Accordingly, the formerly so-called "Tetori Flora" is now divisible chronologically into the followings.

Tamodani Flora:
Description; the present work

Table 1. Stratigraphical relation between the standard area and the Tamodani valley section, and subdivision of the so-called "Tetori Flora".
(Thickness of formation is in the average)

Geological age and subdivision of "Tetori Flora"				Stratigraphy of standard area: Tetori Group by S. MAEDA (1958)		Stratigraphy of standard area: Tetori Super-Group by M. KAWAI (1961)			Tamodani (Present work)		Outer Side; "Ryoseki Flora"	
Early Cretaceous	Albian	So-called the "Tetori Flora"									So-called the "Ryoseki Flora"	Upper Monobegawa Flora
Early Cretaceous	Aptian	So-called the "Tetori Flora"	Tamodani Flora	Akaiwa Subgroup	Kitadani Sandstone, Shale & Tuff Alternation (275 m)				Tamodani Formation	Uppermost Tuff, Shale & Sandstone	So-called the "Ryoseki Flora"	Upper Monobegawa Flora
Early Cretaceous	Late Neocomian	So-called the "Tetori Flora"	Akaiwa Flora	Akaiwa Subgroup	Akaiwa Sandstone (900 m)		Myogadani Formation (252 m) Akaiwa Formation (288 m)	$A_1 \sim A_5$ $M_1 \sim M_2$	Tamodani Formation	Upper Sandstone Middle Sandstone & Shale Alternation Lower Conglomerate	So-called the "Ryoseki Flora"	Lower Monobegawa Flora
Early Cretaceous	Early Neocomian	So-called the "Tetori Flora"	Oguchi Flora	Itoshiro Subgroup	Kuwashima Sandstone & Shale Alternation (400 m) Gomishima Conglomerate (50 — 350 m)	Oguchi Formation	Kuwashima Alternation Gomishima Conglomerate				So-called the "Ryoseki Flora"	Ryoseki Flora
Late Jurassic			"Kuzuryu Flora"	Kuzuryu Subgroup		Kuzuryu Group						

Geological age; Aptian

Akaiwa Flora:

Description; the present work in part

Geological age; late Neocomian

Remarks; the main subject will be shown in detail in the near future

Oguchi Flora: (=Kaga flora formerly proposed by YOKOYAMA, 1889)

Description; GEYLER, 1877; YOKOYAMA, 1889; YABE, 1905, 1922; OISHI, 1936. 1940, 1941; SHIMAKURA, 1937; MATSUO & OMURA, 1968; KIMURA, 1961; KIMURA, & SEKIDO, 1963, 1965, 1966, 1967, 1970, 1971, 1972, 1973, 1974 (in press)

Geological age; early Neocomian

Remarks; collected mainly from the Kuwashima (=Kuwajima) sandstone and shale alternation and its equivalent of the Itoshiro Group (by KAWAI) or the Itoshiro Subgroup (by MAÉDA)

"Kuzuryu Flora":

Description; KIMURA, 1958, 1959

Geological age; late Jurassic

The stratigraphical relation of these floras is shown in Table 1.

On the Early Cretaceous floras of Japan

General remarks

We have two distinct floras in the early Early Cretaceous, the "Ryoseki Flora" and the Oguchi Flora or the main part of the "Tetori Flora". The former includes the floras or florules of the Omoto Formation, the Ofunato Group, the Jusanhama Group, the Kukunari and the Ayukawa Formations, the Shiroi Formation, the Tatsukawa Formation, the Ryoseki Group, the Lower Monobegawa Group and the Kawaguchi Formation of early Neocomian in age.

The rich Oguchi flora has been regarded as Late Jurassic in age and the "Ryoseki Flora" as early Early Cretaceous, and the difference in composition between both floras has been considered to be due to the difference in age.

The writer (1961, 1963) has observed that both floras were synchronous and that the difference in composition was not due to a difference in age but to the surroundings in those days, and has provisionally established the following palaeofloristic provinces in the age from Middle Jurassic to Early Cretaceous.

Outer side (or Outer zone) palaeofloristic province

Northeast subprovince

Soma subprovince

Southwest subprovince

Inner side (or Inner zone) (=Hida) palaeofloristic province

Toyora palaeofloristic province

On the other hand, based upon the recent results of palaeobotanical studies in the Soviet Union, together with those in other parts of Eurasia, VAKHRAMEEV (1964, 1966) proposed the following palaeofloristic provinces extending from Jurassic to Early Cretaceous.

Siberian palaeofloristic pravince

Indo-European palaeofloristic province

European subprovince

Indian subprovince

East Asian subprovince

He later proposed to subdivide the Siberian province into the Lena and the Amur subprovinces (1970, 1971). The boundary between both palaeofloristic provinces was considered by him to have removed northward as the time proceeded.

The early Early Cretaceous floras of his Indo-European province are represented by one of the "Wealden" type. The "Ryoseki Flora" and its equivalent in the Outer side province of Japan are very similar to the "Wealden flora" in composition. While the Oguchi Flora in the Inner side province of Japan is, on the other hand, similar in composition to the floras of VAKHRAMEEV's Siberian province.

Judging from floral composition, it seems clear that the Early Cretaceous floras of Southern Primorye (KRYSHTOFOVICH and PRYNADA, 1932; KRASSILOV, 1967) belong to the Indo-European province, although they include some "strangers" from the Siberian province.

Accordingly, the Oguchi Flora appears to be isolated in the Indo-European province. According to VAKHRAMEEV (1971), Siberian floras existed under temperate and moderately moist climates, whereas those of the Indo-European province existed under more arid climates.

Now, in the case of discussing the Japanese Early Cretaceous floras, it seems to be quite necessary to introduce the recent knowledge regarding two distinct early Early Cretaceous floras, the "Ryoseki Flora" and the Oguchi Flora, as mentioned below.

The "Ryoseki Flora"

Predominant elements are Matoniaceous, Gleicheniaceous and Schizaeaceous ferns. Matoniaceous ferns have not yet been found in the "Tetori Flora" and Dicksoniaceous ferns are very rare in the "Ryoseki Flora".

Recently *Weichselia*, a Matoniaceous fern, was recorded by FUJIOKA (HUZIOKA) from the Ryoseki Group of Kochi prefecture. This genus is considered to be peculiar to the Indo-European province in the early Early Cretaceous (ALVIN, 1968, 1971; DABER, 1968).

Thirteen *Cladophlebis* species have been recorded so far, most of which have tri- or more pinnate fronds with very small pinnules often with lobed margins. These pinnules or lobes are mostly reflexed. *Cladophlebis takezakii* with unusually large-sized pinnules may belong to the Osmundaceae.

It is highly probable that some species of *Sphenopteris* belong to *Pachypteris* or its allies, because they represent leathery pinnules. *Acrostichopteris* was once recorded by NAGAO (1926) and YABE (1927) from the Yuasa Formation and later was assigned to *Sphenopteris goepperti* by OISHI (1931, 1940). New specimens, however, recently obtained by KANSHA from the same formation, are very similar to those described as *Acrostichopteris* from the Lower Cretaceous of Portugal, North America and Southern Primorye, and are clearly distinguishable from *Sphenopteris goepperti* or *Ruffordia goepperti*.

Without cuticular analyses, it is difficult or even impossible to make distinctions between the Cycadales and the Bennettitales depending only on external appearance of leaves, so the term cycadophyte including both orders is quite useful. Cycadophytes are represented by such genera as *Otozamites*, *Ptilophyllum*, *Williamsonia* (or *Weltrichia*), *Zamites*, *Cycadolepis* (or *Deltolepis*), *Nilssoniopteris* (or *Williamsoniella*), *Zamiophyllum* and *Nilssonia*. Except for entire leaves regarded as *Nilssonia orientalis*, or *N.* ex gr. *orientalis*, no species is common with the "Tetori Flora".

Otozamites klipsteinii is, though not abundant, a typical Wealden element. Fairly abundant are *Ptilophyllum* leaves which are variable in form, and the leaf fragments regarded as *Ptilophyllum pecten* may include such species as those were studied by JACOB and JACOB (1954), and BOSE and KASAT (1972).

Cycadolepis is an organ genus considered to represent the scale leaves of some bennettitalean plants. It is, however, difficult to make distinction between this genus and the cycadean *Deltolepis* which is similar to *Cycadolepis* on the basis of external feature only.

No *Dictyozamites* leaf has been found in the " Ryoseki Flora " and no definite *Zamiophyllum* blade has been found in the " Tetori Flora ". *Nilssonia* leaves are generally small in size. The leaves regarded as *Nilssonia schaumburgensis* represent three leaf forms, two of which are quite different from its type specimens originally described from the German Wealden.

Quite recently VAKHRAMEEV stated as follows: " In the Neocomian of the Siberian area, abundant are the remains of ginkgos (*Ginkgo*, *Baiera*, *Sphenobaiera; Pseudotorellia* in the Amur subprovince), czekanowskias (*Czekanowskia*, *Phoenicopsis*), conifers (*Pityophyllum*, *Podozamites*) and seeds of various gymnosperms (*Pityospermum*, *Schizolepis*, *Ixostrobus*, *Stenorachis*, etc.). The number of species of these gymnosperm group is considerably less than that of ferns and cycadophytes. This appears to be related to the fact that morphological variety of leaves of ginkgos, czekanowskias and conifers is not great, and the species distinguished by palaeobotanists are based, as a rule, on leaf remains. Study of cuticles of Ginkgoales, Czekanowskiales and conifers has revealed a great diversity of epidermal structures as compared to morphological variety of leaves. This will enable in the future to distinguish a large number of species especially among such genera as *Ginkgo*, *Phoenicopsis*, *Pityophyllum*."

This presumption was supported by the detailed study of KRASSILOV (1972), who distinguished 21 ginkgoalean genera and 39 species from the Jurasso-Cretaceous of Bureja basin.

In contrast to the Siberian and the " Tetori " floras, ginkgoaleans are very few in the " Ryoseki Flora " as was formerly mentioned by KOBAYASHI (1942); only doubtful *Baiera browniana* (OISHI, 1940) and *Czekanowskia*? sp. have been known from the Ryoseki Group.

In the Late Jurassic and the Early Cretaceous floras of the Indo-European province, ginkgoaleans are also quite few; a single species of *Pseudotorellia* from the English Wealden (WATSON, 1969); two species from India described by SEWARD (1919) based on imperfect specimens; *Ginkgoites rajmahalensis* (SAH, 1952, 1953; MEHTA and SUD, 1953; SAH and JAIN, 1965) from the Jurassic of Rajmahal Hills; and *Ginkgoites feistmantelli* (BOSE and DEV, 1958) and ?*Baiera* sp. (BOSE, 1957) known only from the Early Cretaceous of Jabalpur; only *Ginkgo pluripartita* and *Sphenobaiera* sp. from the Lower Cretaceous of Southern Primorye (KRASSILOV, 1967).

Frenelopsis cfr. *hoheneggeri* from the Ayukawa Formation resembles closely the forms from the European Wealden and the Potomac Formation. *Brachyphyllum japonicum* is known from various localities. But the exact attribution of both species is still uncertain, as their cones for distinguishing genera and species have not yet been obtained.

Nageiopsis of uncertain affinity and *Podozamites* are both rare in the " Ryoseki Flora ".

VAKHRAMEEV (1971) emphasized that the Jurassic and the Early Cretaceous floras in the Indo-European province had existed under arid climate, in striking contrast to those in the Siberian province.

The above would also be indicated by the association of red formations and carbonate-bearing layers in the deposits of this province at that time.

According to BOWER (1961), the characteristics of xerophytes are as follows:

a) The leaf-area is reduced, and its texture is often fleshy to serve for water storage (especially on the dry areas of the Old World).
b) The leaf-reduction goes along with a corresponding distension of the stem (especially on the dry areas of the New World).
c) In some cases the stem swells to an almost spherical form, by which means greatest possible proportion of bulk to surface area is attained.
d) A spiny or thorny character is common.
e) Many possess extensive and deep root systems and root hairs are characterised by high osmotic pressures.
f) Thickened epidermal walls and cuticle and the leathery texture of leaves are common.
g) Hairiness or waxy surface of leaves is common.
h) The stomata are frequently sunk in deep pits.
i) A lengthwise rolling of the leaf is common.
j) Some leaves occupy a vertical rather than a horizontal plane due to a bending of the petiole.

As previously stated, in most of the ferns, pinnules are small-sized, often lobed; the surface of pinnules and lobes are strongly convex and the leaf-margin is reflexed; most of the long pinnules of Matoniaceous ferns have lengthwise rolling; in cycadophytes and some fern-like plants, leathery leaves are predominant; entire or nearly entire cycadean or bennettitalean leaves are also predominant; cuticular characters are little known, because of the ill-preservation of fossil material.

In the Wealden flora of England described by WATSON (1969), *Nilssonia schaumburgensis* shows thickened cuticle and has small-sized stomata with unicellular trichome bases around, but stomata are not sunken; in *Beckelesia sulcata* and *Pseudotorellia heterophylla*, stomata are sunken and surrounded by thick-walled cells; in most of the ferns and *Pachypteris lanceolata*, leaf-margins are reflexed.

Many barrel-shaped bennettitalean stems are known from the Early Cretaceous of England (STOPES, 1915) and North America (FONTAINE, 1889). These manoxylic stems are not known either from the Siberian province or from the Tetori Supergroup.

Prof. HARRIS told the writer that the Wealden floras of England were not exactly in an arid climate, but in the one where there was a good period of rain and a very pronounced dry, hot period.

The plant characters indicating xeric conditions, and the occurrence of red layers in the Ryoseki Group, leads to a conclusion that the "Ryoseki Flora" existed under an edaphic condition similar to that of other Wealden floras, and a more arid condition than that is indicated for the "Tetori Flora".

According to "Geological Materials in China" (1956, 1958), red formations are predominant in the Jian-de and the Pantou Series of Southern China, whereas in the Mishan and the Mulin Series of Northeastern China, there are coal intercalations but is no red formation.

SMILEY (1969) distinguished eight floral zones extending from Albian to Maestrichtian in North Alaska by his detailed field work, and mentioned that each florule had existed on the coastal plain under a temperate and moderately humid climate, this seems true also for the Early Cretaceous floras of the Kolyma basin (SAMYLINA, 1964, 1967). It seems certain that the environment of the "Ryoseki

Flora" was quite different from that of North Alaska and the Kolyma basin.

In China, the Mishan and the Mulin floras have been assigned to Late Jurassic in age. VAKHRAMEEV (1965, p. 152) inferred the age of both floras to be early Early Cretaceous, because both floras resembled in composition the Early Cretaceous floras of nearby Southern Primorye and the geological structure of the Mulin Series is very similar to that of the adjacent early Lower Cretaceous coal-bearing formation along the Suifun river.

The writer agrees with VAKHRAMEEV in the age of both floras. Among the Chinese Early Cretaceous floras, those of the Mishan, Mulin, Nenjiang, He-gang, Hua-shan and Sha-he-tze Series and that of Shan-dong peninsula are more like the "Tetori Flora" than the "Ryoseki Flora" in composition. On the other hand, the Jian-de flora in the western part of Zhe-jiang and the Pantou flora in the western part of Fujian are similar to the "Ryoseki Flora".

SZE (1956) divided the late Mesozoic floras of China into two, i.e. the earlier Mishan flora and its equivalents which he considered to be of Dogger-Malm age, and the later Pantou flora and its equivalent which he regarded as of Wealden age.

The writer, however, believes that these Chinese floras are synchronous and of early Early Cretaceous age, and represent a heterogeneous vegetation like the relation between the "Tetori" and the "Ryoseki" Floras of Japan.

The rich Early Cretaceous floras of Southern Primorye were recently studied by KRASSILOV (1967), representing a floral succession extending from Berriasian to Albian age. Floras of the Taukhin (Berriasian) and the Kljuchev (Valanginian) Formations include elements both of the "Tetori" and the "Ryoseki" Floras; those of the Old Sutschan and the Ussuri (Barremian) are similar to the "Ryoseki Flora", although both include *Dictyozamites cordatus.*

Dictyozamites species have been known from South America (MENÉNDEZ, 1966; ARCHANGELSKY and BALDONI, 1972), Italy (BARNARD, 1965), Yorkshire (HARRIS, 1969), Bornholm (NATHORST, 1889; FLORIN, 1931 and others), India (OLDHAM, 1863; MORRIS, 1863; FEISTMANTEL, 1877 and others), Southern Primorye (KRYSHTOFOVICH, 1929, 1933; KRYSHTOFOVICH and PRYNADA, 1932; SAMYLINA, 1964; KRASSILOV, 1967), Malaysia (KON'NO, 1967), Nagdong (YABE, 1905; TATEIWA, 1929; OISHI, 1936, 1940), Oguchi, the main part of "Tetori" (YOKOYAMA, 1889; OISHI, 1936, 1940; KIMURA, 1961; KIMURA and SEKIDO, 1966, 1967), Kiyosue (TAKAHASHI and NAITO, 1950) and Lena basin (VAKHRAMEEV, 1970).

The Oguchi Flora, main part of the "Tetori Flora"

The writer considers the age of the Oguchi Flora to be synchronous or nearly so with the "Ryoseki Flora" for the reasons previously mentioned (1973), but its composition is quite different from the "Ryoseki Flora".

The known early Cretaceous or Jurasso-Cretaceous floras in the Siberian province are from the following areas;

East Siberia; Zeia river (LEBEDEV, 1963), Bureja basin (VAKHRAMEEV and DOLUDENKO, 1961), Tul and Uda rivers (VAKHRAMEEV and LEBEDEV, 1967), South Yakutsk (VASSILEVSKAJA and GENKINA, 1961), Lena basin (VASSILEVSKAJA, 1958, 1959; VASSILEVSKAJA and PAVLOV, 1963; VAKHRAMEEV, 1958,

1962, 1970; SAMYLINA, 1956, 1963; KIRICHKOVA and SLASTENOV, 1968; KIRICHKOVA and BUDANTSEV, 1967) and Kolyma basin (SAMYLINA, 1964, 1967).

West Siberia; left side of the Yenisey river (MOGUCHEVA, 1963)

In addition to the above, coeval floras or florules are known from New Siberian Islands, Franz Josef Land, Svalbard (Spitzbergen). Among these, the floras of Zeia, Tul, Uda and Bureja areas were included in the Amur subprovince, and the others in the Lena subprovince. The boundary between both subprovinces is along the Stanovoy Range (VAKHRAMEEV, 1971).

According to VAKHRAMEEV, characteristic genera and species of the early Early Cretaceous of the Siberian province are as follows:

Lena subprovince; *Cladophlebis argutula* (HEER) FONTAINE, *C. atyrkanensis* (HEER), *C. lenaensis* VACHRAMEEV, *C. pseudolobifolia* VACHRAMEEV, *C. angarensis* VACHRAMEEV, *Coniopteris burejensis* (ZALESSKY) SEWARD, *C. nympharum* (HEER) VACHRAMEEV, *C. onychioides* VASSILEVSKAJA and KARA-MURSA, *C. setacea* (PRYNADA) VACHRAMEEV, *C. saportana* (HEER) VACHRAMEEV, *Jacutopteris lenaensis* VASSELEVSKAJA, *Gleichenia lobata* VACHRAMEEV, *Gonatosorus ketovae* VACHRAMEEV, *Aldania auriculata* SAMYLINA, *A. umanskii* VACHRAMEEV and LEBEDEV, *A. vachrameevi* SAMYLINA, *Anomozamites angularis* HEER, *Ctenis burejensis* PRYNADA, *C. nana* SAMYLINA, *C. tygyensis* VASSILEVSKAJA and ABRAMOVA, *Heilungia amurensis* (NOVOPOKROVSKY) PRYNADA, *H. sangarensis* VASSILEVSKAJA, *Jacutiella amurensis* (NOVOPOKROVSKY) SAMYLINA, *Neozamites verchojanensis* VACHRAMEEV, *Nilssonia lobatidentata* VASSILEVSKAJA, *Pterophyllum acuta* (VASSILEVSKAJA) VACHRAMEEV, *P. polynovii* (PRYNADA) KRASSILOV, *P. tyrmensis* (PRYNADA) KRASSILOV, *Ginkgo paradiantoides* SAMYLINA, *Sphenobaiera angustiloba* HEER, *Podozamites gramineus* HEER, *Rhipidiocladus flabellata* PRYNADA.

