The Mesozoic Floras of Japan

By

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With 48 Plates, 1 Text-figure and 1 Table

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I. INTRODUCTION

Since pioneering works by foreign palaeobotanists such as H. T. GEYLER and T. G. NATHORST at the end of the nineteenth century and by eminent Japanese palaeontologists as M. YOKOYAMA and H. YABE at the beginning of the present century, very few contributions have been made to the knowledge of the Mesozoic palaeobotany of the Japanese Empire. On matriculating as a geological student in the Institute of Geology and Palaeontology, Tôhoku Imperial

University, Sendai, the writer was set at palaeobotanical problems for study by Professor YABE, and under his most kind guidance chiefly the study of the Mesozoic plants of Tyôsen (Korea) and China has been followed, the results of which have already been printed during 1928–1933 mostly as joint works with Professor YABE.

On removing from Sendai in 1930 to the Department of Geology and Mineralogy, Hokkaidô Imperial University, Sapporo, the writer began, again through the suggestion of Professor YABE, a synthetic and systematic study of the Mesozoic floras of Japan which until that time had been very little investigated except classical ones. Several papers have been made public by the writer during the past ten years.

According to the writer's investigation, the Mesozoic floras in Japan are much more rich, both as regards the number of species and the abundance of material, than had been expected. More than 300 distinct species of plants several of which are botanically of considerable interest and importance have been discriminiated. In the present work the writer has aimed chiefly at the revision, if necessary, and description of species already described by previous authors in addition to the description and discussion of many species discriminated by the writer himself during recent years, with possible special palaeobotanical as well as geological interpretations. The Kôbôsan flora in Tyôsen is omitted from the present study as it is, in its constituents, more closely related to the Permian flora than to the Mesozoic; palaeobotanical and chronological discussions on this flora may be presented in the near future in a separate note.

Before going further, let attention be directed to the facts that 1) in order to avoid duplication it contains neither figures nor any part of the description already published except diagnostic characters and necessary parts of discussion of the previous works, therefore the original publications are always necessary for reference; 2) algal flora and fossil woods also occupy an important role in the line of research of Japanese Mesozoic Palaeobotany, but descriptions of them are omitted in this work because there is no special additional material now at the writer's disposal except a part of the specimens already described and disccused by such experts as Prof. YABE, Mr. S. TOYAMA and Mr. W. ISIJIMA for algae, and Profs. STOPES, FUJII, OGURA, and Mr. M. SHIMAKURA for anatomy, although necessary references for them are elsewhere made in the present work.

In connection with the palaeobotanical study, the writer has intended also to present some ideas in regard to the stratigraphical value of each element constituting the flora. But a precise stratigraphical study of some of the Mesozoic areas is not yet fully completed because of the complication of the structure and the scantiness of leading marine fossil beds which are in an intimate stratigraphical relation with the plant beds. Thus there are sometimes considerably diverse opinions among stratigraphers, palaeozoologists and palaeobotanists in regard to the geological age of the plant beds. Discussions on this point, however, are briefly entered into Chapter VI.

II. ACKNOWLEDGMENT

At this place, the writer wishes to express his deep gratitude to those who have encouraged and helped him.

First of all, it is the writer's greatest pleasure to express his most warm thanks to Professor HISAKATSU YABE of the Institute of Geology and Palaeontology, Tôhoku Imperial University, Sendai, who first introduced the writer to the very interesting subject, Palaeobotany, for study, and who gave him valuable suggestions and advice throughout the course of the present study. Especially he has very kindly interested himself in no small degree in Palaeobotany, and to his wide knowledge the writer is particularly indebted. To Professor TAKUMI NAGAO of our Department the writer is also much indebted in respect to the palaeontological and stratigraphical discussions he so kindly offered to the writer during the course of the present work. Without the help and supervision of the Professors it would have been almost impossible to carry on the present study.

Dr. T. KOBAYASI of the Geological Institute, Tôkyô Imperial University, kindly submitted his own collection of fossil plants for the writer's study and generously discussed various stratigraphical problems. From the writer's colleagues, Messrs. K. HUZIOKA and E. TAKAHASI, he received much help in the palaeobotanical discussions moreover being forwarded their own private collections for his study. To Professor T. KATÔ of the Geological Institute, Tôkyô Imperial University, Professors S. NAKAMURA and J. MAKIYAMA of the Geological Institute, Kyôto Imperial University, Dr. K. WATANABE of the Geological Survey of Tôkyô, Prof. E. KON'NO of the Sizuoka Higher School and Messrs. B. GOKAN and S. IZIRI of the Tôkyô Science Museum the writer is very grateful too for their friendly permission to examine the respective Institutes, Geological Survey, Sizuoka Higher School and Museum collections. Mr. T. SHIKAMA of the Institute of Geology and Palaeontology, Tôhoku Imperial University, Prof. S. IMAMURA of the Toyama Higher School, Mr. K. ÔTATUME of the Hokkaidô Colliery and Steamship Co., Messrs. M. HAYASAKI, S. UMEDA and Miss Y. MATUMOTO kindly forwarded their own collections for the writer's use. From Messrs. M. TAKEZAKI, H. KON, M. HUZISAWA, T. OGAWA, T. TAKAMI, S. NAGAO, Y. SUGIWARA and K. HASIMOTO the writer received direct help in collecting fossils in the fields. To all these persons the sincere thanks of the writer are due.

The writer's cordial thanks are also due to Drs. I. TATEIWA, Director of the Government Geological Survey of Tyôsen (Korea), S. KAWASAKI, T. SHIRAKI and R. KODAIRA, who helped him in many ways during his journey through Tyôsen, especially to Drs. TATEIWA, KAWASAKI and KODAIRA who kindly forwarded their valuable collections for the writer's study and for kindly discussing various geological and palaeobotanical problems.

Lastly the writer wishes to express his sincere thanks to the Tôsyôgû Sambyakunen-sai Kinen-kai from whom he received a grant in prosecuting a part of the present work and to the Hattori Hôkô-kai who gave him a part of the expence for printing the present volume.

The photographs were made by Messrs. U. TAKEDA and S. KUMANO under the supervision of the writer, to whom he is very grateful.

III. MATERIAL

The plant fossil material dealt with in the present work was chiefly collected by the writer himself from various localities in the Mesozoic areas so widely distributed in the Japanese Empire, to which were added valuable collections made by many persons who kindly submitted them for the writer's study. Moreover, through the permission of the respective authorities the writer examined almost all of the specimens stored in the Geological Institutes of Tôhoku (Sendai), Tôkyô and Kyôto Imperial Universities, and the collections of the Tôkyô Science Museum, the Geological Survey of Tôkyô, Government Geological Survey of Tyôsen (Korea), Sizuoka Higher School and Toyama Higher School. Some specimens which are not found in the writer's collection were borrowed, described if necessary, photographed and figured in this work.

