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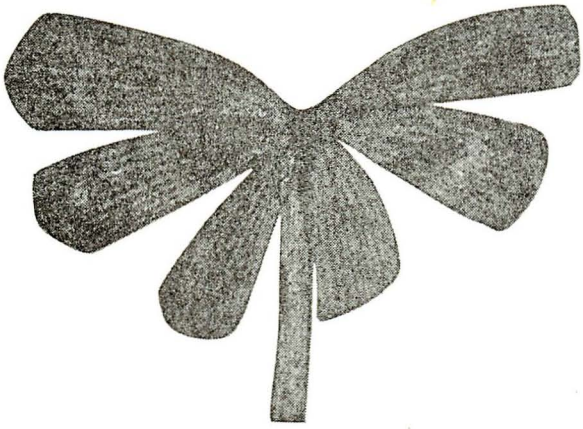

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Fossil on the cover is the six leaves in a whorl of *Trizygia oblongifolia* (GERM. & KAULF.) ASAMA from the Maiya Formation (*Parafusulina* zone), Maiya, N. E. Japan.

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663. MESOZOIC PLANTS FROM THE AKAIWA FORMATION (UPPER NEOCOMIAN), THE ITOSHIRO GROUP, CENTRAL HONSHU, JAPAN*

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ネオコミアン上部赤岩層（石徹白層群上部）の植物化石：赤岩層の植物化石は一般に保存が悪く，従来は木村（1975）の研究を除いてはその古植物学的研究は行なわれていない。今般，石川県石川郡白峰村別当崩れ（白山中腹）および大杉谷苛原からやや保存のよい標本が多量に得られたのでここに報告する。赤岩層の植物化石は下位の尾口層の植物群と組成が異なるので，以下赤岩植物群とよび，さきに木村によって記載された福井県大野郡和泉村半原地域の田茂谷（多母谷）層群中部層の植物化石を含める。赤岩植物群は内帯植物地理区（木村，1961；1975）の植物群で，たかわらび科，うらじろ科および所属不明のシダ，ソテツ葉類，イチョウ類およびその類縁のもの，および球果類（広葉のものが優勢）からなる植物群である。赤岩植物群は，たかわらび科をはじめ，シダ類が劣勢であること，ソテツ葉類が劣勢かつ小型化すること，また葉縁が鋸歯状を呈するものが優勢になること，および，*Ginkgoidium* を除き，イチョウ類の葉が小型化することなどの諸点で尾口植物群と異なる。また上位の田茂谷植物群とも組成が異なる。赤岩植物群を構成する属種の大部分，すなわち，*Coniopteris*, *Birisia*, *Asplenium*, *Raphaelia*, *Adiantites*, *Dictyozamites* cfr. *cordatus*, *Nilssonia lobatidentata*, *Ginkgoites*, *Leptostrobus*, *Pseudotorellia*, *Podozamites* などは，同時代のシベリア植物地理区植物群と共通もしくはきわめて近縁のものであり，同時代の下部物部川層植物群（木村・平田，1975）とはいちじるしく異なる。以上は，木村のいう日本の内帯植物地理区の古環境がシベリア植物地理区のそれに近縁であり，日本の外帯植物地理区のそれとは異なったものであることを裏付けている。赤岩層からは，多量の材化石を入手しているが，これらについては別に記載報告する。

木村達明・関戸信次

Introduction

The Tetori Supergroup is widely distributed over Nagano, Gifu, Toyama, Ishikawa and Fukui Prefectures in the Inner Zone of Central Japan. Table 1 summarises the stratigraphy of this supergroup. We now mention work on the floras of the Tetori Supergroup. The flora of the Kuzuryu Group (Kuzuryu Flora) was described by KIMURA (1958b, 1959b). The flora of the Oguchi For-

* Received April 5, 1976: read Jan. 11, 1974 at Fukuoka and June 14, 1975 at Morioka.

mation (also called the Oguchi Flora and by earlier authors, the "Tetori Flora") has been described by GEYLER (1877), YOKOYAMA (1889), YABE (1905, 1922, 1927a), OISHI (1936, 1940, 1941), MATSUO & OMURA (1968), KIMURA (1961) and KIMURA & SEKIDO (1965, '66, '67, '71, '72, '74, '75). The monographical study of this flora is now in progress by us.

The Akaiwa Flora is dealt with in this paper but we now realize that the lower and middle parts and the upper part of the Tamodani Formation along the Tamodani, studied by KIMURA & HAYASHI may correspond to the Akaiwa Formation and the lower part of the Kitadani Formation respectively. The uppermost member of the Tamodani Formation have yielded a rich and peculiar flora (called the Tamodani Flora by KIMURA, 1975a) which includes *Arctopteris* and *Jacutopteris* and is of a character previously known only in Siberia.

Now under a new heading, the flora of the Akaiwa Formation, we collected in 1973-1975 many fossil plants and non-marine shells from the Akaiwa Formation at Bettokuzure on the southern slope of Mt. Hakusan (2702 m) and Irahara along the Osugidani, a branch of the upper course of the Tetori River, Shiramine-mura, Ishikawa-gun, Ishikawa Prefecture, with the cooperation of Mr. K. YAMAZAKI, a staff of the Komatsu City Museum and several students of the Tokyo Gakugei University.

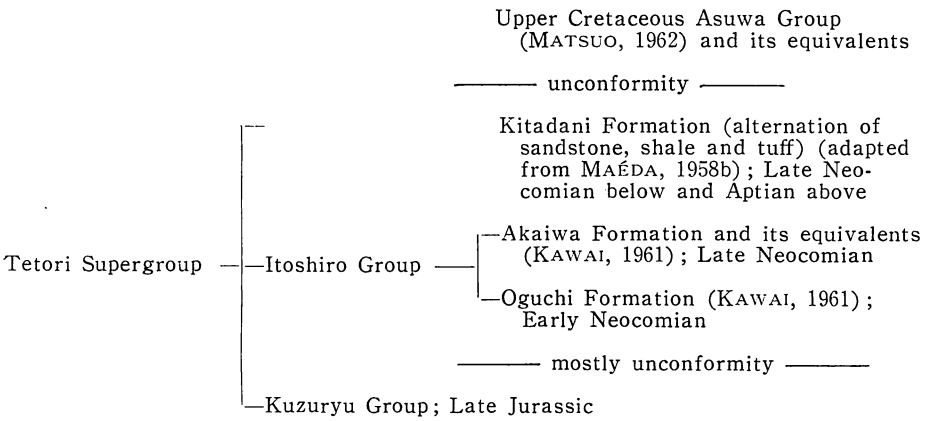
Thus, this paper is the second palaeobotanical study of the Akaiwa Flora, the first being in the paper by KIMURA (1975a).

Material

The plant remains described in this paper have been graphitised or removed from the plant substance and so, while showing their form and venation clearly, they are not suitable for the preparation of spores or cuticles.

The letters, BK and OS used for registered number show the abbreviation of fossil localities, Bettokuzure and Osugidani respectively. Specimens here described are all deposited at the Komatsu City Museum, Komatsu City, Ishikawa Prefecture.

Table 1. Brief stratigraphy and subdivision of the Tetori Supergroup.



Composition of the Akaiwa Flora

Among the collection from Bettokuzure and Osugidani (Irahara), the determined genera and species are shown in Table 2 together with those from the middle member of the Tamodani Formation (after KIMURA, 1975a). Besides the above, MAÉDA, MAÉDA & TAKENAMI and KAWAI listed the following species from various localities of the Akaiwa Formation and its equivalents:

Kumanogawa Formation (alternation of sandstone and shale) along the Jintsu and the Kumanogawa Rivers, Toyama Prefecture (adapted from MAÉDA & TAKENAMI, 1957);

Adiantites sewardi, Onychiopsis elongata, Sphenopteris goepperti, Cladophlebis argutula, C. denticulata, C. distans, C. exiliformis, C. hukuiensis, C. triangularis, C. lobifolia, Nilssonia orientalis, Pterophyllum ? sp., *Ginkgoites digitata, Czekanowskia rigida, Podozamites lanceolatus, P. reinii* and *Taeniopteris* sp.

Nochino Formation (conglomerate and sandstone) along the Uchinami and the Itoshiro Rivers, branches of the Kuzuryu River, Fukui Prefecture (adapted from MAÉDA, 1957);

Onychiopsis elongata, Cladophlebis exiliformis, Podozamites lanceolatus, P. reinii and *Xenoxylon latiporosum.*

Tochio Formation (alternation of sandstone and shale) along the Gamata River, Gifu Prefecture (adapted from MAÉDA, 1958a);

Onychiopsis elongata, Cladophlebis denticulata, C. exiliformis, Podozamites lanceolatus and *Xenoxylon latiporosum.*

Akaiwa Formation around Mt. Hakusan in Fukui, Ishikawa and Gifu Prefectures (KAWAI, 1961);

Marchantites yabei, Equisetites ushimarensis, E. sp., *Coniopteris burejensis, C. hymenophylloides, C.* sp., *Onychiopsis elongata, Adiantites sewardi, Sphenopteris goepperti, S. nitidula*?, *S.* sp., *Cladophlebis argutula*?, *C. denticulata, C. distans, C. exiliformis, C. hukuiensis, C. ishikawaensis, C. lobifolia, C. triangularis, C.* sp., *Nilssonia kotoi, N. nipponensis*?, *N. orientalis, Otozamites klipsteinii, Ginkgodium nathorsti, Czekanowskia rigida, Elatocladus* sp., *Taxodium* sp., *Sequoia*? sp., *Podozamites griesbachi, P. lanceolatus, P. reinii, Taeniopteris richthofeni*?, *T.*? sp. and *Xenoxylon latiporosum.*

Characteristics of the Akaiwa Flora

The following characteristics of the Akaiwa Flora seem noteworthy.

1) The Equisetales are only represented by several tubers and a fragment of stem with a node. These tubers resemble closely in general outline those from the Oguchi Formation, the Nagdong Group of Korea and the Lower Cretaceous of the Siberian Palaeofloristic Area proposed by VAKHRAMEEV (1964, 1966, 1970, 1971).

2) Ferns are fairly numerous and varied, though not so predominant as in the Oguchi Flora. The specimens named *Gleichenites* aff. *porsildi* agree well with those in the Tamodani Flora. *Coniopteris* which is diverse and abundant in the Oguchi Flora is rather rare. Only doubtfully determined sterile leaf and several detached fertile pinnules were obtained. *Birisia onychioides* formerly called *Coniopteris onychioides* agrees with material described from the various localities of the Lower Cretaceous in the Siberian Palaeofloristic Area. *Cladophlebis shinshuensis* originally described by TATEIWA from the Shinshu (Chinju in Korea) Formation, Korea and that followed by KIMURA (1958a) from the uppermost member of the Tamodani Formation is now clearly referable to *Birisia onychioides. Asplenium* sp. may remind us of a certain frond of *Onychiopsis.* Its pinnae, however, are shorter than those of *Onychiopsis* and its elongate-oval segments

Table 2. Composition and localities of the Akaiwa Flora.

Genera & Species \ Localities	BK	OS	T
Equisetites sp. (tubers)			○
E. sp. (stem)	○		
Gleichenites aff. *porsildi*	○	○	
Coniopteris sp. cfr. *C. hymenophylloides*	○		
C. sp. cfr. *C. burejensis*		○	
Birisia onychioides			○
Asplenium cfr. *dicksonianum*		○	
Cladophlebis ex gr. *denticulata*			○
C. distans	○		
C. williamsoni var. *tenuiculis*	○		
C. sp.	○	○	
Sphenopteris goepperti	○		
S. kochibeana	○		
Adiantites sp. B	○		○
A. sp. C		○	
A. sp. D		○	
Raphaelia sp. A	○		
R. sp. B	○		
Onychiopsis elongata	○	○	○
Dictyozamites cfr. *cordatus*	○		
Nilssonia kotoi	○		
N. lobatidentata	○		
N. nipponensis	○		○
N. cfr. *orientalis*			○
Tetoria endoi	○		
Ginkgoites digitata	○		
G. huttoni	○		
G. sibirica	○		
G. sp.			○
Ginkgoidium nathorsti	○		
Pseudotorellia sp.	○		○
Czekanowskia sp.	○		
Leptostrobus sp.	○		
Podozamites angustifolius	○		
P. ex gr. *lanceolatus*	○		
P. reinii	○		○
P. sp.			○
Elatocladus sp. A	○		
E. sp. B	○		
Pityophyllum lindstroemi	○		
Xenoxylon latiporosum	○	○	
Carpolithes sp.	○		
Problematica	○	○	

BK: Bettokuzure; southwestern slope of Mt. Hakusan (2702 m), Shiramine-mura, Ishikawa-gun, Ishikawa Prefecture.
OS: Osugidani; Irahara, Shiramine-mura, Ishikawa-gun, Ishikawa Prefecture.
T: Tamodani; Hambara, Izumi-mura, Ono-gun, Fukui Prefecture.

or pinnules rather resemble the sterile part of such *Asplenium* species as *A. dicksonianum* which is an abundant element of the Early Cretaceous floras in the Siberian Palaeofloristic Area.

3) Unclassified ferns are represented by such form-genera as *Cladophlebis*, *Sphenopteris*, *Adiantites*, *Raphaelia* and *Onychiopsis*. *Cladophlebis* is rather rare and is represented by *C. denticulata*-type frond having large pinnules and another type fronds having small and finely lobed pinnules which remind us of sterile frond of *Klukia* or *Alsophilites*.

A single incomplete pinna fragment regarded as *Sphenopteris goepperti* is indistinguishable from the specimens hitherto described under this comprehensive name. Though obscurely preserved, three distinct types of *Adiantites* are recognizable. *Raphaelia* has two species, and it is the first record from Japan. The distinct basal constriction of *Raphaelia* pinnules remind us of that seen in some *Osmunda* pinnules. *Raphaelia* is one of the common elements in the Late Jurassic floras in the Siberian Palaeofloristic Area.

4) Cycadophytes are much poorer than those in the Oguchi Flora and are represented by *Dictyozamites*, *Nilssonia* and *Tetoria*. *Dictyozamites* which is diverse and abundant in the Oguchi Flora, is only represented by a single incomplete pinna. Several detached leaves of *Nilssonia nipponensis* were obtained, but the general outline of these leaves is slightly different from that of leaves of this species from the Oguchi Formation. The occurrence of *Nilssonia lobatidentata* is worth mentioning because such species with dentate distal margin as this species, *Nilssonia orskica* GENKINA, *N. prinadae* VACHRAMEEV, *N. magnifolia* SAMYLINA and *N. denticulata* THOMAS are mainly known in the floras in the Siberian Palaeofloristic Area. The present specimens agree well with the original specimens of *N. lobatidentata* described by VASSILEVSKAJA (1972). *Tetoria endoi* is represented by an incomplete ultimate pinna fragment.

5) In marked contrast to the meagreness in cycadophytes, ginkgoaleans, particularly *Ginkgoidium nathorsti*, are diverse and abundant. Had cuticular analyses succeeded in these leaves, the number of species of ginkgoaleans in the Akaiwa Flora would have increased.

6) *Czekanowskia* is rather rare. Only a few leaf-fragments were obtained. Some detached *Leptostrobus* capsules were found in association with ill-preserved cone axes and doubtful scale leaves which seem to be basal scales of the cone.

7) *Podozamites* leaves are also very abundant and diverse. *Podozamites angustifolius*, *P.* ex gr. *lanceolatus* and *P. reinii* were recognized. Both *Podozamites angustifolius* and *P. reinii* are usually encountered in the Oguchi and the Nagdong Floras, and those in the Siberian Palaeofloristic Area. It is worth mentioning that ginkgoaleans and *Podozamites* leaves are very rare in the "Ryoseki Flora" located in the Outer Zone Palaeofloristic Province of Japan (KIMURA, 1961, 1975a, b; KIMURA & HIRATA, 1975).

8) Conifers apart from *Podozamites* are very rare. We have only two types of coniferous shoots which we place Form-genus *Elatocladus* (emended by HARRIS) and some needle-like leaves we provisionally determine as *Pityophyllum*.

9) Picnoxylic wood determined as *Xenoxylon latiporosum* is fairly abundant.

10) No dicotyledons have not yet been recognized, but *Sabal*-like blades with thick axis occur abundantly at Irahara, the Osugidani. Full analysis and discussion of the *Sabal*-like leaves will be made after a more complete study of our

material.

Geological age of the Akaiwa Flora

Among strata constituting the Tetori Supergroup, both the lowest Kuzuryu Group and the uppermost Kitadani Formation might be able to date by their marine and brackish shells. The Kuzuryu Group is now said to be Callovian-Kimmeridgian in age by its ammonites, trigonians, etc., and the lower part of the Kitadani Formation to be Late Neocomian in age by its shells such as *Nakamuranaia*, "*Schistodesmus*", *Plicatounio*, *Trigonioides*, etc.

Unfortunately no useful time indicator has been found from the Oguchi and the Akaiwa Formation. We, however, now regard the Oguchi Formation as Early Neocomian in age and the Akaiwa Formation as Late Neocomian, because the Oguchi Formation overlies the Upper Jurassic Kuzuryu Group with notable unconformity in the Kuzuryu River area and the Akaiwa Formation is conformably covered with the Kitadani Formation at the Omichidani valley, a branch of the Tetori River and in the Takinami River area. Accordingly the geological age of the Akaiwa Formation is naturally considered to be Late Neocomian.

Comparison of floras

The Akaiwa Flora is distinguishable from the Oguchi Flora below by its less abundant ferns and its poor representation of cycadophytes, and from the Tamodani Flora above by its composition. All the floras of the Tetori Supergroup, however, show resemblance to one another. All have Dicksoniaceous ferns, *Cladophlebis* with large pinnules and common ginkgoalean and *Podozamites* leaves. KIMURA (1961, 1975a, b) based his idea of the Inner Zone Palaeofloristic Province of Japan on these resemblance.

These floras are quite different in composition from the "Ryoseki Flora" located along the Outer Zone of Japan. It was the reason that KIMURA has established the Outer Zone Palaeofloristic Province of Japan. The floral transitional history in the Tetori Supergroup will be discussed in the monograph of the Oguchi Flora by us.

1) Comparison with the contemporaneous Lower Monobegawa Flora (in Outer Zone) in Kochi Prefecture, Southwest Japan.

The Lower Cretaceous System in the Outer Zone of Japan is now divided into three series, namely, the Lower Neocomian Ryoseki, the Upper Neocomian Arita and the Aptian-Albian Miyako Series. The Arita and the Miyako Series are called the Lower Monobegawa and the Upper Monobegawa Formations respectively in the Outer Zone of Southwest Japan.

The "Ryoseki Flora" was studied by NATHORST (1890), YOKOYAMA (1894), YABE (1922, 1927a, b), HUZIOKA (1939) and OISHI (1939a, b, 1940), but unfortunately exact stratigraphical distribution of the fossil plants was not clear.

Recently, working for forty years, M. HIRATA (1972) showed his valuable result regarding the stratigraphical distribution of fossil plants in Kochi Prefecture. According to HIRATA, the fossil plants from the Lower Monobegawa Formation are as follows:

Marchantites yabei KRYSHTOFOVICH, *Nathorstia oishii* HUZIOKA, *Klukia koraiensis* (YABE) OISHI, *K. yokoyamae* OISHI, *Naktongia yabei* OISHI, *Gleichenites nipponensis* OISHI, *Weichselia reticulata* (STOKES & WEBB) WARD, *Sphenopteris goepperti* DUNKER, *S.*

spp., *Adiantites sewardi* YABE, *A. yuasensis* YOKOYAMA, *Onychiopsis elongata* (GEYLER) YOKOYAMA, *O.* sp., *Cladophlebis acutipennis* OISHI, *C. argutula* (HEER) FONTAINE, *C. denticulata* (BRONGNIART) NATHORST, *C. distans* (HEER) em. YABE, *C. exiliformis* (GEYLER) em. OISHI, *C. falcata* OISHI. *C. hukuiensis* OISHI, *C. parvula* OISHI, *C. takezakii* OISHI, *C. undulata* OISHI, *C.* spp., *Pachypteris* sp., *Otozamites klipsteinii* (DUNKER) SEWARD, *O.* spp., *Ptilophyllum pecten* (PHILLIPS) MORRIS, *Wielandiella* sp., *Zamiophyllum buchianum* (ETTINGSHAUSEN) NATHORST, *Z.* sp., *Nilssonia orientalis* HEER, *N. schaumburgensis* (DUNKER) NATHORST, *N. tenuicaulis* (PHILLIPS) FOX-STRANGWAYS, *N. yabei* TATEIWA, *N.* spp., *Taeniopteris* spp., *Podozamites lanceolatus* (LINDLEY & HUTTON) BRAUN, *Frenelopsis hoheneggeri* (ETTINGSHAUSEN) SCHENK, *Brachyphyllum expansum* (STERNBERG) SEWARD, *B. japonicum* (YOKOYAMA) OISHI, *B.* sp., *Elatocladus obtusifolia* OISHI, *Sphenolepidium* sp.

Critical palaeobotanical studies are needed on these fossil plants, but some palaeobotanical informations have been given by HUZIOKA (1973). However, as is seen in the above list, the distinction in composition between the Akaiwa Flora and the contemporaneous Lower Monobegawa Flora is notable. Common species between them are merely five, namely, *Sphenopteris goepperti, Onychiopsis elongata, Cladophlebis denticulata, Nilssonia orientalis* and *Podozamites lanceolatus.*

Moreover, according to KIMURA's critical observation of HIRATA's collection deposited in the Division of Fossil Exhibition, MAKINO Botanical Garden of Kochi City, the specimens regarded as *Nilssonia orientalis* by HIRATA are somewhat different from *N.* cfr. *orientalis* in the Akaiwa Flora. HIRATA's *Cladophlebis denticluata* is extremely small-sized. At any rate, *Sphenopteris goepperti, Cladophlebis denticulata* and *Podozamites lanceolatus* are comprehensively identified species, and are, as are generally known, inappropriate to make them the materials for floral comparison.

The Lower Monobegawa Flora is characterized by the occurrence of Marattiaceous and Matoniaceous ferns and by the predominance of *Cladophlebis* with small or finely lobed pinnules, *Zamiophyllum* blades and *Cupressus*-like sterile shoots are regarded as *Brachyphyllum* (KIMURA & HIRATA, 1975).

No Dicksoniaceous fern has been recorded. Ginkgoalean and *Podozamites* leaves are quite rare. It is worth mentioning that the first occurrence of *Weichselia* in Japan is recorded by HUZIOKA (1973). *Weichselia* is one of the well-known elements in the Early Cretaceous floras in many parts of the world. The Lower Monobegawa Flora is similar in composition to the Early Cretaceous floras in the Indo-European Palaeofloristic Area (VAKHRAMEEV, 1964, 1966, 1970, 1971) in Late Jurassic to Early Cretaceous in age.

2) Comparison with an Early Cretaceous flora in the Siberian Palaeofloristic Area.

Recently the palaeobotanical studies in Siberia have promptly developed and many comparable floras with the Akaiwa Flora have been described. For example, Early Cretaceous flora described by ABRAMOVA (1970) from the middle course of the Lena River area, near Zhigansk, is referred to comparison. The composition of this flora is as follows:

Equisetites cfr. *rugosus* SAMYLINA, *Coniopteris onychioides* VASSILEVSKAJA & KARA-MURSA, *Cladophlebis argutula* (HEER) FONTAINE, *C. bulunkanensis* ABRAMOVA, *C. lenaensis* VACHRAMEEV, *Scleropteris ermolaevii* VASSILEVSKAJA, *Scleropteris tyrmensis* SEWARD, *Neozamites verchojanensis* VACHRAMEEV, *N.*? sp., *Anomozamites arcticus* VASSILEVSKAJA, *Aldania umanskii* VACHRAMEEV & LEBEDEV, *A.*? sp., *Nilssonia lobatidentata*

VASSILEVSKAJA, *N. orientalis* HEER, *Taeniopteris* sp., *Ginkgo* ex gr. *adiantoides* (UNGER) HEER, *G. paradiantoides* SAMYLINA, *G. parahuttoni* ABRAMOVA, *Sphenobaiera pseudolongifolia* ABRAMOVA, *S.* sp., *Pseudotorellia nordenskioldi* (NATHORST) FLORIN, *Phoenicopsis* cfr. *mirabilis* (FLORIN) SAMYLINA, *Stenorachis memkerensis* ABRAMOVA.

This flora is very similar in general feature to the Akaiwa and the Oguchi Floras except for *Aldania* showing unusual venation, though common species between them are three, namely *Coniopteris onychioides* (=*Birisia onychioides*), *Nilssonia lobatidentata* and *N. orientalis*. *Cladophlebis* fronds have usually large-sized pinnules. *Cladophlebis argutula*, *C. lenaensis*-type and *Scleropteris*-type fronds are also known in the Oguchi Flora. Recently we found *Neozamites* in the Oguchi Flora (KIMURA & SEKIDO, 1971). *Ginkgo* leaves are extremely similar to those in the Akaiwa and the Oguchi Floras in external features.

According to VAKHRAMEEV (1971), typical genera and species in the Neocomian floras in the Siberian Palaeofloristic Area are as follnws:

**Cladophlebis argutula* (HEER), **C. lenaensis* VACHRAMEEV, **C. pseudolobifolia* VACHRAMEEV, *C. sangarensis* VACHRAMEEV, **Coniopteris burejensis* (ZALESSKY) SEWARD, **C. nympharum* (HEER) VACHRAMEEV, **C. onychioides* VASSILEVSKAJA & KARA-MURSA, *C. setacea*, (PRYNADA) VACHRAMEEV, *C. saportana* (HEER) VACHRAMEEV, **Jacutopteris lenaensis* VASSILEVSKAJA, **Gleichenia lobata* VACHRAMEEV, *Gonatosorus ketovae* VACHRAMEEV, *Aldania auriculata* SAMYLINA, *A. umanskii* VACHRAMEEV & LEBEDEV, *A. vachrameevi* SAMYLINA, *Anomozamites angulatus* HEER, **Ctenis burejensis* PRYNADA, *C. nana* SAMYLINA, *C. tygyensis* VASSILEVSKAJA, *Heilungia amurensis* (NOVOPOKROVSKY) PRYNADA, *H. sangarensis* VASSILEVSKAJA, *Jacutiella amurensis* (NOVOPOKROVSKY) **Neozamites verchojanensis* VACHRAMEEV, **Nilssonia lobatidentata* VASSILEVSKAJA, *Pterophyllum acuta* (VASSILEVSKAJA) VACHRAMEEV, *P. 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.

Each species in the above list with asterisk (or an allied form) occurs in the floras of the Tetori Supergroup. Thus it is clear that the Akaiwa Flora together with other floras of the Tetori Supergroup is close to the Early Cretaceous floras in the Siberian Palaeofloristic Area, though such cycadophytes as *Aldania*, *Heilungia* and *Jacutiella* have not yet been recognized in the floras of the Tetori Supergroup.

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Systematic description

We here describe whole our specimens obtained from the Akaiwa Formation and its equivalents, but among them those from the middle member of the Tamodani Formation are briefly noted. For further details, see KIMURA, 1975a.