Amur subprovince; *Cladophlebis argutula* (HEER) FONTAINE, *Coniopteris burejensis* (ZALESSKY) SEWARD, *C. nympharum* (HEER) VACHRAMEEV, *C. onychioides* VASSILEVSKAKA and KARA-MURSA, *C. saportana* (HEER) VACHRAMEEV, *Anomozamites angulatus* HEER, *Ctenis burejensis* PRYNADA, *Heilungia amurensis* (NOVOPOKROVSKY) PRYNADA, *Pterophyllum polynovii* (PRYNADA) KRASSILOV, *P. tyrmensis* (PRYNADA) KRASSILOV, *Ginkgo paradiantoides* SAMYLINA, *Sphenobaiera angustiloba* HEER, *Czekanowskia rigida* HEER, *Phoenicopsis angustifolia* HEER, *Podozamites gramineus* HEER, *Rhipidiocladus flabellata* PRYNADA.

VAKHRAMEEV (1971) mentioned that the Neocomian Siberian floras had existed under temperate and moderately humid climates, instead of more arid climates under which coeval Indo-European floras had developed, for the following reasons:

1) Insertion of rich coal layers.
2) Wide distribution of pycnoxylic wood remains with well-developed annual rings.
3) No manoxylic wood remains or arborescent ferns which were well-developed in the Indo-European province during Neocomian time.
4) Abundant occurrence of deciduous ginkgoaleans and *Podozamites* leaves which would fall in a certain season similar to recent *Ginkgo* leaves.

In the Neocomian of Siberian province, most *Cladophlebis* species represent bipinnate fronds with large-sized pinnules lacking reflexed margins; such *Cladophlebis* species are known from the Older Mesozoic floras and the Oguchi Flora in Japan.

The main locality of the Oguchi Flora is now the upper course of Mekkodani, a tributary of the Tetori (=Tedori) river. Characteristics of the Oguchi Flora are as follows:

1) Abundant occurrence of older type *Cladophlebis* species representing bipinnate fronds with large-sized pinnules lacking reflexed margins.
2) Occurrence of older type *Todites* species.
3) Abundant occurrence of various Dicksoniaceous ferns and such cycadophytes as *Dictyozamites*, *Ctenis*, *Nilssonia* and *Nilssoniocladus* (KIMURA and SEKIDO, in press).
4) Abundant occurrence of various ginkgoaleans and *Podozamites* leaves.
5) No Matoniaceous fern has been found.
6) Among the cycadophytes, except for entire or nearly entire leaves of *Nilssonia orientalis* or *N.* ex gr. *orientalis*, there is no known species in common with the "Ryoseki Flora".

Judging from the composition and the characteristic external features of individual species, the Oguchi Flora is very similar to the Early Cretaceous floras of the Siberian province, and not to the "Ryoseki Flora" of Japan and the late Neocomian floras of Southern Primorye; some *Coniopteris*, *Gleichenites* (or *Gleichenia*), *Sphenopteris*, *Cladophlebis*, *Nilssonia*, *Ctenis*, *Ginkgo* and *Podozamites* species are common or similar to those of the Early Cretaceous floras of Siberia.

KIMURA and SEKIDO (1969) found *Neozamites* which is considered to be one of the characteristic of Siberian floras. A *Ctenis* species (KIMURA and SEKIDO, MS) is indistinguishable from *Ctenis burejensis*, one of the elements of the Siberian floras. Recently *Podozamites reinii* and its allies have been described from the Lena and the Kolyma basins (VASSILEVSKAJA and PAVLOV, 1963; LEBEDEV, 1965; GENKINA, 1966). This species is one of the characteristic elements of the "Tetori Flora".

Xenoxylon latiporosum is a pycnoxylic wood and no manoxylic wood has been found in the "Tetori Flora".

It is highly probable that the Oguchi Flora existed under a temperate and moderately humid climates, because of the characters mentioned above, the fairly rich association of coals, and lack of red formations as is the case also with the Early Cretaceous floras of the Siberian province.

The material from the Oguchi Formation and its equivalents is only of impressions, and unfortunately no cuticular preparation is available at the present time.

Brief notes on the late Neocomian Akaiwa Flora

Along the Tamodani section, four plant beds were noticed but the lowest one produced indeterminable fragments only. Among the collection, the following species have been identified; *Equisetites* sp., *Birisia onychioides*, *Adiantites* sp. B, *Cladophlebis* ex gr. *denticulata*, *Onychiopsis elongata*, *Nilssonia* cfr. *orientalis*, *N.* cfr. *nipponensis*, *Pseudotorellia* sp., *Ginkgoites* sp., *Podozamites reinii* and *P.* sp. Leaves of ferns, Ginkgos and *Podozamites* are abundant but cycadophyte leaves less common.

Equisetites sp. is represented only by several tubers which are so close to those from the Early Cretaceous of Siberia in general outline rather than those from the Oguchi Formation.

Birisia onychioides was fomerly regarded as *Coniopteris onychioides.* This species is widely spread in the Siberian palaeofloristic province over the Early Cretaceous except early half of Neocomian. *Cladophlebis shinshuensis* originally illustrated by TATEIWA (1929) from the Chin-ju (Shinshu in Japanese) Formation, the Nagdong Group (or Kyongsang Group) is now identical with this Dicksoniaceous species. *Adiantites* sp. B is represented by incomplete leaf fragments. *Onychiopsis elongata* is rather poorly represented than abundant in the early Early Cretaceous in Japan. In Siberia, this genus is said to appear since Aptian (VAKHRAMEEV, 1971).

Nilssonia cfr. *orientalis* is represented by a single small fragment of *N. orientalis* var. *minor* type lamina. *N.* cfr. *nipponensis* is also represented by several fragments and resembles some specimens regarded as *N. schmidtii.* These cycadophytes are commonly smaller in size than those from the late Jurassic Kuzuryu Group and also from the Oguchi Formation.

Ginkgoes are represented by many isolated leaves which strongly remind us of *Pseudotorellia* and by many fragments of *Ginkgoites* leaves. *Podozamites reinii* is less abundant than in the Oguchi Formation. *Podozamites* sp. has more longer leaves than the former.

This flora is quite similar in composition to the rich flora of the Akaiwa Formation newly found by the writer in cooperation with the staffs of the Komatsu City Museum, Ishikawa Prefecture, from the southeastern slope of Mt. Hakusan and the Osugidani valley, a tributary of the Tetori (KIMURA and SEKIDO, MS).

The Akaiwa flora is characterised by the predominance of ginkgoalean and *Podozamites* leaves like the Oguchi Flora and is quite different in composition from the early Early Cretaceous "Ryoseki Flora" and Aptian-Albian floras of the Outer side palaeofloristic province of Japan.

It is clear that the Akaiwa Flora existed in the Inner side palaeofloristic province of Japan, but its floral composition became fairly different from that of the Oguchi flora as shown below;

1) Diversity of ferns was decreased. Only Dicksoniaceous ferns were rather prominent.
2) Diversity of cycadophytes was decreased. *Nilssonia* leaves were changed in form and were reduced in size.
3) Ginkgoes were predominant and diverse in form. *Ginkgodium* leaves were increased in size. *Pseudotorellia* species appeared for the first time.
4) *Podozamites* leaves were also predominant and diverse in form, and new type of this genus, such as *P. angustifolius* appeared.
5) Conifers were rather rare as well as the Oguchi Flora, but the coniferous wood, *Xenoxylon latiporosum* was predominant.

Except several new types, it is clear that the species of the Akaiwa Flora are mostly the descendants or the survivors from those of the Oguchi Flora. The palaeobotanical detail of the Akaiwa Flora will be shown by KIMURA and SEKIDO in the near future.

Note on the Aptian Tamodani Flora

Most of specimens were obtained from two tuff beds as shown in Fig. 2. Among the collection, the following species have been identified; *Osmundopsis* ? sp., *Gleichenites* aff. *porsildi*, *Arctopteris* sp., *Jacutopteris* sp., *Adiantites* sp. A, *Cladophlebis* cfr. *pseudolobifolia*, *Sphenopteris kochibeana*, *Sphenobaiera* ? sp., *Pseudotorellia* sp., *Ginkgodium* ? sp., *Podozamites* sp. cfr. *P. eichwaldi*, *Pityophyllum* sp. and *Conites* sp.

No cycadophyte has been noticed in the collection. Ferns are abundant but quite different in composition from those of the Middle Member and also from the Akaiwa Formation. *Osmundopsis* ? sp. is close to *Osmundopsis efimoviae* originally described by SAMYLINA (1964) from the Early Cretaceous Zyrianka coal basin in general appearance of pinnae and pinnules. *Jacutopteris* sp. has long perpendicular pinnules and is quite close to *J. lenaensis* originally described by VASSILEVSKAJA (1960) from the Early Cretaceous of Lena basin. *Arctopteris* sp. is rather close to *A. kolymensis* SAMYLINA than *A. rarinervis* SAMYLINA which was formerly regarded as *Cladophlebis huttoni* in North Alaska (FONTAINE in WARD, 1905; KNOWLTON, 1914; SAMYLINA, 1964).

Gleichenites aff. *porsildi* is widely known from the Early and Late Cretaceous of Arctic region. The present specimens are so similar to this species originally described by SEWARD (1926) in external morphology. *Adiantites* sp. A is close to *Adiantites sewardi* originally described by YABE (1905) from the Nagdong Group and also to *Adiantopteris grandis* VAÇHRAMEEV (1968) from the Early Cretaceous of Southern Primorye in general outline. *Cladophlebis* cfr. *pseudolobifolia* is similar to some specimens regarded as *C. pseudolobifolia* originally described by VAKHRAMEEV from the Early Cretaceous of Lena basin. *Sphenopteris kochibeana* is indistinguishable from the original specimen described by YOKOYAMA as *Adiantites kochibeana* (1889) from Kuwashima of the Oguchi Formation. Recently this species was found from Mongolia (JÄNICHEN and KAHLERT, 1972) under its original generic name.

Ginkgo leaves are abundant but not clearly distinguishable because of ill-preservation of material. *Podozamites* leaves are represented by such small leaves as *Podozamites* sp. cfr. *P. eichwaldi* which is common to the Early Cretaceous of Siberia. *Pityophyllum* sp. is represented by detached needle-like leaves in crowds. Such leaves are common to the Early Cretaceous of Siberia, too. *Conites* sp. is too imperfect to identify.

This flora is quite distinct and new to Japan, and is similar to the late Early Cretaceous floras of Arctic region in composition.

No common species has been noticed between this flora and the Early Cretaceous floras of the Outer side palaeofloristic province of the Japanese Islands. The presence of this flora would support the existence of the Inner side palaeofloristic province extending to the late Early Cretaceonus in Japan.

Systematic Description

Equisetales

Genus *Equisetites* STERNBERG, 1833

Equisetites sp.

Pl. 5, fig. 1

Description of Specimens: The collection consists of a number of tubers. These are oval, 1.5 cm long, 7 mm wide and have an irregularly wrinkled surface. They are attached in opposite pairs to slender rhizomes which are only faintly visible.

Remarks: From the early Lower Cretaceous Oguchi Formation, YOKOYAMA (1889) originally described *Equisetum ushimarense* with circular tubers. They seem to be different from the present ones in shape.

The writer and SEKIDO (1967) described some tubers together with rhizomes and aerial shoots from the same formation as *Equisetites ushimarensis* (YOKOYAMA) OISHI, but they differ from the present ones in that their apical portion is divided into four lobes (leaves ?) with acuminate apices.

The present tubers are rather close to those described by YABE (1905, p. 43, pl. 3, fig. 10) from the early Lower Cretaceous Nagdong Group, Korea as *Equisetum ushimarense*, both in external appearance and in form.

Equisetum burejense originally described by HEER (1876, p. 99, pl. 22, figs. 5-7) and represented by rhizomes with tubers which sometimes jointed each other like beads, is similar in form to the present tubers.

Some imperfect tubers illustrated by VASSILEVSKAJA and PAVLOV (1963) as *Equisetites burejensis* (HEER) KRYSHTOFOVICH (pl. 1, fig. 2) and its variety *parvula* VASSILEVSKAJA (pl. 1, fig. 3), both from the Lower Cretaceous of Lena basin, are also similar in form to the present ones. SAMYLINA (1964) described two types of tubers as *Equisetites* sp. A (p. 47, pl. 1, figs. 6, 7) and sp. B (p. 48, pl. 1, figs. 8, 9) from the Lower Cretaceous of Kolyma basin. They are somewhat different from the present ones in having roundish form in the former and more elongated and irregularly attached to the rhizomes in the latter.

It is difficult to identify such tubers as mentioned above, unless they represent some characteristics.

Horizon & Occurrence: C-Tamodani. Common.

Depository: TC-9026, TC-9029B-1.

Filicales

Osmundaceas

Genus *Osmundopsis* HARRIS, 1931

Osmundopsis ? sp.

Pl. 5, figs. 2-5; Fig. 4-1a, b

Description of Specimens: Several imperfect sterile pinna fragments and an ill-preserved fertile pinna fragment were examined. Unfortunately the sterile and fertile fragments are separate.

Pl. 5, fig. 2 (TH-029) shows an imperfect sterile pinna with pinnules which are triangular in shape, directed forwards, set closely, attached to the pinna axis with whole base; margins shallowly lobed as shown in Pl. 5, fig. 3 (TH-031), but entire in the apical ones; nerves rather *Sphenopteris*-type as shown in Fig. 4-1a than that of *Cladophlebis*; midnerve distinct in the proximal half, sending off secondaries forking once but not forking so in apical pinnules.

Pl. 6, fig. 4 (TG-011) shows an ill-preserved penultimate pinna with small ultimate pinna bearing fertile pinnules. Fertile pinnules remotely set; laminae strongly reduced and bear many circular sporangia on both sides of supposed midnerve as shown in Pl. 5, fig. 5 enlarged. Preservation is too poor to show sporangial details. Fig. 4-1b shows the lobed margins of pinnules.

Remarks: This genus was originally defined by HARRIS as follows; "sterile leaf bipinnate, a *Cladophlebis*; fertile leaf tripinnate, ultimate branches with no lamina, but bearing tufts of pear-shaped sporangia. Wall of apical part of sporangium indurated, dehiscence by a longitudinal stomium. The type species, *Osmundopsis sturi* (RACIBORSKI) is repesented by fertile pinnae resembling those of *Osmunda*. The specimens were named *Osmundites* but this is essentially a genus of stems, and I consider it available to make a new genus for the leaves."

It is much probable that both sterile and fertile leaves here described belong to the same plant although they occurred separately. If so, the present specimens would belong to HARRIS' genus though the writer was unable to show the detail of the sporangial character fully.

Horizons & Occurrence: G, H-Tamodani. Not rare.

Depository: TG-011, TH-002, TH-013, TH-016, TH-029, TH-031.

Gleicheniaceae

Genus *Gleichenites* GOEPPERT, 1836

Gleichenites aff. *porsildi* SEWARD

Pl. 7, figs. 1-3, 5; Pl. 8, fig. 2; Fig. 4-4a, b

Compare:

1926. *Gleichenites porsildi* SEWARD; p. 76, pl. 6, figs. 18, 19, 24, 30.
1935. *Gleichenites porsildi* SEWARD; SEWARD and CONWAY, p. 5, pl. 1, fig. 5.
1956. *Cladophlebis* (*Gleichenites*) *porsildi* SEWARD; BELL, p. 63, pl. 14, fig. 4; pl. 19, fig. 4; pl. 21, figs. 2, 3.

Description of Specimens: Many pinna fragments were obtained, but they do not show the size of the whole frond. Ultimate pinnae set rather closely, the distance being 1 cm as shown in Pl. 7, fig. 1 (TG-039), long and narrow, nearly parallel-sided, attached alternately to the slender penultimate pinna axis at an angle of 45 degrees, pinna apex unknown.

Pinnules set closely but not contiguous at base, mostly uniform in size, long and narrow, linear sometimes falcate, 6 mm long and 1 mm wide, nearly parallel-sided, gradually narrowing towards the bluntly pointed apex, attached to the pinna axis at wide angle with whole bases which are often constricted with rounded basal corners or sometimes strongly decurrent; upper surface mostly convex, and the lower concave; margin entire (Pl. 7, fig. 2) or broadly undulated (Pl. 8, fig. 2), often reflexed; nerves indistinct, midnerve persisting to the tip, giving off the secondaries which are sparse, directed forwards, mostly once forking but sometimes twice.

The sori can not be seen directly because the present specimens are, for the most part, represented by the convex upper surface of laminae. Judging from the depressions on the upper surface of the lamina, they are circular, fairy large, 0.4-0.45 mm across measured on impression, each consisting of 4-6 sporangia with a possible slender central placenta, forming a single row, 3-5 in number on each side of the midnerve as partly shown in Fig. 4-4b. Unfortunately the writer could not get the balsam transfer preparation because of being little organic material preserved there.

Remarks: There seems to be little evidence to justify to include the present specimens in Gleicheniaceae, but their general appearance as described above would strongly remind us of rather Gleicheniaceous affinity than Cyatheaceous.

About 65 *Gleichenia* species among

which some one third were instituted by HEER, have been known, and 24 species of them are overlapping with those of corresponding *Gleichenites* species of which about 50 in number have been known. Besides the above two genera, *Gleicheniopsis* and *Gleichenoides* with a few species have also been known.

According to the result of the writer's examination of these species described by various authors, he found, in the secondary nerves strongly directed forward, the arrangement of sori and the outline of pinnules, that the most closest specimens to him were some of those of *Gleichenites porsildi* originally established by SEWARD (1926) from the Lower Cretaceous of Greenland and also of Western Canada.

The original specimens, however, have the following features which have not been recognizable in the present specimens; 1) many "dichotomously forking stems" each with a bud or a bud scar at an angle, occurred in association with fronds, though whether these stems and fronds belong to the same plant has not been proved, 2) the existence of fronds with longer pinnules, 2.5-3 cm long though SEWARD considered it might be possible to separate them from this species when more material had been found, 3) longer sori, 1.8 mm in diameter, 4) the occurrence of another type of fertile pinnules having small depressions or small groups of sporangia above the anadrome branch of a secondary nerve as was in his text-fig. 4, 5) the distinction between sterile and fertile pinnules is fairy clear.

BELL's specimens from Western Canada are also comparable with the present ones in general appearance of pinnules, though BELL's pinnules are all sterile and are larger than those of the present ones.

As indicated the present specimens do not agree fully with SEWARD's *Gleichenites porsildi* and may ultimately be satisfactorily distinguishable, but for the present it seems best to call them *Gleichenites* aff. *porsildi.*

Horizons & Occurrence: G, H-Tamodani. Common.

Depository: TG-012, TG-024, TG-033, TG-035, TG-037, TG-039, TG-040, TG-042, TH-009.