The localities of species are listed at the end of the description of each species, and abbreviated names are used only for the places where specimens not immediately at hand to the writer are deposited. Therefore, the specimens described and figured in the present work are in the possession of the Department of Geology and Mineralogy, Hokkaidô Imperial University, Sapporo, unless otherwise mentioned in the lists of localities at the end of the description of each species. Abbreviated names used for the places where specimens not ready to hand are deposited are:

Sendai ......Institute of Geology and Palaeontology, Tôhoku Imperial University, Sendai.
Tôkyô ....Geological Institute, Tôkyô Imperial University.
Kyôto ....Geological Institute, Kyôto Imperial University.
T. S. M. .....Tôkyô Science Museum.
G. S. T. .....Geological Survey of Tôkyô.
G. S. K. .....Geological Survey of Tyôsen, Keizyô.

The number in the parentheses following the locality names denote the exact positions of fossil occurrences in certain districts where fossils occur from several localities. As to the geographical positions of localities in the Nariwa district, see ÔISHI and HUZIOKA: Fossil Plants from Nariwa, a Supplement, 1938, Pl. I; as to those in Yamaguti pref. (Nagato), see ÔISHI and TAKAHASI: The Rhaetic Plants from Prov. Nagato, 1936, Text-fig. 1.

The negatives of the photographs in Pl. I, figs. 2, 4; Pl. VII, fig. 7; Pl. XIX, fig. 3; Pl. XXIX, fig. 5 belong to the Geological Survey of Tyosen. That of Pl. XLV, fig. 7 belongs to the Institute of Geology and Palaeontology, Tôhoku Imperial University, while others belong to the Department of Geology and Mineralogy, Hokkaidô Imperial University.

IV. CONDITION OF PRESERVATION AND CRITERIA OF DETERMINATION

The material forming the basis of the present study is mostly impressions of leaves, fronds or certain reproductive organs and is in unfavourable condition for anatomical study, for instance, for cuticular preparations or any other preparations for microscopical use. Only some of the leaves found in the Hakobuti sandstone (Urakawa Series) in Hokkaidô are sometimes available for such study, but they are too imperfect for description. The occasional occurrences of fossil plants in petrified condition are of special interest for such study. Certain ferns from *Dictyophyllum* and *Onychiopsis* Series (see Chapter VII) are in the fructified condition, but in neither of them are the spores obtainable.

In determining the several impressions of the Japanese Mesozoic plants so numerously disposed, the writer sometimes faced serious difficulties. It is often impossible to decide whether a Japanese species is actually identical with or merely closely allied to a species described from another region. This difficulty arises especially when one proposes to compare a specimen from Japan with that from a distant region, based on sterile examples. For instance, the comparison of the Japanese plants with those of Europe, America and Australia in corresponding geological horizons leads sometimes to an unnecessary amount of specific distinction in the naming of plants, and the too frequent use of distinct generic and specific names makes obscure the true botanical resemblance of any floras. In the case of the Japanese Nariwa flora, the species common with the East Greenland flora which it most nearly resembles in floral composition are only 15 among 110 species or only 13.6%. This is chiefly because of the narrow delimitation of the Greenland plants the criteria of determination of which are chiefly based on the cuticular structure of vegetative parts. But if a comparison is made by means of allied as well as common species, the resemblance becomes closer since at least 40% of the Nariwa plants may be identical or very closely related to those of East Greenland.

However the chief object of the present study of fossil flora is primarily to determine the resemblance or difference in regard to the general facies of vegetation and to trace the changes of the floral evolution of the Japanese Islands during the Mesozoic Era rather than to determine the strict specific identity of a plant or the forcible narrow geological delimitation of elements for stratigraphical use. Such being the case, in determining certain groups of Japanese Mesozoic plants, for instance, form-genera such as *Cladophlebis* and *Taeniopteris*, the writer may have used too many distinct names for allied species recorded from distant regions, but the resemblance as a whole may possibly be far closer than would be interpretated from the actual identical species only. Such classification is, the writer thinks, not necessarily vague when it is based on well-developed and typical specimens, and it is sometimes very convenient and useful not only for palaeobotanical interpretations but also even for stratigraphical use, at least in the Japanese Islands and probably in adjacent lands too. But there is a great possibility that certain names of the *Cladophlebis* species as delimitted in the present study may subsequently be altered in case of the discovery of fructifications.

V. PREVIOUS WORKS

H. T. GEYLER (1877) was the first to describe systematically the Mesozoic fossil leaves from Japan. The material was collected by REIN at Kuwasima (upper course of the river Tetori) among which GEYLER discriminated the following species and suggested the Jurassic age of the flora (at the right are the revised names accepted in the present work):

Thyrsopteris elongata GEYL.	= *O. elongata* (GEYL.)
? *Coniopteris*	= ?
Asplenium argutulum HR.	= *Cladophlebis argutula* (HR.)
Adiantites amurensis HR.	= *Coniopteris hymenophylloides* (BRONGN.)
Adiantites	= *Onychiopsis elongata* (GEYL.)
Pecopteris Saportana HR.	= indeterminable.
Pecopteris exiliformis GEYL.	= *Cladophlebis exiliformis* (GEYL.)
Zamites parvifolius GEYL.	= indeterminable.

Podozamites ensiformis HR.	= *Podozamites lanceolatus* (L. and H.)
P. tenuistriatus GEYL.	= ,,
P. lanceolatus var. *genuina* HR.	= ,,
P. lanceolatus var. *intermedia* HR. ..	= ,,
P. lanceolatus var. *Eichwaldi* SCHIMP.	= ,,
P. Reinii GEYL. var *latifolia* GEYL. ..	= *P. Reinii* GEYL.
P. Reinii GEYL. var. *angustifolia* GEYL.	= ,,
? *Podozamites*	= *Ginkgoidium Nathorsti* YOK.
Cycadeospermum japonicum GEYL. ..	= ?

Stimulated by REIN's discovery of many Jurassic plants at Kuwasima, the locality was subsequently visited by several Japanese geologists, such as B. KOTÔ, T. KOCHIBE, etc., and a further extensive geological reconnaissance of various parts of Central Honsyû was carried on by the Geological Survey of Tôkyô in 1883. The numerous examples of fossil plants then collected, together with those forwarded by Messrs. KOTÔ and KOCHIBE, were systematically studied by Dr. M. YOKOYAMA, who described the following species in 1889:

Thyrsopteris Murrayana BRONGN. ..	= *Coniopteris hymenophylloides* (BRONGN.)
T. prisca EICH.	= *C. hymenophylloides* (BRONGN.)
T. kagensis YOK.	= *Sphenopteris Goepperti* (DKR.)
Dicksonia gracilis HR.	= *Onychiopsis elongata* (GEYL.)
D. acutiloba HR. var.	= *O. elongata* (GEYL.)
D. nephrocarpa BUNB.	= *Coniopteris hymenophylloides* (BRONGN.)
D. cfr. *Glehniana* HR.	= indeterminable.
Onychiopsis elongata (GEYL.)	
Adiantites Heerianus YOK.	= *Coniopteris Heeriana* (YOK.)
A. Kochibeanus YOK.	= *Sphenopteris Kochibeana* (YOK.)