In describing the species our descriptive notes and figures refer solely to our material from the Akaiwa Formation. Only in later discussion do we refer to specimens from other formations.

Equisetales

Genus *Equisetites* STERNBERG, 1833 : 43

Equisetites sp. (stem)

Pl. 39, fig. 7

Pl. 39, fig. 7 shows a piece of stem with one node. Stem impression 13 mm wide, showing longitudinal ridges, node slightly wider (no other significant details visible).

Locality: Bettokuzure.

Occurrence: One specimen only.

Specimen: BK-135.

Equisetites sp. (tubers)

1975a. *Equisetites* sp.: KIMURA, p. 68, pl. 5, fig. 1.

It is noteworthy that no upright aerial stems have yet been found with these tubers.

Locality: Tamodani, Horizon-TC.

Occurrence: Common.

Filicales

Family Gleicheniaceae

Genus *Gleichenites* GOEPPERT, 1836: 172

Gleichenites aff. *porsildi* SEWARD

Pl. 36, fig. 2; Text-fig. 2

1975a. *Gleichenites* aff. *porsildi* SEWARD: KIMURA, p. 70, pl. 7, figs. 1, 2, 3, 5; pl. 8, fig. 2; figs. 4-4a, b.

The present specimens agree well with those described by KIMURA as *Gleichenites* aff. *porsildi* from the uppermost member of the Tamodani Formation (Horizon-TG and TH).

Localities: Bettokuzure & Osugidani.

Occurrence: Common.

Specimens: BK-148, OS-002, OS-006, OS-031.

Family Dicksoniaceae

Genus *Coniopteris* BRONGNIART, 1849: 26

Coniopteris sp. cfr. *C. hymenophylloides* (BRONGNIART) SEWARD

Pl. 36, fig. 3A, B; Text-fig. 1

Description: A sterile leaf with four penultimate pinnae is shown in Pl. 36, fig. 3A, B and Text-fig. 1. Ultimate pinnae on the right penultimate pinna in Pl. 36, fig. 3A are fairly large in size; ultimate pinnae set closely, overlapping each other laterally, linear, elongate-lanceolate in outline, 4-5 cm long and 1-1.5 cm wide at basal portion, attached to the slender penultimate pinna axis at an angle of 50 degrees; pinnules set closely, attached to the very delicate ultimate pinna axis at a wide angle below and at an acute angle above; posterior pinnules, 1-1.2 cm long and 4 mm wide, of which lamina divided into 9-11 deep lobes with rounded or obtusely pointed apex; lobes directed forward; on the middle portion of ultimate pinna, the number of lobes of pinnule decreased and the basiscopic laminae are markedly

reduced; apical pinnules rhomboidal in form, small, with obtusely or subacutely pointed apex. Venation of *Sphenopteris*-type; midnerve distinct, persisting to the tip of each pinnule,decurrent at base, giving off indistinct secondaries at an acute angle; posterior secondaries once forking and anterior ones simple; each lobe receiving one secondary nerve. In penultimate pinna, basal basiscopic pinnules all missing, upper pinnules probably anadromic order. Basal acroscopic pinnules not specialized. Ultimate pinnae on left penultimate pinna long and narrow, with small, rhomboidal and entire pinnules.

Pl. 36, fig. 3B is associated with the specimen in fig. 3A. Ultimate pinnae short-lanceolate in outline and with acuminate apex. Pinnules rhomboidal or elongate-oval in outline with rounded or obtusely pointed at apex; laminae of posterior ones shallowly lobed. The basal basiscopic ones not specialized.

Remarks: In general outline of pinnules, the present specimen resembles some sterile leaves hitherto described under the name of *Coniopteris hymenophylloides* and *C. burejensis*. No fertile leaf has been found. According to HARRIS (1961, p. 147) in a typical size leaf of *Coniopteris burejensis*, sterile pinnules are rhomboidal, about 7 mm long and 2.5 mm wide, with acutely pointed apices pointing forward; the margins more or less indented to form lobes with sharp apices.

The present pinnules, however, are mostly with rounded or obtusely pointed apices instead of acutely pointed ones.

LEBEDEV (1965) illustrated in detail several sterile leaves of *Coniopteris burejensis* derived from the Upper Jurassic of Zeia River area. The deeply divided lobes with rounded or obtusely pointed apices, as usually seen in the posterior pinnules of the present specimen, are not illustrated in his figure.

Yet, the present specimen is not fully identifiable with *Coniopteris hymenophylloides*, because the basal basiscopic pinnules which might hold the key to the attribution of this specimen, are all missing.

Under such circumstances, we here regard the present specimen as *Coniopteris* sp. cfr. *C. hymenophylloides*.

Locality: Bettokuzure.
Occurrence: One specimen only.
Specimen: BK-156.

Coniopteris sp. cfr. *C. burejensis* (ZALESSKY) SEWARD

Text-fig. 10

Several detached fertile and sterile pinnules were preserved. Text-fig. 10 shows one sterile and three fertile pinnules which strongly remind us of these of *Coniopteris burejensis*.

Locality: Osugidani.
Occurrence: One slab only.
Specimen: OS-108.

Genus *Birisia* SAMYLINA, 1972: 95

Birisia onychioides (VASSILEVSKAJA & KARA-MURSA) SAMYLINA

1975a. *Birisia onychioides* (VASSILEVSKAJA & KARA-MURSA) SAMYLINA: KIMURA, p. 71, pl. 5, figs. 6-9; pl. 6, figs. 1-4; figs. 4-2a-d.

For further references, see KIMURA, 1975a.

Locality: Tamodani, Horizon-TD.
Occurrence: Abundant.

Family Aspleniaceae

Genus *Asplenium* LINDÉ, 1753

Text-figs. 1-7.

1. *Coniopteris* sp. cfr. *C. hymenophylloides*, drawn from Pl. 36, fig. 3A. 2. *Gleichenites* aff. *porsildi*, from Pl. 36, fig. 2. 3. *Sphenopteris goepperti*, from Pl. 37, fig. 4. 4. *Onychiopsis elongata*, from Pl. 36, fig. 1. 5. *Cladophlebis williamsoni* var. *tenuicaulis*, from Pl. 36, fig. 5 and Pl. 38, fig. 6. 6. *Cladophlebis distans* (BK5-003). 7. *Sphenopteris kochibeana* (BK5-022).

Asplenium cfr. *dicksonianum* HEER

Text-fig. 11

Text-fig. 11 shows a part of a penultimate (?) pinna. Ultimate pinnae (or pinnules) set remotely, linear, elongate-lanceolate in outline, 3 cm long and 0.5 cm wide at middle, attached alternately or subopposite to the slender axis at an angle of 60 degrees. Pinnules (or lobes), set very closely, 5-6 in number on each side of delicate axis, linear, elongate-lanceolate in outline, entire with acutely pointed apex and strongly directed forward. Venation not visible.

Two incomplete sterile pinna fragments were obtained. In general appearance, the present specimens resemble some pinnae with entire pinnules (or lobes) originally described by HEER (1874) from

the Lower Cretaceous of Greenland under the name of *Asplenium dicksonianum* (p. 31, pl. 1, figs. 1-5) and later by VASSILEVSKAJA & PAVLOV (1963) from the Lower Cretaceous of Lena Basin (pl. 33, figs. 1-3).

Full description and discussion of the Osugidani material must await the discovery of better specimens.

Locality: Osugidani.
Occurrence: Rare.
Specimens: OS-102, OS-111.

Unclassified ferns

Form-genus *Cladophlebis* BRONGNIART, 1849: 105

Cladophlebis distans (HEER) YABE (non FONTAINE)

Text-fig. 6

1877. *Asplenium* (*Diplazium*) *distans* HEER: p. 97, pl. 19, figs. 5-6, ?7 (Jurasso-Cretaceous of Amurland).
1889. *Asplenium distans* HEER: YOKOYAMA, p. 32, pl. 3, fig. 2; pl. 11, fig. 4; pl. 14, fig. 1 (Kuwashima, Hakogase and Ushimaru, Oguchi Formation and its equivalents).
1922. *Cladophlebis distans* (HEER) YABE: p. 13, pl. 1, fig. 6; pl. 2, fig. 3; text-fig. 9 (Shurihama, Upper Jurassic Moné Formation; Nochino, an equivalent of Oguchi Formation).
1940. *Cladophlebis distans* (HEER) YABE: OISHI, p. 258, pl. 11, figs. 2, 3, 3a (Kuwashima, Oguchi Formation).
1958b. *Cladophlebis distans* (HEER) YABE: KIMURA, p. 19, pl. 3, figs. 3, 6; pl. 4, figs. 1, 2; text-fig. 3 (Wakogo, Kuzuryu Group).

Remarks: The present specimens, though incomplete fragments of pinnae with large-sized pinnules, agree well with the emended diagnosis of this species given by YABE (1922, p. 14), and are indistinguishable from those illustrated by the previous authors.

Cladophlebis distans instituted by FONTAINE (1889, p. 77) is a homonym of the present species.

Locality: Bettokuzure.
Occurence: Common.
Specimens: BK5-003, BK5-030, BK5-036, BK5-050, BK5-057.

Cladophlebis williamsoni (BRONGNIART) BRONGNIART var. *tenuicaulis* THOMAS

Pl. 36, figs. 5, 6; Pl. 38, fig. 6; Text-fig. 5

1911. *Cladophlebis* (*Todites*) *williamsoni* (BRONGNIART) var. *tenuicaulis* THOMAS: p. 69, pl. 3, figs. 11, 12a (Jurassic of Kamenka).
1926. *Cladophlebis williamsoni* BRONGNIART cfr. var. *tenuicaulis* THOMAS: KAWASAKI, p. 26, pl. 7, fig. 21 (Nampo, Rhaeto-Liassic Daedong Group, Korea).

Description: Frond probably bipinnate; size unknown. Pinnae long and narrow, linear, set closely, often overlapping each other laterally, narrowing gradually towards the acuminate apex, 1-2 cm wide at middle. Pinnules vary considerably in size and form with their position on the frond, set closely, acutely or subacutely pointed at apex; laminae expanded and continuous at their bases. Midnerve distinct, persisting to the tip, fairly decurrent at base, secondaries once or twice forked.

Pl. 38, fig. 6 (BK-123) shows a typical form of pinna; posterior pinnules elongate-triangular in form, slightly falcate, attached to the pinna axis at an angle of 50 degrees; anterior ones deltoid in shape, directed forward. Pl. 36, fig. 5 (BK-072) shows a pinna apex. Pl. 36, fig. 6 (BK-140) shows a fragment of large-sized pinna probably near the base of

the frond; pinnules are large-sized, attached to the pinna axis at an angle of 50 degrees; secondaries forking twice. Text-fig. 5 shows a pinna reconstructed from the specimens shown in Pl. 36, fig. 5 and Pl. 38, fig. 6.

Remarks: Many specimens were obtained, though they are all incomplete fragments of pinnae. It is difficult to identify such sterile *Cladophlebis* leaves as mentioned above depending only on their external features, because there are many similar *Cladophlebis* forms hitherto known.

The present specimens, however, are very like *Cladophlebis williamsoni* (BRONGNIART) var. *tenuicaulis* originally described by THOMAS from the Jurassic of Kamenka and later by KAWASAKI as cfr. var. *tenuicaulis* from the Rhaeto-Liassic of Korea.

The present specimens are also like those regarded as *Cladophlebis williamsoni* (BRONGNIART) by VAKHRAMEEV (1958), VAKHRAMEEV & DOLUDENKO (1961) and VASSILEVSKAJA & PAVLOV (1963) from the Jurasso-Cretaceous of Siberia.

Some specimens regarded as *Cladophlebis denticulata* (BRONGNIART) resemble the present ones, but in the former secondary nerves are usually forking once. *Cladophlebis fastuosa* originally described by KIMURA (1959a) from the Liassic of Iwamuro, Gumma Prefecture, Japan, is another allied form, but in the former pinnules the secondary nerves are forking once, too.

Locality: Bettokuzure.

Occurrence: Common.

Specimens: BK-006, BK-014, BK-041, BK-059, BK-070, BK-072, BK-086, BK-123, BK-125, BK-131, BK-140, BK-144, BK-152, BK-169.

Cladophlebis ex gr. *denticulata* (BRONGNIART) FONTAINE

1975a. *Cladophlebis* ex gr. *denticulata* (BRONGNIART) FONTAINE: KIMURA, p. 78, pl. 5, fig. 11; pl. 6, fig. 5; figs. 4-5a, b.

Locality: Tamodani, Horizon-TD.

Occurrence: Not rare.

Cladophlebis sp.

Text-fig. 15

An incomplete frond with small-sized pinnules of *Pecopteris*-type was obtained. Venation not visible. In general appearance, it resembles *Cladophlebis exiliformis* (GEYLER) OISHI taken in broad sense.

Locality: Bettokuzure.

Occurrence: One specimen only.

Specimen: BK-148.

Form-genus *Sphenopteris* (BRONGNIART) STERNBERG, 1825: 15

Sphenopteris goepperti DUNKER

Pl. 37, fig. 4; Text-fig. 3

Japanese specimens only:

1889. *Thrsopteris kegensis* YOKOYAMA: p. 23, pl. 1, figs. 6, 6a; pl. 11, fig. 7 (Kuwashima & Ushimaru, Oguchi Formation).

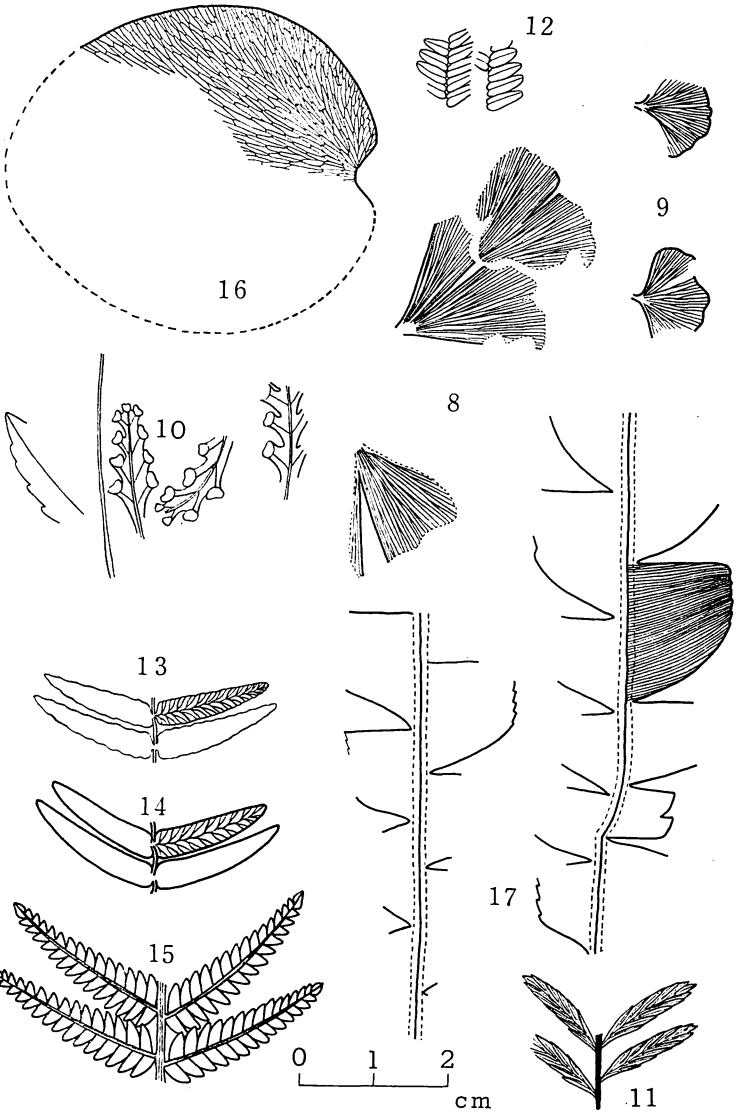
1889. *Sphenopteris* sp. YOKOYAMA: p. 34, pl. 14, figs. 13, 13a (Hakogase, Oguchi Formation).

1890. *Sphenopteris* cfr. *goepperti* DUNKER NATHORST, p. 11, pl. 6, figs. 2, 3 (Ryoseki, Ryoseki Formation).

1894. *Sphenopteris tenuicula* YOKOYAMA: p. 217, pl. 20, fig. 11 (Kagahara, Upper Monobegawa Formation); p. 21, figs. 2, 2a, 3 (Yuasa, Ryoseki Formation); pl. 28, fig. 6 (Kaisekiyama, Ryoseki Formation); pl. 28, fig. 6 (Kaisekiyama, Ryoseki Formation).

1922. *Sphenopteris* (*Ruffordia*) *goepperti* DUNKER: YABE, p. 4, pl. 3, fig. 5 (Kuwashima, Oguchi Formation).

1927a. *Sphenopteris göpperti* DUNKER: YABE,



Text-figs. 8-17.

8. *Adiantites* sp. D, drawn from Pl. 36, fig. 4; 9. *Adiantites* sp. C (OS-031); 10. *Coniopteris* sp. cfr. *C. burejensis* (OS-108); 11. *Asplenium* cfr. *dicksonianum* (OS-102); 12. *Raphaelia* sp. B (BK-151); 13 & 14. *Raphaelia* sp. A, from Pl. 38, fig. 2; 15. *Cladophlebis* sp. (BK-148); 16. *Dictyozamites* cfr. *cordatus*, from Pl. 37, fig. 1; 17; *Nilssonia nipponensis*, from Pl. 37, fig. 2.

p. 41 (Tannohama & Mizutani, Ryoseki Formation).

1931. *Sphenopteris goepperti* DUNKER: OISHI, p. 6, pl. 1, figs. 11, 12 (Takada, Ryoseki Formation).

1940. *Sphenopteris (Ruffordia) goepperti* DUNKER: OISHI, p. 238, pl. 8, fig. 4 (Takaji, Ryoseki Formation).

1958b. *Sphenopteris (Ruffordia) goepperti* DUNKER: KIMURA, p. 17 (Mochiana, Kuzuryu Group).

Remarks: Two incomplete sterile pinnae only were found. Their venation is not visible but they agree in general appearance with the specimens cited above. *Sphenopteris goepperti* is very common in Japan in the Late Jurassic and Early Cretaceous in age.

OISHI (1940, p. 238) included *Acrostichopteris longipennis* recorded by NAGAO (1926, p. 380) and *A.* cfr. *longipennis* by YABE (1927a, p. 41) from the Arita Formation, an equivalent of the Lower Monobegawa Formation in *Sphenopteris goepperti*. But we distinguish them as a result of unpublished work (KIMURA & KANSHA, MS).

Locality: Bettokuzure.

Occurrence: Rare.

Specimens: BK-010, BK-113.

Sphenopteris kochibeana (YOKOYAMA) OISHI

Text-fig. 7

1975a. *Sphenopteris kochibeana* (YOKOYAMA) OISHI: KIMURA, p. 79, pl. 5, fig. 10; figs. 4-7a, b (uppermost member of the Tamodani Formation).

Remarks: As was stated by OISHI (1940, p. 242), this species should be placed in the Form-genus *Sphenopteris* rather than *Adiantites* as the habit of the frond, especially the shape of pinnules and nervation are *Sphenopteris*-like.

Locality: Bettokuzure.

Occurrence: Rare.

Specimens: BK5-022, BK5-034.

Form-genus *Adiantites* GOEPPERT, 1836: 173

Adiantites sp. B

1975a. *Adiantites* sp. B. KIMURA: p. 76, pl. 7, figs. 6, 7.

A single incomplete pinnule, though its apical part missing, agrees in general outline and venation with those described by KIMURA as *Adiantites* sp. B from the middle member (Horizons-TC & TD) of the Tamodani Formation.

Localities: Tamodani, Horizons- TC & TD; Bettokuzure.

Occurrence: Rare, one specimen only from Bettokuzure.

Specimen: BK-047.

Adiantites sp. C

Text-fig. 9

Text-fig. 9 shows an incomplete slender pinnate frond, the rachis is buried in the matrix. Pinnules small, possibly short stalked, semi-orbicular in form, and with undulate or irregularly and shallowly lobed distal margin; nerves numerous, divergent and repeatedly forking dichotomously. Fructification not known.

The present pinnules, which show their veins faintly, remind us of those of *Adiantites toyoraensis* originally named by OISHI (1931) and described in 1940 from the Kiyosué Formation, Yamaguchi Prefecture, but their venation is somewhat different.

Locality: Osugidani.

Occurrence One slab only.

Specimen: OS-031.

Adiantites sp. D

Pl. 36, fig. 4; Text-fig. 8

Pl. 36, fig. 4 shows an incomplete slender pinnate frond, its rachis is buried in the matrix. Pinnules small, cuneate and short stalked; lamina divided into two segments by a deep median sinus; apex of each segment finely dentate. Nerves numerous, fine and dichotomously forking at all levels.

The present pinnules are different in form from those of *Adiantites* sp. C in which they are semi-orbicular in form and their laminae are not divided into two segments by a deep median sinus.

Locality: Osugidani.

Occurrence: One specimen only.

Specimen: OS-095.

Form-genus *Raphaelia* DEBEY & ETTINGSHAUSEN, 1859: 40

This form-genus is characterised by entire or lobed pinnules attached to the pinna axis by a constricted base. We here describe two types of pinnules under this generic name. Some living species of *Osmunda* have very similar pinnules.

Raphaelia sp. A

Pl. 38, fig. 2; Text-figs. 13, 14

Description: Pinnules set closely at a wide angle to slender pinna rachis, subopposite. Pinnules slightly falcate, typically 1.5-1.7 cm long, narrowing gradually to an acute apex, base strongly constricted, distal pinnules shorter and triangular. Upper surface of pinnules convex, and margins often reflexed. Midrib distinct, slightly sinuous, secondaries at an angle of about 60 degrees, mostly forked once in the middle region.

Several pinna fragments were obtained. Pl. 38, fig. 2 (BK-163) shows one of the pinna fragments obtained and Text-fig. 13 and 14 show the outline of pinnules and detailed venation.

Remarks: The present fragments agree with the genus *Raphaelia* in their pinnules which have a characteristically constricted base and similar venation. Species with pinnules of this form range from the Upper Triassic of Northern and Central Americas into Cretaceous.

They are particularly common in the Upper Jurassic of Siberia.

Raphaelia stricta VACHRAMEEV (VAKHRAMEEV & DALUDENKO, 1961, p. 77, pl. 24, fig. 3; pl. 29) from the Bureja Basin is similar but has narrower pinnules.

These specimens are the first record of *Raphaelia* in Japan.

Locality: Bettokuzure.

Occurrence: Not rare.

Specimens: BK-163 (collected by E. FUJII), BK-164, BK-121.

Raphaelia sp. B

Text-fig. 12

Ultimate pinnae set closely, nearly parallel-sided, about 1 cm wide, unknown length, attached to the axis at a wide angle. Pinnules set closely, small-sized, rectangular in form, 6 mm long and 2 mm wide, constricted at base, obtusely or rounded at apex, attached to the axis at a wide angle; both basal margins expanded. Midnerve distinct (but the secondaries invisible). Upper surface of pinnules mostly convex and both lateral margins are slightly reflexed.

Two ill-preserved pinna fragments were obtained. Text-fig. 12 shows an outline of pinnules.

The attribution of the present speci-

mens, two ill-preserved pinna fragments, to *Raphaelia* is based on their markedly constricted bases of their pinnules. The present pinnules are different in form and size from those of *Raphaelia* sp. A shown above.

Locality: Bettokuzure.

Occurrence: Rare.

Specimens: BK-151, BK-128.

Form-genus *Onychiopsis* YOKOYAMA, 1889: 26

Onychiopsis elongata (GEYLER) YOKOYAMA

Pl. 36, fig. 1; Text-fig. 4

1877. *Thyrsopteris elongata* GEYLER: p. 224, pl. 30, fig. 5; pl. 31, figs. 4-5 (Kuwashima, Oguchi Formation).
For further references, see KIMURA, 1975a.

Many sterile pinna fragments referable to this well-known species were obtained, one of which was shown in Pl. 36, fig. 1 (BK-103). Text-fig. 4 shows an outline of pinnules and venation drawn from BK-103.

Localities: Tamodani (Horizons-TC, TD); Bettokuzure; Osugidani.

Occurrence: Common.

Specimens: BK-030, BK-103, BK-138, OS-022, OS-009, OS-041, OS-052, OS-093, OS-103, OS-107.

Bennettitales

Genus *Dictyozamites* OLDHAM & MORRIS, 1863: 37

We illustrated in our previous paper the typical pinna forms of 25 *Dictyozamites* species known at that time. It is worth mentioning that *Dictyozamites* is quite rare in the Akaiwa Formation and represented only by *Dictyozamites* cfr. *cordatus* in contrast with the abundant occurrence of various *Dictyozamites* species from the underlying Oguchi Formation.

Dictyozamites cfr. *cordatus* (KRYSHTOFOVICH) PRYNADA

Pl. 37, fig. 1; Text-fig. 16

Compare:

1929. *Proteaephyllum cordatum* KRYSHTOFOVICH: p. 125, pl. 59, fig. 5.
1932. *Proteaephyllum cordatum* KRYSHTOFOVICH: KRYSHTOFOVICH & PRYNADA, p. 373.
1933. *Proteaephyllum cordatum* KRYSHTOFOVICH: pl. 3, fig. 1.
1963. *Dictyozamites cordatus* (KRYSHTOFOVICH) PRYNADA: p. 109, pl. 3, fig. 2.
1967. *Dictyozamites cordatus* (KRYSHTOFOVICH) PRYNADA: KRASSILOV, p. 155, pl. 42, fig. 1; pl. 43, fig. 1.
1970. *Dictyozamites cordatus* (KRYSHTOFOVICH) PRYNADA: VAKHRAMEEV, p. 121, Text-figs. 1, 2.

Description: Pinna nearly circular in outline, 4.5 cm long and 4 cm wide at middle, attached to the rachis by a very narrow area at the centre of its cordate base; both basal angles rounded; upper surface of lamina convex; lamina filled with fine meshes as partly shown in Text-fig. 16.

A single pinna fragment was obtained and all that we could make out of its margin and venation is shown in Text-fig. 16.

Remarks: In its pinna outline and evenly distributed fine meshes on its lamina, the present specimen reminds us of *Dictyozamites cordatus* originally regarded by KRYSHTOFOVICH as a dicotyledon, *Proteaephyllum cordatum* and later transferred by PRYNADA (1963) and

KRASSILOV (1967) with the help of their new material from the Lower Cretaceous of Southern Primorye to *Dictyozamites* and also by VAKHRAMEEV (1970) from the Lower Cretaceous of Lena Basin.

Dictyozamites cordatus is the only species known to us with round, sessil pinnae but because our specimen is ill-preserved we merely determine it as *D.* cfr. *cordatus*. *Dictyozamites kawasakii* is somewhat similar but has oblong pinnae and its vein meshes are long and wide in the middle region and short and narrow near the margins instead of being uniform (see KIMURA & SEKIDO, 1976).

Locality: Bettokuzure.

Occurrence: One specimen only.

Specimen: BK-112.