Dicksoniaceae

Genus *Birisia* SAMYLINA, 1972

Birisia onychioides (VASSILEVSKAJA, and KARA-MURSA) SAMYLINA

Pl. 5, figs. 6-9; Pl. 6, figs. 1-4; Figs. 4-2a-d

1878. *Dicksonia gracilis* HEER; p. 13, pl. 3, figs. 8-14.
1929. *Cladophlebis shinshuensis* TATEIWA; plate, fig. 24.
1940. *Cladophlebis shinshuensis* TATEIWA; OISHI, p. 285, pl. 20, figs. 5, 6; pl. 21, figs. 5, 5a, 6, 7.
1957. *Coniopteris onychioides* VASSILEVSKAJA & KARA-MURSA; KRYSHTOFOVICH, p. 231, fig. 201.
1958. *Cladophlebis shinshuensis* TATEIWA; KIMURA, p. 166, pl. 25, figs. 1, 2; text-fig. 1.
1958. *Coniopteris onychioides* VASSILEVSKAJA & KARA-MURSA; VAKHRAMEEV, p. 77, pl. 3, fig. 6; pl. 4, figs. 1-3; pl. 5, figs. 1, 2; pl. 6, figs. 3, 4.
1963. *Coniopteris onychioides* VASSILEVSKAJA & KARA-MURSA; VASSILEVSKAJA & PAVLOV, pl. 11, fig. 3; pl. 19, figs. 5, 6; pl. 31, figs. 6-8, 9a.
1964. *Coniopteris onychioides* VASSILEVSKAJA & KARA-MURSA; SAMYLINA (pars), p. 60, pl. 8, fig. 2; pl. 9, figs. 1, 3, 5.
1970. *Coniopteris onychioides* VASSILEVSKAJA & KARA-MURSA; ABRAMOVA, p. 38, pl. 1, figs. 3-5.

1972. *Birisia onychioides* (VASSILEVSKAJA & KARA-MURSA) SAMYLINA; p. 100.

Unfortunately the present writer has been unable to have an opportunity to refer to the original description of this species by VASSILEVSKAJA and KARA-MURSA (1957) and the subsequent one by VASSILEVSKAJA (1958).

Description of Specimens: Fronds are supposed to be fairly large in size, at least tripinnate; pinnae and pinnules are variable in size and form according to their position on the frond.

Pl. 6, fig. 1 shows a large proximal ultimate pinna, more than 15 cm long, 5 cm wide at the middle portion, but abruptly tapering towards the acuminate apex. Apical pinnules small, long and narrow, tapering gradually towards the acuminate apex, with entire or shallowly lobed margin, set closely, attached to the pinna axis with whole base at an acute angle. Midnerve straight, persisting to the tip, sending off several simple secondaries at an acute angle. Other pinnules are long and narrow, nearly parallel-sided, some reaching about 5 cm long, 4-5 mm wide, then narrowing gradually towards the acuminate apex, attached to the pinna axis at an angle of 45-50 degrees. Margin deeply pinnatified, segments triangular in form, directed forwards, acutely pointed at apex, as

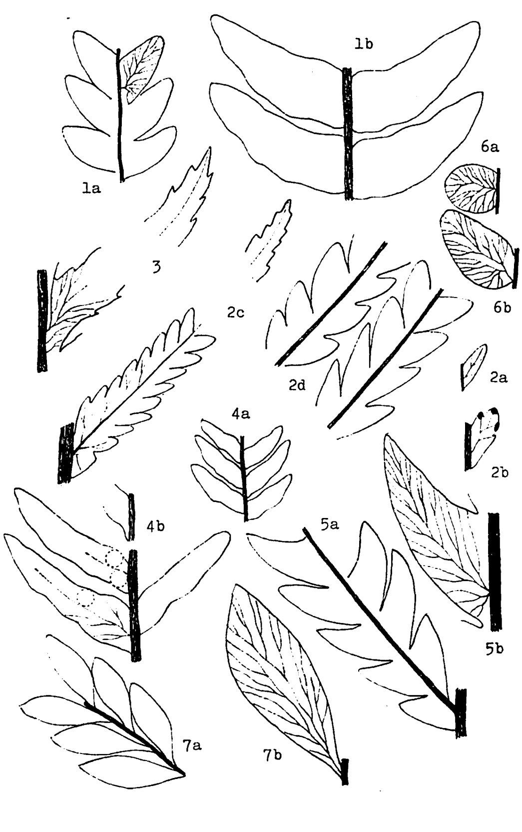

Fig. 4-1~7. (Unless otherwise referred to, all enlarged twice). 1; *Osmundopsis ?* sp.; 1a: showing triangular pinnules on anterior portion of pinna, and nervation (TH-029). 1b: large pinnules with shallowly lobed margin (TH-031). 2; *Birisia onychioides* (VASSILEVSKAJA & KARA-MURSA) SAMYLINA; 2a: showing anterior pinnule with entire margin and nervation (TDY-001). 2b: anterior small pinnule with lobed margin, each lobe has *Coniopteris*-type sorus at the tip (TDY-001). 2c: posterior large, long and narrow pinnule with lobed margins (TD-001). 2d: variation of lobes on the large pinnules (×3) (TD-001). 3; *Arctopteris* sp.; showing the shape of pinnule with serrate margins and nervation in part (×1) (TG-019). 4; *Gleichenites* aff. *porsildi* SEWARD; 4a: showing the shape of small pinnules with shallowly lobed margins (TG-046). 4b: large pinnules with decurrent bases, and with scars of circular sori (TG-035). 5; *Cladophlebis* ex gr. *denticulata* (BRONGNIART) FONTAINE; 5a; showing the outline of pinna and pinnules (×1) (TDX-001). 5b; nervation (TDX-001). 6; *Cladophlebis* cfr. *pseudolobifolia* VACHRAMEEV; 6a: showing circular pinnules and nervation (TH-012). 6b; another form of pinnule and nervation (TH-012). 7; *Sphenopteris kochibeana* (YOKOYAMA) OISHI; 7a; showing a part of pinna and the outline of pinnules. 7b; nervation (×4) (TF-007).

shown in Pl. 6, figs. 2, 3 and Figs. 4-2c-d. Each segment receives one simple secondary nerve, giving off 2-3 simple laterals as shown in Figs. 4-2c.

Pl. 5, fig. 6 shows an apical portion of a delicate penultimate pinna. Ultimate pinnae long and narrow, nearly parallel-sided, narrowing gradually towards the acuminate apex, attached to the slender penultimate pinna axis at an angle of 30 degrees, then bending outwards, set closely, overlapping each other laterally. Distal pinnules small, triangular in form, directed forwards, acutely pointed at apex, attached to ultimate pinna axis with whole base, margin entire. Mid-nerve faintly preserved but persisting to the tip with 2-3 simple secondaries as shown in Fig. 4-2a. Posterior pinnules larger than the distal, long and narrow, tapering gradually towards the acute or acuminate apex. Margin shallowly lobed, each lobe receives acutely one secondary nerve mostly forking once. Small sori are recognizable at the tips of apical lobes in some reduced pinnules at the distal portion of ultimate and penultimate pinnae as shown in Fig. 4-2b. The arrow in Pl. 5, fig. 6 shows a pinnule with such sori and fig. 7 shows it enlarged.

Pl. 6, fig. 4 shows a similar specimen to the above. Pinnules on the distal portion of ultimate pinnae are reduced and bear the sori at the tips of apical lobes.

Pl. 5, fig. 8 shows a fertile portion of a penultimate pinna. Ultimate pinnae rather remotely set because of reduction of pinnules. Fertile pinnules small, lower ones with 4-7 lobes, upper ones with 1-3, each lobe bearing a *Coniopteris*-like sorus at the tip, as shown in Pl. 5, fig. 9 enlarged.

Comparison & Remarks: The present specimens are very close to the specimens described by VAKHRAMEEV (1958), VASSILEVSKAJA and PAVLOV (1963) and ABRAMOVA (1970) from the Lower Cretaceous of Lena basin, and some of those described by SAMYLINA (1964) from the Kolyma basin, as *Coniopteris onychioides*.

VAKHRAMEEV illustrated seven penultimate pinnae and one ultimate pinna of various positions on the frond. They are indistinguishable with the present specimens of corresponding position, especially of the fertile ones, though some of the ultimate pinnae of the former are set more remotely.

VASSILEVSKAJA and PAVLOV illustrated seven specimens. They are also close to the present ones, especially to the fertile ultimate pinnae and the long and narrow pinnatified sterile pinnules, though some of the ultimate pinnae as in their pl. 31, fig. 6. are set more remotely. Their pl. 31, fig. 8 shows a penultimate pinna with two sterile and four fertile ultimate pinnae in organic connection. The sterile pinnules are long and narrow, deeply pinnatified as those in the present Pl. 6, fig. 2. The fertile ones are also long and narrow, deeply pinnatified and bear the sori at the tips of reduced segments, 10-12 in number on the proximal ones, more reduced in number on the apical. It is clear that such long and narrow pinnules also become fertile as well as small and shallowly lobed ones, though this case has not been recognized in the present specimens.

In 1972, SAMYLINA instituted the new genus *Birisia* to the Dicksoniaceous ferns with sterile pinnules of *Cladophlebidium*-type and fertile pinnules of *Coniopteris*-type. She described four species under this new genus among which one was new.

SAMYLIMA excluded some of the specimens derived from the Kolyma basin, which she (1964) had formerly assigned to *Coniopteris onychioides*, from *Birisia onychioides* and included them in her

Birisia aculata (1964, p. 60, pl. 8, figs. 3, 4) and *Birisia alata* (PRYNADA), the type species (ibid., pl. 8, fig. 1; pl. 9, fig. 4). The rest (ibid., pl. 8, fig. 2; pl. 9, figs. 1, 3, 5) are close to the present ones.

SAMYLINA (1972, p. 100) included her specimen (1964, pl. 9, fig. 2) in *Birisia onychioides* but its general appearance would rather recall her *B. alata* or *B. aculata* than *B. onychioides*. At the same time, she excluded her pl. 9, fig. 5 from *B. onychioides*, but so far as her figure shows, it appears to resemble the long and narrow, pinnatified sterile pinnules of *B. onychioides*. At any rate, the present writer agrees well with her dealing to establish the new genus for the ferns representing both *Cladophlebidium*-type sterile pinnules and *Coniopteris*-type sori to separate them from *Coniopteris*.

ABRAMOVA (1970) showed two pinna fragments showing clear nervation, as *Coniopteris onychioides*, which were also externally very close to the present ones.

In 1958, from the same locality, the writer described a fern with *Cladophlebidium*-type sterile pinnules as *Cladophlebis shinshuensis* originally illustrated by TATEIWA from the Lower Cretaceous of Nagdong Group, Korea. Now it is evident the writer's *Cladophlebis shinshuensis* is synonymous with *Birisia onychioides* because such *Coniopteris*-type fertile pinnules as described above are represented in organic connection with the sterile *Cladophlebis shinshuensis*.

The writer believes that the original specimens of *Cladophlebis shinshuensis* and those described by OISHI (1940, pl. 20, figs. 5, 6; pl. 21, figs. 6, 7; pl. 21, fig. 5 reproduced from one of the original specimens), are also synonymous with *Birisia onychioides*, though in the Korean specimens, fertile pinnules have not been found yet.

OISHI (1940) stated that *Cladophlebis shinshuensis* resembled *Polypodium oregonense* FONTAINE from the Jurassic of Oregon, but they are quite different as their sori are near the sides of the midnerve and not marginal.

Among other similar looking Early Cretaceous ferns are *Birisia alata* (PRYNADA) SAMYLINA and *B. aculata* SAMYLINA, *Cladophlebis alata* FONTAINE from Alaska and *C. alberta* (DAWSON) BELL from Western Canada.

Horizon & Occurrence: D-Tamodani. Abundant.

Depository: TD-0001, TD-0001B, TD-0001D, TDY-001, TDY-002, TDY-004, TD-9143, TD-9149, TD-9151, TD-9152, TD-9159, TD-9174, TD-9174B, TD-9185, TD-9192.

Pteridaceae

Genus *Arctopteris* SAMYLINA, 1964

Arctopteris sp.

Pl. 8, fig. 1; Fig. 4-3.

Description of Specimen: Pl. 8, fig. 1 shows a single imperfect ultimate pinna only obtained, with several pinnules faintly preserved, none of which showing complete.

Pinnules set closely, continuous at base each other, long triangular in shape, 1-1.5 cm long, 4 mm wide at base, attached by their whole bases to the pinna axis with 45 degrees, falcate in their distal halves, united at base by a decurrence of their base, margin serrated. Midnerve distinct persisting to the acutely pointed apex. Secondaries faintly preserved but *Cladophlebis*-type, crowded, with an acute angle to the midnerve, once forking near the base, basal ones usually forking.

On the lower side of pinnules, one or

more lateral nerves go off from the pinna axis as shown in Fig. 4-3. Fructification not known.

Remarks: Though the full character of this fern can not make clear because of ill-preservation, it is highly probable that the present specimen belongs to *Arctopteris* by representing the characteristic feature of this genus in that some secondary nerves directly from the pinna axis on the lower side of the base of pinnules.

SAMYLINA (1964) instituted this genus on the material derived from the Lower Cretaceous of the Kolyma basin, placed it in Pteridaceae based on some well-preserved fertile leaves and described *Arctopteris kolymensis*, *A. rarinervis* and *A.* sp.

She included *Cladophlebis huttoni* FONTAINE from the Lower Cretaceous of Alaska (FONTAINE in WARD, 1905, p. 161, pls. 41-43; KNOWLTON, 1914, p 48, pl. 6, fig. 3) into her *Arctopteris rarinervis*.

The present specimen, though fragmental and also fairly imperfect in preservation, resembles closely some sterile leaves of *Arctopteris kolymensis* in general aspect.

Horizon & Occurrence: G-Tamodani. Rare.

Depository: TG-019.

Filicales Incertae Sedis

Genus *Jacutopteris* VASSILEVSKAJA, 1960

Jacutopteris sp.

Pl. 7, fig. 4

Description of Specimen: Two imperfect pinna fragments are obtained. Pl. 7, fig. 4 shows a part of pinna with pinnules. Pinnules long and narrow, 1.8 cm long, attached to the slender pinna axis at wide angle or perpendicularly with their slightly expanded whole bases, 2.7 mm wide, sickle-shape, narrowing gradually towards the acutely pointed apex. Midnerve distinct, strong, straightly persisting to near the apex, sending off the secondaries which are directed forwards, mostly once forking, but the basal one twice. Margin shallowly lobed, each lobe directed forwards. The upper surface strongly convex and the margin reflexed, so the pinnules appear to set remotely except the basal part of pinnules. Fructification not known.

Remarks: VASSILEVSKAJA (1960) instituted this genus and described *Jacutopteris lenaensis* (p. 63, pl. 1, figs. 1-10; pl. 2, figs. 1-9) from the Lower Cretaceous of the Lena basin.

Externally the present specimens resemble closely the sterile pinnules of *Jacutopteris lenaensis* originally described by VASSILEVSKAJA and later by VASSILEVSKAJA and PAVLOV (1963, pl. 5, fig. 1) and VASSILEVSKAJA and ABRAMOVA (1966, p. 75, pl. 1, figs. 4, 5), though these sterile pinnules are all entire and the secondary nerves are more densely crowded.

In some of fertile pinnules of *Jacutopteris lenaensis*, margins are shallowly lobed as was shown in original specimens (pl. 2, figs. 3, 8, 9). It would be probable that the present shallowly lobed pinnules were just before producing the sori. The writer feels that the present specimens belong to *Jacutopteris*.

Horizon & Occurrence: F-Tamodani. Rare.

Depository: TF-002, TF-005.

Genus *Adiantites* GOEPPERT, 1836

Adiantites sp. A

Pl. 7, fig. 5; Pl. 8, fig. 4

Description of Specimens: Many

detached fan-shaped pinnule fragments were obtained. Pl. 7, fig. 5 shows a part of some pinnules of which upper margin apparently crenulated. Nerves numerous, fine, uniform, united below at the base, radially spreading and dichotomously forking.

Pinnules variable both in size and form. Pl. 8, fig. 4 shows a part of larger pinnule with deeply crenulated upper margin. Fructification not known.

Remarks: Without the pinnule fragment as shown in Pl. 7, fig. 5, showing fan-shaped in outline, dichotomously forking nerves and crenulated upper margin as is seen in *Adiantites sewardi* originally described by YABE (1905) both from the Lower Cretaceous Nagdong Group and the Oguchi Formation, even the generic assignment could not have made.

Depending only on the external resemblance to the recent *Adiantum*, more than one hundred species have so far been described not only from the Mesozoic but also from the Palaeozoic strata, but by the later studies, some of them have been removed to different fern groups.

Unfortunately the present specimens are too imperfect to compare them specifically. VASSILEVSKAJA (1963) had proposed a new generic name *Adiantopteris* instead which has since been followed by Russian palaeobotanists.

Horizons & Occurrence: G, H-Tamodani. Common.

Depository: TG-004, TG-005, TG-008, TG-009, TG-020, TG-036, TH-009, TH-010.

Adiantites sp. B

Pl. 7, figs. 6, 7

Description of Specimens: Several pinna fragments with pinnules which look like some ginkgoalean leaves, were examined. Pl. 7, fig. 6 shows one of the two pinnae with pinnately arranged pinnules to the pinna axis, though imperfect. Pinnules triangular to fan-shaped, appear to have short petioles. Lateral margins entire, apical margin entire or shallowly lobed. Nerves numerous dichotomously forking everywhere, as shown in Pl. 7, fig. 7 enlarged, the density 20 per cm at the basal half but twice at the apical margin. Fructification not known.

Remarks: The present specimens recall some ginkgoalean leaves but the pinnately arranged pinnules show apparently their attribution to the fern genus *Adiantites*.

The present specimens resemble in form those described as *Adiantites yuasensis* YOKOYAMA from the Lower Cretaceous Ryoseki Group (YOKOYAMA, 1894, p. 216, pl. 21, fig. 15; OISHI, 1940, p. 235, pl. 47, figs. 6-8; pl. 48, fig. 5) and as *Adiantopteris yuasensis* (YOKOYAMA) KRASSOLOV from the Lower Cretaceous of Southern Primorye (KRASSILOV, 1967, p. 123, pl. 20, figs. 3-6). But the present specimens differ from *Adiantites yuasensis* in less lobed apical margin and densely crowded nervation in the former.

Also comparable specimens with the present ones are those described as *Adiantites toyoraensis* OISHI from the Upper Jurassic Kiyosue Group and the Lower Cretaceous Ryoseki Group (OISHI 1940, p. 235, pl. 7, figs. 2, 2a, 3, 4, 4a) and recently from Mongolia (JÄNICHEN and KAHLERT, 1972, p. 967, pl. 2, figs. 1, 2). But *Adiantites toyoraensis* differs from the present ones in that the pinnules are semicircular in shape.

More similar specimens to the present ones are those illustrated by VASSILEVSKAJA and PAVLOV as *Adiantites polymorpha* VASSILEVSKAJA from the Lower Cretaceous of the Lena basin (1963, pl.

33, figs. 4-6) and as *Adiantopteris gracilis* (VASSILEVSKAJA) VASSILEVSKAJA also from the Lena basin (Ibid., pl. 19, fig. 9; VASSILEVSKAJA, 1966, p. 53, pl. 1, fig. 4).

Adiantites sp. A described here, would be rather close to *Adiantites sewardi* and to *Adiantopteris grandis* originally described by VAKHRAMEEV (1968, p. 13, pl. 4, figs. 2-4).

Horizons & Occurrence: C, D-Tamodani. Common.

Depository: TC-9019B, TDX-006, TDX-007, TDX-007B.