A. lanceus YOK. .... = *S. lanceus* (YOK.)
Asplenium whitbiense BRONGN. .... = *Todites Williamsoni* (BRONGN.)
A. argutulum HR. .... = *Cladophlebis argutula* (HR.)
A. distans HR. .... = *C. distans* (HR.)
Sphenopteris sp. .... = *Sphenopteris Goepperti* (DKR.)
Pecopteris exilis PHIL. .... = *C. exiliformis* (GEYL.)
P. Saportana HR. .... = indeterminable.
Taeniopteris ? .... = ?
Macrotaeniopteris cfr. *Richthofeni* SCHENK .... = *Taeniopteris Richthofeni* (SCHENK)
Sagenopteris sp.
Equisetum ushimarense YOK. ...... = *Equisetites ushimarensis* (YOK.)
E. sp.
Anomozamites sp.
Nilssonia orientalis HR.
N. ozoana YOK. .... = *Nilssonia orientalis* HR.
N. nipponensis YOK.
N. ? .... = ? *Taeniopteris Richthofeni* (SCHENK)
Dioonites Kotoi YOK. .... = *Nilssonia Kotoi* (YOK.)
Zamites parvifolius GEYL. .... = Indeterminable.
Podozamites lanceolatus (L. and H.). = *Podozamites lanceolatus* (L. and H.)
var. *intermedia* HR. .... = „
var. *Eichwaldi* SCHIMP. .... = „
var. *minor* HR. .... = „
var. *latifolia* HR. .... = „
var. *brevis* SCHENK .... = „
P. tenuistriatus GEYL. .... = „
P. Reinii GEYL.
Dictyozamites indicus FEIST. var. *distans* YOK. .... = *Dictyozamites falcatus* (MORRIS)
D. indicus var. *grossinervis* YOK. ... = *D. falcatus* (MORRIS)
Cycadeospermum japonicum GEYL. .. = ?

Ginkgodium Nathorsti YOK.
Ginkgo digitata BRONGN. .... = *Ginkgoites digitata* (BRONGN.)
G. cfr. *lepida* HR. .... = *Ginkgoites sibirica* (HR.)
G. sibirica HR. .... = ,,
Czekanowskia rigida HR. ?
Taxites sp. .... = ?
Pinus cfr. *prodromus* HR. .... = ?
P. Nordenskjöldi HR. .... = ?
Palissya sp. .... = ? *Elatocladus tennerima* (FEIST.)
Vallisnerites jurassicus HR. ? ...... = ?
Carpolithus ginkgoides YOK.

YOKOYAMA considered the flora "as a kind or connecting link between the northern or Siberian, and the southern or Indian, facies of one great Oolitic flora," and proposed the name "Tetori Series" (YOKOYAMA, 1934, p. 212) for this plant-bearing series.

In 1890, A. G. NATHORST described a number of specimens which E. NAUMANN collected from several localities at the Ryôseki district, Kôti pref., Sikoku Island, and suggested the Jurasso-Cretaceous age of the plant-beds. The species described by NATHORST are as follows:

Onychiopsis elongata (GEYL.)
Cladophlebis sp. .... = *Cladophlebis denticulata* (BRONGN.)
Sphenopteris cfr. *Goepperti* DKR. .. = *Sphenopteris Goepperti* DKR.
Pecopteris Geyleriana NATH. ...... = *Cladophlebis exiliformis* (GEYL.)
P. sp. ....
P. cfr. *Browniana* DKR. .... = *Cladophlebis triangularis* sp. nov.
Dicksoniopteris Naumanni NATH.
Zamiophyllum Buchianum (ETT.)
Z. Naumanni NATH. .... = *Zamiophyllum Buchianum* (ETT.)
Nilssonia cfr. *schaumburgensis* (DKR.) .... = *Nilssonia schaumburgensis* (DKR.)

Ptilophyllum cfr. *cutchense* MORRIS = *Ptilophyllum pecten* (PHIL.)
Macrotaeniopteris ? *marginata* NATH. = *Taeniopteris* sp.
Podozamites lanceolatus latifolius SCHENK .... = *Podozamites lanceolatus* (L. and H.)

Plants from the Ryôseki district were again studied by Dr. M. YOKOYAMA (1894) together with those from other localities in the equivalent deposits in Sikoku and Honsyû. He named the plant-bearing deposits the "Ryôseki Series" and described the following species:

Thyrsopteris sp. .... = *Cladophlebis acutipennis* sp. nov.
Dicksonia tosana YOK. .... = *Sphenopteris tosana* YOK.
Dicksoniopteris Naumanni NATH. = *Klukia Yokoyamae* ÔISHI
Onychiopsis elongata (GEYL.)
O. elegans YOK. .... = *Sphenopteris elegans* YOK.
Adiantites yuasensis YOK.
Pteris ? sp. .... = *Cladophlebis Takezakii* sp. nov.
Sphenopteris tenuicula YOK. .... = *Sphenopteris Goepperti* DKR.
Pecopteris Browniana DKR. ...... = (pars) *Cladophlebis exiliformis* (GEYL.)
= (pars) *C.* sp.
P. Geyleriana NATH. .... = *Cladophlebis exiliformis* (GEYL.)
P. cfr. *virginiensis* FONT. .... = *Cladophlebis acutipennis* sp. nov.
Cladophlebis Nathorsti YOK. .... = *C. denticulata* (BRONGN.)
Macrotaeniopteris ? marginata NATH. .... = *Taeniopteris* sp.
Lycopodites sp. .... = indeterminable.
Podozamites lanceolatus L. and H.
P. pusillus VELEN. .... = ?
P. sp. .... = *Nageiopsis zamioides* FONT.
Zamiophyllum Buchianum (ETT.).

Z. Buchianum var. *angustifolium* FONT. .... = *Zamiophyllum Buchianum* (ETT.)
Z. Naumanni NATH. .... = *Zamiophyllum Buchianum* (ETT.)
Glossozamites parvifolius YOK. .. = ?
Nilssonia Johnstrupi HR. .... = *Nilssonia orientalis* HR.
N. schaumburgensis (DKR.)
N. pterophylloides YOK. .... = *Ptilophyllum pecten* PHIL.
Ptilophyllum cfr. *cutchense* MORRIS = *Ptilophyllum pecten* PHIL.
Cyparissidium ? *japonicum* YOK. . = *Brachyphyllum japonicum* (YOK.)
Torreya venusta YOK. .... = indeterminable.