Cycadales

Genus *Nilssonia* BRONGNIART, 1825: 200

In the Akaiwa Formation *Nilssonia* leaves are rather rare than those in the Oguchi Formation and only *Nilssonia kotoi*, *N. lobatidentata*, *N. nipponensis* and *N.* cfr. *orientalis* have been known.

Nilssonia kotoi (YOKOYAMA) OISHI

Pl. 37, fig. 5

1889. *Dioonites kotoei* YOKOYAMA: p. 44, pl. 7, figs. 1a-c, 1e; pl. 14 fig. 14 (Kuwashima & Hakogase, Oguchi Formation and its equivalent).

1905. *Dioonites*? sp. YABE: p. 14, pl. 3, fig. 7 (Nagdong Group, Korea).

1905. *Ctenophyllum*? sp. YABE: p. 15, pl. 4, fig. 7 (Nagdong Group).

1940. *Nilssonia kotoi* (YOKOYAMA) OISHI: p. 302, pl. 25, figs. 3, 3a; pl. 44, fig. 3B (Kuwashima & Okamigo, Oguchi Formation and its equivalent).

1961. *Nilssonia kotoi* (YOKOYAMA) OISHI: KIMURA, p. 29, pl. 5, fig. 3 (Mekkodani, Oguchi Formation).

Description: Segments long and narrow, with acutely pointed apices, attached to the upper edge of rachis at a wide angle below and about 50 degrees above, by their whole bases. Upper segments falcate. Nerves simple, parallel, distant, 4-5 in number in each segment, running obliquely downwards in the grooved surface of the rachis to its median line.

Two leaf fragments which agree well with those dercribed by YOKOYAMA under the name of *Dioonites kotoei* regarded later by OISHI as *Nilssonia kotoi*, were obtained. Pl. 37, fig. 5 (BK-027) shows a part of an elongate-obovate to leaf.

Remarks: *Nilssonia brongniarti*(MANTEL) BRONN is one of the allied forms to this species. *N. brongniarti* is known from the Wealden of England and Germany and from the Lower Cretaceous of Western Canada (BELL, 1956) and Southern Primorye (KRASSILOV, 1967). KRASSILOV referred *Dioonites kotoi* described by KRYSHTOFOVICH (1916, 1928) and by KRYSHTOFOVICH & PRYNADA (1932) to *N. brongniarti*.

According to OISHI (1940), *Nilssonia kotoi* is distinguishable by its nerves which bend downwards on the rachis instead of being straight in *N. brongniarti*.

Several allied forms to this species have been described from the Lower Cretaceous in the Siberian Palaeofloristic Area. They include *Nilssonia sinensis* YABE & OISHI (1933, p. 224, pl. 33, figs. 7-9, 9a; pl. 35, fig. 2) from the Jurasso-Cretaceous (or Liassic) of Sha-ho-tzu and Wei-chia-pu-tzu, Liaoning, N-E China, *N. borealis* SAMYLINA (1964, p. 70, pl. 18, figs. 1-3) from the Lower Cretaceous of Kolyma Basin, and so on. As was pointed out by OISHI (1940), this species is indis-

tinguishable externally from *N. sinensis*. *Dioonites* ? sp. and *Ctenophyllum* ? sp. described by YABE from the Lower Cretaceous Nagdong Group is now referable to this species, though YABE's specimens are incomplete.
Locality: Bettokuzure.
Occurrence: Rare.
Specimens: BK-027, BK-079.

Nilssonia lobatidentata VASSILEVSKAJA

Pl. 36, fig. 7; Pl. 38, fig. 1; Text-figs. 18, 19

1963. *Nilssonia lobatidentata* VASSILEVSKAJA: VASSILEVSKAJA & PAVLOV, pl. 6, figs. 1-3 (Lower Cretaceous of Lena Basin).
1972. *Nilssonia lobatidentata* VASSILEVSKAJA: p. 322, pl. 74, figs. 1, 2 (original description; Lower Cretaceous of Lena Basin).
1970. *Nilssonia lobatidentata* VASSILEVSKAJA: ABRAMOVA, p. 45, pl. 4, figs. 2-5 (Lower Cretaceous of Lena Basin).
1976. *Nilssonia lobatidentata* VASSILEVSKAJA: KIMURA & SEKIDO: p. 307, text fig. 41 (Mekkodani, Oguchi Formation).

Description: Leaf elongate-oblanceolate in outline, tapering gradually below, lamina divided into segments which are uneven in width; commonly equal to length below, then longer than middle to above; apical segments unusually broad. Shape of segments very varied and the distal margin of segments irregularly and strongly dentate. Nerves simple, 28 per cm at the middle of segment.

Several leaves were obtained. Two of which are shown in Pl. 36, fig. 7 (BK-153) and Pl. 38, fig. 1 (BK-136) and Text-figs. 18 and 19.
Remarks: In our previous paper we described three incomplete leaves of this species obtained from the Oguchi Formation. From this locality of the Akaiwa Formation, we collected the similar leaves by the help of several students. These leaves agree essentially with this Siberian species.

The comparison with other *Nilssonia* leaves with dentate distal margin of segments, i.e., *Nilssonia orskica* GENKINA, *N. prinadae* VACHRAMEEV, *N. magnifolia* SAMYLINA, *N. denticulata* THOMAS and *N. serrulata* OISHI, was already mentioned in our previous paper.

Indeed, it is worth mentioning that the first four are all Siberian and the last one is from the Lower Cretaceous Nagdong Group, Korea.

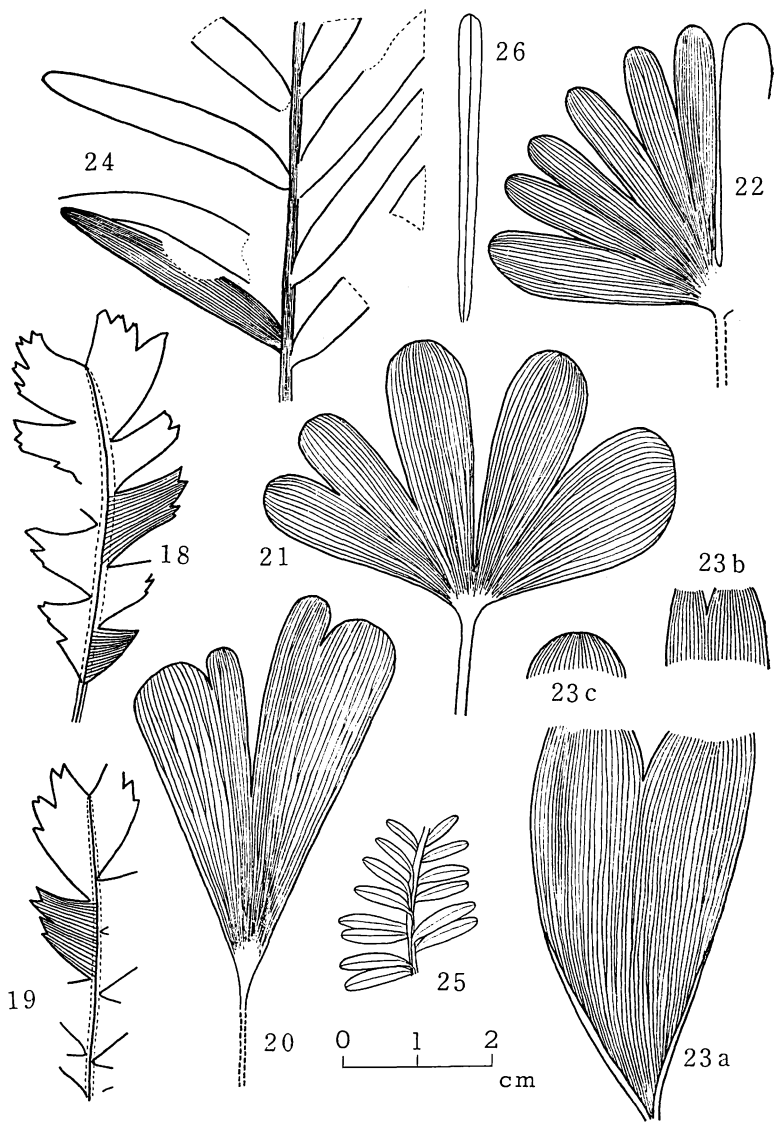
The occurrence of this species from the Lower Cretaceous of "Tetori Basin" is notable because it gives evidence suggesting similarity of environment at that time between Siberia and the "Tetori Basin", Inner Zone of Japan.
Locality: Bettokuzure.
Occurrence: Common.
Specimens: BK-044, BK-073, BK-136, BK-143, BK-153 (collected by J. HORIUCHI), BK-154, BK-157, BK-173 (collected by N. SASAKI), BK5-021, BK5-064.

Nilssonia nipponensis YOKOYAMA

Pl. 37, fig. 2; Text-fig. 17

1889. *Nilssonia nipponensis* YOKOYAMA: p. 42, pl. 6, fig. 8d; pl. 7, figs. 2-7, 8a; pl. 12, fig. 6; pl. 13, fig. 1 (Kuwashima & Okamigo, Oguchi Formation and its equivalent).
For further references, see KIMURA & SEKIDO, 1975.

Description: Leaf petioled, oblanceolate in outline, segmented, incisions sharp. Segments alternate, perpendicular to the rachis, mostly broader than length, straight in the upper margin, strongly convex in the lower, distal margin often finely serrate. Nerves dense, simple, parallel, rising at right angle to the



Text-figs. 18-26.

18 & 19. *Nilssonia lobatidentata*, drawn from Pl. 38, fig. 1 and Pl. 36, fig. 7; 20. *Ginkgoites digitata*, from Pl. 38, fig. 3; 21. *Ginkgoites huttoni*, from Pl. 38, fig. 5 and Pl. 39, fig. 6; 22. *Ginkgoites sibirica* (BK-167); 23. *Ginkgoidium nathorsti* (BK-145, BK-032B, BK-052); 24. *Podozamites angustifolius*, from Pl. 37, fig. 3; 25. *Elatocladus* sp. A, from Pl. 39, fig. 8; 26. *Pityophyllum lindstroemi* (BK-096).

rachis.

Many leaf fragments were obtained. Text-fig. 17 shows two typical leaves drawn from Pl. 37, fig. 2 (BK-088).

Remarks: The general feature of present leaves agrees well with the original diagnosis of *Nilssonia nipponensis* given by YOKOYAMA (1889).

Nilssonia nipponensis is the only species of *Nilssonia* so far known in which the leaves have been found still attached to a stem, the stem being slender and named *Nilssoniocladus nipponensis* by us (KIMURA & SEKIDO, 1975).

It is evident that the present leaves agree with those of *Nilssoniocladus nipponensis*, although in this locality no leafy shoot has been found so far.

There are, however, some slight differences in the form of segments between the leaves of the Akaiwa Formation and those of the Oguchi Formation; in the specimens from the Akaiwa Formation, segments are broader than long, strongly convex in the lower margin and finely serrate at the distal margin, while in those from the underlying Oguchi Formation, segments are rising obliquely, mostly longer than broad except for basal ones, not so convex in the lower margin and entire at the distal margin. We now think that such differences as mentioned above do not deserve to institute a new species. It is, however, certain that the form of segments of this species altered with the passage of geological time.

The present leaves resemble somewhat *Nilssonia schmidtii*(HEER) SEWARD known from the Jurasso-Cretaceous of Amurland in some roundish segments in outline.

We originally described the stem bearing *Nilssonia nipponensis* leaves as *Nilssoniocladus nipponense*. Now we do emend here its specific suffix as *nipponensis*.

Localities: Tamodani (Horizons-TC & TD); Bettokuzure.

Occurrence: Common.

Specimens: BK-001, BK-009, BK-046, BK-060, BK-069, BK-074, BK-088, BK-093, BK-117, BK-155.

Nilssonia cfr. *orientalis* HEER

1975a. *Nilssonia* cfr. *orientalis* HEER: KIMURA, p. 80, pl. 7, fig. 8.

Locality: Tamodani, Horizon-TD.

Occurrence: Rare.

Genus *Tetoria* KIMURA & SEKIDO, 1974: 23

We instituted this genus based upon the bipinnate cycadean leaves from the Oguchi Formation, of which penultimate pinnae were close to pinnate leaves of *Pseudocycas* in external morphology, and described *Tetoria endoi* (1974).

The name *Tetoria* has also been used for an animal, a bivalve, but this does not affect its validity as a name for a plant.

Tetoria endoi KIMURA & SEKIDO

Pl. 37, fig. 6

1940. *Pseudocycas*? *acutifolia* OISHI: p. 337, pl. 33, figs. 2, 3, 3a (Kuwashima & Kowashimizu, Oguchi Formation and its equivalent).

1974. *Tetoria endoi* KIMURA & SEKIDO: p. 23, pls. 1-3; text-figs. 1-6 (Mekkodani, Oguchi Formation).

Description: Ultimate pinna linear, long and narrow, nearly parallel-sided through the most part of blade, gradually tapering towards the acuminate apex, narrowing near base and decurrent at base. Midnerve occupying a half of the breadth

of blade.

Remarks: The present specimen, the only one obtained is incomplete and ill-preserved, but agrees with the penultimate pinna of this species.

As formerly mentioned by us, apart from the bipinnate character, the external morphology of this species reminds us of *Pseudocycas insignis* originally described by NATHORST (1907, p. 4, pl. 1, figs. 1-5) from the Upper Cretaceous of Greenland.

Judging from the strongly decurrent base, OISHI's *Pseudocycas ? acutifolia* corresponds to the apical portion of penultimate pinna of this species.

Locality: Bettokuzure.

Occurrence: One specimen only.

Specimen: BK-089.

Ginkgoales

Genus *Ginkgoites* SEWARD, 1919:10

Our material offers no basis for further discussion of the distinction between the use of *Ginkgo* and *Ginkgoites* for a fossil leaf. We follow various recent Russian authors in using the name *Ginkgoites*.

Our material provides no microscopic details.

The following is a key to *Ginkgoites* leaves from Bettokuzure;

1) Laminae divided by a shallow sinus into two halves with truncated or irregular apical margins ..... *G. digitata*
2) Laminae deeply divided into four segments with a rounded or somewhat lobed apex ..... *G. huttoni*
3) Laminae deeply cleft into five or more linear segments..... *G. sibirica*

Ginkgoites digitata (BRONGNIART) SEWARD

Pl. 38, fig. 3; Text-fig. 20

1940. *Ginkgoites digitata* (BRONGNIART) SEWARD: OISHI, p. 377, pl. 38, figs. 7-9 (various localities, Oguchi Formation and its equivalents).
1948. *Ginkgo digitata* (BRONGNIART) HEER: HARRIS, p. 207, figs. 7A-D; fig. 8 (Yorkshire).

For further references, see OISHI, 1940, p. 377 and HARRIS, 1974, pp. 9-10.

Description: Laminae cuneate, with a basal angle of 45 degrees, divided by a shallow sinus into two halves with truncated or irregularly lobed apical margins. Nerves divergent, dichotomously forking at all levels on the apical half of lamina.

Several incomplete *Ginkgoites* leaves referable to this comprehensive species were obtained, one of which was shown in Pl. 38, fig. 3 (BK-176). Text-fig. 20 shows an entire leaf joined leaf fragments at hand together.

Remarks: Leaves of considerably varied gross form have been described under the name *Ginkgo* or *Ginkgoites digitata* from Jurassic and Crataceous floras of many parts of the world.

The present specimens are fairly varied in gross form from the type specimens illustrated by BRONGNIART (1830, p. 219, pl. 61, figs. 2, 3) as *Cyclopteris digitata*. But the present specimens agree well in gross form with those described by OISHI from the Oguchi Formation and also with those shown by SEWARD (1919, p. 17) in fig. 635-I from the Jurassic of Yorkshire and fig. 635-J from the Jurassic of Scotland (after STOPES). Accordingly we here followed OISHI's treatment that the type of leaves which he had called *Ginkgoites digitata* included all the leaves of *Cyclopteris digitata*-type of BRONGNIART, the laminae of which were almost entire or shallowly lobed and the apex of each segment was more or less truncated or broadly rounded instead of

being rather obtusely rounded.
Locality: Bettokuzure.
Occurrence: Common.
Specimens: BK-176, BK-168 and many leaf-fragments.

Ginkgoites huttoni (STERNBERG) BLACK

Pl. 38, fig. 5; Pl. 39, fig. 6; Text-fig. 21

1940. *Ginkgoites digitata* (BRONGNIART) var. *huttoni* SEWARD: OISHI, p. 378, pl. 38, fig. 10 (Upper Triassic and Lower Jurassic of Japan).
1948. *Ginkgo huttoni* (STERNBERG) HEER: HARRIS, p. 192, figs. 4, 5, 6I-L, 7E (Yorkshire; the type locality).
1958. *Ginkgo huttoni* (STERNBERG) HEER: VAKHRAMEEV, p. 107, pl. 25, figs. 4, 5; pl. 26, figs. 2, 3 (Lower Cretaceous of Lena Basin).
1961. *Ginkgo* ex gr. *huttoni* (STERNBERG) HEER (pars): VAKHRAMEEV & DOLUDENKO, p. 101, pl. 47, figs. 2, 5, 6 (Jurasso-Cretaceous of Bureja Basin).
1963. *Ginkgo huttoni* (STERNBERG) HEER: VASSILEVSKAJA & PAVLOV, pl. 8, fig. 2; pl. 13, fig. 2; pl. 26, fig. 2; pl. 36, fig. 5 (Lower Cretaceous of Lena Basin).
1966. *Ginkgo huttoni* (STERNBERG) HEER: GENKINA, p. 93, pl. 43, figs. 1-4 (Upper Triassic and Lower Jurassic of Issyk-Kul Basin).
1970. *Ginkgo huttoni* (STERNBERG) HEER: TESLENKO, p. 152, pl. 35, figs. 2-5, 7 (Jurassic of Western and Southern Siberia).
1972. *Ginkgoites huttoni* (STERNBERG) BLACK: DOLUDENKO & LEBEDEV, p. 93, pls. 1-3; text-figs. 6, 7 (Yorkshire and Jurasso-Cretaceous of East Siberia).
For further references, see DOLUDENKO & LEBEDEV, 1972, pp. 96-98 showing the occurrence of this species in Soviet Union and HARRIS, 1974, pp. 9-11.

Description: Laminae broadly cuneate, with long petioles, deeply divided into four ultimate segments with rounded apex. A lateral segment usually repeatedly shallowly lobed at apex. Nerves forking occasionally only on the basal half of segments, 15-18 in number at the middle portion of each segment.

Several incomplete specimens were obtained, two of which were shown in Pl. 38, fig. 5 and Pl. 39, fig. 6 (BK-109, BK-083). Text-fig. 21 is a restoration made from various damaged leaves.

Remarks: The present set of leaves seem remarkably little varied in outline for a fossil *Ginkgoites* leaves. The present specimens agree well in gross form with that illustrated by OISHI (1940, pl. 38, fig. 10) from Kuwashima of the Oguchi Formation, most of those by HARRIS (1948, fig. 4A-K) from the Jurassic of Yorkshire and those by HEER (1876, pl. 10, fig. 10; 1878, pl. 5, fig. 1b; pl. 7, fig. 4; pl. 10, fig. 8) from the Jurasso-Cretaceous of Svalbard and East Siberia.

Ginkgo jampolensis originally described by LEBEDEV (1965, p. 108) from the Jurasso-Cretaceous of Zeia River area (v. g., pl. 27, figs. 1, 3; pl. 28, fig. 1; text-figs. 34, 35) is most allied form to this species.

Ginkgo polaris including its variety *pigmaea* NATHORST originally described by NATHORST (1889, pl. 1, fig. 8) from the Jurassic of Franz-Josef Land and later by THOMAS (1911, pl. 4, fig. 8) from the Jurassic of Kamenka and by VASSILEVSKAJA & PAVLOV (1963, pl. 37, figs. 2-4) from the Lower Cretaceous of Lena Basin, is also another allied form to this species.

Locality: Bettokuzure.
Occurrence: Common.
Specimens: BK-011, BK-083, BK-109, BK-118, BK-084.

Ginkgoites sibirica (HEER) SEWARD

Text-fig. 22

Similar leaves:

1876. *Ginkgo sibirica* HEER: p. 61, pl. 9, fig. 5b; pl. 11, figs. 1-8; pl. 22, fig. 3 (Jurassic of Irkutsk Basin).
1876. *Ginkgo lepida* HEER: p. 62, pl. 12, figs. 1-10 (Jurassic of Irkutsk Basin).
1876. *Ginkgo schmidtiana* HEER: p. 60, pl. 13, figs. 1, 2 (Jurassic of Irkutsk Basin).
1876. *Ginkgo flabellata* HEER p. 60, pl. 13, figs. 3, 4 (Jurassic of Irkutsk Basin).
1876. *Ginkgo pusilla* HEER: p. 61, pl. 13, fig. 6 (Jurassic of Irkutsk Basin).
1919. *Ginkgoites sibirica* (HEER) SEWARD: p. 24.
1940. *Ginkgoites sibirica* (HEER) SEWARD: OISHI, p. 380, pl. 38, fig. 11; pl. 39, fig. 1 (Kiyosué and Oguchi Formations).
1958. *Ginkgo sibirica* HEER: VAKHRAMEEV, p. 108, pl. 26, fig. 1 (Lower Cretaceous of Lena Basin).
1963. *Ginkgo sibirica* HEER: VASSILEVSKAJA & PAVLOV, pl. 8, fig. 3; pl. 36, fig. 3 (Lower Cretaceous of Lena Basin).
1966. *Ginkgo sibirica* HEER: PROSVIRJAKOVA, p. 100, pl. 20, figs. 2, 7 (Jurassic of Mangwishlak).
1970. *Ginkgo sibirica* HEER: TESLENKO, p. 150, pl. 33, figs. 3-6; pl. 34, figs. 1-6; pl. 51, fig. 4 (Jurassic of Western and Southern Siberia).
1972. *Ginkgoites sibirica* (HEER) SEWARD: DOLUDENKO & RASSKAZOVA, p. 10, pl. 1, figs. 1-6 (figs. 1-5, HEER's specimens); pl. 2, figs. 1-10 (HEER's specimens); pl. 3, figs. 1-4; pl. 4, figs. 1-5; pl. 5, figs. 1-5; pl. 6, figs. 1-3; pl. 7, figs. 1-4; pl. 8, figs. 1-3; pl. 9, figs. 1-10; pl. 10, figs. 1-6 (fig. 6, HERR's specimen); pl. 12, fig. 1 (all specimens except HEER's ones from the Jurassic of Irkutsk Basin).
1972. *Ginkgoites sibirica* (HEER) SEWARD: DOLUDEDKO & LEBEDEV, p. 83, text-figs. 1-3 (HEER's specimens) (Jurassic of Irkutsk Basin).

For further references, see HARRIS, 1974, pp. 20-21.

Description: Text-fig. 22 shows, though incomplete, a half of lamina preserved, a *Ginkgoites* leaf referable to *Ginkgoites sibirica* which is applied more or less in wide sense to cover all the leaf-impressions including types of *Ginkgo sibirica*, *G. flabellata*, *G. pusilla*, *G. lepida* and *G. schmidtiana* described by HEER from the rich plant beds at Ust-Balei near Irkutsk in East Siberia.

Judging from the specimen shown in Text-fig. 22, lamina semi-orbicular in form, deeply divided into about ten lanceolate ultimate segments each with an obtusely pointed apex. Nerves parallel, 7-14 in number in each segment, forking at the middle portion.

Remarks: Leaves we determine as *Ginkgoites sibirica* are rather rare, the best specimen (BK-167) is shown in Text-fig. 22.

A large number of similar leaves have been figured under the names given by HEER from many Jurassic to Cretaceous flora of Siberia, China and Japan and indeed occur under still other names over most of the world.

Our material does not give an adequate basis for discussing the taxonomy of the whole group, we merely compare our specimens with the Japanese specimens by OISHI (1932, p. 347, pl. 49, figs. 4, 5).

We think it unlikely that they are specifically identical because the ages of them are quite different.

Locality: Bettokuzure.

Occurrence: Rather rare.

Specimens: BK-167 and several fragments.

Genus *Ginkgoidium* YOKOYAMA, 1889: 56

Ginkgoidium nathorsti YOKOYAMA

Pl. 39, figs. 1-4; Text-figs. 23a-c

1877. ?*Podozamites* GEYLER: p. 230, pl. 32, fig. 3 (Kuwashima, Oguchi Formation).
1889. *Ginkgodium nathorsti* YOKOYAMA: p. 57, pl. 2, fig. 4e; pl. 3, fig. 7; pl. 8; pl. 9, figs. 1-10; pl. 12, figs. 14, 15 (Kuwashima and Ozo, Oguchi Formation).
1911. *Ginkgodium nathorsti* YOKOYAMA: THOMAS, p. 75, pl. 4, figs. 9-11; pl. 8, fig. 3 (Jurassic of Kamenka).
1929. *Ginkgodium nathorsti* YOKOYAMA: TATEIWA, plate, fig. 17 (Lower Cretaceous of Nagdong Group)
1940. *Ginkgoidium nathorsti* YOKOYAMA: OISHI, p. 382, pl. 39, figs. 2-5 (Kuwashima and Kowashimizu, Oguchi Formation and its equivalent).
1965. *Ginkgodium nathorsti* YOKOYAMA: KIMURA & SEKIDO, p. 3, pl. 2, fig. 2 (Mekkodani, Oguchi Formation).

Description: Leaves varied both in form and size. Pl. 39, fig. 4 (BK-145) shows the largest specimen, 15 cm long, of which lamina deeply divided by a median sinus into divergent segments; lamina cuneate, narrowing to fuse to short petiole, then it is difficult to notice the boundary between the lamina and petiole; segments asymmetrical, nearly parallel-sided but increasing the width towards the distal part, then narrowing to truncate or obtusely rounded apex, the maximum width 2.3 cm. Nerves originate both from petiole and the marginal thick ones which are particularly prominent in the lower two-thirds of the margin as also shown in Pl. 39, fig. 1 (BK-149), parallel. often dichotomously forking at the lower half of segment, not converging at apex as shown in Text-fig. 23c. The number of nerves varied, 25-60 in each segment; they are distant on large segments while densely crowded on small ones. No interstitials observed.

Pl. 39, fig. 3 (BK-032B) shows two medium-sized specimens. The apex of segment often shallowly bilobed as shown in this figure and Text-fig. 23b. Pl. 39, fig. 2 (BK-052) shows the smallest specimen, 4 cm long, the width of which comparatively broad. Text-fig. 23a shows the form of lamina and nervation typically.

Many specimens referable to *Ginkgoidium nathorsti* originally described by YOKOYAMA from Kuwashima of the Oguchi Formation were obtained.

The detached leaves described by THOMAS (1911) as *Ginkgodium nathorsti* (p. 75, pl 4, figs, 9-11; pl. 8, fig. 3) from the Jurassic of Kamenka, are smaller in size than those from Japan and the nerves of the former are, according to THOMAS, seldom forked.