Genus *Onychiopsis* YOKOYAMA, 1889

Onychiopsis elongata (GEYLER) YOKOYAMA

Pl. 6, figs. 6, 7

1877. *Thyrsopteris elongata* GEYLER; p. 224, pl. 30, fig. 5; pl. 31, figs. 4-5.
1877. ?*Adiantites* GEYLER; p. 225, pl. 30, figs. 2b, 3.
1877. *Sphenopteris gaepperti* DUNKER (pars); SCHENK, p. 210, pl. 30, figs. 2, 2a.
1883. *Thyrsopteris elongata* GEYLER; SCHENK, p. 263, pl. 54, fig. 1.
1889. *Dicksonia gracilis* YOKOYAMA; p. 24, pl. 1, figs. 5, 5a; pl. 12, fig. 13.
1889. *Dicksonia acutiloba* YOKOYAMA; p. 24, pl. 1, figs. 1b, 2, 2b.
1889. *Onychiopsis elongata* YOKOYAMA; p. 27, pl. 2, figs. 1-3, 4a-c.
1890. *Onychiopsis elongata* YOKOYAMA; NATHORST, pp. 4, 8, 10, 11, pl. 5, fig. 3; p. 12, pl. 2, fig. 6; pp. 13, 14, pl. 6, fi. 5.
1894. *Onychiopsis elongata* (GEYLER) YOKOYAMA; SEWARD, p. 59, pl. 2, fig. 2.
1894. *Onychiopsis elongata* (GEYLER) YOKOYAMA; p. 215, pl. 20, fig. 8; pl. 21, figs. 1, 4.
1905. *Onychiopsis elongata* (GEYLER) YOKOYAMA; YABE, p. 22, pl. 1, figs. 9-14; pl. 3, fig. 15.
1913. *Onychiopsis elongata* (GEYLER) YOKOYAMA; YABE, p. 3, pl. 1, figs. 1-5.
1929. *Onychiopsis mantelli* (BRONGNIART) NATHORST; TATEIWA, plate, fig. 7.
1931. *Onychiopsis psilotoides* (STOKES & WEBB) WARD; OISHI, p. 4, pl. 1, figs. 6-10.
1935. *Sphenopteris* (*Onychiopsis*) *elongata* (GEYLER) OISHI; p. 83, pl. 6, fig. 2.
1940. *Onychiopsis elongata* (GEYLER) YOKOYAMA; OISHI, p. 228, pl. 6; pl. 7, fig. 7.
1958. *Onychiopsis elongata* (GEYLER) YOKOYAMA; KIMURA, p. 14.
1958. *Onychiopsis elongata* (GEYLER) YOKOYAMA; VAKHRAMEEV, p. 72, pl. 1, figs. 4-6; pl. 2, fig. 4.
1960. *Onychiopsis elongata* (GEYLER) YOKOYAMA; NISHIDA, p. 190, pl. 1, fig. 4.
1963. *Onychiopsis elongata* (GEYLER) YOKOYAMA; SAMYLINA, p. 74, pl. 3, fig. 4.
1963. *Onychiopsis elongata* (GEYLER) YOKOYAMA; VASSILEVSKAJA & PAVLOV, pl. 31, figs. 3, 4, 9b.

Description of Specimens: Several ultimate pinna fragments referable to this well-known species were obtained, two of which were shown in Pl. 6, figs. 6, 7. A more detailed description of this species based on good fertile and sterile material will be given by the writer in the near future.

Remarks: In Japan, this species has been known from the Nishi-Nakayama Formation, Yamaguchi Prefecture regarded as late Liassic to the Albian Yatsushiro Formation, Kumamoto Prefecture. According to VAKHRAMEEV (1971), this genus has not been recorded in the Neocomian beds of Siberia and has penetrated into the Siberian area in Aptian, though its occurrence is scarce.

This species is one of the most abundant elements both of the Early Neocomian Ryoseki and Oguchi Floras. Depending only on the sterile material, it is fairely difficult or impossible to distinguish this species from *Onychiopsis psilotoides* (STOKES and WEBB) WARD and *O. mantelli* (BRONGNIART) NATHORST and their allies widely known from the Lower Cretaceous of both hemispheres.

In the case of small fragments, this species is also indistinguishable from those of *Birisia onychioides*.

Horizons & Occurrence: C, D-Tamodani. Not rare.

Depository: TC-9028, TC-9029B, TDX-002, TD-9017.

Genus *Cladophlebis* BRONGNIART, 1849

Cladophlebis ex gr. *denticulata* (BRONGNIART) FONTAINE

Pl. 5, fig. 11; Pl. 6, fig. 5; Figs. 4-5a-b

1890. *Cladophlebis* sp. NATHORST; p. 4, pl. 1, figs. 1-3,

Description of Specimens: Pl. 5, fig. 11 shows an imperfect pinna fragment, which is lanceolate in outline, more than 4 cm long, 1.5 cm wide at the widest portion. Pinnules arranged catadromic in order, variable in shape according to their position on pinna, triangular in form, falcate. Margin entire, upper margin concave or straight, lower margin strongly convex, attached to the rachis by their whole base, continuous each other at base. Midnerve distinct persisting to the tip, secondaries faintly preserved, sparse, once forking on their way as shown in Figs. 4-5a and 5b. The lowest one on catadromic side, is extremely smaller in size, its midnerve originates from the joint of pinna axis. The lower ones smaller in size, getting larger towards the middle part of pinna, then reducing the size again gradually towards the pinna apex.

Pl. 6, fig. 5 derived from the upper horizon shows a pinna fragment with broader pinnules. Midnerve faintly preserved but persisting to the tip with dichotomously once forking secondaries. This specimen somewhat differs from the former specimen in the form of pinnules, but it is difficult to draw a sharp border between both specimens here described. Fructification not known.

Remarks: Bipinnate steril fronds with pinnules which are triangular in shape, falcate, with once forking secondaries, have often been included *Cladophlebis denticulata*. Moreover very similar leaves have been named *Cladophlebis argutula* (HEER) FONTAINE, *C. frigida* (HEER) SEWARD, *C. vaccensis* WARD, *C. williamsoni* (BRONGNIART) BRONGNIART, *Pecopteris atyrkanensis* HEER, etc.

Regarding sterile fern fronds, their classification now results in confusion which seems to be a matter of course. Having nothing to do more about the present specimens, so far the time being the writer is obliged to refer it to comprehensive species *Cladophlebis denticulata*, though the specimens described under this specific name are fairly variable in general outline of pinnae and pinnules owing to their ages and localities.

Externally one of the present specimens (Pl. 5, fig. 11) resembles very closely those described by NATHORST from the Lower Cretaceous Ryoseki Group, Kochi Prefecture as *Cladophlebis* sp., and later referred to *Cladophlebis denticulata* by OISHI (1940).

Horizons & Occurrence: D, G-Tamodani. Not rare.

Depository: TDX-001, TG-001.

Cladophlebis cfr. *pseudolobifolia* VACHRAMEEV

Pl. 5, fig. 12; Pl. 8, fig. 3; Figs. 6a-b

Compare:

1958. *Cladophlebis pseudolobifolia* VACHRA-

MEEV; p. 95, pl. 16, figs. 1–3; pl. 17, figs. 2, 3.

1963. *Cladophlebis pseudolobifolia* VACHRAMEEV; SAMYLINA, p. 78, pl. 7, figs. 1–4a; pl. 20, fig. 8a.

Description of Specimens: Frond unknown in size, at least bipinnate. Pinnae 8 mm wide, nearly parallel-sided, set closely, overlapping each other laterally; pinnules variable in form, probably due to their position on pinna, semicircular, finger-shape, rhombic or rhomboidal, 3.5 mm long and 3 mm wide at the middle portion, nearly perpendicular to the pinna axis, 1 mm across, with contracted base, sometimes slightly directed forward, margin entire mostly with rounded apex; midnerve distinct at lower half but radially branching at upper half of pinnule, secondaries dichotomously forking twice.

Figs. 4–6a and 6b redrawn from the imperfect pinna fragment shown in Pl. 8, fig. 3 show various forms of pinnules; semicircular in Fig. 4–6a, and larger one with contracted base in Fig. 4–6b.

Pl. 5, fig. 12 shows two rows of pinnae on which finger-shape pinnules are set perpendicularly to the pinna axis. Fructification not known.

Remarks: In external morphology and nervation of pinnules, the present specimens are close to those originally described by VAKHRAMEEV from the Lower Cretaceous of Lena basin as *Cladophlebis pseudolobifolia*, and followed by SAMYLINA also from the Lower Cretaceous of the Aldan river area. In Siberian specimens, pinnules are not so constricted at base, and between the secondaries, laminae are reduced in width at the margin, so the present specimens would not be fully in accordance with *Cladophlebis pseudolobifolia*.

Other rather similar leaves are *Lobifolia novopokrovskii* (PRYNADA) RASSKAZOVA and LEBEDEV and *L. ajakensis* (LEBEDEV) RASSKAZOVA and LEBEDEV from the Lower Cretaceous of Bureja basin and the Aldan river area respectively, but our material is too poor for satisfactory comparison.

Horizons & Occurrence: G, H-Tamodani. Common.

Depository: TG-006, TH-001, TH-007, TH-008, TH-016, TH-023, TH-025, TH-026, TH-028, TH-035.

Genus *Sphenopteris* (BRONGNIART) STERNBERG, 1825

Sphenopteris kochibeana (YOKOYAMA) OISHI

Pl. 5, fig. 10; Fig. 4–7a–b

1889. *Adiantites kochibeanus* YOKOYAMA; p. 29, pl. 1, figs. 7, 7a.

1940. *Sphenopteris kochibeana* (YOKOYAMA) OISHI; p. 242.

1972. *Adiantites kochibeanus* YOKOYAMA; JÄNICHEN & KAHLERT, p. 966, pl. 1, figs. 1, 4: pl. 4, fig. 2; text-fig. 1.

Description of Specimen: Judging from a single fragment of frond as shown in Pl. 5, fig. 10, frond probably tripinnate. Ultimate pinnae lanceolate in outline, slightly falcate, 2.2 cm long, 8 mm wide measured at the middle portion, set closely together, overlapping each other laterally, attached to the delicate penultimate pinna axis at an angle of 40 degrees. Pinnules rhombic or rhomboidal in outline, directed forwards, margin mostly entire but upper halves often shallowly lobed or coarsely serrated; nerves faintly preserved, but the writer was able to detect traces of the typical *Sphenopteris*-type. Figs. 4–7a and 7b show the outline of pinnules and nervation respectively.

Remarks: The present specimen is referable to that originally described by

YOKOYAMA as *Adiantites kochibeanus* from the Oguchi Formation of Kuwashima, in the delicate habit of frond, outline of pinnules and the nervation, though according to YOKOYAMA margins were said to be entire.

Comparable specimens with the present one are those described by SAMYLINA (1964, p. 70, pl. 2, fig. 1; pl. 11, figs. 4-6) as *Sphenopteris* sp. from the Lower Cretaceous of the Kolyma river area, but they differ from the present one in having more pinnatified pinnules in proximal portion of pinnae and longer pinnae than the latter.

Sphenopteris acrodentata FONTAINE described by BELL (1956, p. 68, pl. 22, figs. 4, 6; pl. 23, fig. 2) is another comparable one, but it differs from the present one in representing rather roundish pinnules.

It is highly probable that the present specimen would represent the sterile pinnae of such a fern as *Coniopteris nympharun* (HEER) VACHRAMEEV.

Horizon & Occurrence: F-Tamodani. Rare.

Depository: TF-007.

Nilssoniales

Genus *Nilssonia* BRONGNIART, 1825

Nilssonia sp. cfr. *N. nipponensis* YOKOYAMA

Pl. 7, fig. 9

Description of Specimens: Several imperfect fragments were obtained. Laminae apparently cover the upper surface of rachis. Pl. 7, fig. 9 shows the basal part of lamina, though the petiole is missing; lamina irregularly segmented, each segment triangular in shape, rather small in size, continuous at base, upper margin nearly straight or concave, but lower margin strongly convex; nerves simple, parallel, nearly perpendicular to the rachis, 3 per mm in density.

Remarks: Among numerous *Nilssonia* species, comparable with the present specimens are the following ones which have laminae irregularly dissected into triangular segments; *Nilssonia acuminata* (PRESL) GOEPPERT, *N. acutiloba* (HEER) PRYNADA, *N. compta* (PHILLIPS) BONN, *N. comptula* HEER, *N. curvifolia* JACOB and SHUKLA, *N. glossinervis* PRYNADA, *N. kendalli* HARRIS, *N. magnifolia* SAMYLINA, *N. nipponensis* YOKOYAMA, *N. polymorpha* SCHENK, *N. prinadai* VACHRAMEEV, *N. schaumburgensis* (DUNKER) NATHORST, *N. schmidtii* (HEER) SEWARD, *N. serotina* HEER and *N.* sp. LEBEDEV (1965, p. 93, pl. 24, figs. 2-4).

Depending only on external appearance, the present specimens resemble closely *Nilssonia nipponensis* which abundantly occurs from the Oguchi Formation and the Kuzuryu Group in the Tetori basin, though it is fairly difficult to distinguish between *N. nipponensis* and *N. serotina*.

The present specimens as well as being imperfect, are smaller in size than those described from the Oguchi Formation and the Kuzuryu Group, so the writer hesitates to refer them to YOKOYAMA's species.

Horizons & Occurrence: C, D-Tamodani. Not rare.

Depository: TC-9205, TD-9017.

Nilssonia cfr. *orientalis* HEER

Pl. 7, fig. 8

Description of Specimens: Pl. 7, fig. 8 shows apparently an apical portion of lamina showing a notch as usual in most of *Nilssonia* leaves; nerves simple, parallel, 2-3 per mm in density, making a wide angle to the rachis.

Another specimen not illustrated here, shows a *Nilssonia* lamina which covers the upper surface of rachis, but unfortunately both ends and also both margins are missing. Lamina appears to be thin in texture, not segmented but entire; nerves simple, parallel, perpendicular to the rachis, 2 per mm in density.

Remarks: Among numerous *Nilssonia* species hitherto described, comparable with the present specimens are following species which have perfectly entire or mostly entire laminae over leaves; *Nilssonia canadensis* BELL, *N. grossoformis* MATSUO, *N. inouei* YOKOYAMA, *N. orientalis* HEER, *N. orientalis* HEER var. *minor* FONTAINE, *N. ozoana* YOKOYAMA, *N. revoluta* HARRIS, *N. saighanensis* SEWARD, *N. simplex* OISHI, *N. taeniopteroides* (HALLE) var. *bifurcata* PROSVIRJAKOVA, *N. tenuinervis* SEWARD, *N. thomasi* HARRIS, *N. vittaeformis* PRYNADA, *N.* sp. HARRIS (1964, p. 39, text-fig. 16), *N.* sp. PROSVIRJAKOVA (1966, p. 97, pl. 19, figs. 1-2), etc.

It is very difficult or impossible to refer such imperfect specimens as the present ones to known species depending only on external appearance, unless they have some characteristic features. Under such circumstances, the attribution to the present ones is not expected, but it would be true that they are very close to those described by YOKOYAMA, from the Oguchi Formation as *Nilssonia orientalis* (1889, p. 40, pl. 14, figs. 4-9).

Horizon & Occurrence: D-Tamodani. Rare.

Depository: TDX-005, TDX-008A, TDX-008B.

Ginkgoales

Genus *Sphenobaiera* FLORIN, 1936

Sphenobaiera? sp.

Pl. 8, fig. 8

Description of Specimens: Many detached leaf fragments were obtained. Leaves long and narrow, ribbon-like, tapering gradually towards the base; upper surface of lamina sometimes convex as shown in Pl. 8, fig. 8; nerves parallel through the most part of lamina but dichotomously forking near the base, 20 per cm in density. Pl. 8, fig. 8 shows two leaves which seem to converge below the broken end.

Remarks: There is no favourable proof to assign the present specimens to *Sphenobaiera*, though their general appearance recall such leaves as those of *Sphenobaiera longifolia* (POMEL) FLORIN known from the Lower Cretaceous of the Lena basin and the Kolyma river area.

Horizons & Occurrence: G, H-Tamodani. Common.

Depository: TG-007, TH-014, TH-022, TH-027.

Genus *Pseudotorellia* FLORIN, 1936

Pseudotorellia sp.

Pl. 8, figs. 5, 6

Description of Specimens: Many detached leaves were obtained. Leaves spatula-shape, 3.5 cm long, 0.7 cm wide at the widest portion near the apex as shown in Pl. 8, fig. 5; nerves 25 per cm in density, often dichotomously forking at the basal part as shown in Pl. 8, fig. 6.

Remarks: The present specimens agree well with the form definition given by FLORIN (1936, p. 142). Among 14 *Pseudotorellia* species hitherto described, the present specimens agree in form with some of those described by VAKHRAMEEV and DOLUDENKO as *Pseudotorellia crassifolia* (PRYNADA) DOLUDENKO (1961, p.

114, pl. 56, figs. 4, 5) from the Jurasso-Cretaceous of the Bureja basin.

Later according to LUNDBLAD (1968, p. 190), it was said that this species without showing cuticles should be excluded from *Pseudotorellia* because this genus was defined by FLORIN with special reference to its epidermal characters.

Pseudotorellia nordenskiöldi (NATHORST) FLORIN described by ORLOVSKAJA (1962, p. 1438, pl. 1, fig. 2) from the Jurassic of Kazakhstan is similar in form to the present ones.

Pseudotorellia angustifolia DOLUDENKO described by KRASSILOV in his monograph regarding Ginkgoales and Czekanowskiales of the Bureja basin (p. 58, pl. 20, fig. 9; pl. 21, figs. 2-5; text-fig. 10) is another allied form to the present ones, but it differs from the latter in coarser nervation.

It may be inappropriate to identify a leaf with an unknown cuticle as belonging to the genus *Pseudotorellia* (see LUNDBLAD, 1968), but there is no better name to give to the present leaves.

Horizons & Occurrence: C, D, G-Tamodani. Common.

Depository: TC-9027, TC-9027B, TD-9147, TDX-004, TG-002, TG-010, TG-030.

Genus *Ginkgoites* SEWARD, 1919

Ginkgoites sp.

Pl. 8, fig. 9

Description of Specimen: Pl. 8, fig. 9 shows a deeply segmented ginkgoalean leaf fragment of which four irregular segments are represented and one is now buried in the matrix. Segments various in width, more than 5 cm long; nerves coarse, 20 per cm in density, dichotomously forking at basal third.

Remarks: The present specimen is too imperfect to refer to the specifically identified ginkgoalean species, but externally it resembles such leaves as those of *Ginkgo singularis* described by SAMYLINA (1964, p. 141, pl. 5, fig. 5) from the Lower Cretaceous of the Zyrianka coal basin.

Horizon & Occurrence: D-Tamodani. Rare.

Depository: TD-9030.

Genus *Ginkgodium* YOKOYAMA, 1889

Ginkgodium ? sp.

Pl. 8, fig. 7

Pl. 8, fig. 7 shows an imperfect ginkgoalean leaf fragment composed of two segments. The segment on the right side appears to be narrower than another because its left half is buried under the matrix. Faintly preserved nerves make it difficult to show their detail. Several specimens were examined but they were all too imperfect to refer to known ginkgoalean species.

Horizon & Occurrence: G-Tamodani. Not rare.

Depository: TG-013, TG-017.

Podozamitales

Genus *Podozamites* BRAUN, 1843

Podozamites reinii GEYLER

Pl. 7, fig. 10

1877. *Podozamites reinii* GEYLER; p. 229, pl. 33, fig. 4a; pl. 34, figs. 1, 2, 3b, 4, 5a.
1889. *Podozamites reinii* GEYLER; YOKOYAMA, p. 50, pl. 3, figs. 6a–c; pl. 4, figs. 1b, 3b; pl. 6, figs. 2, 3b–d, 4–7, 8a–d; pl. 9, fig. 12a; pl. 12, fig. 4.
1905. *Podozamites reinii* GEYLER; YABE, p. 16, Pl. 4, fig. 6.
1929. *Podozamites reinii* GEYLER; TATEIWA,

plate, fig. 11.