In 1891, Dr. YOKOYAMA examined several specimens of fossil plants obtained by Dr. T. KOCHIBE from Yamanoi, Yamaguti pref. (Nagato) and recognised in Japan the presence of plant-beds which are decidedly older (probaby Rhaetic) than the Jurassic Tetori flora. Thus he described the following species:

Asplenium Roesserti PRESL ...... = *Cladophlebis nebbensis* (BRONGN.)
A. Roesserti var. *whitbiensis* BRONGN. .... = *C. haiburnensis* (L. and H.)
Dictyophyllum cfr. *acutilobum* BRAUN .... = *Dictyophyllum Nathorsti* ZEILL.
D. japonicum YOK.
D. Kochibei YOK. .... = *Thaumatopteris Kochibei* (YOK.)
Podozamites lanceolatus L. and H.
Baiera ? sp. .... = *Baiera paucipartita* NATH.

A subsequent collection of fossil plants from Yamanoi by Dr. K. INOUE was also examined by Dr. YOKOYAMA, who partly revised his former determination of the Yamanoi plants and in 1905 described the following species, together with some plant remains from the nearly equivalent deposits of Nariwa, Okayama pref. (Bitchû).

Yamanoi:

Cladophlebis nebbensis (BRONGN.)
C. yamanoiensis YOK. .... = *Cladophlebis haiburnensis* (L. and H.)

Dictyophyllum japonicum YOK.
D. Nathorsti ZEILL.
D. Kochibei YOK. .... = *Thaumatopteris Kochibei* (YOK.)
Podozamites lanceolatus L. and H.
Nilssonis Inouyei YOK.
Baiera paucipartita NATH.

Nariwa:

Cladophlebis sp. .... = *Cladophlebis nebbensis* (BRONGN.)
Sagenopteris sp. .... = ? *Sagenopteris Nilssoniana* PRESL
Anthrophyopsis ? sp. .... = *Ctenis japonica* ÔISHI
Nilssonia sp. .... = *Taeniopteris nabaensis* ÔISHI
Podozamites lanceolatus L. and H.

YOKOYAMA did not mention the exact locality of the Nariwa plants. However the lithic character of the specimens which the writer examined in the Geological Institute, Tôkyô Imperial University, shows a close agreement with that of the plant-bearing rocks of Nabae (loc. 21 of the Nariwa district) where *Ctenis japonica, Taeniopteris nabaensis,* etc. were obtained.

In 1905, Prof. YABE described several plants from Tyôsen. This is the first record of Mesozoic plants, systematically studied, from that peninsula. The material treated by him was collected by himself at Pul-tan-kokai near Naktong (Naktong or Rakutô Series by Prof. YABE) and includes several species common with the Tetori flora studied by Dr. YOKOYAMA. This analogy led Prof. YABE to the announcement of the contemporaneity of the Naktong flora with that of the Tetori series. Prof. YABE described the following species:

Dictyozamites falcatus (MORRIS)
Nilssonia orientalis HR.
N. sp. .... = *Nilssonia orientalis* HR.
Dioonites ? sp. .... = ? *Nilssonia Kotoi* (YOK.)
Ctenophyllum ? sp. .... ≐ ? *N. Kotoi* (YOK.)
Podozamites Reinii GEYL.

P. lanceolatus (L. and H.)
Pinus sp.
Onychiopsis elongata (GEYL.)
Coniopteris Heeriana (YOK.) ...... = *Coniopteris burejensis* (ZAL.)
Coniopteris hymenophylloides (BRONGN.) .... = ?
Cladophlebis cfr. *denticulata* BRONGN. = *Cladophlebis denticulata* (BRONGN.)
C. koraiensis YABE .... = *C.* (*Klukia*?) *koraiensis* YABE
C. cfr. *Dunkeri* (SCHIMP.) .... = *C. exiliformis* (GEYL.)
Sphenopteris naktongensis YABE ... = *Sphenopteris Goepperti* DKR.
S. sp.
Adiantites Sewardi YABE
Sagenopteris bilobata YABE .... = (pars) *Marchantites Yabei* KRYSHT.
Equisetum ushimarense YOK. ...... = *Equisetites ushimarensis* (YOK.)

In 1913, Prof. YABE described some fragments of fossil plants from Omoto, Iwate pref., which show as he suggested, strong similarity with the Ryôseki flora. The species described are as follows:

Onychiopsis elongata (GEYL.)
Cladophlebis Browniana (DKR.) ... = *Cladophlebis exiliformis* (GEYL.)
C. sp. indet.
Coniopteris sp. indet.
Nilssonia schaumburgensis var. *parvula* YABE
Zamiophyllum Buchianum (ETT.) ?

In 1922, Prof. YABE described some Mesozoic plants in the collection of the Institute of Geology and Palaeontology, Sendai. The material dealt with came from various localities in Japan and China, and this work is of special importance as it treated the critical revision of the older names which had until then been current among Japanese geologists. He described the following species from Japan:

Annulariopsis inopinata ZEILL. .... = (pars) *Lobatannularia ensifolia* (HALLE).
= (pars) *L. inequifolia* (TOK.)

Sphenophyllum sino-coreanum YABE

Sphenopteris (*Ruffordia*) *Goepperti* DKR.

Cladophlebis Browniana (DKR.) ... = (pars) *Cladophlebis exiliformis* (GEYL.)

C. Geyleriana (NATH.) .... = *C. exiliformis* (GEYL.)

C. (*Eboracia*) *lobifolia* (PHIL.)

C. denticulata (BRONGN.)

C. distans (HR.) emend YABE

C. nebbensis (BRONGN.)

C. argutula (HR.)

C. haiburnensis (L. and H.)

Clathropteris cfr. *meniscoides* (BRONGN.) .... = *Clathropteris obovata* ÔISHI

Pterophyllum (*Anomozamites*) *inconstans* F. BRAUN

Zamiophyllum Buchianum (ETT.) .. = (pars) *Zamites Yabei* sp. nov.

Ctenis sp. .... = *Equisetites* sp. cfr. *Neocalamites Carrerei* (ZEILL.)

Ginkgo sibirica HR. .... = (pars) *Ginkgoites sibirica* (HR.)
= (pars) *G. digitata* var. *Huttoni* SEWARD

Baiera ? *concinna* (HR.)

Phoenicopsis angustifolia HR. forma *media* (KRASERS) .... = *Phoenicopsis angustifolia* HR.

Frenelopsis cfr. *Hoheneggeri* (ETT.) = *Frenelopsis Hoheneggeri* (ETT.)

Elatocladus manchurica (YOK.)