Among the leaves regarded as *Sphenobaiera* or *Baiera*, there are such similar forms to those of *Ginkgoidium* as some leaves of *Baiera polymorpha* (v. g. SAMYLINA, 1963, p. 95, pl. 23, fig. 2), *Sphenobaiera pulchella* (HEER) FLORIN (v. g., SAMYLINA, 1963, p. 103, pl. 25, fig. 10; pl. 26, fig. 4), some leaves of *Sphenobaiera huangi* (SZE) KRASSILOV (v. g., KRASSILOV, 1972, p. 12, pl. 10, figs. 1, 7; pl. 11, fig. 1), etc., but this similarity in gross form is only apparent and they are quite different from *Ginkgoidium nathorsti* in nervation.

YOKOYAMA mentioned that the laminae were always bilobed with a median sinus, though in the very young or small leaves they were often simple. If so, a new question how to explain the existence of such small leaves with median sinus as shown in Pl. 39, fig. 2, would arise.

Generally speaking in regard to gross form, wedge-shaped leaves with nerves springing both from the petiole and the marginal thick nerves have possibly been referred to *Ginkgoidium* or *Eretmophyllum*.

According to YOKOYAMA, *Ginkgoidium nathorsti* has two leaf-forms; one is cuneate, broader at apex which is retuse

or is divided by a deep median sinus into divergent obtusely pointed segments, another one is entire, obovate or lanceolate in outline and with truncate or obtuse distal end.

In 1965, we described *Eretmophyllum tetoriense* (p. 2, pl. 2, fig. 1 ; text-fig. 1) based upon the fairly long dwarf shoot with the terminal crown of leaves which were referable to entire form of *Ginkgodium nathorsti* leaves as shown by YOKOYAMA (1889) in his pl. 8, figs. 2c, 10, 11 and pl. 9, figs. 9, 10 from Kuwashima of the Oguchi Formation.

In *Ginkgo biloba*, the leaves terminally on the dwarf shoots are generally nearly entire or shallowly divided by a median sinus (KIMURA & SEKIDO, 1965, pl. 1, figs. 2-4) but those spirally on the long shoots are generally deeply divided form (*ibid.*, fig. 1).

We (1965) preliminarily considered that *Eretmophyllum tetoriense* might be conspecific with *Ginkgoidium nathorsti* and that the entire leaves were attached to the dwarf shoots as terminal crown and other leaves were attached spirally to the supposed long shoots as one by one.

Our presumption mentioned above has not generally accepted because the cuticular characters which might give one of the influential proofs regarding the identity of both forms of leaves are still unknown and both distal long shoots bearing leaves of deeply divided form and basal long shoots supporting the dwarf shoots terminally with the crown of entire leaves, have not been found.

There are, however, some favourable records, that is, the association in occurrence of entire and deeply divided ginkgoalean leaves for our presumption, as follows.

In one locality of the Lower Cretaceous Nagdong Group, Korea, entire leaves regarded by TATEIWA (1929) as *Ginkgodium gracile* (his plate, fig. 16 ; OISHI, 1940, p. 382, pl. 38, fig. 3) is coexisted with deeply divided leaves of *Ginkgoidium nathorsti* (TATEIWA, 1929, plate, fig. 17 ; OISHI, 1940, p. 382).

In the Lower Cretaceous of Alaska, *Nageiopsis longifolia* originally described by FONTAINE (in WARD, 1905, p. 171, pl. 45, figs. 1-5) being referable to *Eretmophyllum* as mentioned by SEWARD (1919, p. 60), those entire leaves might be in association in occurrence with the deeply divided leaves described also by FONTAINE as *Ginkgodium ? alaskense* (p. 168, pl. 44, figs. 3, 4).

KRASSILOV (1972) illustrated several leaves as *Eretmophyllum grandulosum* (SAMYLINA) from the Jurasso-Cretaceous of Bureja Basin (pl. 15, figs. 1-5 ; text-figs. 7a-i), among which some leaves were entire and others retuse. These leaves from the Lower Cretaceous of Aldan River area were formerly regarded by SAMYLINA as *Ginkgoidium glandulosum* (1956, p. 1526, pl. 1, figs. 8-10 ; text-fig. 1 ; 1963. p. 98, pl. 15, figs. 6-9 ; text-fig. 12). From the Aldan River area SAMYLINA also described *Ginkgoidium amgaensis* (p. 98, pl. 27, figs. 5, 6), the laminae of which were cuneate and deeply divided by a median sinus into divergent segments, but this species did not coexist in occurrence with *Eretmophyllum glandulosum*.

In *Eretmophyllum pubescens* originally described by THOMAS from the Jurassic of Yorkshire, the leaves are entire or retuse. Unfortunately the species mentioned above were all based on detached leaves.

Besides the above, several species regarded as *Eretmophyllum* have been known ; *Eretmophyllum whitbiense* THOMAS (THOMAS, 1913 ; HARRIS, 1974) from the Jurassic of Yorkshire, *E. pulchellus* (HEER) NATHORST (1919) from the Upper

Jurassic of Svalbard, *E. saighanense* (SEWARD) THOMAS (SEWARD, 1912; THOMAS, 1913) from the Jurassic of Afghanistan, *E. thomasii* DOLUDENKO & SVANIDZE (1969) from the Upper Jurassic of Georgia, *E.* cfr. *whitbiense* THOMAS (KRASSILOV, 1972) from the Jurasso-Cretaceous of Breja Basin and *E. baikonicum* ORLOVSKAJA from the Jurassic of Kazakhstan.

These leaves are too few in number in occurrence or too incomplete to use them for the favourite records for our presumption.

Eretmophyllum baikonicum (ORLOVSKAJA, 1962, p. 1443, fig. 3) has the laminae without marginal thick nerves, differing from other leaves referred to *Ginkgoidium* or *Eretmophyllum*. The same is to *Cyclopteris squamata* (ETTINGSHAUSEN, 1952, p. 13, pl. 4, fig. 1) from the Lower Cretaceous of Austria which was said to included possibly in *Eretmophyllum* by SEWARD (1919, p. 59).

Under such conditions as mentioned above, the relation between *Ginkgoidium nathorsti* and *Eretmophyllum tetoriense* is still uncertain. Then we now unavoidably regard the present detached leaves as *Ginkgoidium nathorsti* followed by YOKOYAMA.

The name *Ginkgoidium* was suggested by HARRIS (1935, p. 6) in reference to *Ginkgodium* YOKOYAMA.

Locality: Bettokuzure.

Occurrence: Very abundant.

Specimens: BK-004, BK-013, BK-032, BK-052, BK-056, BK-057, BK-062, BK-080, BK-081, BK-092, BK-126, BK-130, BK-145, BK-149, BK5-037, BK5-066, BK5-035, BK5-029.

Genus *Pseudotorellia* FLORIN, 1936: 142

Pseudotorellia sp.

Pl. 39, fig. 5

1975a. *Pseudotorellia* sp. KIMURA: p. 81, pl. 8, figs. 5, 6 (middle member of the Tamodani Formation).

The present specimens are similar in gross form and nervation to those previously described by KIMURA from the middle member of Tamodani Formation.

Localities: Tamodani (Horizon-TD); Bettokuzure.

Occurrence: Common.

Specimens: BK-127, BK-015, BK-146, BK-035, BK-104, BK-142.

Czekanowskiales

Genus *Czekanowskia* HEER, 1876: 70

Czekanowskia sp.

Several incomplete filamentous leaves referable to this genus were obtained.

Locality: Bettokuzure.

Occurrence: Rare.

Specimen: BK-115.

Genus *Leptostrobus* HEER, 1876 em. HARRIS, 1951: 485

Our material does not add to the information given by HARRIS, 1951 and KRASSILOV, 1972. They regard *Leptostrobus* as the fructification of various species of *Czekanowskia*, *Phoenicopsis* or allied genera of the Czekanowskiales.

Recently TAKAHASHI & OKAFUJI (1970) described *Leptostrobus longus* HARRIS on their new material from the Middle Triassic Momonoki Formation, the Miné Group, Ominé Coal-Field, Yamaguchi Prefecture and removed Cfr. *Leptostrobus luxiflora* HEER formerly described by OISHI & TAKAHASHI (1936, p. 130, text-fig. 5) and by OISHI (1940, p. 413) from the Middle Triassic Yamanoi Formation,

Yamaguchi Prefecture, to *L. longus*.

According to TAKAHASHI & OKAFUJI, their fructifications determined as *Leptostrobus longus* were associated with *Phoenicopsis angustifolia* but not with any *Czekanowskia* leaves.

Leptostrobus sp.

Pl. 38, fig. 7

Cone axis 1.5 mm thick, elongated (imperfectly known), Probably arising from a whorl of scale leaves about 3 mm long and 0.5 mm wide. Lateral appendages 3 mm wide borne singly on stalks 1 mm long at a wide angle, each appendage round flattened composed of two valves. Valves typically marked by seven ridges passing from the stalk to the margin, ridges mostly simple but occasionally forked.

Our material is plentiful but poorly preserved. Some of the appendages are empty and flat but others full of matrix and nearly spherical. We have no proof that the cluster of scale leaves is really at the base of the cone axis.

We note that both this and *Czekanowskia* are from Bettokuzure but the *Czekanowskia* is rare. No fragments which could be *Czekanowskia* or *Phoenicopsis* occur with the *Leptostrobus* capsules.

The present cones resemble in the form of valves described by SAMYLINA (1967) as *Leptostrobus marginatus* from the Lower Cretaceous of Zyrianka Coal-Field (p. 150, pl. 11, figs. 4-7) and by VASSILEVSKAJA and PAVLOV (1963) as *L. limbatus* VASSILEVSKAJA from the Lower Cretaceous of the Lena Basin (pl. 9, fig. 8,; pl. 43, fig. 12).

Locality: Bettokuzure.

Occurrence: Common.

Specimens: BK-114, BK5-041, BK5-042, BK5-011, BK5-012, BK5-069.

Coniferales-Broad leaves

Genus *Podozamites* BRAUN, 1843

Podozamites angustifolius (EICHWALD) HEER

Pl. 37, fig. 3; Text-fig. 24

1876. *Podozamites angustifolius* (EICHWALD) HEER: p. 45, pl. 26, fig. 11 (Jurasso-Cretaceous of East Siberia).

1878. *Podozamites angustifolius* (EICHWALD) HEER: p. 22, pl. 5, fig. 12 (fig. 11b?) (Lower Cretaceous of Amurland).

1933. *Podozamites angustifolius* (EICHWALD) HEER: KRYSHTOFOVICH & PRYNADA, p. 17, pl. 4, fig. 1 (Jurassic of Ural).

1958. *Podozamites angustifolius* (EICHWALD) HEER: VAKHRAMEEV, p. 122, p. 31, figs. 3-5; pl. 32, fig. 5 (Lower Cretaceous of Lena Basin).

1963. *Podozamites angustifolius* (EICHWALD) HEER: VASSILEVSKAJA & PAVLOV, pl. 9, fig. 2; pl. 17, fig. 1a; pl. 41 (Lower Cretaceous of Lena Basin).

1963. *Podozamites angustifolius* (EICHWALD) f. *brevis* VASSILEVSKAJA: VASSILEVSKAJA & PAVLOV, pl. 8, fig. 10 (Lower Cretaceous of Lena Basin).

1966. *Podozamites angustifolius* (EICHWALD) HEER: GENKINA, p. 110, pl. 55, figs. 1-6 (Upper Triassic and Lower Jurassic of Issyk-Kul Basin).

1966. *Podozamites angustifolius* (EICHWALD) HEER: PROSVIRJAKOVA, p. 105, pl. 22, fig. 1 (Jurassic of Mangwishlak).

1970. *Podozamites angustifolius* (EICHWALD) HEER: TESLENKO, p. 168, pl. 45, figs. 1-4; pl. 52, fig. 1 (Jurassic of Western and Southern Siberia).

Description: Pinnae long and narrow, nearly parallel-sided, typically 3.5 cm long and 5 mm wide, narrowing gradually towards obtusely pointed apices, attached at an angle of about 60 degrees, distichously by their contracted bases to

the slender rachis. Nerves parallel, simple, converging at the apex, 15 in number on each pinna.

Many incomplete shoots with slender leaves were obtained, one of which is shown in Pl. 37, fig. 3 (BK-002). Text-fig. 24 shows distichously attached leaves drawn from BK-002.

Remarks: This species is widely known from the Triassic to Lower Cretaceous of Siberia and Central Asia and is characterized by its long and narrow leaves with obtusely pointed apex.

In our material the leaves are borne one at each node in two lateral ranks, the distichous arrangement but in many other species the leaves arise on all side of the axis in spiral.

The first occurrence of this species is of special significance, because it might show one of the favourable materials representing the close relation between the floras in the Siberian Palaeofloristic Area and the Akaiwa Flora.

The present leaves resemble those of *Podozamites schenki* HEER known from the Upper Triassic and the Jurassic of China, Korea, Japan and Siberia and many other parts of the Northern Hemisphere, but in *P. schenki* leaves are with acuminate apices instead of obtuse ones.

Podozamites gramineus HEER known also from the Mesozoic of Siberia is another allied form to this species, but in *P. gramineus*, leaves are more slender in habit than those of this species.

Locality: Bettokuzure.

Occurrence: Common.

Specimens: BK-002, BK-071, BK-090, BK-139, BK-160, BK-162, BK5-074.

Podozamites ex gr. *lanceolatus* (LINDLEY & HUTTON) BRAUN

Locality: Bettokuzure.

Occurrence: Common.

Specimens: BK-033, BK-019, BK-061, BK-021, BK-082, BK-051, BK-050, BK-100, BK5-013.

Podozamites reinii GEYLER

1877. *Podozamites reinii* GEYLER: p. 229, pl. 33, fig. 4a; pl. 34, figs. 1, 2, 3b, 4, 5a (Kuwashima, Oguchi Formation).

1975a. *Podozamites reinii* GEYLER: KIMURA, p. 82, pl. 7, fig. 10 (middle member of the Tamodani Formation).

For further references, see KIMURA, 1975a.

Remarks: Many specimens were obtained. It is worth mentioning that this species and its allied forms are, as mentioned in detail by KIMURA (1975a), known mainly from the Younger Mesozoic of Siberia, Central Asia, Korea and the "Tetori Basin" of Japan.

Localities: Tamodani (Horizons-TD, TE), Hayashidani (Horizon-HC); Bettokuzure.

Occurrence: Very abundant.

Specimens: BK-003, BK-008, BK-016, BK-019, BK-020, BK-034, BK-036, BK-039, BK-040, BK-042, BK-053, BK-055, BK-066, BK-067, BK-068, BK-075, BK-076, BK-078, BK-087, BK-091, BK-095, BK-099, BK-101, BK-116, BK-119, BK-129, BK-134, BK-137, BK-159, BK5-054, BK 5-016, BK5-061, BK5-023, BK5-070, BK 5-056.

Coniferales-Narrow leaves

Form-genus *Elatocladus* HALLE em HARRIS, 1969: 249

HARRIS (1969) gave the emended definition to this form-genus originally instituted by HALLE in such a way as to be available for any sort of conifer shoots,

as follows; Shoot bearing leaves spirally (rarely opposite). Leaf elongated, dorsiventrally flattened, diverging from stem; at base strongly contracted and forming a short petiole attaching it to basal cushion. Lamina with a single vein.

Elatocladus sp. A

Pl. 39, fig. 8; Text-fig. 25

Spirally disposed and closely set leaves dorsiventrally flattened, elongate-lanceolate in outline, 6.5–10 mm long and 1.2–2 mm wide at middle, contracted at base to form very short petiole attaching it to basal cushion and with obtusely pointed apex. Lamina with a single vein.

Our specimens shown in Pl. 39, fig, 8 (BK-094) and Text-fig. 25 agree in external features with the emended definition given by HARRIS. They resemble closely *Palissya* sp. described by YOKOYAMA (1889, p. 64, pl. 3, fig. 11) from Kuwashima of the Oguchi Formation, though in his specimen, all apices are broken.

Locality: Bettokuzure.
Occurrence: Rare.
Specimens: BK-094, BK-171.

Elatocladus sp. B

Pl. 38, fig. 4; Pl. 39, fig. 9

Leaves long and narrow, 5.5 cm long and 0.4 mm wide, nearly parallel-sided, contracted at base, attaching spirally to the axis by very short petiole, decurrent to the leaf-cushion, dorsiventrally flattened. Lamina with a midvein, persisting to the bluntly pointed apex, both lateral margins strongly reflexed.

Four incomplete leafy shoots were obtained. The present specimens are different in leaf-form from *Elatocladus* sp. A here described. The present specimens are also too incomplete to make any comparison.

Locality: Bettokuzure.
Occurrence: Rare.
Specimens: BK-005, BK-161 (collected by T. TOJO).

Form-genus *Pityophyllum*
NATHORST, 1897: 62

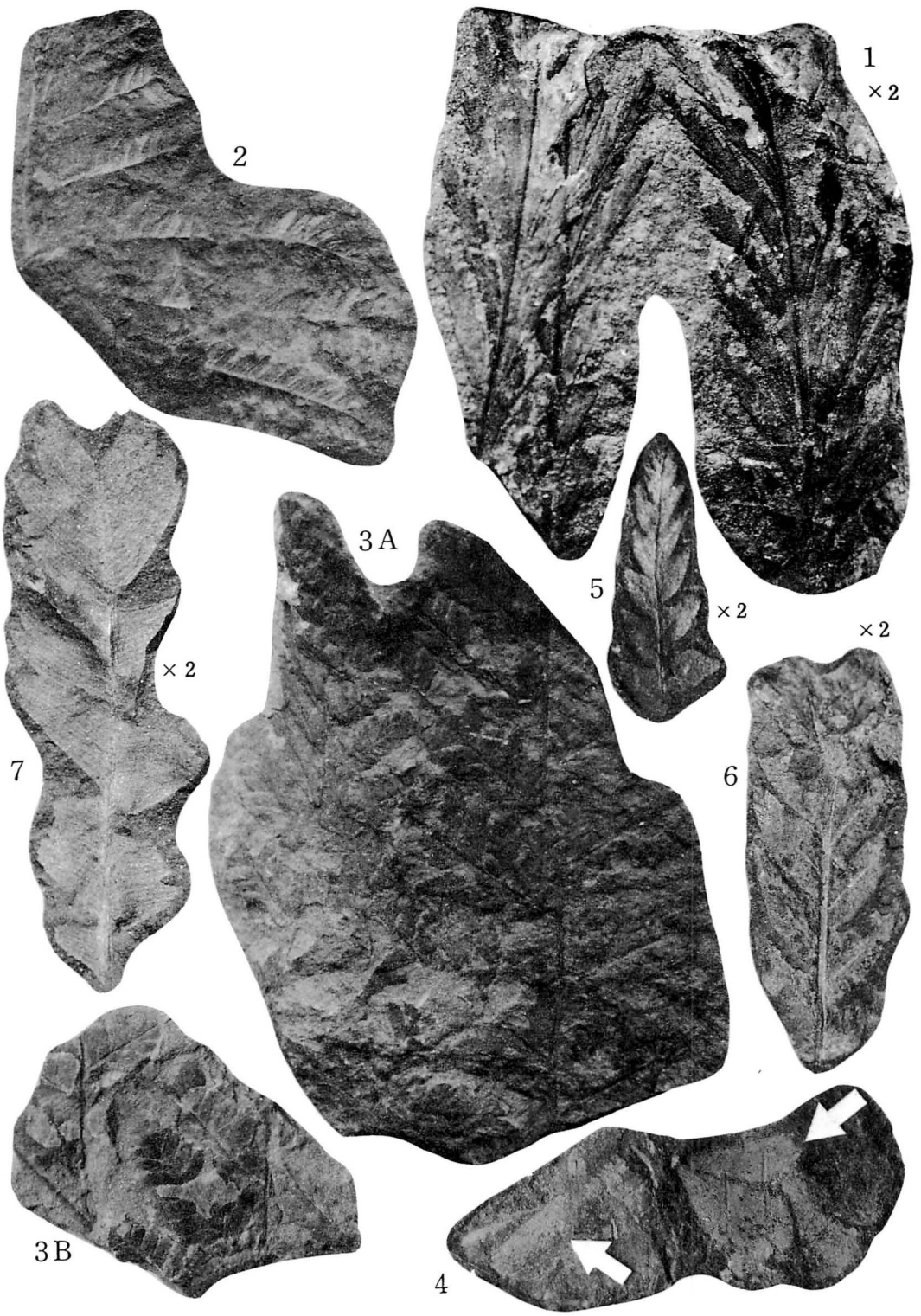
Pityophyllum lindstroemi NATHORST

Text-fig. 26

1897. *Pinites* (*Pityophyllum*) *lindstroemi* NATHORST: p. 40; p. 67, pl. 5, figs. 13-15, 18-31; pl. 6, figs. 17, 18 (Jurasso-Cretaceous of Svalbard).
1889. *Pinus nordenskijoldi* HEER: YOKOYAMA, p. 63, pl. 9, fig. 12b (Kuwashima, Oguchi Formation).
1910. *Pityophyllum lindstroemi* NATHORST: KRYSHTOFOVICH, p. 16, pl. 3, fig. 9 (Jurasso-Cretaceous of Ussuri).
1915. *Pityophyllum lindstroemi* NATHORST: KRYSHTOFOVICH, p. 113, pl. 6, fig. 9

Explanation of Plate 36

Fig. 1. *Onychiopsis elongata* (GEYLER) YOKOYAMA; ×2 (BK-103)
Fig. 2. *Gleichenites* aff. *porsildi* SEWARD; nat. size (OS-006)
Fig. 3. *Coniopteris* sp. cfr. *C. hymenophylloides* (BRONGNIART) SEWARD; nat. size (BK-156)
Fig. 4. *Adiantites* sp. D; arrows show pinnules; nat. size (OS-095)
Fig. 5. *Cladophlebis williamsoni* (BRONGNIART) BRONGNIART var. *tenuicaulis* THOMAS; ×2 (BK-072)
Fig. 6. Ditto; ×2 (BK-140)
Fig. 7. *Nilssonia lobatidentata* VASSILEVSKAJA; ×2 (BK-153)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×2
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3A
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×2

(Jurasso-Cretaceous of Tyrm).

1915. *Pityophyllum lindstroemi* NATHORST: KRYSHTOFOVICH, p. 85, pl. 1, figs. 6-8 (Jurassic of Baikal).

1963. *Pityophyllum lindstroemii* NATHORST: SAMYLINA, p. 109, pl. 9, fig. 1b (Lower Cretaceous of Aldan).

1975a. *Pityophyllum* sp. KIMURA: p. 85, pl. 7, fig. 11; pl. 8, fig. 11 (Uppermost Member of Tamodani Formation).

Leaves over 4 cm long, 1.5-2 mm wide, lamina tapering gradually to the base and abruptly to the apex, petiole absent, apex obtuse. Midrib conspicuous and two thicker bands present but less conspicuous.

Pityophyllum lindstroemi is represented by many detached leaves. They agree with those previously described by KIMURA as *Pityophyllum* sp. from the uppermost member of Tamodani Formation.

Locality: Bettokuzure.

Occurrence: Common.

Specimens: BK-096, BK-180, BK5-034.

Postscript: Many wood remains collected by us from the Akaiwa Formation will be described in the near future.

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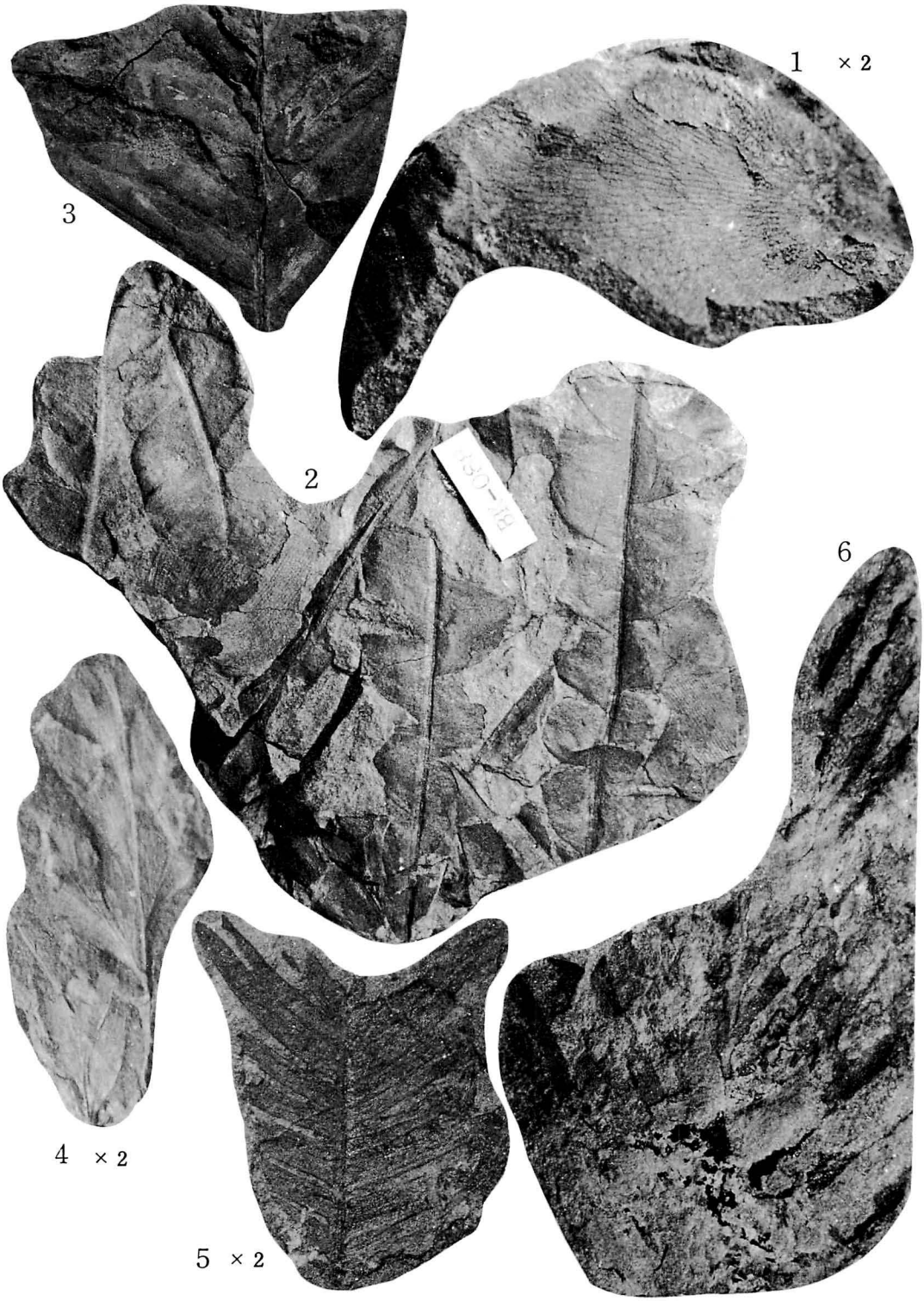
Explanation of Plate 37