1940. *Podozamites reinii* GEYLER; OISHI, p. 408, pl. 44, figs. 1-3.
1957. *Podozamites reinii* GEYLER; KRYSHTOFOVICH, p. 357, figs. 351-2.
1963. *Podozamites reinii* GEYLER; VASSILEVSKAJA & PAVLOV, pl. 28, fig. 2.
1966. *Podozamites reinii* GEYLER; VASSILEVSKAJA, p. 68, pl. 6, figs. 3, 4.
1967. *Podozamites reinii* GEYLER; KIMURA & SEKIDO, p. 417, pl. 2, fig. 2; pl. 3, fig. 3.
1967. *Podozamites reinii* GEYLER; SAMYLINA, p. 152, pl. 8, fig. 9a.

Comparison & Remarks: KIMURA and SEKIDO (1967) made the measurement on many leaves of this species obtained from the Oguchi Formation, making it clear that this species showed considerable variation in the form of leaves (p. 418, fig. 2).

Adding the formerly known occurrence from the Oguchi Formation and the Nagdong Group, this species has recently been known from the Upper Neocomian Akaiwa Group (KIMURA and SEKIDO, MS) and the Lower Cretaceous of both the Lena basin and the Kolyma river area (VASSILEVSKAJA and PAVLOV, 1963; VASSILEVSKAJA, 1966; SAMYLINA, 1967).

According to VAKHRAMEEV (1971, p. 82, table 1), this species is a member of Aptian-Albian floras in the Lena and the Amur palaeofloristic subprovinces and has not yet been recorded from the Neocomian of Siberia.

Podozamites cfr. *reinii* described by LEBEDEV (1965, p. 126, pl. 24, fig. 6) from the Lower Cretaceous of the Zeia river area, though it was a single imperfect specimen, is externally indistinguishable from the original specimens described by GEYLER.

Based on a single leaf, KRYSHTOFOVICH and PRYNADA (1932) described *Podozamites subreinii* from the Nikanian Series, Southern Primorye (in the "Selected Works of A.N. KRYSHTOFOVICH", vol. 2, 1962, p. 164, pl. 2, fig. 6). This species resembles closely *P. reinii* in general form, but smaller in size, 1.5 cm long and 8 mm wide at the widest portion. The writer has not encountered such a small specimen in his good collection.

VASSILEVSKAJA stated the occurrence of *Podozamites reinii* from the Nikanian Series (1966, p. 69), but KRASSILOV adopted *P. subreinii* in his voluminous description of the Lower Cretaceous flora of Southern Primorye (1967, p. 51). Accordingly the writer is now not sure of the exact information on the occurrence of *Podozamites reinii* from the Lower Cretaceous of Southern Primorye.

The writer has also learned the occurrence of this species from the Lower Cretaceous of the West Siberia Lowland, but unfortunately having not been acquainted with the work by KIRICHKOVA and TESLENKO (1962), the writer could not refer to it.

This species showing wide variation in the size and the form of leaves, it is often difficult to distinguish it externally from similar species as described below.

Podozamites eichwaldii SCHIMPER illustrated by VASSILEVSKAJA and PAVLOV (1963, pl. 27, fig. 4; pl. 28, fig. 3; pl. 30, fig. la) from the Lower Cretaceous of Lena basin, has long oval leaves, 5.5 cm long, 1.6 cm wide. Such leaves being constantly more slender in habit than those of *Podozamites reinii*, *Podozamites eichwaldii* appears to be distinct from the former.

Podozamites issykkulensis originally described by GENKINA (1966, p. 112, pl. 56, figs. 6-10; pl. 57, fig. 1) from the Older Mesozoic of Issyk-Kul basin, would be similar in form to *P. reinii*, but the former is different from the latter in that the nerves are not astringent at the pointed apex in the former.

Podozamites latifolius HEER illustrated by VASSILEVSKAJA and PAVLOV (pl. 29, fig. 2B; pl. 30, fig. 1B) from the Lower Cretaceous of Lena basin and by LEBEDEV (1965, p. 124, pl. 32, figs. 1-3; pl. 33; pl. 34, fig. 5) from the Lower Cretaceous of the Zeia river area, is similar in form to *P. reinii*, but *P. latifolius* has leaves which taper in their upper half.

The general appearance of leaves in both *P. issykkulensis* and *P. latifolius* reminds us of those of *P. griesbachi* originally described by SEWARD (1912, p. 36, pl. 4, fig. 58; pl. 6, fig. 79) from the Jurassic of Afghanistan and by OISHI (1932, p. 12, pl. 3, fig. 12) from the Older Mesozoic of Maizuru coal-field, Japan.

VASSILEVSKAJA and PAVLOV (1963) illustrated more three *Podozamites* species from the Lower Cretaceous of Lena basin as follows; *Podozamites olenekensis* VASSILEVSKAJA (pl. 30, fig. 3) has long oval leaves, 8.5 cm long, 2.7 cm wide, which, in the ratio of L/W, are similar to those of *P. eichwaldii* mentioned above; *Podozamites ovalifolius* VASSILEVSKAJA (pl. 16, figs. 6, 7) has extraordinally small leaves, 1.3 cm long and 7 mm wide, which resemble closely that of *P. subreinii*; Three imperfect large leaves were illustrated under the specific name of *Podozamites striatus* VELENOVSKY (pl. 29, figs. 1, 2), which are almost indistinguishable externally from those of *P. reinii*.

Though the above mentioned species have all been established depending only on their external morphology, it should be noted that oval or long-oval *Podozamites* leaves as *P. reinii* and its allies, occur not only from the Lower Cretaceous Oguchi and Akaiwa Formations and Nagdong Group, but also from the coeval of both the Lena and the Amur palaeofloristic provinces, Siberia.

KOBAYASHI (1951) mentioned the closely associated occurrence of *Podozamites reinii*, and the wood *Xenoxylon latiporosum* (CRAMER) GOTHAN. As was mentioned by KIMURA and SEKIDO (1967), the writer found a thick stem sending off several shoots with leaves which were referable to *Podozamites reinii*, from the Oguchi Formation, but unfortunately its anatomy could not be made out because of ill-preservation.

DELLE (1967) described the Middle Jurassic flora from Tkvarchelian coal basin, Transcaucasia with the description of *Xenoxylon latiporosum*, but this flora did not contain such *Podozamites* leaves as *P. reinii* or its allies but *P.* cfr. *lanceolatus*.

Horizons & Occurrence: D, E-Tamodani, C-Hayashidani. Common.

Depository: TD--9032, TD-9170, TD-9163, TDX-010, TDX-011, TDX-012, TE-9032, HC-9009, HC-9010.

Podozamites sp. cfr. *P. eichwaldii* SCHIMPER

Pl. 8, fig. 10

Description of Specimens: Several long oval-shaped leaf fragments as shown in Plate 8, fig. 10, were examined. Laminae 3-3.5 cm long or more, 0.8-1 cm wide measured at the middle portion; both ends ronuded; nerves simple, parallel, crowded, converging to both ends, 60 per cm in density.

Remarks: The present specimens differ from those of *Podozamites reinii* in representing smaller and more longer leaves than the latter.

The present specimens strongly recall those of *Podozamites eichwaldii* known from the Upper Jurassic to the Lower Cretaceous of Spitzbergen, East Siberia, Mongolia, Northeast China and Alaska.

Horizon & Occurrence: H-Tamodani.

Common.

Depository: TH-004, TH-020.

Coniferales

Genus *Pityophyllum* NATHORST, 1897

Pityophyllum sp.

Pl. 7, fig. 11; Pl. 8, fig. 11

Description of Specimens: Many detached coniferous leaves as shown in Pl. 8, fig. 11 were obtained. They are all imperfect fragments, elongate-lanceolate in outline, linear or sickle-shaped, unknown in length and 1.9 mm in width, tapering gradually towards an acuminate end but the other end is semicircular in form as shown in Pl. 7, fig. 11. Midnerves are faintly preserved. Other indications of, transversely wrinkled lamina, two marginal veins and longitudinal striations marking the position of row of stomata as stated by SEWARD (1919, p. 381), were not recognized.

Remarks: The generic term *Pityophyllum* has been employed for detached, long and narrow, coniferous leaves, and has been known from the Upper Triassic to the Cretaceous, but some of which have been confused with the leaves of *Neocalamites*.

So far as the writer knows, six species of *Pityophyllum* have been described. They are separated mainly by the width of lamina. The widest is, as the specific name indicates, *Pityophyllum latifolium* TURTANOVA-KETOVA from the Upper Triassic of Issyk-Kul basin (TURTANOVA-KETOVA, 1960; GENKINA, 1966), reaching 6 mm wide. *Pityophyllum nordenskiöldi* (HEER) NATHORST, which has been described from the Upper Triassic or the Lower Jurassic to the Lewer Cretaceous of Spitzbergen, Sweden, Issyk-Kul basin and its environs, Northeastern China, Western Canada and Eastern Siberia by various authors, is intermediate, 3-6 mm wide.

More narrow, 1.5-2.5 mm are both *Pityophyllum angustifolium* (NATHORST) MÖLLER from the Upper Triassic or the Lower Jurassic of Sweden and Issyk-Kul basin (NATHORST, 1878; MÖLLER, 1903; JOHANSSON, 1922; GENKINA, 1966), and *Pityophyllum staratschini* (HEER) NATHORST from the Lower Jurassic of Sweden and the Lower Cretaceous of Eastern Siberia (NATHORST, 1897; SAMYLINA, 1967). The above mentioned species are different in width from the present specimens which are constant in the maximum width, 1.9 mm.

Pityophyllum longifolium (NATHORST) MÖLLER, from the Upper Triassic and the Lower Jurassic of Sweden and Japan (NATHORST, 1876, 1878; BARTHOLIN, 1894; MÖLLER, 1903; OISHI, 1931, 1932, 1935; OISHI and TAKAHASHI, 1936) and from the Lower Cretaceous of Western Canada (BELL, 1956), is also a narrow type, but it differs from the present specimens in that the fomer leaves are extremely long, hence the specific name.

So far as the width is concerned, the most comparable species might be *Pityophyllum lindströmi* NATHORST, of which laminae are 1-2 mm wide, described from the Jurassic to the Lower Cretaceous of Spitzbergen, Amur, Eastern Siberia (NATHORST, 1897; KRYSHTOFOVICH, 1910, 1914, 1915; SAMYLINA, 1963; VASSILEVSKAJA, 1966), but it differs also in general outline of leaves from the present specimens which are more shorter in length and elongate-lanceolate in form.

The detached leaves described by YOKOYAMA (1889, p. 63, pl. 9, fig. 12b) under the name of *Pinus nordenskioldi* HEER, from the Oguchi Formation of Kuwashima, is indistinguishable from the present specimens.

Though NATHORST (1897) and SEWARD (1919) considered that such detached narrow coniferous leaves as above mentioned, have no real botanical value, it is noted that the narrower form of *Pityophyllum* are characteristic in the Lower Cretaceous time of Eastern Siberia and the Tetori basin.

Horizon & Occurrence: H-Tamodani. Common.

Depository: TH-018, TH-021, TH-034.

Specimens are all deposited at the Department of Astronomy and Earth Sciences, Tokyo Gakugei University. Regarding the registered number of the depository, the first letter T indicates the Tamodani valley and H the Hayashidani valley, and the second letter stratigraphical horizon yielding fossils collated to that in Fig. 2.

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Explanation of Plate 5

Fig. 1. *Equisetites* sp. Two tubers oppositely disposed and nearly perpendicular to a slender rhizome buried in the rock matrix. ×2, TC-9026.

Figs. 2–5. *Osmundopsis* ? sp.

2. An imperfect pinna with triangular pinnules. ×2, TH-029.
3. An imperfect pinna, pinnules with shallowly lobed margins. ×2, TH-031.
4. Showing a part of fertile frond; A: rachis, B: a pinna with small fertile pinnules. ×1, TG-011.
5. Fertile pinnules enlarged from Fig. 4B, ×3.

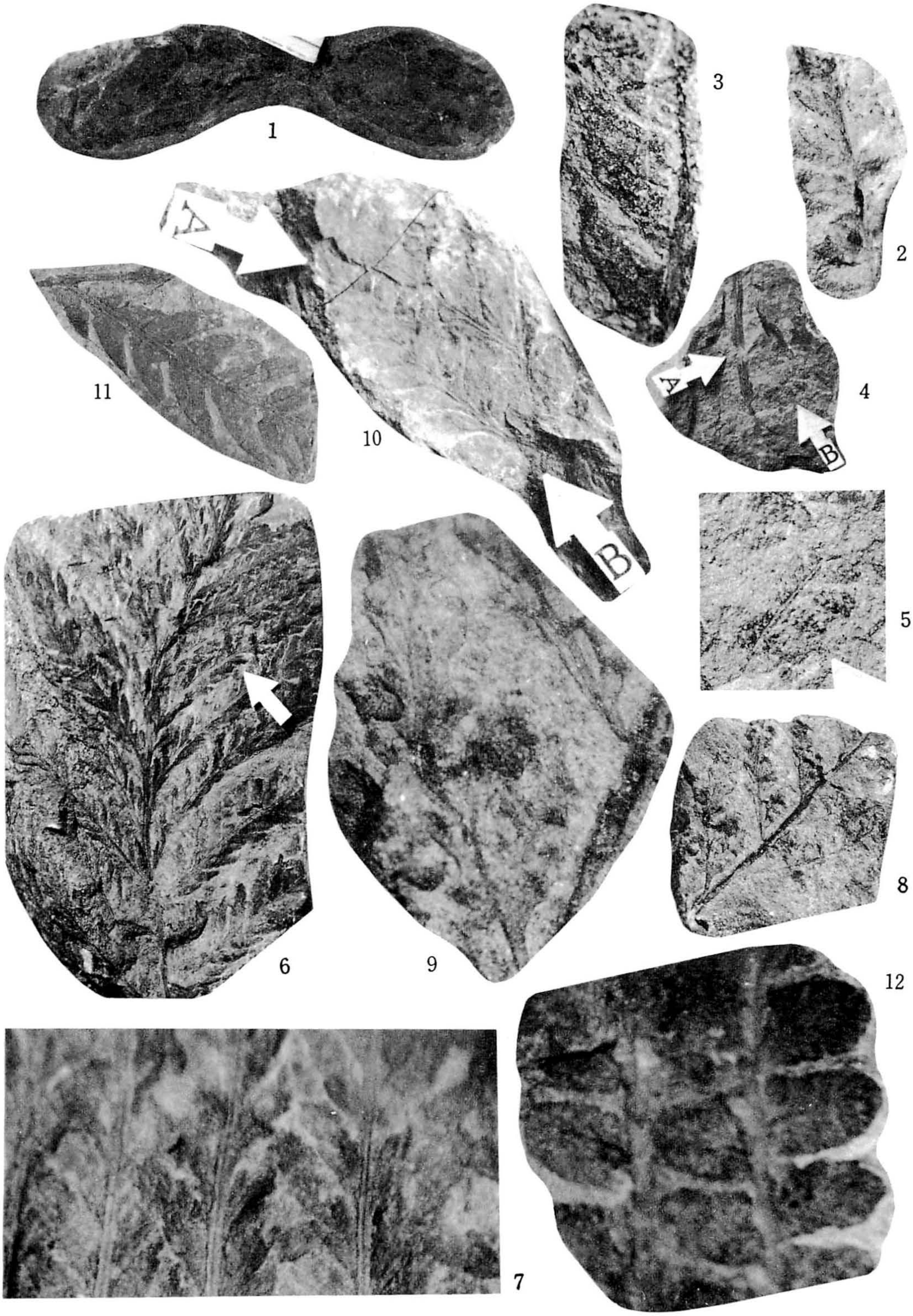
Figs. 6–9. *Birisia onychioides* (VASSILEVSKAJA & KARA-MURSA) SAMYLINA

6. Apical portion of a penultimate pinnae. ×1,TDY-001.
7. Enlarged from portion indicated by arrow in Fig. 6, showing lobed laminae with small sori at the tips of lobes. ×4.
8. Fertile part on the apical portion of a penultimate pinna. ×2, TD-9174B.
9. Enlarged from the lowest pinna in Fig. 8. ×6.

Fig. 10. *Sphenopteris kochibeana* (YOKOYAMA) OISHI Showing an imperfect frond with two pinnae; A: the apex of pinna, B: slender rachis. ×2, TF-007.

Fig. 11. *Cladophlebis* ex gr. *denticulata* (BRONGNIART) FONTAINE Showing an imperfect pinna fragment. ×1, TDX-001.

Fig. 12. *Cladophlebis* cfr. *pseudolobifolia* VACHRAMEEV Showing the shape of pinnules. ×4, TH-026.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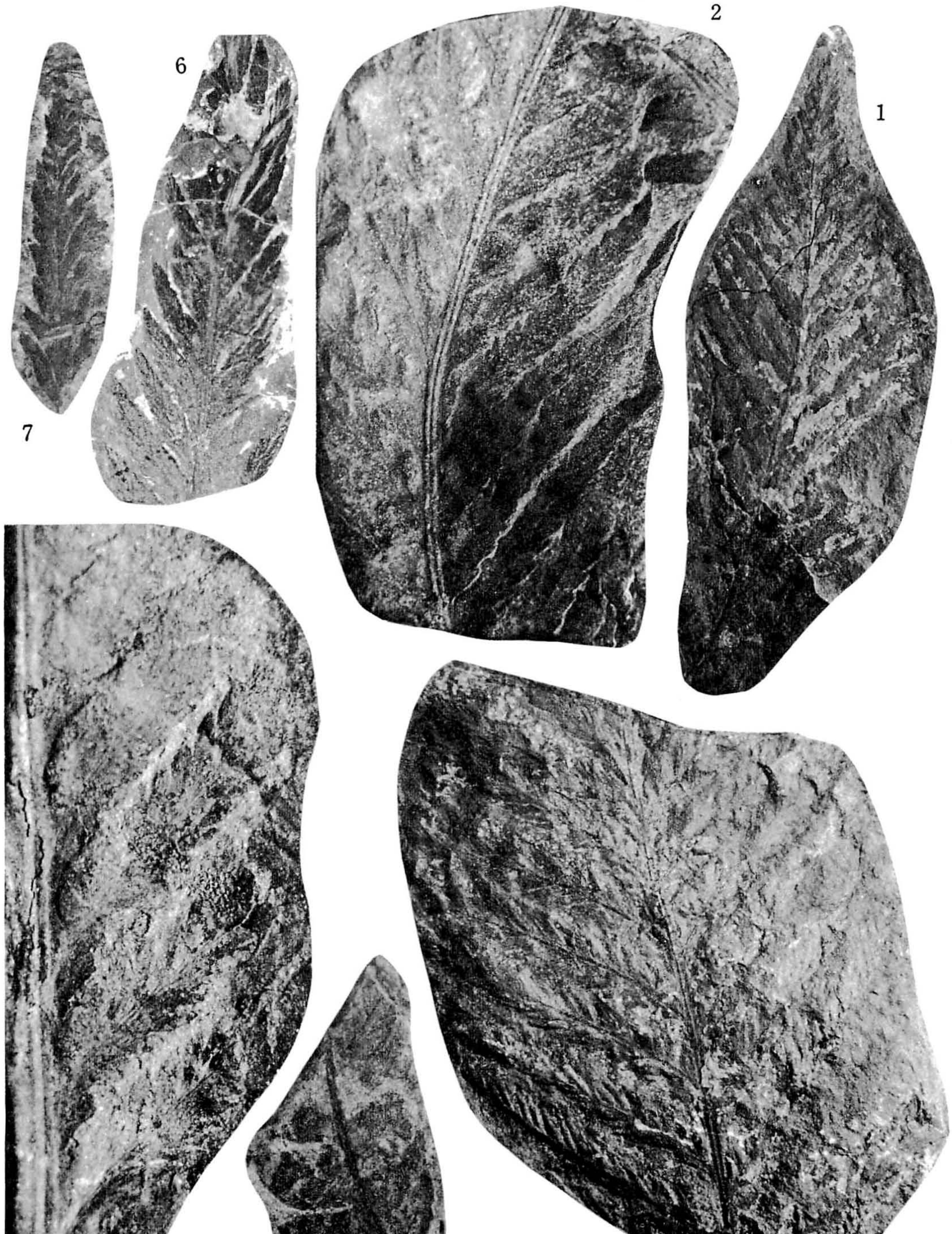
Explanation of Plate 6

Figs. 1–4. *Birisia onychioides* (VASSILEVSKAJA & KARA-MURSA) SAMYLINA
1. A large proximal ultimate pinna fragment, tapering abruptly towards the acuminate apex. Pinnules long and narrow except ones on the apical portion. ×1, TDY-004.
2. Showing the shape of pinnules on the proximal portion of a frond. ×2, TD-0001.
3. Showing the deeply lobed pinnules on the proximal portion of a frond. ×4, TD-0001.
4. Showing a distal ultimate pinna, pinnules small and with entire margins. ×1, TDY-002.