In 1925, the flora of the Hakobuti Sandstone (Senonian) of Hokkaidô was first treated by Dr. S. ENDÔ who described the following species:

Pteris frigida HR. .... = *Cladophlebis frigida* HR.
Asplenium Dicksonianum HR. ?.... = *Sphenopteris Dicksoniana* (HR.)
Phyllites sp. (Cfr. *Adiantum formosum* HR.)
Pecopteris Torelli HR. ?
Glossozamites ? *Imaii* ENDÔ
Phyllites sp. (Cfr. *Sphenozamites rogersianus* FONT.)
Cycadeoidea nipponica ENDÔ
Nilssonia cfr. *orientalis* HR. ...... = *Nilssonia orientalis* HR.
N. cfr. *Johnstrupi* HR. .... = „
N. serotina HR.
Libocedrus sabiniana HR.
Sequoia heterophylla VELEN.
Populus denticulata HR. .... = *Trochodendroides denticulata* (HR.)
P. arctica HR. ?.................. = *T. arctica* (HR.)
Rhamnites apiculatus LESQ.
Protophyllum obovatum NEWB.

Of these species from the Hakobuti Sandstone, the occurrence of *Cycadeoidea* is very striking and important, as it indicates the undoubted existence in Hokkaidô of this remarkable Bennettitalean plant in the Senonian age. KRYSHTOFOVICH once described *Cycadeoidea ezoana* KRYSHT. from Hokkaidô. Though he did not mention the exact geological horizon of the specimen, it is almost unquestionable that it was derived from the Hakobuti Sandstone. Other fossil leaves listed above are very fragmentary and unsatisfactorily preserved.

In 1925 and 1926, Dr. S. KAWASAKI made an important contribution to the older Mesozoic floras of Tyôsen (Daidô Series) which until that time were very meagrely known to science. In the first volume in 1925, he discriminated 45 distinct species (of which two are from the Heian System) including several new types, and in the additional volume in 1926 he described approximately 15 species from other localities not mentioned in his previous work. The species described by him in these two volumes are as follows:

Coniopteris hymenophylloides BRONGN.
Eboracia lobifolia (PHIL.)
Laccopteris polypodioides (BRONGN.) . . = *Phlebopteris polypodioides* (BRONGN.)
L. sp.
Clathropteris meniscoides (BRONGN.) . . = *Clathropteris obovata* ÔISHI
Cladophlebis denticulata (BRONGN.)
C. Raciborskii ZEILL.
C. nebbensis (BRONGN.)
C. haiburnensis (L. and H.)
C. nampoensis KAWASAKI
C. Williamsoni (BRONGN.)
C. whitbiensis (BRONGN.) . . . . = *C. Williamsoni* (BRONGN.)
C. argutula (HR.)
Marattiopsis Muensteri (GOEPP.)
Taeniopteris cfr. *stenophylla* KRYSHT. . = *Taeniopteris stenophylla* KRYSHT.
T. eurychoron (SCHENK) . . . . =*T. Richthofeni* SCHENK
T. Mc'Clellandi (O. and M.) . . . . =*T. Richthofeni* SCHENK
T. cfr. *superba* SAPORTA . . . . =*T.* ? sp. nov.
Equisetites sp. cfr. *E. ferganensis* SEWARD
E. sp.
E. sp. cfr. *E. Sarrani* ZEILL.
Neocalamites Carrerei (ZEILL.)
Schizoneura nampoensis KAWASAKI . . = *Lobatannularia nampoensis* (KAW.)
Otozamites sp. nov.
Anomozamites Nilssoni (PHIL.)
A. minor KAWASAKI
A. cfr. *Nathorsti* (SCHENK)
Pterophyllum aequale BRONGN.
Pseudoctenis sp. cfr. *Ctenophyllum angustifolium* FONT. . . . . = *Pterophyllum* ?
Ctenis Yamanarii KAWASAKI
Nilssona pterophylloides NATH. . . . . . . = ? *Nilssonia Muensteri* PRESL

N. cfr. *tenuicaulis* (PHIL.)
Ginkgoites sibirica (HR.) .... = (pars) *Ginkgoites digitata* var. *Huttoni* SEW.
Baiera Phillipsis NATH.
B. gracilis BUNB. .... = (pars) *G. sibirica* HR.
= (pars) *B. Guilhaumati* ZEILL.
B. concinna (HR.) .... = *Baiera Asadai* YABE and ÔISHI
B. Lindleyana (SCHIMP.)
B. longifolia (POMEL)
Phoenicopsis angustifolia HR.
P. speciosa HR.
Elatocladus sp. cfr. *Palissya Braunii* END.
Pityophyllum longifolium NATH.
Podozamites lancolatus (L. and H.)
P. distans (PRESL)
P. Schenki HR.
Cfr. *P. gracilis* ARBER
Stenorachis sp. nov.
Spirangium sp.

During 1930 and 1938, many works on the Mesozoic plants of Japan (incl. Tyôsen) were published by the present writer and his colleagues particularly devoted to the description of plants which were collected one after another by the writer from various localities of the Mesozoic areas together with those forwarded by many persons for study. As it is not necessary to review all these publications, only a few of them may be introduced at this place.

In 1931, the writer (1931f) visited Kita-Otari for the purpose of collecting fossil plants, a part of which had already been examined by KRYSHTOFOVICH. The species which the writer described are as follows:

Equisetites sp.
Neocalamites hoerensis (SCHIMP.)
Cladophlebis nebbensis (BRONGN.)
C. denticulata (BRONGN.)

C. cfr. *Raciborskii* ZEILL. .... = *Cladophlebis Raciborskii* forma *integra* Ô. and T.
C. haiburnensis (L. and H.)
C. spp.
Thaumatopteris Schenki NATH ...... = ? *Thaumatopteris elongata* ÔISHI
Clathropteris sp.
Dictyophyllum sp.
Marattiopsis Muensteri (GOEPP.)
Taeniopteris sp.
Pterophyllum propinquum GOEPP.
P. Jaegeri BRONGN.
Ginkgoites digitata var. *Huttoni* SEWARD
Czekanowskia rigida HR.
Phoenicopsis ? sp.
Pityophyllum longifolium (NATH.)
Elatocladus sp.
Podozamites lanceolatus (L. and H.)
Carpolithus sp.

From the constituents of the florule, the writer announced the striking similarity between this and that of the Nariwa Series in the Nariwa district.

In the next year, the writer (1932) described some plants from Shitaka which seem certainly to belong to older flora than the Upper Jurassic Tetori flora but are apparently younger than that of Nariwa. The following species were described:

Neocalamites sp. cfr. *N. Carrerei* ZEILL.
Cladophlebis nebbensis (BRONGN.)
C. argutula (HR.)
C. denticulata (BRONGN.)
C. haiburnensis (L. and H.)
C. cfr. *Raciborskii* ZEILL. .... = *Cladophlebis Raciborskii* forma *integra* Ô. and T.
C. maizurensis ÔISHI
C. tenuissima ÔISHI } .... = ? *C. Raciborskii* forma *integra* Ô. and T.
Cfr. *Zamites megaphyllum* (PHIL.)
Otozamites spp. .... = *Otozamites Klipsteinii* (DKR.)