Fig. 1. *Dictyozamites* cfr. *cordatus* (KRYSHTOFOVICH) PRYNADA; ×2 (BK-112)
Fig. 2. *Nilssonia nipponensis* YOKOYAMA; nat. size (BK-088)
Fig. 3. *Podozamites angustifolius* (EICHWALD) HEER; nat. size (BK-002)
Fig. 4. *Sphenopteris goepperti* DUNKER; ×2 (BK-113)
Fig. 5. *Nilssonia kotoi* (YOKOYAMA) OISHI; ×2 (BK-027)
Fig. 6. *Tetoria endoi* KIMURA & SEKIDO; nat. size (BK-089)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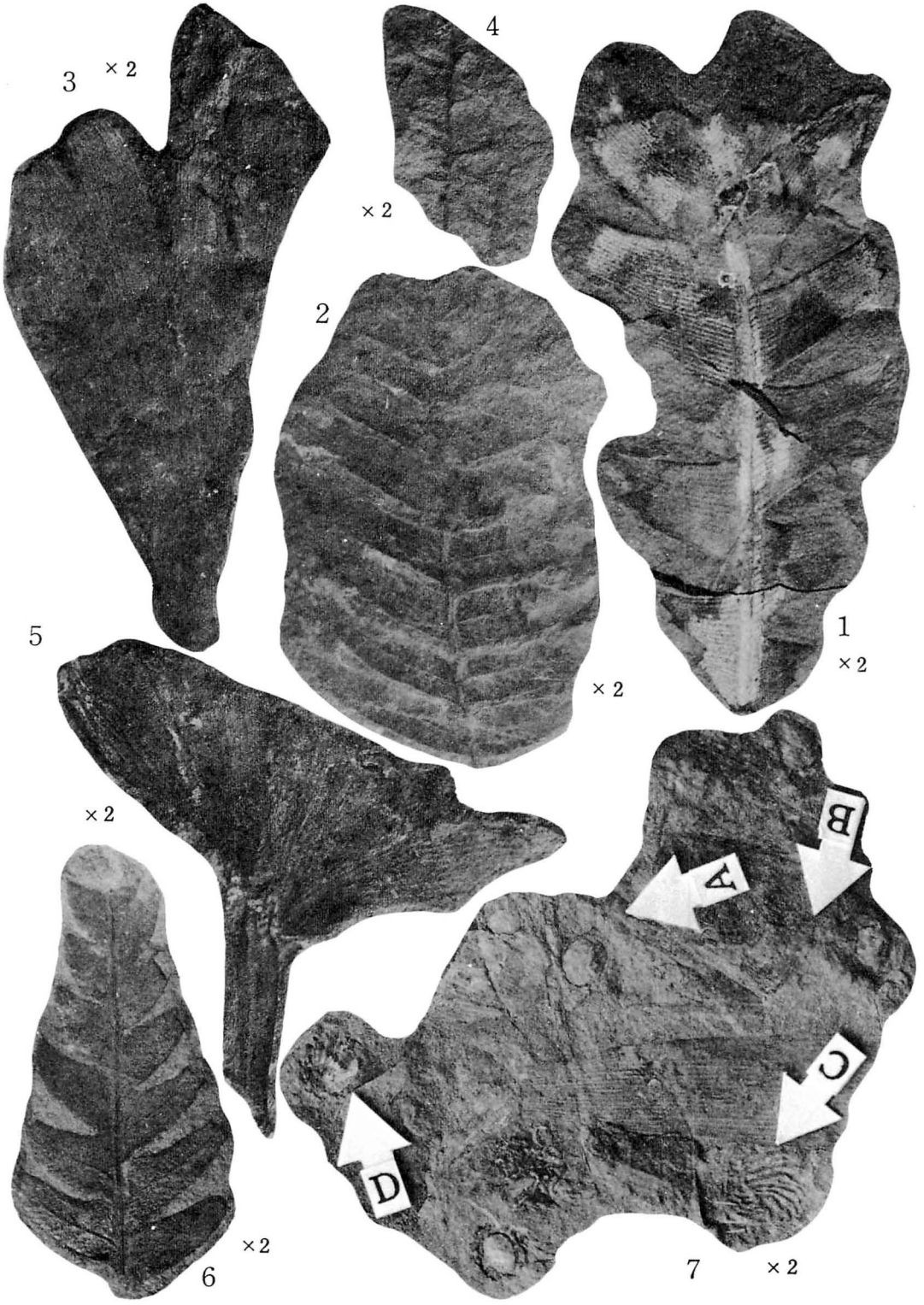
Explanation of Plate 38

Fig. 1. *Nilssonia lobatidentata* VASSILEVSKAJA; ×2 (BK-136)
Fig. 2. *Raphaelia* sp. A; ×2 (BK-163)
Fig. 3. *Ginkgoites digitata* (BRONGNIART) SEWARD; ×2 (BK-176)
Fig. 4. *Elatocladus* sp. B; ×2 (BK-005)
Fig. 5. *Ginkgoites huttoni* (STERNBERG) BLACK; ×2 (BK-083)
Fig. 6. *Cladophlebis williamsoni* (BRONGNIART) BRONGNIART var. *tenuicaulis* THOMAS; ×2 (BK-123)
Fig. 7. *Leptostrobus* sp.; A showing a slender cone axis; B showing scale leaves; C & D showing the surface of detached valves; ×2 (BK-114)


3
× 2
4
× 2
2
× 2
1
× 2
5
× 2
A
B
C
D
6
× 2
7
× 2

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Akaiwa	赤岩	Miyako	宮古
Arita	有田	Monobegawa	物部川
Bettokuzure	別当崩れ	Nagdong (formerly Naktong)	洛東
Gamatagawa	蒲田川	Nochino	後野
Hakusan	白山	Oguchi	尾口
Irahara	苛原	Omichidani	大道谷
Ishikawa	石川	Osugidani	大杉谷
Itoshiro	石徹白	Ryoseki	領石
Jintsugawa	神通川	Shinshu (Chinju in Korean)	晋州
Kitadani	北谷	Shiramine	白峰
Kiyosué	清末	Takinamigawa	滝波川
Kochi	高知	Tamodani	田茂谷 (田母谷, 多母谷)
Komatsu	小松	Tetori (Tedori)	手取
Kumanogawa	熊野川	Tochio	栃尾
Kuzuryu	九頭竜	Uchinami	打波
Mekkodani	目附谷		

Explanation of Plate 39

Figs. 1-4. *Ginkgoidium nathorstii* YOKOYAMA: all nat. size (BK-149, BK-052, BK-032B, BK-145)
Fig. 5. *Pseudotorellia* sp.; ×2 (BK-127)
Fig. 6. *Ginkgoites huttoni* (STERNBERG) BLACK; ×2 (BK-109)
Fig. 7. *Equisetites* sp. (stem); ×2 (BK-135)
Fig. 8. *Elatocladus* sp. A; ×2 (BK-094)
Fig. 9. *Elatocladus* sp. B; ×2 (BK-005)


1
7
2
3
× 2
4
× 2
5
× 2
9
× 2
6
× 2
8

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 103, pp. 379-397, pls. 40, 41, Oct. 15, 1976

664. *SAWAMURAIA, KATAHIRAIA* UND *YOSHIDAIA*, DREI NEUE DIATOMGATTUNGEN AUS DEM NEOGEN JAPANS*

SEIICHI KOMURA

Japan Petroleum Exploration Co., Ltd. (JAPEX)

天北新第三系産の珪藻3新属, *Sawamuraia*, *Katahiraia* および *Yoshidaia*: 北海道天北地域に分布する中部中新統-下部鮮新統の地層から羽状目珪藻3新属を記載する。*Sawamuraia* は端結節・広い無装飾中央区・短い疑縦溝を有することを特徴とする。*Katahiraia* と *Yoshidaia* は結節状管縦溝が中央頂軸線上にあることを特徴とし, 両者は表面細孔の構造上の特徴と対称性の相違によって区別される。*Katahiraia* では Poroid のある Areole が不規則に配列し, *Yoshidaia* では Poroid 列が規則的に配列している。属の名称は地質調査所主任研究官沢村孝之助博士・石油資源開発(株)副部長片平忠実博士・同次長吉田義孝氏にそれぞれちなむ。

小村精一

Einleitung

Es gibt in der langen Geschichte der Diatomeenforschung eine große Anzahl von Gattungen, die von zahlreichen Autoren eingerichtet wurden, und viele unterschiedliche umfassende Klassifikationssysteme, die vorgeschlagen wurden, wenn sie auch nicht immer alle diese Klassen zusammenfassen (VAN HEURCK, 1896; PERAGALL, 1897-1908; HUSTEDT, 1927-64, 1956; KARSTEN, 1928; JOUSE, 1963; HENDEY, 1964; usw.). Von diesen werden die einen endgültig als valid benutzt, die anderen nicht.

Aber handelt es sich um die morphologischen und strukturellen Merkmale, die der Zuerkennung der Gattungsränge zu Grunde liegen, weil die Gattung nun im allgemeinen als die wesentlichste Einheit innerhalb des systematischen Rahmen gedacht ist. Trotzdem sind die Diskussionen nur noch zum Teil darüber geführt worden. Zur biostratigraphischen Untersuchung werden auch winzige und zeitliche Entwicklungsveränderungen solcher Merkmale selbst im Verlauf des geologischen Alters zukünftig eine große Rolle spielen.

Damit erscheint es mir, wenn solche gemeinschaftlichen Unterscheidungsmerkmale festgesetzt werden, daß dadurch die aus zahlreichen Arten bestehenden Gattungen wie z. B. *Coscinodiscus* EHRENBERG, *Synedra* EHRENBERG, *Navicula* BORY und andere weit kleinzügiger untergeteilt werden sollen. Weiterhin deuten wahrscheinlich die leeren Spalten in der von HENDEY (1964, S. 7) angefertigten Tabelle, die in Bezug auf der Diatomeenumriß die Verhältnisse zwischen den Araphideen und den Raphideen zeigt, die Eigentümlichkeiten für in der Zukunft zu entdeckende Gattungen an.

Durch die neue Zusammenfügung der strukturelle Merkmale werden einige Taxa auf Grund der oben diskutierten Gesichtspunkte aus den Exemplaren, die ich an der Hand halte, neu proponiert.

Die Veröffentlichung der Arbeit wird

* Received April 14, 1976; read June 14, 1975 at Morioka.

von der Japan Petroleum Exploration Co., Ltd. (JAPEX) erlaubt. Ich spreche somit Herrn Dr. Y. IKEBE, Vizepräsident der Gesellschaft, dafür und für seine stete Hilfsbereitschaft meinen ganz besonderen Dank aus. Für die fruchtbaren Diskussionen und für die freundlichen Anregungen möchte ich mich bei Herrn F. AKIBA, Mikropaleontologe, Technical Institute, JAPEX, Hamura bedanken.

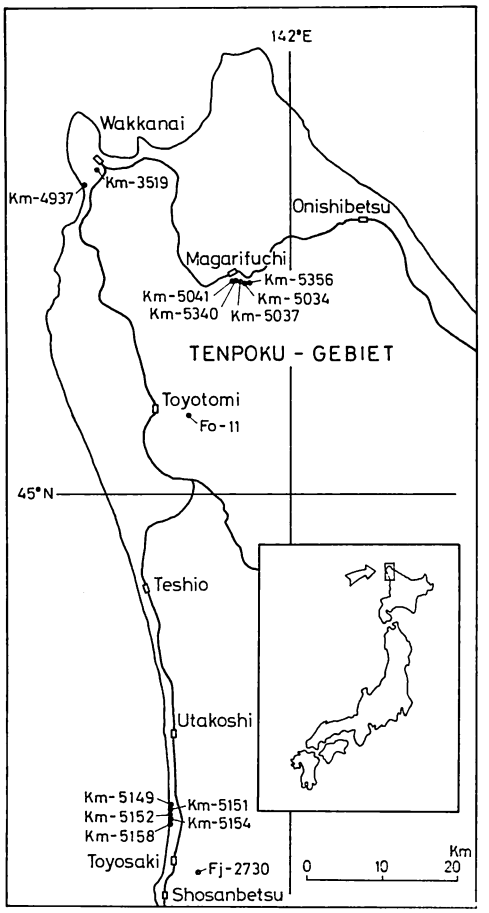


Abb. 1. Lageskizze der Fundpunkte.

Herr M. FUJITA und Herr N. FUJIOKA, Geologen unserer Gesellschaft überließen mir ihre Proben sehr freundlich und Fräulein Yukie TAMANO, JAPEX zeichnete die Abbildungen sehr gewissenhaft. Allen möchte ich an dieser Stelle meinen herzlichen Dank aussprechen.

Material und methodische Hinweise

Das für diese Arbeit verwendete Probenmaterial stammt mittelmiozänen bis unterpliozänen Ablagerungen Nordjapans. Lage, Lithologie, u.ä. der Proben sind wie in der Tabelle 1 angegeben.

Um das mittels Pleurax eingebettete Streupräparat anzufertigen wurden die Proben im Laboratorium nach den üblichen Methoden aufbereitet und behandelt (KANAYA, 1957, 1959). Die Aufnahme wurde mit Hilfe eines normalen Photoaufsatzes abgefaßt, um die Tafel abzufassen und um durch ihre Vergrößerung das Exemplar abzubilden.

Alle Typ-Exemplare der neu beschriebenen Formen werden im Technical Institute, Japan Petroleum Exploration Co., Ltd. (JAPEX), Hamura in Tokio aufbewahrt.

Systematische Beschreibung

Ordnung Pennatae SCHÜTT, 1896

Familie Fragilariaceae KARSTEN, 1928

Gattung *Sawamuraia*, n. gen.

Namengebung: Zu Ehren von Herrn Dr. Konosuke SAWAMURA, japanischer Diatomologe vom Geological Survey of Japan, Kawasaki.

Typusart: Sawamuraia biseriata, n. sp.

Beschreibung: Zellen frei, in der Regel einzeln lebend, zuweilen die kurzen Bänder bildend, in Gürtelansicht rechteckig-tafelförmig mit den buckelartig aufgetriebenen Enden; Zwischenbänder, Septen oder sonstige Innenstrukturen überhaupt nicht vorhanden; Schalen im Umriß linear, selten linear-lanzettlich, mit im allgemei-

Tab. 1. Fundort und stratigraphische Merkmale des Probenmaterials, Tenpoku-Gebiet.

Proben-Nummer	Lithologie	Lage			Ablagerung	Hinweise
		Fundort	Breitengrad (N)	Längengrad (E)		
Km-3519	aschenreicher Kieselgur	Wakkanai	45°23′36″	141°41′22″	Koitoi	MINATO et al. (1956) OSANAI (1954)
Km-4937	harter Tonstein	Sakanoshita	45°22′30″	141°39′29″	Wakkanai	Ebenda
Km-5034	weißer, tuffreicher Tonstein	Magarifuchi	45°15′38″	141°54′57″	Masuporo	MINATO et al. (1956) TAKAHASHI und ISHIYAMA (1968)
Km-5037	dunkel-grauer Tonstein	Ebenda	45°15′39″	141°54′50″	Ebenda	Ebenda
Km-5041	weißer, tuffreicher Tonstein	Ebenda	45°15′30″	141°54′34″	Koitoi	Ebenda
Km-5149	grauer, sandiger Tonstein	Utakoshi	44°37′58″	141°47′45″	Mochikubetsu	MINATO et al. (1956) HATA (1961)
Km-5151	dunkel-grauer Siltstein	Ebenda	44°37′47″	141°47′44″	Ebenda	Ebenda
Km-5152	grauer, feinkörniger Sandstein	Ebenda	44°37′41″	141°47′41″	Ebenda	Ebenda
Km-5154	Ebenda	Ebenda	44°37′32″	141°47′42″	Ebenda	Ebenda
Km-5158	grauer, sandiger Siltstein	Ebenda	44°37′14″	141°47′40″	Enbetsu	Ebenda
Km-5340	dunkel-grauer tuffreicher Tonstein	Magarifuchi	45°15′33″	141°54′43″	Masuporo	MINATO et al. (1956) TAKAHASHI und ISHIYAMA (1968)
Km-5356	Ebenda	Ebenda	45°15′18″	141°55′43″	Onishibetsu	Ebenda
Fo-11	aschenreicher Kieselgur	Toyotomi	44° 5′14″	141°19′17″	Koitoi	MINATO et al. (1956) NAGAO (1960)
Fj-2730	grauer, sandiger Siltstein	Toyosaki	44°33′12″	141°49′45″	Kotanbetsu	MINATO et al. (1956) HATA (1961)

nen parallelen Seiten und kopfig gerundeten Enden; Valvarfläche fast flach oder etwa angeschwellen, mit einige sehr beschränkten, apikal angeordneten Areolenreichen und gleichfalls, gleichartig geschwundenen Pseudoraphe, mit dagegen lang ausgedehnten, strukturlosen Zentralarea und mit beiden buckelartig aufgetriebenen Polknoten, ohne Transapikalrippen wie bei *Plagiogramma* GREVILLE, 1859, knotenartigen Zentralstruktur und Stachelkranz bei *Glyphodesmis* GREVILLE, 1862 oder Gallertporen am Schalenende bei *Synedra* EHRENBERG, 1830.

Bemerkungen: Die neue Gattung ist vielleicht wegen der buckelartigen Endknoten mit *Dimerogramma* RALFS in PRITCHARD, 1861 und *Glyphodesmis* GREVILLE, 1862 am nächsten und mit *Plagiogramma* GREVILLE, 1859 näher verwandt, sie kann aber von ihnen durch die hyaline durchquerende Zentralarea leicht unterschieden werden. Sie ist auch wegen des Fehlen von Zwischenbändern und Septen und des zur Apikal- und Transapikalebene spiegelsymmetrischen, linearen Umrisses zur Gattung *Synedra*, vor allem Untergattung *Eusynedra* EHRENBERG, 1830 nahestehend, von der sie sich aber deutlich durch Vorhandensein der sehr breiten Zentralarea, engerer Areolenfelder und der buckelartigen Polfelder unterscheidet.

Auch erinnert sie in ihrer äußeren Gestalt an die Gattung *Thalassionema* GRUNOW, 1881, aber wegen der Verschiedenheit von Kolonienbildungsweise und des Fehlen der Gallertporen und randständiger Dörnchen kann man sie nicht damit verbinden.

Die oben erwähnten strukturellen Unterscheidungseigentümlichkeiten rechtfertigen nach meiner Meinung die Abtrennung einer Gruppe von den betreffenden folgenden Formen als besondere neue Gattung.

Sawamuraia biseriata, n. sp.

Namengebung: bi (lat.)=zwei und series (lat.)=Reihe, nach dem Ordnungszustande der Areolen.

Holotypus: Präparat Nr. JAPEX Km-4937(2)=7.8×88.2(Fm10755), Taf. 40 Fig. 1, Abb. 2 Fig. 1.

Paratypen: Präparat Nr. JAPEX Km-5034(19)=10.2×88.3(Fm13729, 13555); Abb. 2 Fig. 5a, b; Präparat Nr. JAPEX Km-5356(5)=10.4×78.9(Fm13527), Taf. 41 Fig. 3; Präparat Nr. JAPEX Fo-11(12)=16.9 ×85.5(Fm11861), Abb. 2 Fig. 2; Präparat Nr. JAPEX Fo-11(16)=14.8×91.7(Fm12050), Abb. 2 Fig. 4.

Material: 6 Exemplare.

Typuslage: Meeresklippe am Kleinortschaft Sakanoshita in der Stadt Wakkanai, Tenpoku-Gebiet, Provinz Hokkaido, Japan.

Typusablagerung: Wakkanai-Schichten, Obermiozän.

Beschreibung: Zellen einzeln oder zuweilen mit den Schalenseiten zur kurzen Bändern verbunden, in Gürtelansicht linear-tafelförmig, vierkantig, an den Polen etwas erweitert; Schalen sehr schmal linear bis linear-lanzettlich, oft leicht gekrümmt oder sigmaförmig gebogen, mit den unterhalb der Enden leicht verschmälerten und aus dem Schalenniveau leicht gesenkten Bändern, auf oben denen die Ornamentierung beschränkt ist, mit breit kopfig gerundeten Polen und mit parallel oder leicht erweiterten Seiten, 30-84μ lang, 3-6μ breit; Schalenwand areoliert; Areolen klein, rund, zwi Paare von apikal gerichteten parallelen geraden Längsreihen bildend, nur vor den Polfeldern beschränkt; Pseudoraphe weit, linear, gleichartig beschränkt, 2-7μ lang; Polfelder ziemlich groß, scheinbar hyalin, buckelartig aufgetrieben; Zentralarea zu einer weiten, linearen, hyalinen und ganz strukturlosen Ausdehnung erweitert, etwa

sieben Zehntel von der gazen Schalenlänge einnehmend, 17-61μ lang.

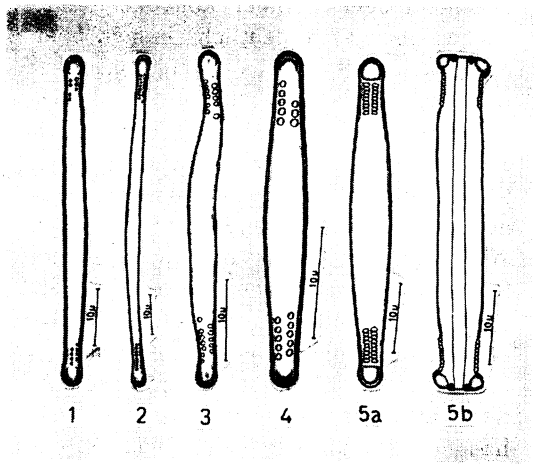


Abb. 2. *Sawamuraia biseriata*, n. sp.

Bemerkungen: Die Art ist in Tenpoku-Proben häufig und sehr variabel hinsichtlich ihrer Länge der Schale und Entwicklung der Areolenreihe. Charakteristisch sind die zweireihigen beschränkten Areolen.

Sawamuraia quadriseriata, n. sp.

Namengebung: quattuor (lat.)=vier und series (lat.)=Reihe, nach der Zahl der Areolenreihen.

Holotypus: Präparat Nr. JAPEX Km-5154(2)=12.2×90.0(Fm12397), Taf. 40 Fig. 2, Abb. 3 Fig. 1.

Paratypen: Präparat Nr. JAPEX Km-3519(11)=8.0×89.3(Fm8505), Taf. 40 Fig. 3, Abb. 3 Fig. 3; Präparat Nr. JAPEX Fo-11(1)=6.4×94.2(Fm11669), Abb. 3 Fig. 4; Präparat Nr. JAPEX Fo-11(1)=14.8×91.3(Fm11658), Abb. 3 Fig. 2.

Material: 4 Exemplare.

Typuslage: Meeresklippe, zirka 1,3 km nordlich der Ortschaft Shosanbetsu, Tenpoku-Gebiet.

Typusablagerung: Mochikubetsu-Schichten, Unterpliozän.

Beschreibung: Schalen 31-52μ lang, 4-5μ breit; Areolen vier Paare von apikal gerichteten, geraden und miteinander parallelen Langsreihen bildend, 12-14 in 10μ; die übrigen morphologischen Charakteristiken wie bei typischer Art.

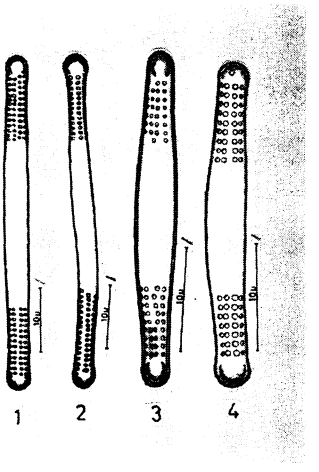


Abb. 3. *Sawamuraia quadriseriata*, n. sp.

Bemerkungen: Sehr nahe verwandt mit der vorigen Typus-Art, unterscheidet die Art sich von ihr durch nicht zwei sondern vier Areolenreihen.

Sawamuraia multibullata, n. sp.

Namengebung: multus (lat.)=viel und bullatus (lat.)=schäumend, nach der Mehrzahl der apikal geordneten Areolenreihen.

Holotypus: Präparat Nr. JAPEX Fo-11(15)=7-9×90.2(Fm12032), Taf. 40 Fig. 4, Abb. 4 Fig. 1.

Paratypus: Präparat Nr. JAPEX Fo-11(11)=12.3×82.8(Fm12045), Taf. 40, Fig. 5, Abb. 4 Fig. 2.

Material: 2 Exemplare.

Typuslage: Ein Aufschluß, etwa 3,8 km südöstlich der Kleinstadt Toyotomi, Tenpoku-Gebiet.

Typusablagerung: Koitoi-Schichten, Oberstmiozän.

Beschreibung: Schalen linear oder li-

near-lanzettlich, leicht sigmaförmig gebogen, 36-63μ lang, 5-6μ breit; Schalenwände zart areoliert; Areolen in geraden Transapikalreihen 12-13 in 10μ. etwas breiter als Längsreihen 14-18 in 10μ; sonst wie die Typus-Art der Gattung.

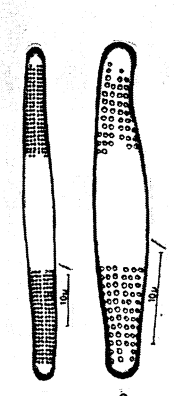


Abb. 4. *Sawamuraia multibullata*, n. sp.

Bemerkungen: Die Art, die vielleicht die stratigraphisch kürzere Verbreitung hat, unterscheidet sich von den übrigen Vertreterinnen der Gattung durch drei oder mehr Paare von Längsareolenreihen.

Familie Epithemiaceae KARSTEN, 1928

Gattung *Katahiraia*, n. gen.

Namengebung: Nach dem japanischen Erdölgeologen, Herrn Dr. Tadami KATAHIRA, JAPEX.

Typusart: Katahiraia aspera, n. sp.

Beschreibung: Zellen frei, einzeln oder mit den Schalenseiten zu dicht geschlossenen Bändern verbunden, sehr stark verkieselt, in Gürtelansicht von rechteckigem und bikonvexem Umriß, mit Kanalraphe, Pseudosepten und Septa, mit Zwischenbändern, ohne Knoten oder Kiele; Schalen eng bis breit linear-lanzettlich, zuweilen in der Mitte transapikal eingeschnürt, von der Mitte gegen den Enden abfallend, mit gerundeten bis leicht geschnabelten Enden und mehr oder weniger konvexer Oberfläche; Axialarea deutlich, immer über Kanalraphe als hyaline Längszone entwickelt; Schalenoberfläche durchweg areoliert, obgleich mit enger hyalinen Axialarea unterbrochen; Areolen grob, isoliert, unregelmäßig sowohl in der Ordnung als im Umriß, von innen nach außen an der Schale mehr oder weniger an Größe abnehmend aber an Gürteloberfläche weit größer und etwas beständig, darin mit einigen Poroiden; Zellwandverdickungen (im Beschreibungsabschnitt der Gattungstypus unten erwähnt) vorhanden; Kanalraphe sehr dick, in der Schalenmittellinie oder leicht seitlich, nie bis in die Seitenkante, verschoben, vom Pol bis an den Pol durchlaufend, mit einer Reihe von knotenartigen Raphenanschwellungen von größerem Durchmesser darin mit Kanalöffnung; Septa über die ganze Valvarfläche entwickelt, mit einer in der Axialrichtung angeordneten Reihe von größen Fenster; Pseudosepten zwischen den beiden Schalenrändern meistens parallel zur Transapikalachse verlaufend, tief ins Zellinnere eindringend.