Fig. 5. *Cladophlebis* ex gr. *denticulata* (BRONGNIART) FONTAINE Showing a pinna fragment with broader pinnules than those shown in Pl. 5, fig. 11. ×2, TH-001.

Figs. 6–7. *Onychiopsis elongata* (GEYLER) YOKOYAMA
6. A proximal pinna fragment. ×2, TG-9028.
7. A distal pinna fragment. ×2, TDX-002.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Explanation of Plate 7

Figs. 1-3. *Gleichenites* aff. *porsildi* SEWARD
1. An imperfect penultimate pinna with rather closely set ultimate pinnae. ×2, TG-039.
2. Showing closely set ultimate pinnae with long, narrow and linear pinnules. ×2, TG-042.
3. Showing pinnules with convex surface, and with broadly undulated margins. ×4, TH-005.

Fig. 4. *Jacutopteris* sp. Showing long and narrow pinnules with shallowly undulated margins. ×2, TF-005.

Fig. 5. *Adiantites* sp. A (left) and *Gleichenites* aff. *porsildi* SEWARD (right) Left; Showing an imperfect pinnules of *Adiantites* sp. A. ×1, TH-009. Right; Imperfect pinna fragments of *Gleichenites* aff. *porsildi*.

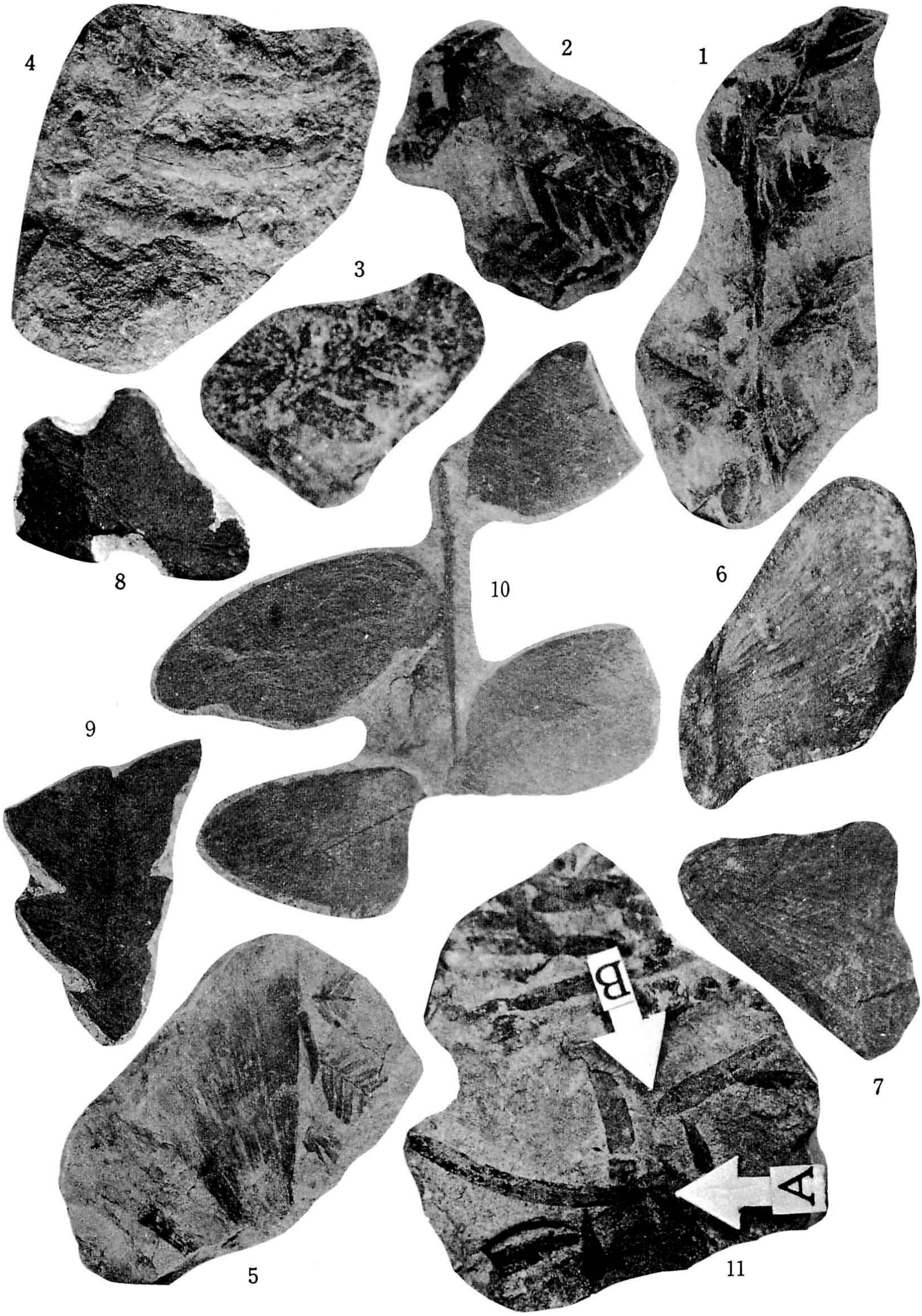
Figs. 6-7. *Adiantites* sp. B
6. Showing one of pinnately arranged pinnules which are fan-shaped and with entire or shallowly lobed apical margin. ×2, TD-007B.
7. An imperfect detached pinnule like the above. ×2, TDX-005.

Fig. 8. *Nilssonia* cfr. *orientalis* HEER Showing apical notch of lamina. ×2, TDX-005.

Fig. 9. *Nilssonia* sp. cfr. *N. nipponensis* YOKOYAMA Showing basal portion of lamina irregularly segmented. ×2, TD-9017.

Fig. 10. *Podozamites reinii* GEYLER Showing a shoot fragment with imperfectly preserved leaves. ×1, HC-9009 (Hayashidani valley, this horizon HC is on equivalent of TC).

Fig. 11. *Pityophyllum* sp. Showing detached long-lanceolate and linear or falcate leaves with single midnerve; A: probably apex. B: probably basal part of a leaf. ×2, TH-021.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Explanation of Plate 8

Fig. 1. *Arctopteris* sp. Showing a pinna fragment with imperfectly preserved pinnules. ×2, TG-019.

Fig. 2. *Gleichenites* aff. *porsildi* SEWARD Showing circular scars of sori on each side of midnerve. ×3, TG-024.

Fig. 3. *Cladophlebis* cfr. *pseudolobifolia* VACHRAMEEV Showing variable form and the *Sphenopteris*-type nervation of pinnules. ×2, TH-012.

Fig. 4. *Adiantites* sp. A Showing a pinnule with crenulated apical margin. ×2, TH-010.

Figs. 5–6. *Pseudotorellia* sp.

5. Showing rounded apex. ×2, TC-9027B.
6. Showing cuneate base. ×2, TC-9027.

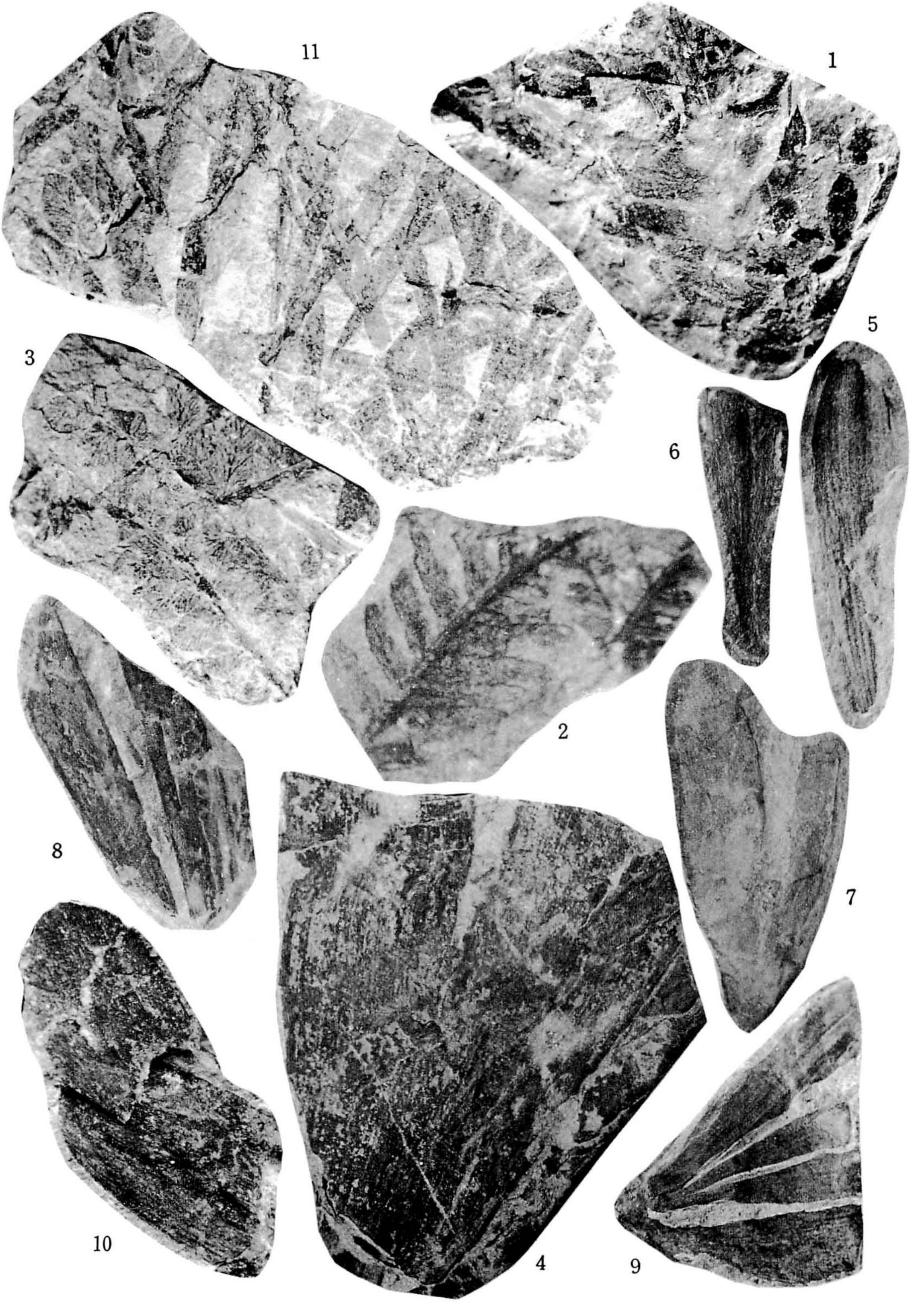
Fig. 7. *Ginkgodium* ? sp. Showing the leaf divided deeply into two segments. ×1, TG-017.

Fig. 8. *Sphenobaiera* ? sp. Showing a part of leaf fragments. ×1, TG-007.

Fig. 9. *Ginkgoites* sp. Showing deeply segmented leaf fragment. ×1, TD-9030.

Fig. 10. *Podozamites* sp. cfr. *P. eichwaldi* SCHIMPER Showing two fragments of leaves. ×2, TH-004.

Fig. 11. *Pityophyllum* sp. and *Cladophlebis* cfr. *pseudolobifolia* VACHRAMEEV Showing long-lanceolate and linear *Pityophyllum* leaves and two pinnules of *Cladophlebis* cfr. *pseudolobifolia*. ×2, TH-034.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Akaiwa	赤岩
Ayukawa	鮎川
Chinaboradani	知那洞谷
Chinju (Jinju)	晋州
Fujian	福建
Hakusan	白山
Hayashidani	林谷
He-gang	鶴崗
Hida	飛驒
Hua-shan	樺山
Itoshiro	石徹白
Izumi	和泉
Jian-de	建徳
Jusanhama	十三浜
Kami-Anama	上穴馬
Kawaguchi	川口
Kitadani	北谷
Kochi	高知
Komatsu	小松
Kukunari	十八成
Kuwashima (Kuwajima)	桑島
Kuzuryu	九頭竜
Kwanmon	関門
Kyongsang (Gyeongsang)	慶尚
Mishan	密山
Monobegawa	物部川
Mulin	穆稜
Nagdong (Naktong)	洛東
Nenjiang	嫩江
Nobudani	ノブ谷
Nochino	後野
Ofunato	大船渡
Oguchi	尾口
Omichidani	大道谷
Omoto	小本
Osugidani	大杉谷
Oyama	大山
Pantou	板頭
Ryoseki	領石
Sha-he-tze	沙河子
Shan-dong	山東
Shimonoseki	下関
Shinshu (=Chinju)	
Shiragi (Silla)	
Silla	新羅
Soma	相馬
Takinami	滝波
Tamodani	田茂谷(田母谷)
Tatsukawa	立川
Tetori (Tedori)	手取
Toyora	豊浦
Uchinami	打波
Yuasa	湯浅
Zhejiang	浙江

PROCEEDINGS OF THE PALAEONTOLOGICAL SOCIETY OF JAPAN

日本古生物学会第115回例会は，1975年6月14日（土）に，岩手大学工学部（盛岡市）において開催された（参会者58名）。

個人講演

ペルム・三畳系境界付近における古生物の変遷 —1. 紡錘虫‥勘米良亀齢・石井健一・鳥山隆三

日本海の有孔虫群集についての一考察‥的場保望

北海道西部の新第三系放散虫について…………………中世古幸次郎・西村明子

A new *Heterophyllia* from the Kanto Massif, Japan‥H. IGO & F. KOBAYASHI（代読）

Halysites 分類上の新基準…………岡村長之助

福地産 *Syringopora*, *Favosites* および *Halysites* の tabula を追求する…………岡村長之助

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A Recent coralline sponge from the Palau Island and its fossil relatives….K. MORI

Two conularids from the Dzhulfian bed in the Ābādeh region, Central Iran…… ……………M. MURATA & F. GOLSHANI

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御所浦層群産の *Pterotrigonia sakakurai* (YEHARA) と *Trigonioides* について….田村 実

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On a Paleogene *Anadara* from the Kiuragi formation in the Karatsu coal-field ….……………...T. SHUTO & Y. IKEDA

沖縄県石垣島宮良層の *Vicarya* について……………………………増田孝一郎

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A record of *Mortoniceras* from Goshonoura ……….T. MATSUMOTO & M. TASHIRO

太平洋底（DSDP Leg XL）から採取されたイノセラムス………………………松本達郎

Albian ammonites from the Central Andes ……I. OBATA, K. SHIBATA & Y. OGAWA

Miocene nautiloid from Nagano and Niigata Prefectures, Japan……….H. NODA

Devonian conodonts from the Fukuji Group, Hida Massif, Central Japan ……………. Hy. IGO, T. KOIKE & Hh. IGO（代読）

Carboniferous conodonts from the Ichinotani Group, Hida Massif, Central Japan …………. Hy. IGO & T. KOIKE（代読）

An armored worm from the Miocene Yoko-o formation, Nagano Prefecture, Japan ..………………… H. HATAI & H. NODA

天北新第三系産硅藻4新属, *Sawamuraia*, *Katahiraia* 他……………………小村精一

On some species of Fucales from the Tertiary of Japan…………….W. ISHIJIMA

On two alga-like fossils from the Cretaceous of Brazil ………… .W. ISHIJIMA

Gigantopteris 植物群の分布について‥浅間一男

Addition to the Early Cretaceous flora from the Akaiwa formation, Tetori Supergroup, Central Japan………………… ..……………….T. KIMURA & S. SEKIDO

A study of leaf compressions of *Buxus protojaponica* …………. ….K. UEMURA

四ツ役フローラ中の数種の興味ある化石植物…………………………………………村井貞允

茂木フローラ……………………柳井敏雅

山形・新潟県境地域の雷植物群概要……………………………藤岡一男・古賀 孝

日本の第三系植物雑筆……………藤岡一男

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647. TWO NEW NON-MARINE SPECIES OF BIVALVIA FROM THE LOWER CRETACEOUS OF SOUTHWEST JAPAN

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下部白亜紀非海棲二枚貝の二新種について： 下部白亜系吉母，川口，領石層より，従来 *Polymesoda* (*Isodomella*) *shiroiensis* (YABE and NAGAO) とされたものを，原標本並びに新しく採集した標本で検討した結果，咬歯の性状から Eomiodontinae に属することが明らかになった。従って *Isodomella* を同亜科の属に改めた。また，吉母，川口，領石層のものは，*I. shiroiensis* とは殻の大きさ，外形，後陵の発達の程度，H/L 等で異なるので新種として区別した。白井層から矢部と長尾 (1926) は，*Myopholas* cfr. *semicostata* を記載しているが，日本でのほぼ同時代の他の地層から発見されていなかった。今回吉母層から類似のものを発見したが，前者と比較すると異なる点が多いので *Myopholas* の新種として記載した。

太田喜久

Introduction

This paper contains a result of the palaeontological studies on the Lower Cretaceous Ryoseki fauna in Japan.

I describe, in this paper, two new species under the genera *Isodomella* and *Myopholas* on the basis of my new collections.

Before entering into the description, I wish to express my sincere thanks to Professor Tatsuro MATSUMOTO for his invaluable advice and critical reading of this manuscript. Also I am indebted to Dr. Itaru HAYAMI for his invaluable suggestions.

Description

Subfamily Eomiodontinae HAYAMI, 1965

* Received Oct. 28, 1974; read Oct. 19, 1974 at Nagoya.

Genus *Isodomella* KOBAYASHI and SUZUKI, 1939

Type-species: *Cyrena shiroiensis* YABE and NAGAO, 1926, from the Lower Cretaceous of Japan.

Diagnosis: Shell small to medium-sized for the Eomiodontinae, equivalve, inequilateral, subtrapezoidal, provided with a prominent posterior carina; umbo prominent, rising high above hinge margin, recurved, more or less prosogyrous, anterior to mid-length; lunule weakly impressed; escutcheon indistinct; surface marked with concentric ribs which are often restricted to the umbonal region as in *Astarte* (s. s.) in the juvenile stage but nearly smooth except for somewhat rugose growth-lines in the adult stage; hinge essentially similar to that of *Eomiodon*, as formulated below:

$$\frac{\text{AIII}\quad\text{AI (3a)}\quad\text{3b}\quad\text{5b}\quad\text{PIII}}{\text{AII}\quad\quad\text{2}\quad\text{4b}\quad\text{PII}},$$

cardinal teeth divergent from the beak,

flattened at the top, stout but 3a rather obscure or weak, 5b clearly separated from nymph; lateral slopes of cardinals transversely crenulated; anterior lateral teeth shorter than posterior ones, PI commonly absent, cross-striation undeveloped on lateral teeth; pallial line simple; umbonal cavity comparatively shallow.