Taeniopteris stenophylla KRYSHT.
T. shitakensis ÔISHI
T. sp.
Czekanowskia ? sp.
Podozamites Griesbachi SEWARD
P. lanceolatus (L. and H.)
Carpolithus sp.

In the same year, a number of fossil plants from Nagato were described by the writer (ÔISHI, 1932a) as an additional note to that of YOKOYAMA (1891, 1905), and in 1936 the writer and E. TAKAHASI wrote a supplementary note on plants from the same district based on the later collection. The species described in these two notes are as follows:

Equisetites sp.
Phyllotheca sp.
Annulariopsis inopinata ZEILL. ?
Neocalamites Carrerei (ZEILL.)
Cladophlebis haiburnensis (L. and H.)
C. Raciborskii forma *intgra* Ô. and T.
C. nebbensis (BRONGN.)
C. denticulata (BRONGN.)
Dictyophyllum Nathorsti ZEILL.
D. japonicum YOK.
D. sp. indet.
Thaumatopteris Kochibei (YOK.)
Clathropteris obovata ÔISHI
Taeniopteris minensis ÔISHI
Cfr. *T. nabaensis* ÔISHI
Pterophyllum yamanoiensis Ô. and T.
P. ? sp. indet.
Nilssonia Inouyei YOK.
N. simplex ÔISHI
N. acuminata PRESL
Ginkgoites digitata var. *Huttoni* SEWARD
Baiera paucipartita NATH.
Czekanowskia ? sp.
Stenorachis elegans ÔISHI

Ctenis ? sp.
Pityophyllum longifolium (NATH.)
Elatocladus sp.
Podozamites lanceolatus (L. and H.)
P. Schenki HR.
Cfr. *Leptostrobus laxiflora* HR.
Cycadocarpidium Swabii NATH.
C. ? sp.
Sagenopteris Nilssoniana PRESL

In the same year, the present writer (1932b) described more than 80 species of plants from the Nariwa Series in the Nariwa district, and the number of species of the florule was increased considerably by subsequent collections by many persons who helped the writer. Thus an additional note was prepared in 1938 as a joint work with Mr. K. HUZIOKA, 1938). The total number of species of the florule thus reaches about 110. The following is a list of species hitherto discriminated from the Nariwa Series in the Nariwa district, with certain slight alterations of names of genera and species:

Equisetites multidentatus ÔISHI
E. sp.
Phyllotheca sp.
Neocalamites hoerensis (SCHIMP.)
N. Carrerei (ZEILL.)
Annulariopsis inopinata ZEILL. ?
Marattiopsis Muensteri (GOEPP.)
Todites Goeppertianus (MUENST.)
T. Williamsoni (BRONGN.)
T. princeps (PRESL).
Cladophlebidium ? *okayamaensis* Ô. and H.
Cladophlebis haiburnensis (L. and H.)
C. gigantea ÔISHI
C. bitchuensis ÔISHI
C. nebbensis (BRONGN.)
C. nariwaensis Ô. and H.
C. Raciborskii ZEILL.
C. „ forma *integra* Ô. and T.

C. (*Osmundopsis* ?) *subplectrophora* Ô. and H.
C. denticulata (BRONGN.)
C. tenue Ô. and H.
C. pseudodelicatula ÔISHI
C. sp.
Clathropteris meniscoides (BRONGN.)
C. var. *elegans* ÔISHI .... = *Clathropteris elegnas* ÔISHI
C. obovata ÔISHI
Thaumatopteris nipponica ÔISHI
T. elongata ÔISHI
T. Kochibei (YOK.)
T. pusilla (NATH.)
T. Schenki NATH.
Cfr. *T. Brauniana* POPP } .... = *Thaumatopteris elongata* ÔISHI
Dictyophyllum spectabile NATH.
D. Nilssoni (BRONGN.)
D. Muensteri (GOEPP.)
Hausmannia nariwaensis ÔISHI
H. dentata ÔISHI
H. crenata NATH.
Spiropteris sp.
Sphenopteris gracilis ÔISHI
S. sp. indet.
Pterophyllum Schenki (ZEILL.)
P. aequale (BRONGN.)
P. Jaegeri BRONGN.
P. angustum (BRAUN)
P. ctenoides ÔISHI
P. serratum Ô. and H.
Cfr. *P. distans* MORRIS
P. ? sp. aff. *Nilssonia tenuicaulis* (PHILLIPS)
P. spp.
Campylophyllum Hoermanii GOTHAN = *Campylophyllum Hoermanni* GOTHAN ?
Otozamites lancifolius ÔISHI
O. indosinensis ZEILL. .... = *O. Molinianus* ZIGNO
O. Huzisawae Ô. and H.

O. sp.
Ptilozamites tenuis ÔISHI
P. Nilssoni NATH. ?
Yabeiella sp.
Taeniopteris lanceolata ÔISHI
T. nabaensis ÔISHI
Cfr. *T. minensis* ÔISHI
T. cfr. *stenophylla* KRYSHT......... = *Taeniopteris stenophylla* KRYSHT.
T. cfr. *Carruthersi* T. W. .... = *T. Richthofeni* SCHENK
T. cfr. *Leclerei* ZEILL.............. = *T. Leclerei* ZEILL.
T. sp.
T. ? sp.
T. ? sp. nov.
Nilssonia simplex ÔISHI
N. orientalis (HR.)
N. acuminata (PRESL)
N. Muensteri (PRESL)
N. brevis BRONGN.
N. sp.
N. ? gen. et sp. indet.
Ctenis japonica ÔISHI
C. Yabei ÔISHI
C. Takamiana Ô. and H.
C. spp.
Ginkgoites digitata var. *Huttoni* SEWARD
G. sibirica (HR.)
B. furcata HR.
B. Muensteriana (PRESL) .... = *Baiera minuta* NATH.
B. filiformis ÔISHI
B. taeniata F. W. BRAUN
B. paucipartita NATH.
B. elegans ÔISHI
B. Guilhaumati ZEILL. ? .... = *Baiera Guilhaumati* ZEILL.
B. spp.
Czekanowskia rigida HR.
Phoenicopsis sp.
Stenorachis bitchuensis ÔISHI

S. elegans ÔISHI
S. (*Ixostrobus* ?) *Konianus* Ô. and H.
Pityophyllum (*Pityocladus*) *longifolium* NATH.
Cfr. *Storgaardia spectabilis* HARRIS
Elatocladus plana (FEIST.)
E. tennerima (FEIST.)
E. sp.
Podozamites Schenki HR.
P. lanceolatus (L. and H.)
P. concinnus Ô. and H.
P. sp.
Nageiopsis rhaetica OISHI
Swedenborgia cryptomerioides NATH.
S. major HARRIS
Drepanozamites ? sp. indet.
Sagenopteris sp. indet.