Bemerkungen: Aufgrund der ungekielten Kanalraphe und transapikalen Pseudosepten stelle ich die neue Gattung zur Familie Epithemiaceae. Sie ist in erstem Anblick sicher verwandt mit Denticula Kützing, 1844, unterscheidet sich aber von dieser Gattung besonders durch das Vorhandensein viel größerer poroidierter Areolen und ihrer unregelmäßigen Anordnung. Die Areolen sind niemals regelmäßig angeordnet, somit werden alle Katahiraia-Arten zu jeder der drei Symmetrieebenen asymmetrisch.

Es geht mir darum, daß alle zu Arten der Gattung gehörigen Individuen auf jeden Fall die deutlichen randständigen Zellwandverdickungen tragen, wenn auch

diese Struktur bislang von keinem Autor für das den Gattungsrang charakterisierende Merkmal, über welches ich bei anderen Gelegenheit eingehender spreche, genommen worden ist.

Durch die letzteren elektronenmikroskopischen Untersuchungen ist bestätigt worden, daß der Bau der Raphe ein erstrangiges Merkmal für die systematische Gliederung der Raphideen ist, und daß der Zusammenhang mit ihrer Lage außerordentliche phylogenetische Bedeutung hat (vgl. Geißler und Gerloff, 1963).

Katahiraia aspera, n. sp.

Namengebung: asper (lat.)=grob, nach der groben und unregelmäßigen Ornamentierung an den Schalen.

Holotypus: Präparat Nr. JAPEX Fj-2730(3)=8.9×91.8(Fm8338), Taf. 41 Fig. 1, Abb. 5 Fig. 1.

Paratypen: Präparat Nr. JAPEX Fj-2730(6)=6.0×78.8(Fm13485), Taf. 41 Fig. 3, Abb. 5 Fig. 5; Präparat Nr. JAPEX Fj-2730(13)=4.4×82.0(Fm13452,13453), Taf. 41 Fig. 2, Abb. 5 Fig. 6a, b; Präparat Nr. JAPEX Fj-2730(11)=19.4×77.9(Fm13463, 13462), Taf. 41 Fig. 4, Abb. 5 Fig. 3; Präparat Nr. JAPEX Fj-2730(3)=14.0×86.1 (Fm13737), Abb. 5 Fig. 2; Präparat Nr. JAPEX Fj-2730(6)=9.5×85.7(Fm13478), Abb. 5 Fig. 4; Präparat Nr. JAPEX Fj-2730(14)=4.6×80.8(Fm13438), Abb. 5 Fig. 7; Präparat Nr. JAPEX Fj-2730(3)=10.1 ×85.3(Fm13756), Abb. 5 Fig. 8.

Material: 9 Exemplare.

Typuslage: Eine Klippe am Nordufer des Flusses Furenbetsugawa, um 3,6 km südostlich der Kleinortschaft Toyosaki, Shosanbetsu.

Typusablagerung: Kotanbetsu-Schichten, Mittelmiozän.

Beschreibung: Zellen einzeln lebend oder zuweilen am Schalenrand zu Bändern verbunden, in Gürtelansicht rechteckig mit leicht bogig gekrümmten Rändern und spitzen bis gerundeten Ecken; Zwischenbänder hyalin und deutlich ringförmig; Schalen stark verkieselt, robust, breit linear-lanzettlich, stark konvex, mit stumpf gerundeten Enden, 25-38μ lang, 10-13μ breit, 4-8μ hoch; Axialarea eng, an den beiden Seiten der Kanalraphe und daroben vom Pol bis an den Pol völlig laufend, ohne Mittelfeld, zirka 1μ breit; Schalenmembranen dick, durchweg areoliert; Areolen grob, sehr unregelmäßig sowohl im Umriß als in der Größe sowie Ordnung, 3-7 in 10μ, darin mit 1-5 winzigen Poroiden (nur durch Phasenmikroskop lichtoptisch deutlich erkennbar, zuweilen in unsere Abbildungen nicht dargestellt); Kanalraphe sehr deutlich, ziemlich dick, vom Pol bis an den Pol in der Mittellinie gerade verlaufend, mit je einer großen elliptischen Raphenanschwellung zwischen den Pseudosepten, daher wie eine einfachen Knotenreihe erscheinend; Kanalöffnungen eine für jeder Anschwellung, 4-5 in 10μ; Septa ganz entwickelt, zwischen den Gürtel- und Zwischenbande angelegt, mit zahlreichen, großen, rundlichen Fenster, etwa 3 in 10μ; Pseudosepten fast miteinander parallel und ziemlich zur Apikalachse senkrecht jedoch oft wellig gebogen, 4-5 in 10μ; Sekundäre Pseudosepten (=secondary pseudosepta *sensu* KANAYA, 1951, S. 112) fehlen, stattdessen marginale Zellwandverdickungen (d.h. "marginal rib-like wall thicknings" *sensu* SIMONSEN and KANAYA, 1961, S. 499) vorhanden; Zellwandverdickungen dick, kurz, gegenüber einander an den beiden Seiten angestoßt, 1-2 zwischen je beide Pseudosepten, 3-4 in 10μ.

Bemerkungen: Charakteristisch sind der breitere, linear-lanzettliche Umriß und die stark geschwollene Oberfläche. In Tenpoku ist die Art sporadisch und nur selten häufig, aber erscheint eine stratigraphisch eingeschränkte Verbreitung zu

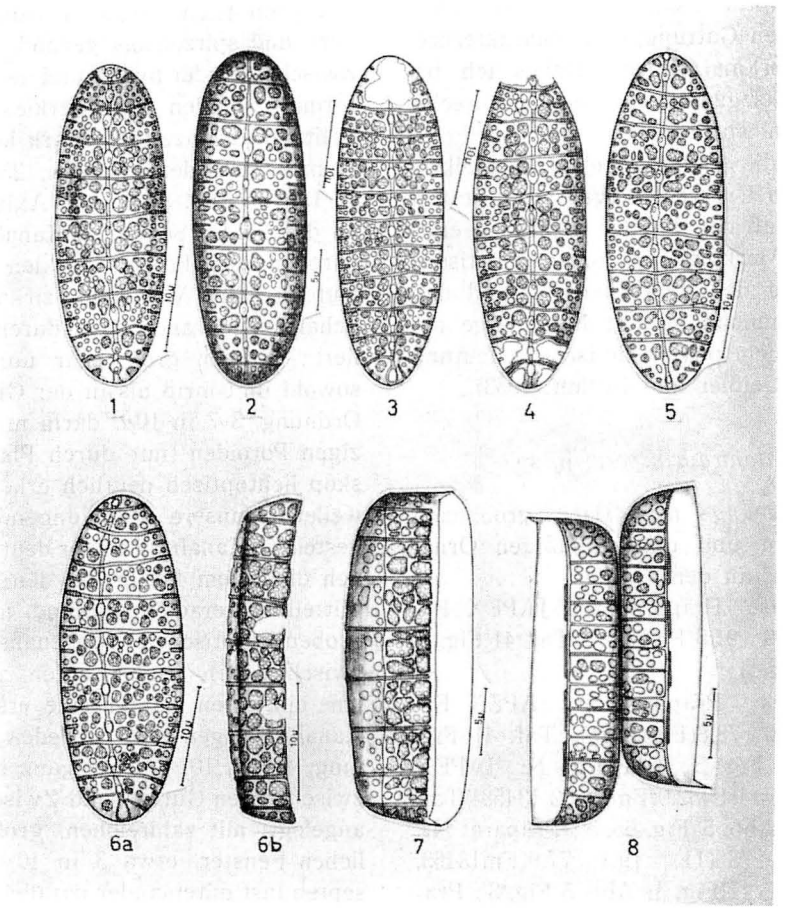


Abb. 5. *Katahiraia aspera*, n. sp.

haben.

Katahiraia oblonga, n. sp.

Namengebung: oblongus (lat.)=langelliptisch, nach dem Umriß.

Holotypus: Präparat Nr. JAPEX Km-5151(1)=14.8×83.1(Fm12302), Taf. 41 Fig. 6, Abb. 6 Fig. 1.

Paratypen: Präparat Nr. JAPEX Km-5152(7)=15.5×89.5(Fm13769), Abb. 6 Fig. 2; Präparat Nr. JAPEX Km-5158(4)=11.5×84.7(Fm13762), Abb. 6 Fig. 3; Präparat Nr. JAPEX Km-5151(2)=9.2×85.9 (Fm13772), Abb. 6 Fig. 4.

Material: 4 Exemplare.

Typuslage: Meeresklippe, etwa 0,9 km südlich der Kleinortschaft Utakoshi in der Kleinstadt Enbetsu, Tenpoku-Gebiet.

Typusablagerung: Mochikubetsu-Schichten, Unterpliozän.

Beschreibung: Schalen sehr stark verkieselt, linear-oblong, mit fast parallelen oder wenig konkaven Rändern und breit gerundeten Enden, 20-28μ lang, 6-8μ breit, ca. 5μ hoch; Axialarea schmal, linear, unregelmäßig begrenzt, ohne Zentralarea, etwa 0,6-1,0μ breit; Schalenoberfläche grob areoliert; Areolen rundlich-vieleckig bis rundlich-elliptisch, von

innen nach außen deutlich an Größe abnehmend, unregelmäßig eng zerstreut, 4-12 in 10μ, darin mit 1-4 undeutlichen Poroiden; Kanalraphe deutlich, dick, mehr oder weniger der Schalenmittellinie genähert, vom Pol bis an den Pol gerade oder leicht bogig verlaufend, mit je einer elliptischen Raphenanschwellung zwischen den Pseudosepten, daher gleichartig wie bei Typus-Art der Gattung als eine einfachen Knotenreihe erscheinend; Kanalöffnungen eine für jeder Anschwellung, 4-5 in 10μ; Septa völlig entwickelt, mit eine Reihe von großen Fenster von etwa 4 in 10μ; Pseudosepten zwischen den beiden Schalenseiten parallel zur Transapikalachse verlaufend, oft leicht gekrümmt, 4-5 in 10μ; Zellwandverdickungen etwas lang, parallel zur Pseudosepten, senkrecht zum Schalenrand nach Mittellinie innen hervorgestoßen, 4-6 in 10μ, 1-2 zwischen den Pseudosepten.

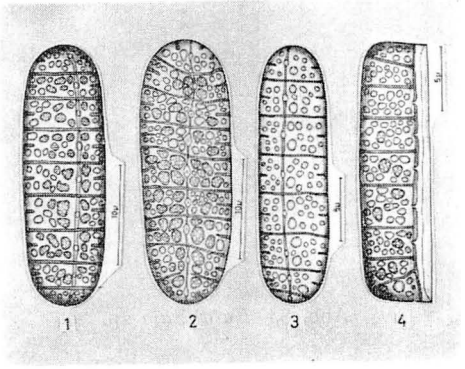


Abb. 6. *Katahiraia oblonga*, n. sp.

Bemerkungen: Schalen sind denjenigen der vorigen typischen Art ähnlich, unterscheiden sich aber durch die fast parallelen Schalenseiten und die weniger konvexe Oberfläche. Übergangsformen zur typischen Art sind bisher nicht nur morphologisch sondern auch stratigraphisch noch nicht gefunden worden, das heißt, die beiden Arten bestehen nicht zusammen mit einander.

Katahiraia pauperata, n. sp.

Namengebung: pauper (lat.)=arm, nach der schwachen Entwicklung der Areolen.

Holotypus: Präparat Nr. JAPEX Km-5149(2)=16.1×79.9(Fm12208), Taf. 41 Fig. 7, Abb. 7.

Material: 1 Exemplar.

Typuslage: Meeresklippe, zirka 0,5 km südlich der Kleinortschaft Utakoshi in der Kleinstadt Enbetsu, Tenpoku-Gebiet.

Typusablagerung: Mochikubetsu-Schichten, Unterpliozän.

Beschreibung: Schale stark verkieselt, ziemlich linear, konvex, an den Enden stumpf abgerundet, mit fast parallelen Seiten, schwach bogig-gekrümmt, 48μ lang, 9μ breit; Schalenfläche dicht areoliert; Areolen kleiner und dichter als, und unregelmäßig wie, bei der andern Arten der Gattung, etwa 7 in 10μ, darin mit 1-3 winzigen Poroiden; Axialarea eng, unregelmäßig begrenzt; Kanalraphe sehr deutlich, von Pol bis an den Pol in der Mittellinie gerade laufend, mit je einer knotigen, elliptischen oder rundlichen Raphenanschwellung zwischen den beiden Pseudosepten wie bei der vorigen Arten; Kanalöffnungen durch Lichtmikroskop sehr schwer zu erkennen, vermut-

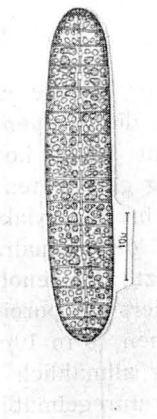


Abb. 7. *Katahiraia pauperata*, n. sp.

lich eine innerhalb einer Anschwellung; Septa völlig entwickelt, mit zahlreichen großen rundlichen Fenster (3 in 10μ); Pseudosepten gerade, vor den Seiten dichter bekommend, miteinander parallel aber zuweilen wellig gekrümmt, in der Schalenmitte zur beiden Rändern senkrecht, 4-5 in 10μ; Zellwandverdickungen dick, kurz, gegenüber einander und mit Pseudosepten abwechsend an den beiden Seiten angestoßt, 4-5 in 10μ.

Bemerkungen: Die Art ist nur durch ein Exemplar vertreten, aber ihr Ornamentierungsmerkmale bestehen außer der Variationsbereich der übrigen neue Arten wie in Abbildungen (Abb. 5, Fig. 1-8; Abb. 6, Fig. 1-4) gezeigt. Eine neue Art dürfte deshalb hier proponiert werden.

Sie unterscheidet sich von vorigen Arten hauptsächlich durch die kleineren Areolen und ihre dichteren Ordnung.

Katahiraia sp.

Typuskollektion: Präparat Nr. JAPEX Km-5340(3)=14.6×84.0(Fm13513), Taf. 40 Fig. 13, Abb. 8.

Material: 1 Exemplar.

Fundort: Ein Aufschluß am Südufer des Uruyagawa-Flusses, ca. 0,9 km östlich des Eisenbahnhofs Magarifuchi, Tenpoku-Gebiet.

Fundschicht: Masuporo-Schichten, Mittelmiozän.

Beschreibung: Schale weit schwacher verkieselt als die übrigen Arten, linearlanzettlich mit leicht konkaven Seiten und keilförmig gerundeten (?) Enden, um 40μ lang, 8μ breit; Axialarea eng, hyalin, um oben den Kanalraphe, unregelmäßig begrenzt; Schalenoberfläche leicht konvex, areoliert und poroidiert; Areolen grob, von innen (6 in 10μ) nach außen (8 in 10μ) nur allmählich an Größe abnehmend, sehr unregelmäßig wie bei allen vorliegenden hier genannten Arteu der Gattung zerstreut, darin mit 1-5 winzigen Poroiden; Kanalraphe sehr deutlich, dick, in der Mittellinie gerade verlaufend, mit je einer großen elliptischen knotenartigen Raphenanschwellung mit darin einer Kanalöffnung zwischen den Pseudosepten, 4 in 10μ; Septa ganz entwickelt mit großen Fenster, je eines zwischen den Pseudosepten; Pseudosepten gerade oder etwas im Zickzack gekrümmt, parallel mit einander und senkrecht zur Mittellinie laufend, vor an den Seiten stabförmig verdickt, 4 in 10μ; Zellwandverdickungen dick, kurz, kopfig, ein Paar von Dickungen stets gegenüber einander und zwischen den beiden Pseudosepten an den Seiten angestoßt, 4 in 10μ.

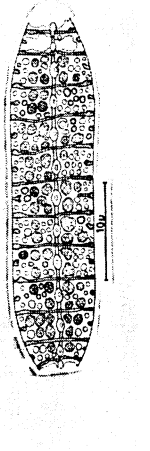


Abb. 8. *Katahiraia* sp.

Bemerkungen: Die Art kann sich von den andern Arten der Gattung durch die schwacher verkieselten, weniger konvexen und eingeschnürten Schale unterscheiden, jedoch ist durch Areolenmerkmale (Große und Ordnung) mit *Katahiraia aspera*, die Typus-Art der Gattung als mit den übrigen näher verwandt.

Da bisher nur diese eine bestätigte Schale gefunden ist, bleibt die Art vorläufig als neu unbenannt.

Gattung *Yoshidaia*, n. gen.

Namengebung: Nach dem japanischen Erdölgeologen, Herrn Yoshitaka YOSHIDA, JAPEX.

Typusart: Yoshidaia divergens, n. sp.

Beschreibung: Zellen frei, einzeln oder mit den Schalenseiten zu kurzen dichtgeschlossenen Bändern vereinigt, meistens sehr kräftig verkieselt, in Gürtelansicht rechteckig-tafelförmig, mit Kanalraphe, Septa mit Zwischenbändern und Pseudosepten, ohne Endknoten oder Kiele; Schalen linear bis linear-lanzettlich, mit gerundeten Enden und meistens transapikal gewölbter Schalenoberfläche; Zellmembranen sowohl an der Schalen- als Gürtelfläche im allgemeinen mit feinen Streifen regel- und gleichmäßig strukturiert, nicht areoliert wie bei vorigen Gattung; Axialarea deutlich, verhältnismäßig breit, stets über Kanalraphe als eine hyaline gestreckte Längszone über die ganze Oberfläche völlig entwickelt; Kanalraphe deutlich, in der Mittellinie oder mindestens vor den Pol dort stehend, mit zahlreichen knotenartigen Anschwellungen; Kanalöffnungen vorhanden; Septa flach, vollständig entwickelt, mit einer Apikalreihe von rundlichen bis elliptischen Fenster; Pseudosepten gerade, gekrümmt oder gegabelt und divergent oder senkrecht zur Apikalachse, gewöhnlich mehr als bei der vorigen Gattung; Zellwandverdickungen randständig und stabförmig oder kopfig.

Bemerkungen: Gegen die dichte Verwandtschaft zur vorigen neu beschriebenen Gattung sprechen eindeutig einige fundamentale Strukturmerkmale wie Umriß, Pseudosepta, Kanalraphe, u.ä., und die Gattung unterscheidet sich durch die regelmäßig angeordnete Ornamentstruktur an der Valvarfläche, demnach auch durch die dreidimensionale Symmetrie.

Yoshidaia kann von allen übrigen kanalraphetragenden Gattungen durch die durch Anschwellungen charakterisierte Raphen-Eigentümlichkeit unterschieden werden.

Yoshidaia divergens, n. sp.

Namengebung: vergo (lat.)=herankommen oder hinneigen, nach der Ordnungsweise der Pseudosepta.

Holotypus: Präparat Nr. JAPEX Km-5034(18)=6.0×83.8(Fm13615), Taf. 40 Fig. 6, Abb. 9 Fig. 1.

Paratypen: Präparat Nr. JAPEX Km-5034(14)=14.5×76.0(Fm13647), Abb. 9 Fig. 2; Präparat Nr. JAPEX Km-5034(18)=13.6×80.7(Fm13618), Abb. 9 Fig. 3.

Material: 4 Exemplare.

Typuslage: Ein Aufschluß am Nordufer des Uruyagawa-Flusses, um 1,3 km östlich des Eisenbahnhofs Magarifuchi, Tenpoku-Gebiet.

Typusablagerung: Masuporo-Schichten, Mittelmiozän.

Beschreibung: Zellen verhältnismäßig stark verkieselt, einzeln, in Gürtelansicht rechteckig-tafelförmig, mit geraden, vor dem Pol etwas eingesenkten Rändern; Schalen typisch linear, zuweilen transapikal leicht-konvex, fast gerade aber oft sigmaförmig gebogen, mit parallelen Rändern und stumpf gerundeten Enden, 31-46μ lang, 6-7μ breit; Valvarmembranen zart und regelmäßig strukturiert; Transapikalstreifen sehr fein, oft teilweise fehlend, zart poroidiert, 17-19 in 10μ, 2-5 zwischen den beiden Pseudosepten; Poroide in Quinkunx, transapikalwärts 19-22 in 10μ, die zur Kanalraphe nächsten Poroiden oft größer werdend, und daher einer Paar von Längsreihen der leicht vergrößerten Poroiden entlang beiderseits des Kanalraphe gegenüber laufend; Axialarea eng, unregelmäßig begrenzt, ohne Mittelfeld; Kanalraphe sehr deutlich, in der Mittellinie oder etwas seitlich dersel-

ben, gerade oder leicht wellig verbogen, von Pol bis an den Pol völlig entwickelt, mit groberer elliptischer Anschwellungen auf eine gleiche Entfernung, 5 in 10μ, je eine zwischen den Pseudosepten liegend, deswegen wie eine einfachen Knotenkette erscheinend; Kanalöffnungen sehr winzig, je eine innerhalb der Raphenanschwellung; Septa flach, mit zahlreichen größen Öffnungen, je eine gleichfalls wie bei Raphenanschwellung; Pseudosepten tief eindringend, im allgemeinen gerade und parallel, jedoch mit Tendenz gegen der morphologisch gleichen Seite zu divergieren, vor dem Schalenrande sich zu gabeln und besonders in der Nähe der Enden kurbelartig sich zu krümmen, 4-5 in 10μ; Zellwandverdickungen kurz, randständig, gegenüber einander bestehend, je eine Paar zwischen den beiden Pseudosepten.

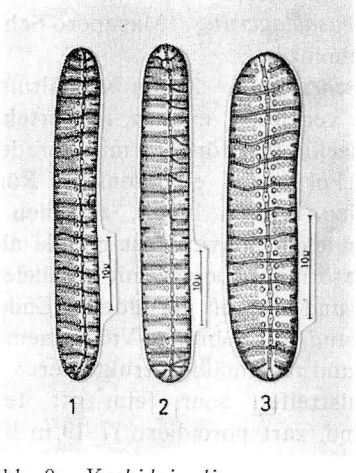


Abb. 9. *Yoshidaia divergens*, n. sp.

Bemerkungen: Die vorliegende Art ist hinsichtlich der diversierten und gekrümmten Pseudosepta und des parallelen Schalenrandes charakteristisch. Sie tritt in Tenpoku-Proben am häufigsten von allen *Yoshidaia*-Arten auf.

Yoshidaia constricta, n. sp.

Namengebung: constringo (lat.)=fest binden, nach dem eingeschnürten Schalenumriß.

Holotypus: Präparat Nr. JAPEX Km-5037(9)=10.6×90.5(Fm10222), Taf. 40 Fig. 9, Abb. 10 Fig. 1.

Paratypen: Präparat Nr. JAPEX Km-5037(8)=10.4×81.7(Fm10101), Taf. 40 Fig. 10, Abb. 10 Fig. 2; Präparat Nr. JAPEX Km-5034(2)=11.6×80.0(Fm13664), Abb. 10 Fig. 3.

Material: 3 Exemplare.

Typuslage: Ein Aufschluß am Südufer des Uruyagawa-Flusses, ca. 1,1 km östlich des Eisenbahnhofs Magarifuchi, Tenpoku-Gebiet.

Typusablagerung: Masuporo-Schichten, Mittelmiozän.

Beschreibung: Zellen frei, einzeln; Schalen linear, stark gewölbt, mit in der Mitte eingeschnürten Seiten und stumpf bis keilförmig gerundeten, zuweilen etwas vorgezogenen Enden, mehr oder weniger heteropol im Umriß, 36-48μ lang, 5-6μ in der Mitte 6-7μ vor den Enden breit; Axialarea schmal, linear, durch kammerartige Struktur unregelmäßig und wellig begrenzt, ohne Zentralarea; Valvarwände linear gestreift; Transapikalstreifen sehr fein, oft schwer zu erkennen, durch hyaline Axialarea stets unterbrochen, parallel zu Pseudosepten, poroidiert, 12-15 in 10μ, 1-3 zwischen den Pseudosepten; Poroiden lichtoptisch nur undeutlich sichtbar, 18-20 in 10μ, die einige vor den inneren Enden leicht vergrößert, verdickt und miteinander vereinigt, so daß uranfängliches unvollständiges Kämmerchen sich bildend; Kanalraphe deutlich, ziemlich gerade, in der Mittellinie oder dazunächst, mit gleich-entfernter verbreiteten elliptischen anschwellungen, je eine vor der Zellwandverdickung, 5-6 in 10μ; Kanalöffnungen äußerst winzig, kaum unter-

scheidbar durch Lichtmikroskop; Pseudosepten divergent, in der Schalenmitte gerade, miteinander parallel und zur apikalachse senkrecht, aber in der Nähe der Schalenenden mit Apikalchse einen spitzen Winkel bildend und kurbelähnlich gebrochen oder zweiästig gegabelt, 5-7 in 10μ; Zellwandverdickungen kurz, randständig, knotig oder kopfig, mit Pseudosepta wechselnd und dazwischen gepaart, 5-7 in 10μ.

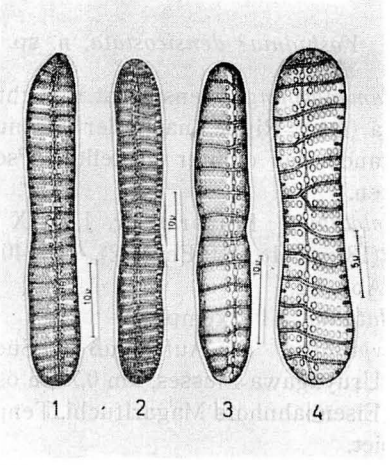


Abb. 10. *Yoshidaia constricta*, n. sp.

Bemerkungen: Keins der untersuchten Exemplare scheint die wahrhaften Septa zu tragen, trotzdem wird die Art sicher wegen der Übereinstimmung von Eigentümlichkeiten in bezug auf die Kanalraphe und Zellwandstruktur zur vorliegende Gattung *Yoshidaia* gestellt. Die septa tragenden Exemplare werden vielleicht durch zukünftige Forschungen gefunden worden.

Yoshidaia constricta wird durch den eingeschnürten Umriß und die teilweise gebildete uranfänglichen Kämmerchen von der typischen Art der Gattung unterschieden.

Yoshidaia loculata, n. sp.

Namengebung: loculus (lat.)=Schmalplatz, nach der in zahlreichen Kämmerchen geteilten Schalenmembran.

Holotypus: Präparat Nr. JAPEX Km-5041(16)=13.9×93.4(Fm9636), Taf. 40 Fig. 11, Abb. 11 Fig. 1.

Paratypen: Präparat Nr. JAPEX Km-5041(35)=6.5×79.7 (Fm13495), Taf. 41 Fig. 9, Abb. 11 Fig. 5; Präparat Nr. JAPEX Km-5041(34)=8.2×76.8(Fm13534), Abb. 11 Fig. 2; Präparat Nr. JAPEX Km -5041(33) = 11.4 × 83.7(Fm13540), Abb. 11 Fig. 3; Präparat Nr. JAPEX Km-5041(13) =13.2×83.2(Fm13543), Abb. 11 Fig. 4.

Material: 5 Exemplare.

Typuslage: Ein Aufschluß am Südufer des Uruyagawa-Flusses, um 0,7 km östlich des Eisenbahnhofs Magarifuchi, Tenpoku-Gebiet.

Typusablagerung: Koitoi-Schichten, Oberstmiozän.