Discussion: YABE and NAGAO noted the presence of three cardinal teeth in each valve, regarding the dentition of this species as cyrenoid. However, as described above, the left valve has only two cardinals 2 and 4b, the cardinal 1 is absent, and the hinge structure is certainly of lucinoid type. While they did not note on the transverse crenulation on the sides of cardinals which is distinct even in the syntype (no. 22451).

KOBAYASHI and SUZUKI (1939, p. 219–220) established *Isodomella* as a section of the genus *Polymesoda* on the basis of *Cyrena shiroiensis* YABE and NAGAO (1926) in describing the characters as "the species reveals the typical mode of dentition in *Polymesoda*, and furthermore the outline of the shell and the entire pallial line reveal its close approach to the *Isodoma* section of the genus. However, compared to *Polymesoda cyrenoides* (DESHAYES) from the Eocene formation of the Paris basin, which is the type of the *Isodoma* section, the hinge teeth are much more prominent and the posterior lateral teeth tolerably longer in this species". The Recent species *Polymesoda caroliniana* (BOSC), the type-species of the genus, which lives in the warm streams of North America, has three strong cardinals in each valve and a pallial line with deep, narrow sinus. The present species is not referred to the genus *Polymesoda*, because the left valve has only two cardinals and the cardinals in each valve have strong crenulation on their sides and the pallial sinus is entire.

SUZUKI and OYAMA (1943) suggested that *Isodomella* KOBAYASHI and SUZUKI (1939) may be a section of subgenus *Geloina* GRAY, 1842, without mentioning the reason. As *Isodomella* has the dentition of a lucinoid type, it is not related to the subgenus *Geloina* of the Corbiculidae.

The presence of the dentition of a lucinoid type, an *Astarte*-like sculpture in the juvenile stage, and a habitat of brackish to marine environments indicate that the present species is certainly assigned to the subfamily Eomiodontinae HAYAMI, 1965, including the genera *Eomiodon* COX, 1935, *Myrene* CASEY, 1955, *Protocyprina* VOKES, 1946, *Costocyrena* HAYAMI, 1965, and *Pseudasaphis* MATSUMOTO, 1938.

Isodomella is distinguished from *Eomiodon* COX, 1935 (type-species: *E. indicus* COX, 1935) by the following significant points. The cardinal 5b of the former is strong and clearly separated from nymph, but that of the latter is weak and connected with nymph. The former has a weak but distinct lateral PIII and the strong crenulation on the sides of cardinals, but these are absent in the latter. Furthermore, the former has no distinct escutcheon.

In many characters, this genus is very similar to *Myrene* CASEY, 1955 (the type-species: *M. fittoni* CASEY, 1955), but the construction and feature of laterals are different between them. Namely, the lateral teeth A0, P0 and lateral cross-striation are absent in the former.

In the presence of the cardinal cross-crenulation and lateral PIII, this genus is also easily distinguishable from *Protocyprina* VOKES, 1946 (the type-species: *Astarte libanotica* FRASS, 1878).

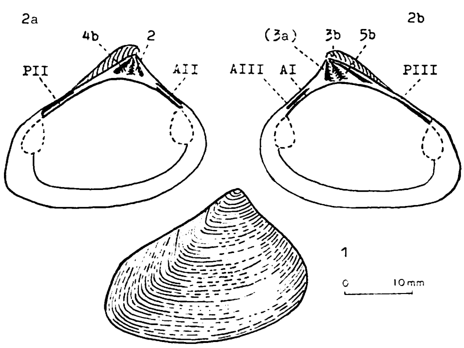
Costocyrena HAYAMI, 1965 (type-species: *C. matsumotoi* HAYAMI, 1965) and *Pseudasaphis* MATSUMOTO, 1938 (type-species: *P. japonicus* MATSUMOTO, 1938) which have radial ribs on their whole surfaces, are characteristic genera in the Eomiodontinae. The present genus has many common characters with them, but it is readily be distinguishable from them by thed ifferences in the surface sculpture and cardinal crenulation.

For the above-mentioned reasons, I propose to include the emended genus *Isodomella* in the Eomiodontinae.

Isodomella matsumotoi sp. nov.

Plate 9, figs. 1-13; Text-figs. 1, 3.

Material: The holotype is a right valve (GF. Y147) collected from the Yoshimo formation at loc. Y51, Yoshimo, Shimonoseki City, Yamaguchi Prefecture. Paratypes (GF. Y106-108, Y110-113, Y127-135, Y142-146, Y148) were collected from the same locality and other paratypes (GF. K2552-2556) from the Kawaguchi formation at loc. K123, Fukami, Sakamoto Village, Yatsushiro County, Kumamoto Prefecture. All are collected by myself and are now kept in Fukuoka University of Education and indicated in this paper with the prefix GF.



Text-fig. 1. *Isodomella matsumotoi* sp. nov. 1. Right valve, showing the outline of shell and the surface ornamentation of the adult stage. 2. Showing the internal feature of left (2a) and right (2b) valves.

The fossil localities (S401, Y51 and K123) and their stratigraphical positions are shown in the map and columns of my previous paper (OHTA, 1973, figs. 1-2).

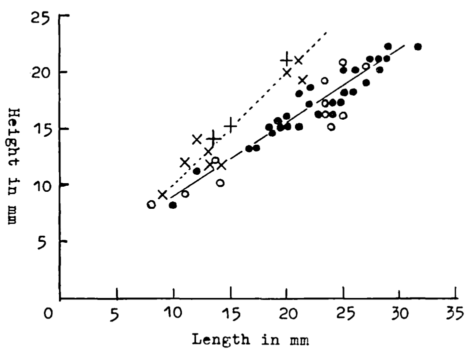
Description: Shell medium-sized, equivalve, inequilateral, trigonally ovate to subtrapezoidal in outline, moderately inflated; test fairly thick; umbo prominent, prosogyrous, placed at about one-third of the length of the shell from the anterior end; antero-dorsal margin comparatively short, faintly concave in front of umbo, passing gradually into antero-ventral margin; postero-dorsal margin long, gently convex or nearly straight; siphonal margin short, obscurely delimited from the posterodorsal margin by an obtuse angle, turning angularly to the ventral margin; ventral margin broadly arcuate, passing gradually into the anterior margin; a blunt carina extends from the umbonal region to the postero-ventral corner; lunule moderate in width, rather shallow, weakly defined; escutcheon indistinct; ligament external, not much elongated; surface ornamented with concentric furrows and distinct lamellae with fine growth-lines; hinge plate fairly broad especially in the adult shells; dentition characterized by much modified lucinoid cardinal teeth having strong trigonian cross crenulation and corbiculoid elongated lateral teeth: cardinal 2 fairly stout, opisthocline, separated from AII, only posterior side crenulated; 4b moderately thick, obliquely elongated, prosocline, both sides fairly strongly crenulated; 3a comparatively small, tubercular, opisthocline, represented by a terminal thickening of AIII; 3b especially large, very stout and broad, acline or slightly prosocline, both sides strongly crenulated; 5b prosocline, separated from nymph, only anterior side crenulated; anterior lateral teeth linearly elongated along the antero-dorsal margin, but AI and AIII ill-defined from the margin of hinge plate; posterior lateral teeth PII and PIII remote from cardinal teeth, longer than anterior laterals; PI not defined; no prominent transverse crenulation on lateral teeth; nymph comparatively wide; adductor scars fairly strongly impressed, comparatively large, subovate, subequal in size, placed near the ends of the lateral teeth; pallial line not sinuated but somewhat abruptly bent upwards below the posterior adductor scar; pedal scar not clearly impressed; umbonal cavity comparatively shallow; ventral margin smooth internally.

Measurements in mm:

Specimen	Length	Height	H/L
GF. Y 147 (Holotype; right valve)	28.0	21.0	0.75
〃 Y 148 (Paratpye; 〃)	26.0	20.0	0.76
〃 Y 146 (〃 ; 〃)	31.5	22.0	0.69
〃 Y 145 (〃 ; 〃)	24.0	17.0	0.70
〃 Y 144 (〃 ; 〃)	22.0	17.0	0.77
〃 Y 143 (〃 ; 〃)	19.0	15.0	0.78
〃 Y 142 (〃 ; right int. mould)	24.0	17.0	0.70
〃 Y 106 (〃 ; 〃)	16.5	13.0	0.78
〃 Y 107 (〃 ; lift int. mould)	10.0	8.0	0.80
〃 Y 108 (〃 ; right int. mould)	23.5	16.0	0.68
〃 Y 110 (〃 ; 〃)	12.0	11.0	0.91
〃 Y 111 (〃 ; 〃)	18.5	15.0	0.81
〃 Y 112 (〃 ; 〃)	27.0	19.0	0.70
〃 Y 113 (〃 ; 〃)	18.5	15.0	0.81
〃 Y 127 (〃 ; left valve)	20.0	15.0	0.75
〃 Y 128 (〃 ; 〃)	19.5	15.0	0.76
〃 Y 129 (〃 ; 〃)	25.0	20.0	0.80
〃 Y 130 (〃 ; 〃)	19.0	15.0	0.78
〃 Y 131 (〃 ; 〃)	23.0	16.0	0.69
〃 Y 132 (〃 ; 〃)	28.0	21.0	0.75
〃 Y 133 (〃 ; left int. mould)	28.0	21.0	0.75
〃 Y 134 (〃 ; left valve)	25.0	18.0	0.72
〃 Y 135 (〃 ; 〃)	22.0	18.5	0.84
GF. K2552 (〃 ; left int. mould)	24.0	16.0	0.66
〃 K2553 (〃 ; left valve)	25.0	16.0	0·64
〃 K2554 (〃 ; left int. mould)	24.0	15.0	0.62
〃 K2555 (〃 ; left valve)	27.0	20.5	0.75
〃 K2556 (〃 ; 〃)	14.0	10.0	0.71

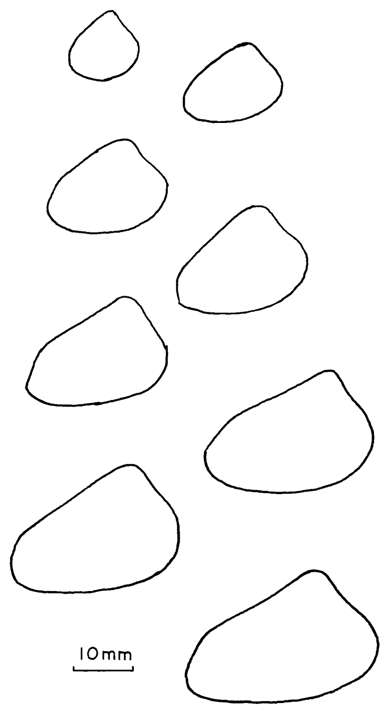
Variation: In addition to the above indicated 28 specimens, many specimens from Yoshimo and other areas at hand are referable to the present species. Most of these specimens are little deformed secondarily except some specimens from Kawaguchi. The average of the ratio of H/L is about 0.74, but the ratio varies apparently to a tolerable extent as shown in the measurements and Text-fig. 2. However, there is a trend that the ratio decreases from the juvenile stage to the adult one. In other words, outline of the juvenile stage is rounded trigonal while that of the adult stage subtrapezoidal as shown in Text-fig. 3. The position of umbo which is indicated by the ratio of L′/L varies also to a fairly wide extent, ranging from one-fourth to two-fifths as shown in Text-figs. 3 and 4.

Discusssion: KOBAYASHI and SUZUKI (1939, pl. 14, figs. 1-9) identified nine specimens from the Yoshimo formation with *Polymesoda* (*Isodomella*) *shiroiensis* (YABE and NAGAO) from the Shiroi formation of the Sanchu Graben in the Kwanto Massif. I have examined the syntype (no. 22451) of *Cyrena shiroiensis* YABE and NAGAO, from the Shiroi formation at Bōmekizawa, Ohinata Village, Minamisaku County, Nagano Prefecture, which is now kept in Tohoku University, and the specimens (GF. S4010-4013) from the same formation at loc. S401, Shiroi, Ueno Village, Tano County, Gunma Prefecture (coll. OHTA). As a result, the average of the ratio of H/L of *Isodomella*

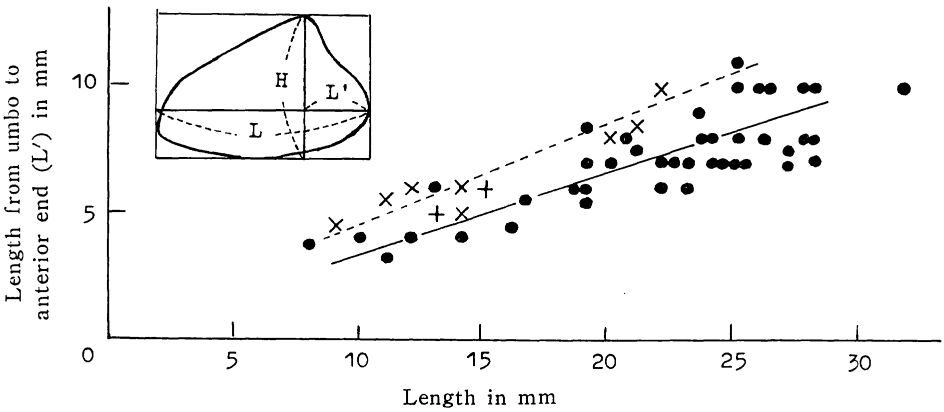


Text-fig. 2. Diagram showing the relation between height (H) and length (L).

Sample composed of 40 individuals of *Isodomella matsumotoi* sp. nov. from the localities Y51 and K123, and 12 individuals of *Isodomella shiroiensis* from the loc. S401 and the illustrated specimens by YABE and NAGAO (1926). *Isodomella matsumotoi* sp. nov. ●: specimen from tne Yoshimo formation. ○: specimen from the Kawaguchi formation. *Isodomella shiroiensis* (YABE and NAGAO) ×: specimen from the Shiroi formation. "*Cyrena*" *shiroiensis* var. *alata* YABE and NAGAO (=*Isodomella shiroiensis* (YABE and NAGAO)) +: specimen from the Shiroi formation.



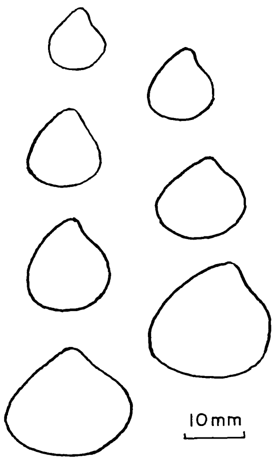
Text-fig. 3. The morphogenetic change of the outline of shell of *Isodomella matsumotoi* sp. nov.



Text-fig. 4. Diagram showing the relation between the length of shell (L) and the one from the umbo to the anterior end (L').

●: *Isodomella matsumotoi* sp. nov.; ×: *Isodomella shiroiensis* (YABE and NAGAO); +: "*Cyrena*" *shiroiensis* var. *alata* (YABE and NAGAO) (=*Isodomella shiroiensis* (YABE and NAGAO)).

shiroiensis (YABE and NAGAO) (=*Cyrena shiroiensis* YABE and NAGAO) is about 1.00 as shown in Text-fig. 2. In the juvenile stage there is a strong resembrance between the present species and *Isodomella shiroiensis* in the outline of shell and the ratio of H/L as shown in Text-figs. 2, 3 and 5. However, in the adult stage the former is easily distinguished from the latter in that the former is larger, subtrapezoidal instead of subtrigonal in outline, and has a smaller ratio of H/L than the latter.



Text-fig. 5. The morphogenetic change of the outline of shell of *Isodomella shiroiensis* (YABE and NAGAO).

YABE and NAGAO (1926, pl. 2, fig. 26; pl. 3, figs. 15, 28) discriminated *Cyrena shiroiensis* var. *alata* from *Cyrena shiroiensis* by the reasons that its umbo is median and its outline is subtrigonal. However, I agree with KOBAYASHI and SUZUKI (1939, p. 220) in considering that *Cyrena shiroiensis* var. *alata* is synonymous with *Cyrena shiroiensis* (=*Isodomella shiroiensis*), because the former is included within the variation of *Isodomella shiroiensis* as shown in Text-figs. 4 and 5.

MAEDA (1959) described *Polymesoda* (*Isodomella*) *kobayashii* from the Tochio alternation of sandstone and shale in the Akaiwa formation at Kamitakara Village, Yoshiki County, Gifu Prefecture. MAEDA (1959, p. 158) noted the presence of three cardinal teeth in each valve, interpreting that the dentition is of corbiculid type.

However, the left valve has only two cardinals 2 and 4b, without cardinal 1 and, thus, the hinge structure is a kind of lucinoid type. Therefore, *P.* (*I.*) *kobayashii* should not be assigned to *Polymesoda* of the Corbiculidae. Furthermore, as it has neither cardinal 5b nor cardinal crenulation, it is not referred to *Isodomella*, but it may be related to the genus *Crenotrapezium* HAYAMI, 1958.

MATSUMOTO and KANMERA (1952) and MATSUMOTO (1954) listed *Polymesoda* (*Isodomella*) *shiroiensis* (YABE and NAGAO) from the Yoshimo and Kawaguchi formations without any description, but their specimens may be referred to the present species.

The specific name is dedicated to Prof. Tatsuro MATSUMOTO who kindly suggested me to study the Mesozoic non-marine Bivalvia.

Occurrence: Black shale of the Yoshimo formation at loc. Y51, Yoshimo, Shimonoseki City, Yamaguchi Prefecture, and black shale of the Kawaguchi formation at a road-cut (K123) between Kawaguchi and Shimofukami, Sakamoto Village, Yatsushiro County, Kumamoto Prefecture.

Family Myopholadidae COX, 1964

Genus *Myopholas* DOUVILLE, 1907

Type-species: *Pholadomya multicostata* AGASSIZ, 1842 (original designation).

Myopholas carinatus sp. nov.

Plate 9, figs. 17-21

Material: The holotype is a left internal mould (GF. Y450) collected from the Yoshimo formation at loc. Y51, Yoshimo, Shimonoseki City, Yamaguchi Prefecture. Paratypes (GF. Y451-458) from the same locality. The holotype and one of the paratypes (GF. Y452) are well preserved.

Description: Shell of small size, inequilateral, elongate-ovate with slight tendency to be rostrate posteriorly; umbo broadly rounded and scarcely protruding, situated about one-third of the shell length from the anterior end, and incurved to slightly prosogyrous beak; inflation of shell strong below umbo and maximum convexity lying near the mid-height below the umbo; thickness decreases gradually toward the posterior end; fairly strong carina from umbo to posteroventral angle, delimiting fairly broad, elongate and partly concave posterior area, while weaker radial ridge delimits small anterior area on the other side of umbo; sharp edge of thickening of dorsal margin that projects into cavity of valve gives rise to groove extending parallel with posterior carina on internal mould; valve margin closed or with a narrow posterior gape; escutcheon long, narrow, bordered by a distinct ridge; ornament of anteromedian part of surface marked with radial and concentric ribs with tubercles at their intersection, while radial ribs on anterior part of surface stronger and more widely separated than median ones, and of posterior part of surface weakly ribbed or almost smooth with fairly strong concentric ribs only; hinge feature, adductor scars and pallial line not clear.

Measurements in mm:

Specimen	Length	Height	1/2 Thickness
GF. Y450 (Holotype, left int. mould)	42.0	21.0	11.0
GF. Y452 (Paratype, right valve)	32.0	16.0	7.0

Variation: The variation on the present species is not exactly known, but a young specimen (Y452, Fig. 18) is less inflated and has a weaker posterior carina than the adult one (Y450, Fig. 17).

Comparison: In many characters the present species is closely allied to *Myopholas multicostata* (AGASSIZ, 1842), the type-species of the genus, from the Kimmeridgean of Switzerland. A sharp edge of thickening of dorsal margin and a mode of sculpture are also known in the latter species. But the latter has some submedian ribs of secondary strength in the interspaces of ribs and is larger and more inflated than the former. *M. ledouxi* DOUVILLE, 1907, from the Albian of France is similar to the present species in the outline and surface ornamentation, but is again larger and more inflated. *M. minor* HAYAMI, 1972, from the Lower Jurassic of Southeast Asia, may also be related to the present species. The latter has, however, a strong carina and not so many radial ribs as compared with the former.