In 1934, Dr. I. TATEIWA wrote an interesting paper containing a description of several fossil Angiosperm leaves derived from the Taisyû Group of Tsushima (Tusima). The florule is particularly interesting and important as the plant-bed can, according to Dr. TATEIWA, be correlated with the Bukkokuzi Series of Southern Tyôsen which is stratigraphically younger than the Siragi Series (Gyliak-Monobegawa Series). The florule consists, though the material is fragmentary, entirely of Angiosperm leaves belonging to Dicotyledoneae, and indicates certainly a younger horizon than that of the Hakobuti Sandstone, as Dr. TATEIWA suggested. Thus he pointed out the possibility of its indicating the uppermost plant-bearing horizon of the Japanese Mesozoic possibly corresponding to the Danian in age. The species he discriminated are as follows:

Myrica ? sp.
Quercus sp.
Ulmus ? Nasai TATEIWA
Leguminosites Satoi TATEIWA
L. tsushimensis TATEIWA
L. ? cfr. *Cassia ambigua* UNG.
Citrophyllum sp.
Celastrophyllum japonicum TATEIWA
Sterculia taishuensis TATEIWA

Aralia sp.
Phyllites spp.

Next a word as to the algal flora. The Mesozoic algal floras of Japan occupy two geological horizons. The one is represented in the Upper Jurassic Torinosu Limestone occupying geographically a wide distribution from northeastern Honsyû southwestwards to northern Kyûsyû but occurring generally in small masses or lenses interbedded in sandstones and shales of the Torinosu Group. Prof. YABE was the first to treat systematically a calcareous alga from the Torinosu limestone, when, in 1912, he described an alga from Sikoku which he thought to resemble both *Solenopora* and *Lithothamnium* under the new generic and specific name, *Metasolenopora Rothpletzi*. But this alga was later discussed again in the joint work by Prof. YABE and Mr. TOYAMA (1928) where they recognized the generic identity of *Metasolenopora* and *Solenopora*.

Later on, calcareous algae were found elsewhere in the Torinosu limestone of various parts of Japan and several interesting types new to science were found by Prof. YABE and Mr. S. TOYAMA as described in 1928.

Other algae-bearing rocks are represented by the so-called *Orbitolina* Limestone of the Lower Ammonite Beds (the Monobegawa Series; Albian-Hauterivian), and some of the algae have already been described in YABE and TOYAMA's work (1928).

The calcareous algae hitherto described from the Mesozoic rocks of the Japanese Islands may be listed below (T.: Torinosu Limestone; O: *Orbitolina* Limestone):

Solenopora Rothpletzi (YABE)	T.
Petrophyton miyakoense YABE	O.
P. tenue YABE and TOYAMA	T. ?
Nipponophycus ramosus YABE and TOYAMA	T. and O.
Pycnoporidium lobatum YABE and TOYAMA	T.
Stenoporidium chaetetiformis YABE and TOYAMA.	Hiraiga Sandstone of the Miyako Cretaceous.
Girvanella tosaensis YABE and TOYAMA	T.

Besides the above, calcareous algae belonging to Melobesieae (*Lithothamnium* ?, *Archaeolithothamnium* ?) appear to be not uncommon in the Torinosu and *Orbitolina* Limestones, but investigation has not yet gone farther than described by YABE and TOYAMA.

As to the anatomical studies of the Japanese Mesozoic plants, we owe much to the contributions made by Drs. STOPES and FUJII, Prof. Y. OGURA, Mr. M. SHIMAKURA and some others.

The first record of such a line of research is that published by K. REISS in 1907.

Drs. M. C. STOPES and K. FUJII studied several petrified fossils obtained from nodules in the Upper Cretaceous rocks of Hokkaidô, and the following species were described by them in 1910, namely:

Petrosphaeria japonica STOPES and FUJII
Schizaeopteris mesozoica STOPES and FUJII
Fasciostelopteris Tansleii STOPES and FUJII
Niponophyllum cordaitiforme STOPES and FUJII
Yezonia vulgaris STOPES and FUJII
Yezostrobus Oliveri STOPES and FUJII
Araucarioxylon tankoense STOPES and FUJII
Cedroxylon Matsumurae STOPES and FUJII
C. Yendoi STOPES and FUJII
Cunninghamiostrobus yubariensis STOPES and FUJII
Cryptomeriopsis antiqua STOPES and FUJII
Saururopsis niponensis STOPES and FUJII
Jugloxylon Hamaoanum STOPES and FUJII
Sabiocaulis Sakuraii STOPES and FUJII
Populocaulis yezoensis STOPES and FUJII
Fagoxylon hokkaidense STOPES and FUJII
Cretavarium japonicum STOPES and FUJII

In the same year, K. SUZUKI described a new fungus together with two new coniferous woods derived from the Urakawa Series of Hokkaidô. The species described are as follows:

Pleosporites Shirainus SUZUKI
Abiocaulis yesoensis SUZUKI
Cryptomeriopsis mesozoica SUZUKI

Between 1927 and 1932, Prof. OGURA made valuable contributions to the anatomical studies of petrified fossils chiefly derived from the Upper Cretaceous formation (Urakawa Series) of Hokkaidô and the Upper Daido Formation (Naktong Series) of Tyôsen. His first contribution which appeared in 1927 contains descriptions of the following species:

Cyathocaulis naktongensis OGURA from Kinpuzan, Tyôsen (Naktong Series); and Huzinami-mura, Wakayama pref. (Monobegawa Series?).
Ciboticaulis Tateiwae OGURA from Kwankadô, Tyôsen (Naktong Series).
Cyathorachis Fujiiana OGURA from Ikushumbets, Hokkaidô (Urakawa Series).

The second one (1930) contains descriptions of the following species, all derived from the Urakawa Series of Yûbari in Hokkaidô;

Yezopteris polycycloides OGURA
Solenostelopteris loxsomoides OGURA
Cycadeoidea petiolata OGURA
Cycadeoidella japonica OGURA
Cunninghamiostrobus yubariensis STOPES and FUJII

OGURA's third paper which appeared in 1932 contains descriptions of the following species, all derived from Yûbari, Hokkaidô, except the last one which was collected from both Yûbari and Ikushumbets, Hokkaidô:

Cycadangium compactum OGURA
Stachycarpites projectus OGURA
Piceophyllum simplex OGURA
Pinus flabellifolia OGURA
P. pseudostrobifolia OGURA
Sciadopitys cretacea OGURA
Yubaria invaginata OGURA

Besides the above, OGURA further described *Protocyathea Tokunagai* OGURA (OGURA, 1931) from the Urakawa Series of the Hutaba district, Hukusima pref., and *Cibotium iwatense* OGURA from the same Series of the Kuzi district, Iwate pref.