Beschreibung: Zellen frei, einzeln oder zuweilen mit den Schalenseiten zu kurzen dicht geschlossenen Bändern verbunden, sehr kräftig verkieselt, in Gürtelansicht rechteckig-tafelförmig mit in der Mitte geraden, vor den Polen allmählich eingesenkten Rändern und abgerundeten Ecken; Schalen linear, stark gewölbt, mit parallelen Rändern und breit gerundeten Enden, 44-49μ lang, 6-8μ breit; Zellwände kompliziert jedoch regelmäßig strukturiert, gekammert und gestreift; Kammern auf der Valvarfläche lang-rechteckig, transapikal gerichtet, beiderseits der Kanalraphe gegenüber paarig geordnet, in einer Seite durch die Axialarea begrenzt und in der andern mit dem Valvarrande geschlossen, ungeteilt, 7-9 in 10μ, je 2-5 zwischen den beiden Pseudosepten; Transapikalstreifen sehr fein, poroidiert, senkrecht zur Mittellinie in Doppelreihen, stets innerhalb der Kammer beschränkt, 13-17 in 10μ; Poroide sehr winzig, licht-

optisch erkennbar nur durch Phasenmikroskop, 16-24 in 10μ, eine Paar von Längsreihen der etwas vergrößerten Poroiden entlang beiderseits der Axialarea oft gebildet; hyaline Zwischenräume zwischen den Kammern als die kräftige Rippe transapikal laufend, an inneren Enden von hyalinen Axialarea gekreuzt und damit einander verschmolzt, an außeren ans Valvarrand reichend und dort stets mit einer von Zellwandverdickungen verbunden; Axialarea schmal, linear, unregelmäßig begrenzt, 0,5-1,0μ breit; Kanalraphe deutlich aber feiner als bei vorigen Arten, vom Pol an den Pol in der Mittellinie gerade laufend, mit kleinen elliptischknotigen gleichentfernten Anschwellungen 8-9 in 10μ, je eine vor der Schalenkammern; Kanalöffnungen unsichtbar; Septa ganz entwickelt, mit zahlreichen, großen, zwischen den Pseudosepten gelegten und elliptischen Fenster (3 in 10μ); Pseudosepten deutlich, gewöhnlich gerade, vor den Polen oft gewellt, senkrecht zum Valvarrand und an dort etwas keulenförmig verdickt, 2-4 in 10μ; Zellwandverdickungen kurz, randstandig, gegenüber einander und dicht angenähert besetzt, 12-16 in 10μ, je eine für jede Schalenkammer und für jeden Zwischenraume.

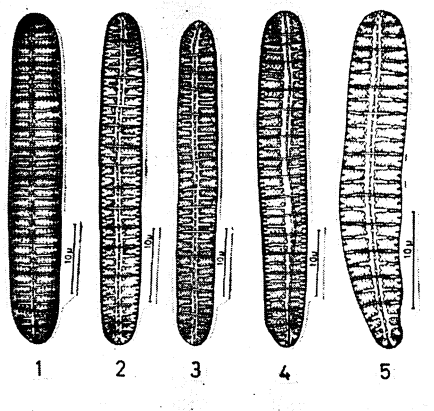


Abb. 11. *Yoshidaia loculata*, n. sp.

Bemerkungen: Die Zellen der Art sind außer vor der Polen apikalweise flach, transapikalweise stark-konvex, und deshalb überhaupt zylindrisch gebildet. Die Art kann sich durch ihre charakteristischen Strukturen, insbesondere die langrechteckigen Kämmerchen und dichter geordneten Zellwandverdickungen von zwei bereits beschriebenen Arten leicht unterscheiden.

Yoshidaia? densicostata, n. sp.

Namengebung: densus (lat.)=dicht und costa (lat.)=Rippe, nach der Ordnungszustande der dichter gestellten Pseudosepten.

Holotypus: Präparat Nr. JAPEX Km-5041(13)=13.4×98.0(Fm9672), Taf. 40 Fig. 12, Abb. 12.

Material: 1 Exemplar.

Typuslage: Ein Aufschluß am Südufer des Uruyagawa-Flusses, um 0,7 km östlich des Eisenbahnhofs Magarifuchi, Tenpoku-Gebiet.

Typusablagerung: Koitoi-Schichten, Oberstmiozän.

Beschreibung: Schale stark verkieselt, linear, mit parallelen Rändern und stumpf gerundeten Enden, 44μ lang, 7μ breit; Schalenoberfläche stark gewölbt, regelmäßig gestreift; Transapikalstreifen zart und undeutlich, in Doppelreihen zwischen den Pseudosepten stehend, von hyaliner Axialarea stets unterbrochen, fein poroidiert, etwa 16 in 10μ; Poroide sehr winzig, unterscheidbar nur durch Phasenmikroskop, 25 in 10μ, eine Paar von Längsporoidenreihen gleicherweise wie bei der Typus-Art der Gattung gebildet; Axialarea gerade, in der Mittellinie, verhältnismäßig breit, ein Sechstel der Schalenbreite besetzend, wellig begrenzt; Kanalraphe gerade, in der Mittellinie deutlich bestehend, enger als die der andern

Arten, mit zahlreichen größeren knotigen Anschwellungen (8-9 in 10μ), je eine zwischen den beiden Pseudosepten; Kanalöffnung unsichtbar; kaum Septa im einfachen Exemplar festgestellt; Pseudosepten deutlich, gerade jedoch zuweilen in der Mitte etwas gekrümmt, senkrecht zur Apikalachse, auf eine dichtere und gleiche Entfernung gestellt, zirka 9 in 10μ; Zellwandverdickungen gar nicht vorhanden.

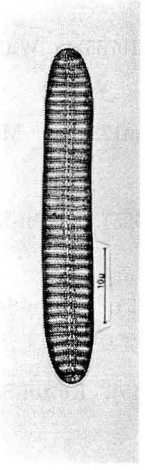


Abb. 12. *Yoshidaia? densicostata*, n. sp.

Bemerkungen: Die Art scheint aufgrund der Verlängerung des linearen Umrisses, der starken Wölbung der Schale und der Doppelreihen der Poroiden mit der vorigen Art, *Yoshidaia loculata* n. sp. verwandt, aber sie unterscheidet sich unterscheidet sich leicht durch das Fehlen der Schalenkämmerchen und das Vorhandensein der weit dichter geordneten Pseudosepten.

Obwohl die Art die für *Yoshidaia* charakteristischen Zellwandverdickungen hat, kann nichts festgestellt werden, da sie beim einzigen Fund fehlen. Die Stellung wird damit unsicher bleiben, bis weitere Exemplare gefunden werden.

Yoshidaia? pupurifera, n. sp.

Namengebung: pupula (lat.)=Pupille und fero (lat.)=tragen, nach der am Rand reihenden augen ähnlichen Poren.

Holotypus: Präparat Nr. JAPEX Km-5034(1)=7.0×89.0(Fm13658), Taf. 41 Fig. 10, Abb. 13 Fig. 4.

Paratypen: Präparat Nr. JAPEX Km-5034(1)=11.1×89.7(Fm13653), Taf. 41 Fig. 11, Abb. 13 Fig. 3; Präparat Nr. JAPEX Km-5034(2)=4.5×88.4(Fm13669), Taf. 41 Fig. 12, Abb. 13 Fig. 1; Präparat Nr. JAPEX Km-5034(2)=15.1×86.5(Fm13661), Abb. 13 Fig. 2.

Material: 4 Exemplare.

Typuslage: Ein Aufschluß am Nordufer des Uruyagawa-Flusses, etwa 1,3 km östlich des Eisenbahnhofs Magarifuchi, Tenpoku-Gebiet.

Typusablagerung: Masuporo-Schichten, Mittelmiozän.

Beschreibung: Zellen frei, einzeln, in Gürtelansicht rechteckig-tafelförmig mit abgerundeten Ecken; Schalen linear-lanzettlich in transapikaler Richtung schwach gewölbt, mit transapikal leicht-erweiterter Mitte und breit bis stumpf gerundeten Enden, zuweilen ein bißchen S-förmig gebogen, 29-36μ lang, 4-8μ breit; Axialarea eng in der Mitte, hyalin, gerade, über Kanalraphe, vor den Polen mehr oder weniger breiter werdend; Valvarmembran gestreift und poroidiert, 9-10 in 10μ; Transapikalstreifen zart, undeutlich, meistens nur unvollkommen entwickelt, stets in einer Reihe zwischen den Pseudosepten und von hyalinear Axialarea unterbrochen; Poroide sehr winzig außer daß die äußersten sehr groß entwickeln, in einer Areole sich zu übergehen und deswegen als eine Längsreihe der augenähnlichen rundlichen Areolen entlang innerhalb des Valvarrandes von Pol bis an den Pol vollständig verlaufen, eine andere Längsreihe der größeren Po-

roiden paarig beiderseits der Kanalraphe mindestens in der Schalenmitte zuweilen gebildet, zwischen diese zwei Arten Längsreihen einige winzige Poroide hauptsächlich in der Nähe der Schalenmitte transapikal geordnet (aber meistens unvollkommen nur in größeren Exemplare); Kanalraphe schmal, gerade, in der Mittellinie gelegen, mit gleichentfernten Raphenanschwellungen, je eine zwischen den bei-

Tafelerklärungen

(Vergrößerung: Jeder schwarze Stock entspricht einheitlich 10 Mikron.)

Tafel 40

Fig. 1. *Sawamuraia biseriata*, n. gen., n. sp.
Holotypus. Präparat Nr. JAPEX Km-4937(2)=7.8×88.2(Fm10755). Wakkanai-Schichten. Obermiozän.

Fig. 2. *Sawamuraia quadriseriata*, n. sp.
Holotypus. Präparat Nr. JAPEX Km-5154(2)=12.2×90.0(Fm12397). Mochikubetsu-Schichten. Unterpliozän.

Fig. 3. *Sawamuraia quadriseriata*, n. sp.
Paratypus. Präparat Nr. JAPEX Km-3519(11)=8.0×89.3(Fm8505). Koitoi-Schichten. Oberstmiozän.

Fig. 4. *Sawamuraia multibullata*, n. sp.
Holotypus. Präparat Nr. JAPEX Fo-11(15)=7.9×90.2(Fm12032). Koitoi-Schichten. Oberstmiozän.

Fig. 5. *Sawamuraia multibullata*, n. sp.
Paratypus. Präparat Nr. JAPEX Fo-11(11)=12.3×82.8(Fm12045). Koitoi-Schichten. Oberstmiozän.

Fig. 6. *Yoshidaia divergens*, n. gen., n. sp.
Holotypus. Präparat Nr. JAPEX Km-5034(18)=6.0×83.8(Fm13615, 13616). Masuporo-Schichten. Mittelmiozän.

Fig. 7. *Yoshidaia divergens*, n. gen., n. sp.
Paratypus. Präparat Nr. JAPEX Km-5034(18)=13.6×80.9(Fm13618, 13620). Masuporo-Schichten. Mittelmiozän.

Fig. 8. *Yoshidaia divergens*, n. gen., n. sp.
Paratypus. Präparat Nr. JAPEX Km-5034(14)=14.5×76.0(Fm13647, 13648). Masuporo-Schichten. Mittelmiozän.

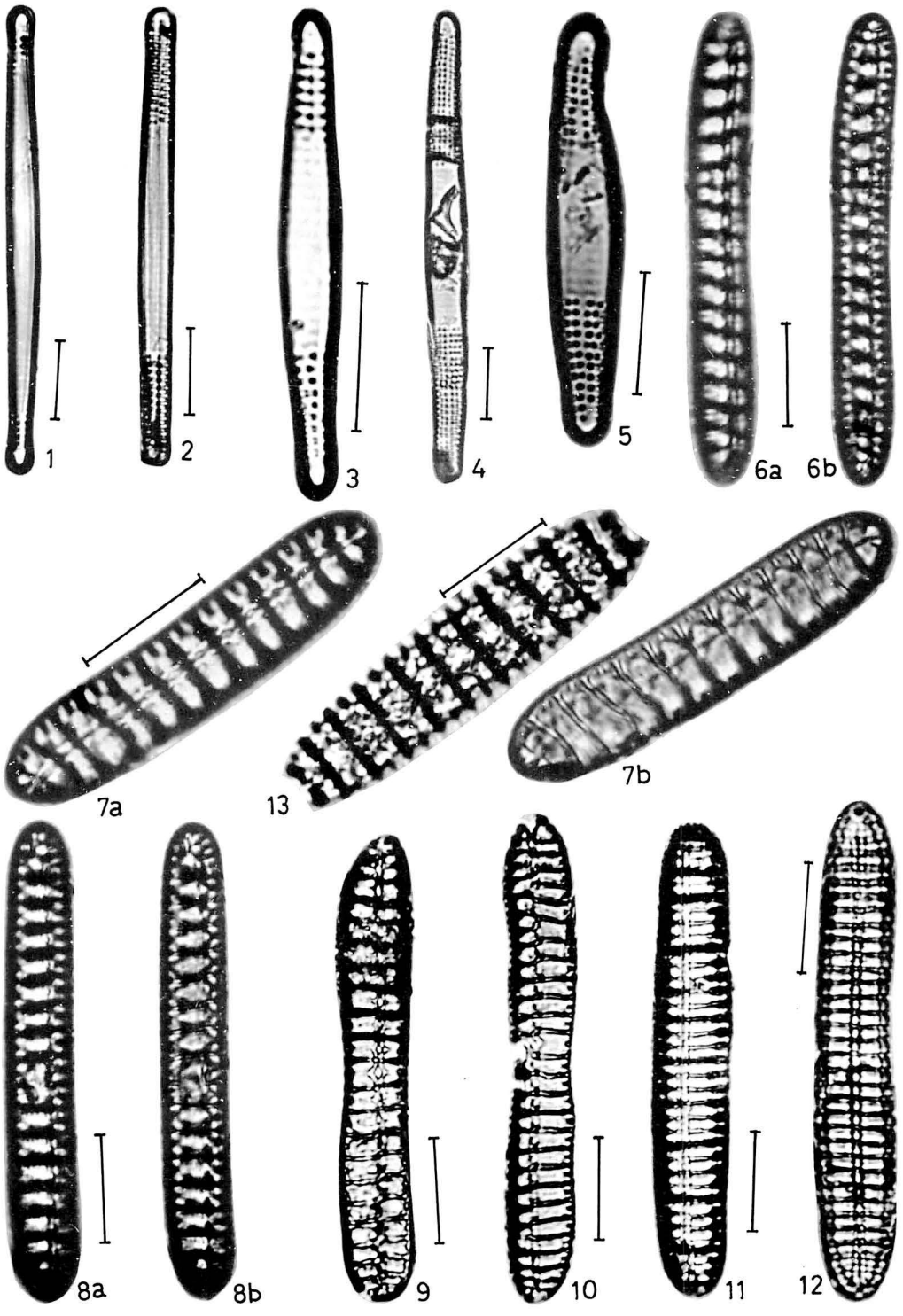
Fig. 9. *Yoshidaia constricta*, n. sp.
Holotypus. Präparat Nr. JAPEX Km-5037(9)=10.6×90.5(Fm10222). Masuporo-Schichten. Mittelmiozän.

Fig. 10. *Yoshidaia constricta*, n. sp.
Paratypus. Präparat Nr. JAPEX Km-5037(8)=10.4×81.7(Fm10101). Masuporo-Schichten. Mittelmiozän.

Fig. 11. *Yoshidaia loculata*, n. sp.
Holotypus. Präparat Nr. JAPEX Km-5041(16)=13.9×93.4(Fm9636). Koitoi-Schichten. Oberstmiozän.

Fig. 12. *Yoshidaia? densicostata*, n. sp.
Holotypus. Präparat Nr. JAPEX Km-5041(13)=13.4×98.0(Fm9672). Koitoi-Schichten. Oberstmiozän.

Fig. 13. *Katahiraia* sp.
Präparat Nr. JAPEX Km-5340(3)=14.6×84.0(Fm13513). Masuporo-Schichten. Mittelmiozän.


1
2
3
4
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6a
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7a
13
7b
8a
8b
9
10
11
12

den Pseudosepten, 9-10 in 10μ; Septen nicht gefunden soweit Exemplare geprüft wurden; Pseudosepten gerade, verhältnismäßig dick, jedoch nicht tief ins Zellinnere eindringend, senkrecht zur Apikalachse, gleichentfernt, 9-10 in 10μ; Zellwandverdickungen gar nicht entwickelt.

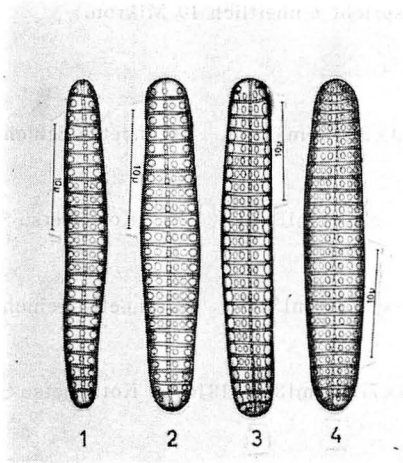


Abb. 13. *Yoshidcia? pupurifera*, n. sp.

Bemerkungen: Die Art mag auf Grund der dicht-entfernt geordneten Pseudosepten mit der oben beschriebenen neuen Art, *Yoshidaia? densicostata* verwandt sein. Sie unterscheidet sich aber durch die Zahl der Transapikalstreifen zwischen den Pseudosepten und Längsreihen der augenartigen randständigen Areolen. Die Determination wird gegenwärtig mit Fragezeichen versehen, solange keine gründliche Suche nach septatragenden Exemplaren unternommen wird.

Yoshidaia sp.

Typuskollektion: Präparat Nr. JAPEX Km-5034(2) = 4.2 × 87.5(Fm10841), Taf. 41 Fig. 13, Abb. 14.

Material: 1 Exemplar.

Fundort: Ein Aufschluß am Nordufer des Uruyagawa-Flusses, zirka 1,3 km östlich des Eisenbahnhofs Magarifuchi. Tenpoku-Gebiet.

Fundschicht: Masuporo-Schichten, Mittelmiozän.

Beschreibung: Schale linear, mit parallelen Rändern und keilformig gerundeten Enden, etwas konvex, 48μ lang, 7μ breit; Transapikalstreifen zart, parallel zur Pseudosepten, fein poroidiert; Poroide sehr winzig, in Quinkunx, transapikalwärts ca. 21 in 10μ; Kanalraphe vor den Polen in der Mittellinie, andernteils daneben; Kanalöffnungen deutlich sichtbar, je eine innerhalb einer Raphenanschwellung; Septa flach, mit zahlreichen elliptischen Fenster in apikalen Richtung; Pseudosepta leicht divergent, in der Nähe der Polen entweder gegabelt oder kurbelartig gekrümmt, 6 in 10μ; Zellwandverdickungen kurz, randständig, gegenüber einander zwischen den beiden Pseudosepten, 6 in 10μ; sonstige strukturellen Merkmale wie bei der typischen Art der Gattung.

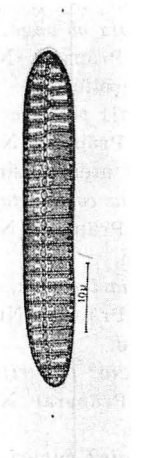


Abb. 14. *Yoshidaia* sp.

Bemerkungen: Die art wird bisher nur mit diesem einen Exemplar vertreten, jedoch ist in Besetz von divergenten, gegabelten oder gekrümmten Pseudosepten und von in Quinkunx geordneten Poroiden mit der Typus-Art der Gattung nahe

verwandt. Sie unterscheidet sich aber von ihr durch dichter stehenden Pseudosepten.

Es ist noch nicht ermittelt, ob morphologischer Übergang sich wesenhaft befindet. Bis Erklären dieser Zweifelpunkte bleibt die Art unbenannt.

Tafelerklärungen

(Vergrößerung: Jeder schwarze Stock entspricht einheitlich 10 Mikron.)

Tafel 41

Fig. 1. *Katahiraia aspera*, n. gen., n. sp.
Holotypus. Präparat Nr. JAPEX Fj-2730(3)=8.9×91.8(Fm8338). Kotanbetsu-Schichten. Mittelmiozän.

Fig. 2. *Katahiraia aspera*, n. gen., n. sp.
Paratypus. Präparat Nr. JAPEX Fj-2730(13)=4.4×82.0(Fm13452, 13453). Kotanbetsu-Schichten. Mittelmiozän.

Fig. 3. *Katahiraia aspera*, n. gen., n. sp.
Paratypus. Präparat Nr. JAPEX Fj-2730(6)=6.0×78.8(Fm13485). Kotanbetsu-Schichten. Mittelmiozän.

Fig. 4. *Katahiraia aspera*, n. gen., n. sp.
Paratypus. Präparat Nr. JAPEX Fj-2730(11)=19.4×77.9(Fm13463, 13462). Kotanbetsu-Schichten. Mittelmiozän.

Fig. 5. *Katahiraia aspera*, n. gen., n. sp.
Paratypus. Präparat Nr. JAPEX Fj-2730(3)=10.1×85.3(Fm13756). Kotanbetsu-Schichten. Mittelmiozän.

Fig. 6. *Katahiraia oblonga*, n. sp.
Holotypus. Präparat Nr. JAPEX Km-5151(1)=14.8×83.1(Fm12302). Mochikubetsu-Schichten. Unterpliozän.

Fig. 7. *Katahiraia pauperata*, n. sp.
Holotypus. Präparat Nr. JAPEX Km-5149(2)=16.1×79.9(Fm12208, 12207). Mochikubetsu-Schichten. Unterpliozän.

Fig. 8. *Yoshidaia constricta*, n. sp.
Paratypus. Präparat Nr. JAPEX Km-5034(19)=8.2×84.5(Fm13562). Masuporo-Schichten. Mittelmiozän.

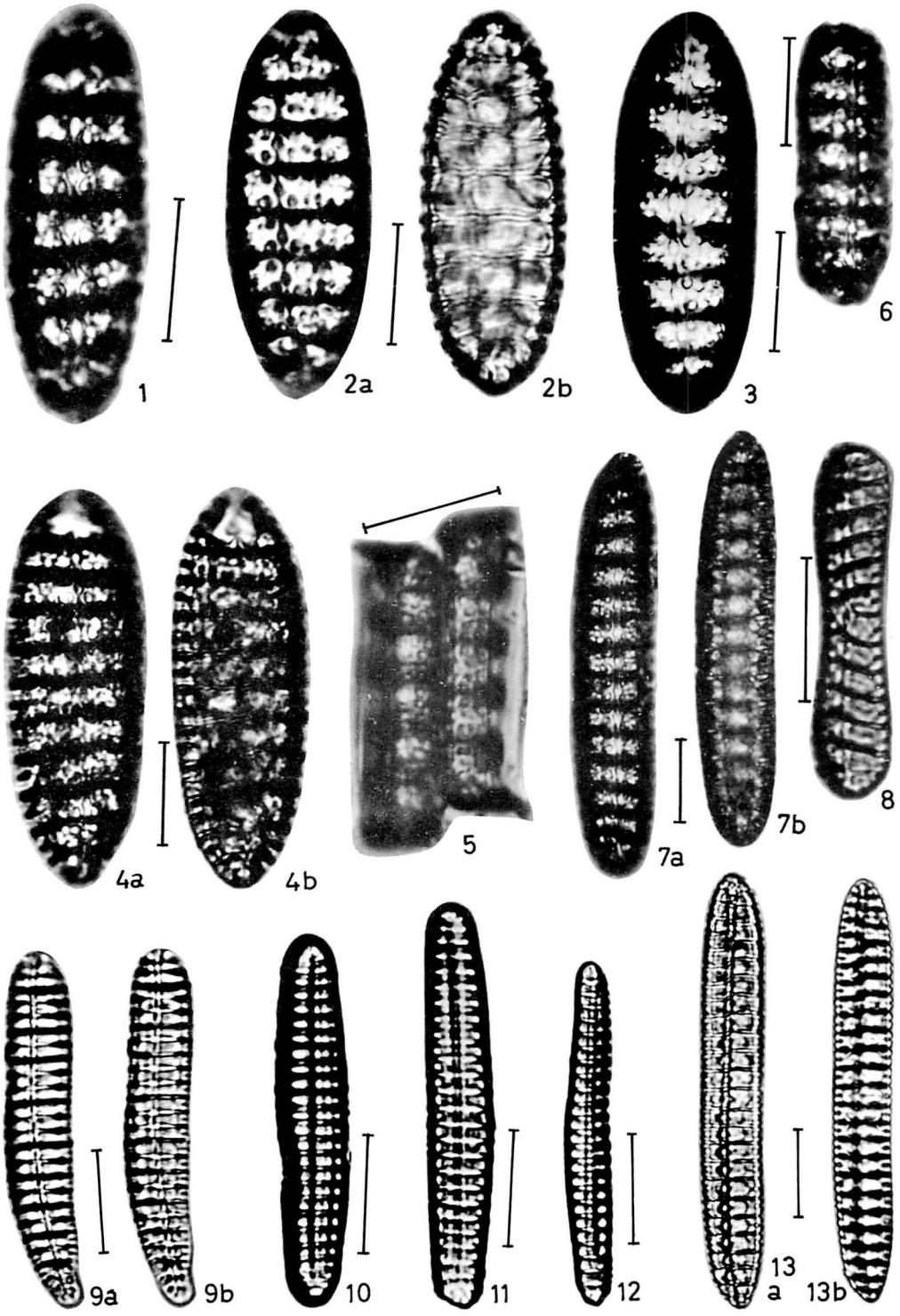
Fig. 9. *Yoshidaia loculata*, n. sp.
Paratypus. Präparat Nr. JAPEX Km-5041(35)=6.5×79.7(Fm13495, 13494). Koitoi-Schichten. Oberstmiozän.

Fig. 10. *Yoshidaia? pupurifera*, n. sp.
Holotypus. Präparat Nr. JAPEX Km-5034(1)=7.0×89.0(Fm13658). Masuporo-Schichten. Mittelmiozän.

Fig. 11. *Yoshidaia? pupurifera*, n. sp.
Paratypus. Präparat Nr. JAPEX Km-5034(1)=11.1×89.7(Fm13653). Masuporo-Schichten. Mittelmiozän.

Fig. 12. *Yoshidaia? pupurifera*, n. sp.
Paratypus. Präparat Nr. JAPEX Km-5034(2)=4.5×88.4(Fm13669). Masuporo-Schichten. Mittelmiozän.

Fig. 13. *Yoshidaia* sp.
Präparat Nr. JAPEX Km-5034(2)=4.2×87.5(Fm10841, 10842). Masuporo-Schichten. Mittelmiozän.