The present species seems to be comparable with *Myopholas* cfr. *semicostata* (AGASSIZ) of YABE and NAGAO, 1926, from the Shiroi formation with regard to many characters, but the posterior carina appears to be stronger than in the latter species, and in the former surface of anteromedian part is covered with rows of minute granules at the intersection of radial and concentric ribs in contrast to smooth radial ribs in the latter species.

The present species is fairly similar to *Burmesia lirata* HEALEY, 1908, from the Rhaetian of Southeast Asia in the elongate-ovate outline, the surface ornamentation and the edentulous hinge, but is clearly distinguishable from the latter by the absence of spoon-like condrophore extending into shell cavity from below the beak. It has only concentric ribs on the posterior area, but the latter has concentric folds and subordinate radial threads.

The present species is fairly similar to the cosmopolitan species, *Pholadomya* (s. s.) *candida* SOWERBY, 1819, the type-species of the genus, ranging from Upper Triassic to Recent, in the elongate-ovate outline and the pustulation of surface ornamentation. However, the latter is strongly inequilateral and widely gaping at the posterior end and its dorsal umbonal ridge is not prominent as compared with the former.

The present species is more or less similar to *Neoburmesia iwakiensis* YABE and SATO, 1942, from the Upper Jurassic Soma group in Japan in the surface ornamentation and strong carina, but the terminal beak, the elongate-oblong outline of shell and the wide posterior gape are diagnostic to the latter.

Occurrence: Rather rare in the impure limestone beds consisting of gregareous *Ostrea* sp. of the Lower Cretaceous Yoshimo formation at loc. Y51, Yoshimo, Shimonoseki City, Yamaguchi Prefecture.

Summary of the Results

From the above described observations of new collections from the Shiroi, Yoshimo and Kawaguchi formations, the following articles are led as a conclusion.

1. "*Cyrena*" *shiroiensis* YABE and NAGAO is a member of the subfamily Eomiodontinae and not that of the family Corbiculidae as YABE and NAGAO (1926) and KOBAYASHI and SUZUKI (1939) have considered respectively.

2. *Isodomella*, which was established for this species as a section of *Polymesoda* by KOBAYASHI and SUZUKI (1939), is emended in this paper as a genus of Eomiodontinae.

3. KOBAYASHI and SUZUKI (1939) identified the specimens from Yoshimo with *Isodomella shiroiensis* (YABE and NAGAO). However, they are clearly distinguished from *I. shiroiensis* from Shiroi in the outline and the size of shell and the ratio of H/L. Therefore, a new species, *Isodomella matsumotoi*, is established for the specimens from Yoshimo and Kawaguchi.

4. Another set of specimens from the Yoshimo formation represents a new species which resembles *Myopholas* cfr. *semicostata* from the Shiroi formation in the outline, size and inflation of the shell, but is distinguished in the strong carina and dissimilar surface ornamentation.

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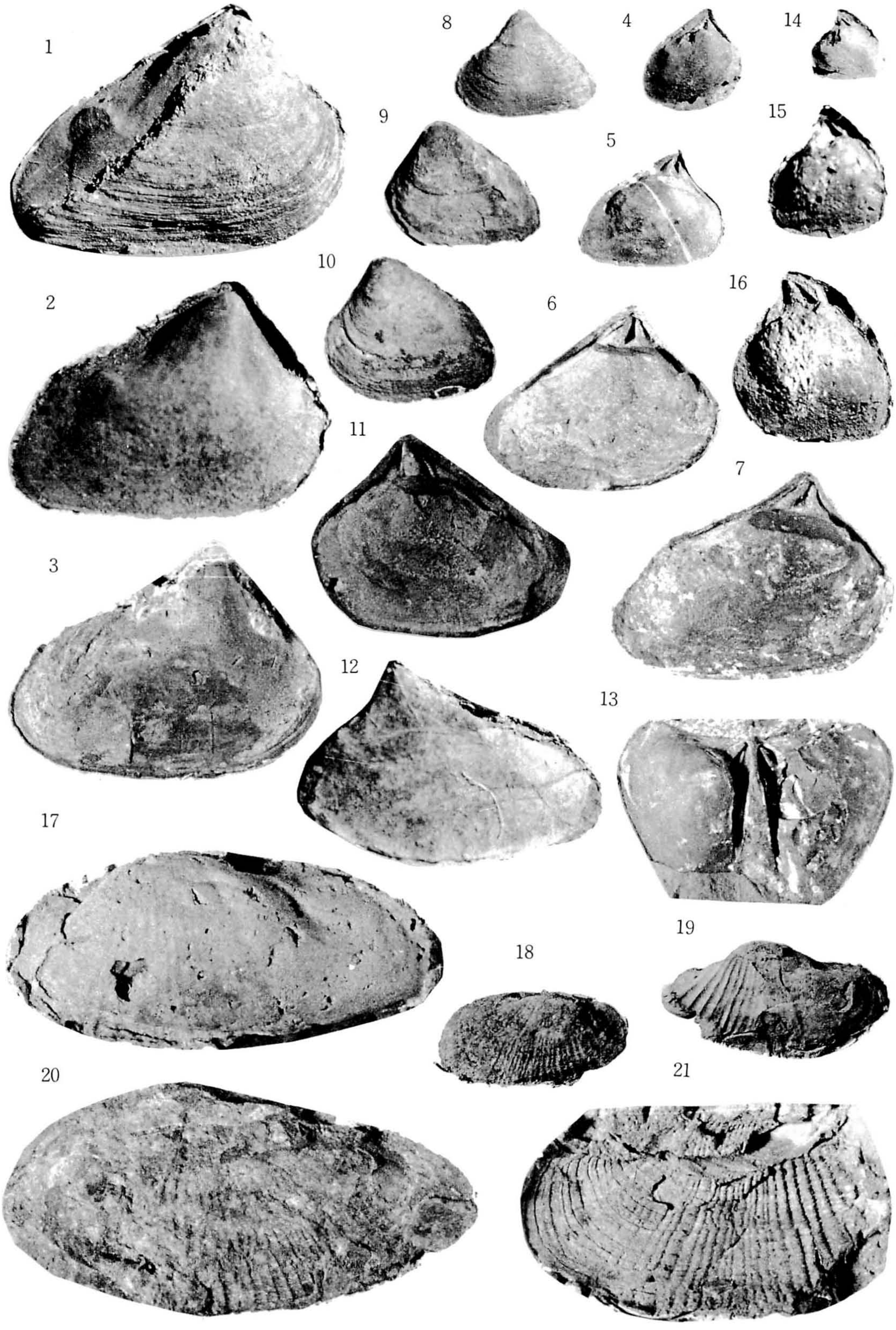
Bōmekizawa	棒目木沢	Shiroi	白 井
Fukami	深 水	Tochio	栃 尾
Kawaguchi	川 口	Yoshimo	吉 母
Shimofukami	下 深 水		

Explanation of Plate 9

Figs. 1-13. *Isodomella matsumotoi* n. sp.
1. Right valve, holotype (GF. Y147) ×1.8
2. Right internal mould, paratype (GF. Y142) ×2.0
3. Right valve, paratype (GF. Y146) ×1.6
4. Right internal mould (GF. Y110), younger specimen ×1.3
5. Right internal mould (GF. Y111), younger specimen ×0.9
6. Right internal mould, paratype (GF. Y103) ×1.6
7. Right internal mould, paratype (GF. Y112) ×1.6
8. Left valve, paratype (GF. Y128) ×1.0
9. Left valve, paratype (GF. Y130) ×1.2
10. Left valve, paratype (GF. Y135) ×1.2 なし
11. Left internal mould, paratype (GF. Y407) ×1.7
12. Left internal mould, paratype (GF. K2554) ×2.0
13. Bivalved internal mould, paratype (GF. Y113) ×1.5

Figs. 14-16. *Isodomella shiroiensis* (YABE and NAGAO)
14. Left internal mould (GF. S4010) ×0.9
15. Left internal mould (GF. S4012) ×2.0
16. Left internal mould (GF. S4011) ×2.0

Figs. 17-21. *Myopholas carinatus* n. sp.
17. Left internal mould, holotype (GF. Y450) ×1.7
18. Right valve, paratype (GF. Y452) ×1.0
19. Left internal mould (GF. Y451) ×1.0
20. Left valve (GF. Y453) ×1.7
21. Left external mould (GF. Y 457) ×1.7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1974年度日本古生物学会奨励金受賞者推薦文

糸魚川淳二君：中新世瀬戸内地域の軟体動物の古生態学的研究

古生態学は精度の高い野外地質調査と厳密なサンプリングの上に成立つものであるが，糸魚川君の研究はまさにこのことを教えている。同君は古瀬戸内統のかなめに当る瑞浪層群の詳細な調査を基礎にして，古瀬戸内統の軟体動物の比較研究を進め，大きな成果をあげた。

糸魚川君は研究の初期から化石群集の多くが生物群集を反映していることを認識し，化石群集を一つの基礎単位として堆積相，化石相の解析を進めた。その結果化石群集と堆積相とが規則正しく対応し，それらは堆積時の環境を代表するという認識に至った。それはまず中新統瑞浪層群の古生態学的研究（1960）に結晶した。この研究では化石群集とそれらを含む地層の岩質を総合することにより汽水ないし内湾の泥底，潮間帯ないし上浅海の砂底，同じく砂•礫•岩礁底，浅い内海の泥底，さらに深い泥底，下浅海ないし亜深海泥底の環境に対応する *Cyclina-Vicarya, Nipponomarcia-Dosinia, Glycymeris-Miogypsina, Lucinoma-Cultellus, Nuculana-Macoma, Portlandia-Linthia* などの基本群集を区別した。さらにこれらの化石群集が瑞浪層群の海侵のサイクルの大枠と盆地の局地的運動とに支配されて，汽水の群集から深い環境のものへの変化を複雑に繰返していることを解析した。この成果をもとにして綴喜層群，藤原層群，さらに淡路島から広島県にかけての古瀬戸内統を比較し，瑞浪層群と同様の海侵のサイクルを反映する化石群集の変化を見出すと同時に，化石群集そのものの構成は近畿以西では変化していることを示した。即ち *Cerithidea* 群集，*Ostrea-Balanus* 群集，*Mactra* 群集，*Miogypsina-Operculina* 群集，*Propeamussium* 群集，*Venericardia-Nuculana* 群集などがその地域の基本的群集である。

このように糸魚川君は軟体動物の古生態学的研究，とくに環境論的方面の開拓と推進に大きな功績をあげた。日本古生物学会はここに学術奨励金を贈り，今後のいっそうの発展を期待する。

日本学術会議第 68 回総会報告

第 68 回総会および部会は 1975 年 4 月 23 日から 3 日間開催された。常置委員会のうち，長期研究計画委員会から，長期的研究計画の樹立，各分野の研究動向調査の必要性について，科学者の待遇問題委員会から，国際婦人年にあたって女性科学者の待遇問題をとりあげる希望，学術体制委員会から，現国会での大学院制度法令改正に関しての政府関係者との話合い，学術交流委員会から，国際団体への加入，国際会議への代表派遣のための基準を検討する必要があること，ならびにその予算が大幅に縮小され苦しい事態にあること，などの報告が行なわれた。第 10 期の常置委員会の活動要綱は，次の 5 つにまとめられる。

1. 本会議の基本的目的，任務，姿勢の堅持，2. 審議機関としての機能の充実強化，3 新たな総合的科学研究将来計画策定の準備と清新な科学・技術政策の策定への寄与，4. 科学者，学協会等との結びつきの強化，5. 日本学術会議の制度上の改革構想の策定とその実現のための努力

常置委員会のうち，従来の長期研究計画委員会は廃止，新たに科学研究計画委員会が設置され，また，学術交流，科学者の待遇問題各委員会は，それぞれ国際学科交流委員会，科学者の地位委員会と改称された。さらに，学術情報・資料，人間と科学，原子力，資源・エネルギー，社会福祉問題，私立大学問題，食糧問題，科学研究者の地位に関するユネスコ勧告，環境科学，国際協力事業の 10 特別委員会の設置が認められた。また，運営審議会に，「勧告案の策定，アフターケア等小委員会」「日本学術会議の改革構想策定小委員会」「沖縄問題委員会」を新設する案が採択された。「研究連絡委員会に関する措置について」はさらに検討を重ね，次の第 69 回総会を目標に努力するよう申し合せ，「学協会との連絡のための登録について」の内規が定められた。また，「『科学研究者の地位に関する勧告』の秋が国における実現について」の要望が採択された。

〔以上，日本学術会議広報委員会からの要請に基き，要約して掲載しました。〕

日本古生物学会報告・紀事（新編）100号記念事業について

日本古生物学会報告・紀事は，昭和11年に第1号を刊行以来，40年の歳月を経て，本年12月号発行号をもって新編100号に達します。本会ではこの快挙を記念し，本年1月の総会の承認を得て，通常号（年間4号とは別に，No. 100s (Supplement) の刊行を企画しました。

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

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

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

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

出版概要

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

募　　金

1口（1,000円）以上。
刊行前，刊行後を問わない。
方法‥‥できるだけ先日送付しました振替用紙を御利用下さい。なお，学会センター事務と混同のおそれがありますので，この振替用紙は会費の払込みには用いないで下さい。
印刷部数は限定されておりますが，多少の余裕はありますので，会員外の方々や研究機関，教室などにも実費で頒布する予定です。

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

浜田隆士　東京大学教養学部宇宙地球科学教室　03-467-1171 内 265
氏家　宏　国立科学博物館分館　03-364-2311 内 422
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日本古生物学会会則　(1975, 1, 25改訂)

第１条　本会は日本古生物学会という。

第２条　本会は古生物学およびこれに関係ある諸学科の進歩および普及を計るのを目的とする。

第３条　本会は第２条の目的を達するため次の事業を行なう。
1. 会誌そのほかの出版物の発行。2. 学術講演会の開催。3. 普及のための採集会・講演会そのほかの開催。4. 研究の援助・奨励および研究業績ならびに会務に対する功労の表彰その他第２条の目的達成に資すること。

第４条　本会の目的を達するため総会の議を経て本会に各種の研究委員会を置くことができる。

第５条　本会は古生物学およびこれに関係ある諸学科に興味を持つ会員で組織する。

第６条　会員を分けて普通会員・特別会員・賛助会員および名誉会員とする。

第７条　普通会員は所定の入会申込書を提出した者につき評議員会の議によって定める。

第８条　特別会員は本会に10年以上会員であり古生物学について業績のあるもので，特別会員５名の推薦のあったものにつき評議員会の議によって定める。

第９条　賛助会員は第２条の目的を賛助する法人で評議員会の推薦による。

第10条　名誉会員は古生物学について顕著な功績のある者につき評議員会が推薦し，総会の決議によって定める。

第11条　会員は第12条に定められた会費を納めなければならない。会員は会誌の配布を受け第３条に規定した事業に参加することができる。

第12条　会費の金額は総会に計って定める。会費は普通会員年4,000円，特別会員年5,600円，賛助会員年１口10,000円以上とする。名誉会員は会費納入の義務がない。在外の会員は年 U.S.＄20とする。

第13条　本会の経費は会費・寄付金・補助金などによる。

第14条　会費を１ケ年以上滞納した者および本会の名誉を汚す行為のあった者は，評議員会の議を経て除名することができる。

第15条　本会の役員は会長１名，評議員15名とし，うち若干名を常務委員とする。任期は総て２年とし再選を妨げない。
会長の委嘱により本会に幹事および書記若干名を置くことができる。
常務委員は評議員会において互選される。評議員は特別会員の中から会員の通信選挙によって選出される。

第16条　会長は特別会員の中から評議員会において選出され，本会を代表し会務を管理する。
会長に事故ある場合は会長が臨時に代理を委嘱する。

第17条　本会には名誉会長を置くことができる。名誉会長は評議員会が推薦し総会の決議によつて定める。名誉会長は評議員会に参加することができる。

第18条　本会は毎年１回定例総会を開く。その議長には会長が当たり本会運営の基本方針を決定する。
総会の議案は評議員会が決定する。
会長は必要があると認める時は臨時総会を召集する。総会は会員の十分の一以上の出席をもつて成立する。会長は会員の三分の一以上の者から会議の目的たる事項および召集の理由を記載した書面をもつて総会召集の請求を受けた場合は臨時総会を召集する。

第19条　総会に出席しない会員は他の出席会員にその議決権の行使を委任することができる。但し，欠席会員の議決権の代行は１人１名に限る。

第20条　総会の議決は多数決により，可否同数の時は議長がこれを決める。

第21条　会長および評議員は評議員会を組織し，総会の決議による基本方針に従い運営要項を審議決定する。

第22条　常務委員は常務委員会を組織し評議員会の決議に基づいて会務を執行する。

第23条　会計監査１名をおく。監査は評議員会において評議員および幹事をのぞく特別会員の中から選出される。任期は２年とし再選を妨げない。

第24条　本会の会計年度は毎年１月１日に始まり12月31日に終る。

第25条　本会会則を変更するには総会に付議し，その出席会員の三分の二以上の同意を得なければならない。

付　則　1) 評議員会の議決は総て無記名投票による。

例会等の通知

	開催地	開催日	講演申込締切日
116回 例会	金沢大学	1975年 9月 23, 24日	1975年 7月 20日
1976年 総会・年会	鳴子川渡 共同セミナーハウス	1976年 1月 30, 31日	1975年 11月 20日

◎ 116回例会ではコロキウム「硬組織の生長」(世話人・小西健二) が予定されている。

◎ シンポジウム「陸の古生態——古生態学の課題 (1)」の開催
1975年10月6日 (月) 表記シンポジウムを日本学術会議大会議室において古生物学研究連絡委員会主催, 日本古生物学会, 日本地質学会後援で開く予定をしております。くわしい内容・日程はおって通知されます。(世話人・大森昌衛ほか15名)。

学会記事

昭和50年6月13日岩手大学において開かれた評議員会で, 次の諸項がきまった。

◎ 本年度 学会に設置される科研費問題小委員会委員は次の諸君に決定した (順不同敬称略)。柳田寿一, 氏家　宏, 小西健二, 森　啓 (以上留任), 佐藤誠司, 坂上澄夫, 糸魚川淳二 (以上新任)。

◎ 文部省学術審議会用語委員会 (地学) への古生物学会推せん委員は, 鹿間時夫君より浜田隆士君に交代する。

◎ 日本学術会議第10期地質学研究連絡委員会委員候補として, 浜田隆士, 高柳洋吉の両君を推せんした。

◎ Bibliography of Palaeontology in Japan (1961-1975) を, 特別号として刊行することに決定した。編集は刊行委員会を中心に, 広く会員各位の協力を得て行なうことになった。委員長に勘米良亀齢君, 委員に首藤次男, 小高民夫, 氏家　宏, 鎮西清高の諸君が選出された。

◎ 次の各君の入・退会が認められた。退会3名 (井上正昭, 西脇昌治, 玉生志郎), 入会5名 (下中昌樹, 小池裕子, 長谷義隆, 植松芳平, 森　忍)。なお, 現会員数は次通り。賛助会員10, 名誉会員6, 特別会員143, 普通会員304, 在外会員56, 計519。

お願い

会員で, IUGS関係のCommission, Subcommission等のメンバー, あるいはWorking group等の役員になっておられる方は, その名称, 役名等を浜田隆士 (地質研連付置 IGC 開催検討小委員会委員) までお知らせ下さい。

◎　本会誌の出版費の一部は文部省研究成果刊行費による。

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CONTENTS

TRANSACTIONS