1
2a
2b
3
6
4a
4b
5
7a
7b
8
9a
9b
10
11
12
13a
13b

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Enbetsu	遠　別
Furenbetsugawa	風蓮別川
Kawasaki	川　崎
Koitoi	声　問
Kotanbetsu	古丹別
Magarifuchi	曲　淵
Masuporo	増　幌
Mochikubetsu	茂築別
Onishibetsu	鬼志別
Sakanoshita	坂ノ下
Shosanbetsu	初山別
Tenpoku	天　北
Toyosaki	豊　岬
Toyotomi	豊　富
Uruyagawa	宇流谷川
Utakoshi	歌　越
Wakkanai	稚　内

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 103, pp. 398-405, pl. 42, Oct., 15, 1976

665. ON THE PERMIAN BRYOZOA FROM THE NORTHERN PART OF SAINBEYLI, CENTRAL TURKEY*

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トルコ中部，サインベイリ北方産二畳紀こけ虫化石について：1972年，文部省海外学術調査研究補助金によるイラン，トルコなどにおける中・古生界境界付近の生層序学的研究がおこなわれたが，その際，トルコのサインベイリ北方約 20 km の地域で二畳・三畳系のセクションをとった折に採集した二畳紀のこけ虫について研究した結果を報告し，種の記載をおこなう。挿図にその産出層準を示したが，産状は散在している程度で密集しているわけではない。識別できたこけ虫は *Cyclotrypa ogbinensis*, *Fistulipora* cf. *monticulosa*, *Pseudobatostomella decora*, *Araxopora araxensis*, *Polypora tubulosa* の5種で，そのうちロシヤ卓状地の二畳系 Kazanian から知られた *Pseudob. decora* をのぞく他の4種はアルメニアのズルファ地域の Gnishik horizon (Guadalupian) から記載報告された種であり，このたび採集し得た標本は種数がすくないとはいえ，アルメニアズルファ地域の同時代こけ虫動物群と密接な関連性を物語るものである。 坂上澄夫

Introduction and Acknowledgments

In 1972, as a part of the research project on the Permian/Triassic boundary problems, our party under the leadership of Professor K. NAKAZAWA, Kyoto University had a chance to visit Turkey, and engaged in the biostratigraphical field survey in the area of Naltas about 20 km north of Sainbeyli which is about 400 km southeast from Ankara. Small bryozoan fauna described here was collected from the middle part of the Permian section taken by us in the area. This is the first paleontological report on the Permian bryozoans from Turkey.

Before going further, I would like to express my sincere thanks to the staffs of *MTA* in Ankara, Turkey for their hearty arrangement and help in making the research successful, especially to Messers. Ethem GÖGER and Ahmet ÖZEAN for their kind guidances in the field. I would also like to thank in particular the members of Japanese party: Drs. Y. BANDO, K. ISHII, M. MURATA, K. NAKAMURA, K. NAKAZAWA, Y. OKIMURA and S. SHIMIZU for their kind cooperations in the field. The field survey was financed by the Overseas Scientific Research Fund of the Ministry of Education, Japan for this project in 1972.

* Received April 14, 1976: read Jan. 30, 1976 at Kawatabi.

Faunal Analysis

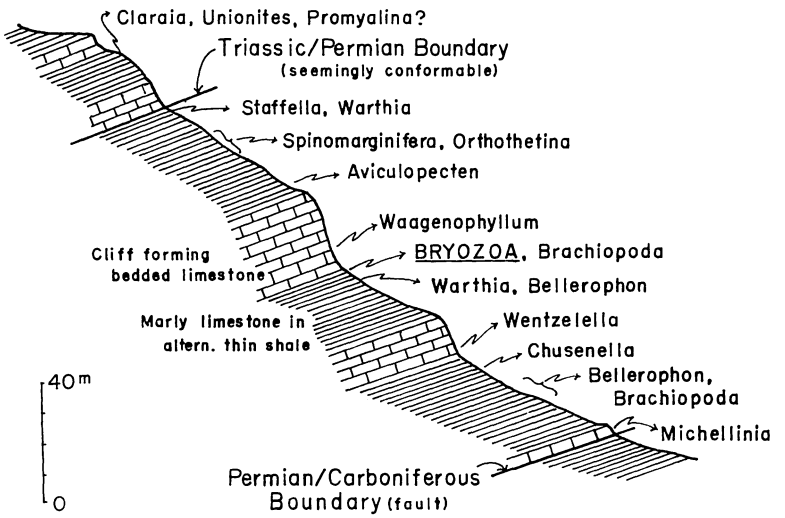
The schematic diagram of the Permian section in the area is shown in the Text-figure. The bryozoans were found in association with some brachiopods from the uppermost part of marly limestone (about 30m thick) which is covered by the cliff forming bedded limestone (about 30m thick). Several other fossils identified in the field are shown also in the Text-figure.

The following five bryozoan species were discriminated:

Cyclotrypa ogbinensis MOROZOVA
Fistulipora sp. cf. *F. monticulosa* NIKIFOROVA
Pseudobatostomella decora MOROZOVA
Araxopora araxensis (NIKIFOROVA)
Polypora tubulosa NIKIFOROVA

Four species of them, except for *Pseudobatostomella decora* originally described from the Upper Kazanian stage of several localities in Russian Platform, have been reported from the Gnishik horizon of the Guadalupian stage in Armenian Dzhulfa of Trans-Caucasia by MOROZOVA (in RUZHENTSEV and SARYCHEVA, 1965).

Thus, it is clear that, in spite of the poor number of species, the present bryozoan fauna is closely related to the Permian bryozoan fauna of Armenian Dzhulfa that is about 800 km east from the present locality.



Text-fig. Schematic diagram of the Permian section at about 20 km. north of Sainbeyli. (by the party (NAKAZAWA et al.) of the field survey, 1972)

Description of Species

Cyclotrypa ogbinensis MOROZOVA

Plate 42, Figs. 1, 2.

1965. *Cyclotrypa ogbinensis* MOROZOVA, p. 183, pl. XXV, fig. 1.

Zoarial observations:—About 3cm×3cm weathered surface specimen of zoarium was collected and three oriented sections were made out of the specimen for examination. Zoarium encrusting and could have been attached to foreign substance such as seaweed. Thickness of zoarium usually 2 to 3mm, 5mm at the maximum.

Tangential section:—Zooecial tubes circular, their average diameter 0.270 mm, ranging from 0.240 to 0.340 mm in some 80 measurements. Usually 3.5 to 4 zooecia per 2 mm diagonally, 17 to 18 zooecia in a field of 4 sq. mm. Occasionally prominently large zooecial tubes disposed at interval of about 2 mm, their diameter ranging from 0.400 to 0.450mm. Vesicular tissue not so regular in size and arrangement, usually one to three vesicles between adjacent zooecia. Usu-

ally 5 to 6 vesicles per mm horizontally. No lunarium developed.

Longitudinal section:—Zooecial tubes run for a short distance along coenelasma but curve gradually upward, making a right angle in mature region. Thin diaphragms well developed nearly straight or slightly concave and interspaces between diaphragms usually about 0.50 mm, ranging from 0.25 to 0.75 mm. Interzooecial tissue consisting of irregularly arranged vesicles like depressed fish-scales but more elongated in some cases.

Remarks:—The present species was originally described from the Gnishik horizon of Armenian Dzhulfa, Trans-Caucasia by MOROZOVA (in R. & S., 1965). Although the zoarial form of the present specimen differs from the holotype, the present form is apparently identical with *Cyclotrypa ogbinensis* in all other essential characters. As pointed out by MOROZOVA the present species is apparently represented the remains of reproductive organs which is extremely rarely found in representatives of the fistuliporids, such organs are developed also in the present specimens as prominently large zooecial tubes.

Specimen Nos.:—TS-101a, 102, 103.

Table 1. Measurements of *Cyclotrypa ogbinensis* MOROZOVA (in mm).

Specimen No.	TS-101a, TS-102 TS-103
Zoarial form	encrusting
Thickest part of zoarium	4.0-5.0
Diameter of zooecium	0.240-0.340
No. of apertures in 2 mm. diagonal	3.5-4
No. of diaphragms in 1 mm.	2-3
No. of vesicles in 1 mm longitudinal	9-12
No. of vesicles in 1 mm horizontal	5-6

Fistulipora sp. cf. *F. monticulosa* NIKIFOROVA

Plate 42, Figs. 3, 4.

Compared:—

1933. *Fistulipora monticulosa* NIKIFOROVA, p. 10, 11; 34, 35, pl. I, figs. 9-15, text-figs. 3, 4.

Zoarial observations:—Form of zoarium unknown owing to only one tangential section of fragmentary specimen.

Tangential section:—Zooecial tube subcircular to rounded triform, the inside longitudinal diameter excluding lunarium ranging from 0.330 to 0.450 mm in outer zone and transverse diameter from 0.350 to 0.400 mm in outer zone and 0.25 to 0.320 mm in the inner. Usually 4 zooecia per 2 mm diagonally. Lunarium well developed and horse-shoe shaped, occupying about one half to one third of zooecial circumference, its thickest part is ranging from 0.030 to 0.050 mm, and the both ends of lunarium projected into zooecial tube in the outer zone. Interval between the both ends of lunarium about 0.200 mm. Vesicular tissue relatively fine and irregularly polygonal. Eight to ten vesicles per mm. horizontally.

Remarks:—Owing to only one fragmentary tangential section at hand, the detailed observation and comparison could not be made. However, the characteristics in the tangential section, the present form agrees *Fistulipora monticulosa* which was originally described from the Djulfa (=Dzhulfa) region by NIKIFOROVA (1933), especially in the sizes and forms of zooecium and lunarium in the tangential section.

Later, MOROZOVA (in R. & S., 1965) reported this species from the Gnishik horizon of Armenian Dzhulfa, Trans-Caucasia without description and illustration.

Specimen No.:—TS-101b.

Table 2. Measurements of *Fistulipora* sp. cf. *F. monticulosa* NIKIFOROVA (in mm).

Specimen No.	TS-101b
Zoarial form	unknown
Diameter of zooecium (a-a) in outer region	0.350-0.400
Diameter of zooecium (a-a) in inner region	0.250-0.320
Diameter of zooecium (b-b) in outer region	0.330-0.450
Thickness of lunarium	0.030-0.050 occasionally 0.070
No. of apertures in 2 mm diagonal	ca. 4
No. of vesicles in 1 mm horizontal	8-10

Pseudobatostomella decora MOROZOVA

Plate 42, Figs. 6, 7.

1970. *Pseudobatostomella decora* MOROZOVA, p. 124, 125, pl. XIX, fig. 4; pl. XX, fig. 1.

Zoarial observations:—A single fragmentary longitudinal section but the tangential in part was examined. Zoarium consisting of smallc ylindrical stem, and its diameter about 1.1 mm. The diameter of immature zone about 0.12 mm. Thickness of mature zone about 0.40 mm.

Longitudinal section:—Zooecial tubes trend nearly parallel to longitudinal direction of zoarium in short distance, but curve gradually outward with outer surface of zoarium at an angle of about 90°. Thin zooecial wall in immature region relatively short but gradually thickened to mature region. Thick walled part of tube relatively long, consisting of fine fibrous tissue without monilae. Diaphragms very thin, slightly concave, usually 2 to 3 in mature region of a tube.

Tangential section:—Zooecial tube circular or oval in mature region but with irregular margin near surface. Zooecial diameters, one measured along horizontal direction 0.100 mm average, ranging from 0.080 to 0.130 mm, and another measured along longitudinal direction 0.120mm in an average, ranging from 0.100 to 0.150 mm on 8 measurements. Zooecial apertures arranged longitudinally but not so irregularly, about 8 per 2 mm of longitudinal direction. Mesoecia present but not so many, usually oval or subcircular, their diameter ranging from 0.020 to 0.050 mm. There are about 25 zooecia and 7 to 8 mesoecia in a field of one sq. mm. Many prominent acanthoecia having very small pores and surrounded by dark concentric fibrous tissue, relatively uniform in size, ranging from 0.020 to 0.030 mm in outer diameter, there are about 320 acanthoecia in one sq. mm.

Remarks:—The present form agrees *Pseudobatostomella decora* which MOROZOVA (in R. & S., 1965) described from

Table 3. Measurements of *Pseudobatostomella decora* MOROZOVA (in mm).

Specimen No.	TS-101c
Orientation of section	Long.
Diameter of zoarium	1.1
Diameter of immature zone	0.20?
Thickness of mature zone	0.40?
Diameter of zooecium (shorter)	0.080-0.130
Diameter of zooecium (longer)	0.100-0.150
Diameter of mesoecium	0.020-0.050
Diameter of acanthoecium (outer)	0.020-0.030
No. of zooecia 2 mm longitudinal	ca. 8

the Upper Permian Kazanian Stage of several localities in Russian Platform in all of the essential characters. The characteristics of the present species are in having very small zoarial diameter and many prominent acanthoecia.

Specimen No.:—TS-101c.

Araxopora araxensis (NIKIFOROVA)

Plate 42, Figs. 8-11.

1933. *Batostomella spinigera* var. *araxensis* NIKIFORAVA, p. 13, 14; 36, pl. IV, figs. 1-4.
1958. *Stenodiscus granularis* YANG, p. 124, 125; 133, 134, pl. II, figs. 2-8.
1965. *Araxopora araxensis* MOROZOVA (in RUZHENTSEV and SARYCHEVA), p. 186, 187, pl. XXV, figs. 4, 5, pl. XXVI, fig. 5, text-fig. 20.

Zoarial observations:—Typical longitudinal, tangential and transverse sections which were made out of a zoarium, and one oblique section were also examined. zoarium consisting of straight, cylindrical stem, 3.0 to nearly about 5.0 mm in diameter.

Longitudinal section:—Zooecial tubes run nearly straight but slightly bend outward and trend parallel to longitudinal direction of zoarium in inner part, rapidly bend at the inner edges of the mature region, and go straight throughout mature region reaching the surface at an angle of about 90°. Length of zooecial tube of mature region rather short, varies from 0.50 to 0.75 mm. Zooecial wall very thin in immature region but becoming thick rapidly and distinctly and consisting of dark, coarse, laminated fibrous tissue in mature region. Diaphragm complete, thicker than that of immature wall, disposed at outer edge of immature tube and one or two in mature tube. Also in immature tube, very thin diaphragm may be rarely present. Diaphragms in mesoecia may be present but indistinct in many cases.

Tangential section:—Zooecial tube polygonal with sharp edges in immature region, elongated oval in mature region, but irregular in the nearest part to surface. Zooecial diameters at the middle level of mature tube, one measured along horizontal (shorter) direction 0.126 mm in an average, ranging from 0.090 to 0.150 mm, and another measured along longitudinal (longer) direction 0.232 mm in an average, ranging from 0.180 to 0.310 mm for 50 measurements. Zooecial apertuers arranged longitudinally but not so regularly, about 5 to 6 per 2 mm of longitudinal direction. Mesoecia irregularly arranged, circular to elongated oval but occasionally irregular in shape, variable in size, their diameter 0.062 mm in an average, ranging from 0.040 to 0.080 mm for 50 measurements. Usually 12 to 15 zooecial apertures and 10 to 14 mesoecia in a field of one sq. mm. Acanthoecia rarely present, about 0.010 mm in diameter.

Transverse section:—In immature region, zooecial tubes show honeycomb like structure, but obliterated in many cases. The characters in mature region are the same with that in the longitudinal section.

Remarks:—The present species was originally described from the "Upper Paleozoic" of the Djulfa (Dzhulfa) region, Armenia by NIKIFOROVA (1933) as a variety of *Batosotmella spinigera*. MOROZOVA (in R. & S., 1965), however, placed that variety as the type species of her newly established genus *Araxopora*, and she found that the present species occurred from the Gnishik and Khachik horizons of Armenian Dzhulfa, Trans-Caucasia.

The present form is identical with *Araxopora araxensis* in all of the essential

Table 4. Measurements of *Araxopora araxensis* (NIKIFOROVA)(in mm).

Specimen No.	TS-201, TS-202, TS-203
Orientation of section	L, Tr, T
Diameter of zoarium	3.0-5.0
Diameter of immature zone	2.1-3.8
Thickness of mature zone	0.50-0.75
Diameter of zooecium (shorter)	0.090-0.150
Diameter of zooecium (longer)	0.180-0.310
Diameter of mesoecium (shorter)	0.040-0.080

characters. According to MOROZOVA, *Stenodiscus granularis* from the Maokou limestone at Tzuchuya of Peichuan County, Szechuan Province, China by YANG (1958) should be included in *A. araxensis*. Further, MOROZOVA stated that "the acanthopores lose their usual shape, become elongated in cross section, bent or vermiform, their axial canal is expanded by hypertrophy and consists of a widely diaphragmed space, surrounded by a thin outer wall" (by the translation to English language by D. A. BROWN in 1968). In the present description, however, all of the kenozooecia except for distinct acanthoecia are mentioned as mesoecia.

The present species differs from *Araxopora malayensis* SAKAGAMI (1973) which was described from the limestone (probably the uppermost Guadalupian) at Jenka Pass of Central Malay in its smaller zoarial diameter and shorter zooecial tube in mature zone and in some characteristics such as the sizes and forms of zooecia, mesoecia and acanthoecia.

Specimen Nos.:—TS-201, 202, 203.

Polypora tubulosa NIKIFOROVA

Plate 42, fig. 5.

1933. *Polypora tubulosa* NIKIFOROVA, p. 15 20-22; 37, 38, pl. III, figs. 1-6, pl. IV, figs. 1-3.

Zoarium expanded laterally, may be about 11 cm long and 9cm wide, but most part is covered by dark gray muddy limestone and only a part of zoarium can be observed as the exposed specimen. A typical tangential section was made from the rock sample for detailed examination. Straight branches connected by dissepiments at regular intervals: 1.14 mm average, ranging from 1.00 to 1.25 mm measured from center to center of dissepiments (25 measurements). Bifurcation of branch not frequent. Width of branch wider than that of fenestrule, ranging from 0.375 to 0.750 mm, after bifurcation 0.375 to 0.500 mm, before bifurcation 0.500 to 0.750 mm, and usually 11 to 12, occasionally 15 per 10 mm horizontally. Interval between branches 0.90 mm in an average, ranging from 0.70 to 1.18 mm measured from center to center of branches (25 measurements). Fenestrule elongated elliptical in outline, width 0.353 mm in an average, ranging from 0.275 to 0.500 mm; length 0.781 mm average, ranging from 0.625 to 0.900 mm (20 measurements), 9 per 10 mm length of branch. Dissepiment narrower than that of branch, width usually 0.375mm, occasionally reaching 0.500mm. Zooecial tubes arranged uaually 4 to 5 intersecting longitudinal rows, but 3 rows in short distance after bifurcation and 6 rows at just before bifurcation. In the tangential section, zooecial tubes rhomboidal or hexagonal but occasionally irregularly polygonal at lower and middle levels of branch, and circular near surface, ranging from 0.100 to 0.120 mm in diameter. Zooecial apertures usually 18 per 5 mm length of one row, unstabilized in position

of aperture in relation to dissepiment, but usually 4 to 5 apertures per fenestrule. Interval between zooecial apertures in longitudinal series from center to center ranging from 0.250 to 0.280 mm. Nodes about 0.005 mm in diameter, may be disposed at each intersection of zooecial apertures but indistinct. Interzooecial materials consisting of dark, very fine fibrous tissue with closely arranged fine granules. Stereom covering the reverse side consisting of inner tissue with usually 3 to 5 prominent capillary canals on which many capillaries arranged longitudinally, and outer thick, dark, fine fibrous tissue with very fine granules.

Remarks:—Except for the zoarial form, all of the characters and measurements are quite similar to those of *Polypora*

Table 5. Measurements of *Polypora tubulosa* NIKIFOROVA (in mm).

Specimen No.	TS-204
No. of branches per 10 mm horizontally	11-12
No. of fenestrules per 10 mm length	9
No. of zooecia per 5 mm length	18
No. of rows of zooecia	3-6 (usually 4-5)
No. of zooecia per fenestrule	4-5
Width of branch (normal)	0.375-0.750
Width of fenestrule	0.275-0.500
Length of fenestrule	0.625-0.900
Interval between branches (center to c.)	0.700-1.180
Interval between dissepiments (center to c.)	1.000-1.250
Width of dissepiment	usually 0.375
Diameter of zooecia near surface	0.100-0.120
Distance between zooecia (center to c.)	0.250-0.280
Diameter of node	ca. 0.050

Explanation of Plate 42

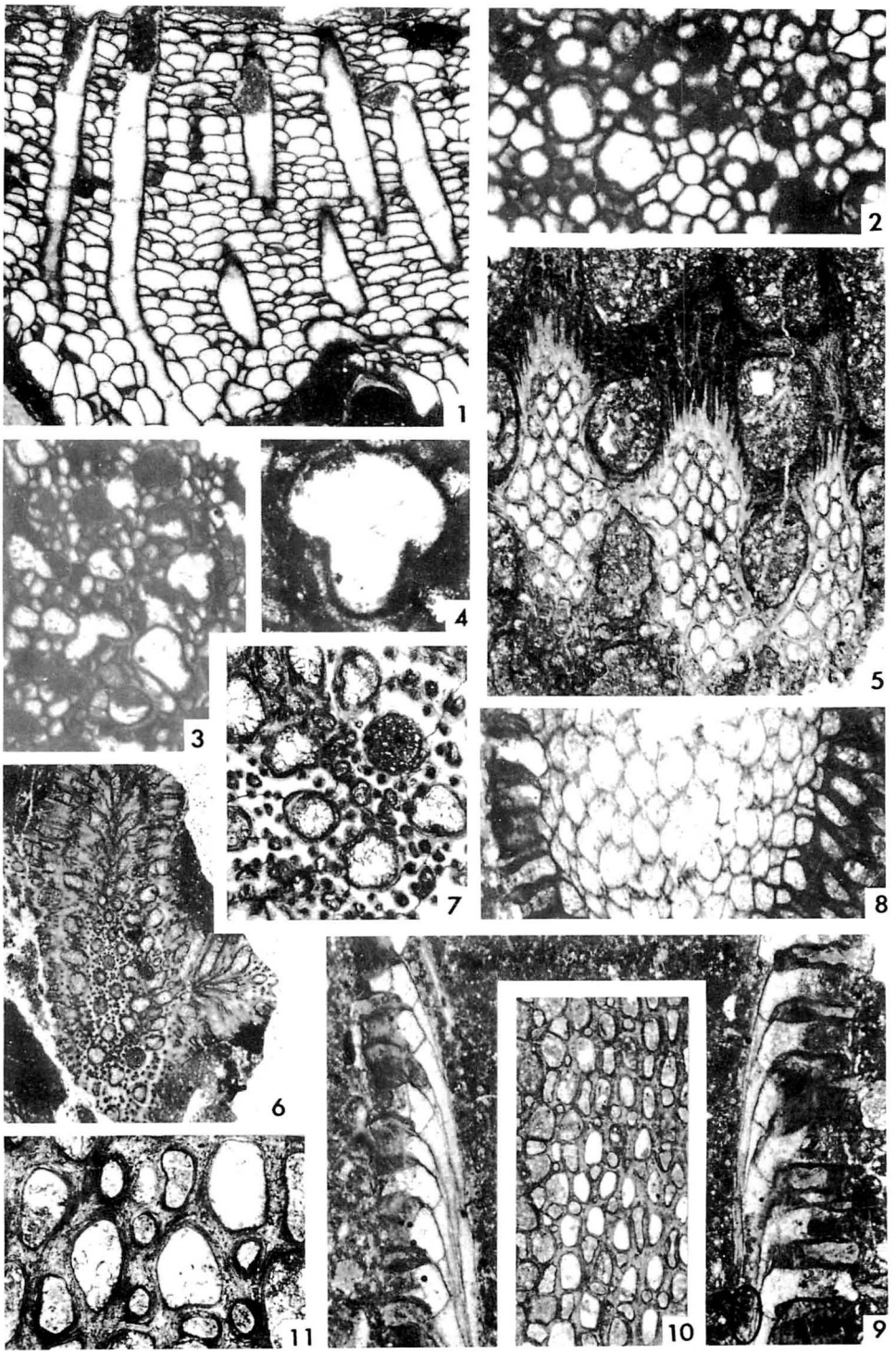
Figs. 1, 2. *Cyclotrypa ogbinensis* MOROZOVA
1, longitudinal section, ×20, No. TS-102; 2, tangential section, ×20, No. TS-103.

Figs. 3, 4. *Fistulipora* sp. cf. *F. monticulosa* NIKIFOROVA
3, tangential section, ×20, No. TS-101b; 4, enlarged part of the same specimen, showing a zooecial tube with well developed lunarium, ×60.

Fig. 5. *Polypora tubulosa* NIKIFOROVA
Tangential section, ×20, No. TS-204.

Figs. 6, 7. *Pseudobatostomella decora* MOROZOVA
6, longitudinal section and tangential section in part, ×20, TS-101c; 7, enlarged tangential part of Fig. 6, showing the arrangements of zooecia, mesoecia and acanthoecia, ×60.

Figs. 8-11. *Araxopora araxensis* (NIKIFOROVA)
8, a part of obliquely transverse section, ×20, TS-202; 9, typical longitudinal section, the immature region has been obliterated, ×20, TS-201; 10, tangential section near surface, ×20, TS-203; 11, enlarged part of tangential section near surface, ×60, TS-203.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tubulosa which was originally described from Djulfa (=Dzhulfa) of Armenia by NIKIFOROVA (1933).

Although NIKIFOROVA stated that one of the distinctive characters of this species is the tubular shape of its zoarium, I am of the opinion that the difference of the zoarial forms in the fenestellid bryozoans is not so important for specific identification. On the other hand, it is considered that the existence of the very prominent capillary canals is more important characteristic.

The present species was reported by MOROZOVA (in R. & S., 1965) without description from the Gnishik horizon of Armenian Dzhulfa, Trans-Caucasia.

Specimen No.:—TS-204.

Repository:—All of the specimens treated in the present paper are preserved in the collection of the Department of Geology, Faculty of Education, Ehime University, Matsuyama.

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日本古生物学会第117回例会は，1976年6月27日（日）に広島大学総合科科学部において開催された（参会者69名）。

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例会等の通知

	開催地	開催日	講演申込締切日*
1977年総会・年会	東京学芸大学	1977年1月21,22日	1976年11月15日

* 講演申込み締切日は，開催予定日の2ケ月前を原則とします。早目にお申込み下さい。

学会記事

◎ 学会「化石」編集幹事は高山俊昭君から石崎国熙君に交代した。

◎ 6月26日に広島大学で行なわれた評議員会において，次の諸君の入会が承認された（敬称略）。
山本滋樹，長井孝一，荒木英夫，石黒義人，三井さち子，奥村　清，佐々木衛（7名）。

◎ 科研費小委員会員の半数改選が行なわれ次の諸君が選出された（* 印は先年度より継続の委員）。
佐藤誠司*，坂上澄夫*，糸魚川淳二*，首藤次男，小畠郁生，速水　格，石崎国熙。

ニュース

◎ 1975年10月6日に古生物学研究連絡委員会主催，日本地質学会ならびに本学会後援のもとに開催された「陸の古生態に関するシンポジウム」の講演集が，「陸の古生態」—古生態学論集Ⅰ—として刊行された（共立全書210）。（シンポジウム世話人 高柳洋吉）

◎ 8月16日～25日に Sydney で開催された第25回 IGC には，わが国から60余名の参加者があった。IGC，IUGS の役員会ならびに IPA 総会には，本会関係者としては池辺展生，浜田隆士の両君が出席した。

◎ IGCP の MCE 北海道集会は8月29日～9月6日に行なわれ，国外より4名，国内より14名の参加者があっは。

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