SHIMAKURA's recent studies of fossil wood are specially worthy of note. He descirbed in 1936 the following:

Dadoxylon (*Araucarioxylon*) *japonicum* Shimakura from Yatuzi, Kôti pref. (Torinosu Group).

D. (*A.*) *sidugawaense* SHIMAKURA from Sidugawa, Miyagi pref. (Sizugawa Series).

Xenoxylon phyllocladoides GOTHAN from Heizyô City, Tyôsen (Lower ? Daidô Formation).

X. latiporosum (CRAMER) from Kuwasima, Isikawa pref. (Tetori Series) ; Heizyô City, Tyôsen (Mid. Daidô Formation).

Phyllocladoxylon heizyôense SHIMAKURA from Heizyô City, Tyôsen (Mid. Daidô Formation).

SHIMAKURA's contribution in 1937 is more important as it contains descriptions of more than twenty different type of fossil woods from the Mesozoic rocks of Japan; the species are:

Dadoxylon cfr. *tankoense* (STOPES and FUJII) from Namikawa, Karahuto (Urakawa Series).

D. (*Araucarioxylon*) *japonicum* SHIMAKURA from Koikorobe, Iwate pref. (Monobegawa Series).

D. sp. indet. (cfr. *D. japonicum*) from Hidesima and Mosi, Iwate pref. (Monobegawa Series).

Brachyphyllum aff. *woodworthianum* TORREY from Mosi, Iwate pref. (Monobegawa Series).

B. sp. indet. (*B. notabile* ?) from Kawakami coal mine, Karahuto (Urakawa Series).

Planoxylon Inaii SHIMAKURA from Ikusagawa, Karahuto (Urakawa Series).

Cedroxylon cfr. *Yendoi* STOPES and FUJII from Kawakami coal-mine, Karahuto (Urakawa Series).

C. sp. indet. from Kikumenzawa, Hokkaidô (Urakawa Series).

Piceoxylon transiens SHIMAKURA from Utasinai-gawa, Hokkaidô (Urakawa Series).

P. scleromedullosum SHIMAKURA from Naibuti-gawa, Karahuto (Urakawa Series).

P. sp. (*P. antiquius* ?) from Namikawa, Karahuto (Urakawa Series).

Phyllocladoxylon aff. *Gothani* (STOPES) from Kawakami coal-mine (Urakawa Series).

Podocarpoxylon woburnense STOPES from Huzinami-mura, Wakayama pref. (Monobegawa Series ?).

P. sp. indet. from Kawakami, Karafuto (Urakawa Series).

Paracupressinoxylon cryptomeriopsoides SHIMAKURA from Kawakami, Karahuto (Urakawa Series).

P. Solmsi (STOPES) from Naibuti-gawa, Karahuto (Urakawa Series); and Tanohata-mura, Iwate pref. (Monobegawa Series).

Taxodioxylon albertense (PENHALLOW) from Oriki in the Hutaba district, Hukusima pref. (Urakawa Series).

Cupressinoxylon vectense BARBER from Kawakami and Okukawakami, Karahuto (Urakawa Series).

C. sachalinense SHIMAKURA from Kawakami (Urakawa Series).

C. sp. (*C. sachalinense*?) from Naibuti-gawa and Kawakami, Karahuto (Urakawa Series).

C. sp. indet. from Pommosiri, Hokkaidô (Gyliak Series).

Dryoxylon cfr. *yezoense* (STOPES and FUJII) from Yûbari (Urakawa Series).

Aptiana ? sp. indet. from Kikumenzawa, Hokkaidô and Okukawakami, Karahuto (Urakawa Series).

Casuaroxylon japonicum SHIMAKURA from Kikumenzawa, Hokkaidô (Urakawa Series).

VI. NOTES ON THE MESOZOIC PLANT-BEARING DEPOSITS IN JAPAN

In this chapter, brief notes are presented on the Mesozoic plant-bearing deposits in Japan dealing chiefly with those in regard to which some stratigraphical problems are left in question. The description may be given for each vegetative Series (see the next Chapter).

A. Dictyophyllum Series

The deposits belonging to this Series are developed in the central and southwestern parts of Honsyû. A brief description and discussion follow:

1. Toyora District, Yamaguti pref.:—

In the Toyora district, plant elements of the *Dictyophyllum* Series are occasionally found in the marine deposits (Tabe Group) together with Liassic Ammonites. The writer (ÔISHI, 1935b) already described *Zamites toyoraensis* ÔISHI allied to *Z. Feneonis* BRONGN., and HUZIOKA (HUZIOKA, 1938) *Phlebopteris Takahasii* HUZIOKA, from the Nisi-Nakayama Bed. Besides above, *Zamites Yabei* sp. nov., *Nilssonia brevis* BRONGN. and *Brachyphyllum expansum* (STERNB.) are described in the present work.

2. Ômine district, Yamaguti pref.:—

The coal bearing series in the Ômine district contains many plant remains of the Rhaeto-Liassic aspect, some of which have already been described by YOKOYAMA (1891, 1905), ÔISHI (1932a) and ÔISHI and TAKAHASI (1936) as Rhaetic plants. According to the recent stratigraphical reconnaissance of the district by KOBAYASHI and KATAYAMA (1938), the coal bearing series is divisible into three beds in the following descending order:

Aso Beds.
Momonoki Beds.
Hirabara Beds.

KOBAYASHI and KATAYAMA state that the Hirabara Beds contain *Halobia charlyana, Lima naumanni lata, Oxytoma zitteli* and *Minetrigonia hegiensis* which are common with the Carno-Noric rocks of Sakawa district, Sikoku, and that the Aso Beds contain *Pecten suzukii, Oxytoma zitteli* which are common with the Carno-Noric or Lower Noric rocks in the same district (Sakawa). Thus they maintain the Carno-Noric age of the plant-beds of Kusaigawa and Momonoki (both the Momonoki Beds) and Mitiiti and probably Mominoki too (the Aso Beds). Here a question arises as to the stratigraphical value of such marine shells as KOBAYASHI and KATAYAMA used as criteria of the stratigraphical subdivision which KOBAYASHI applied in the Sakawa district. If it be admitted that the occurrence of such shells as *Oxytoma zitteli, Pecten Suzukii* etc. are confined to such very narrow stratigraphical stages, then the main plant beds of the Ômine coal bearing Series must belong entirely to the Carno-Noric stages and not the Rhaetic. In the accompanying correlation table the deposits of the Ômine district have been provisionally included in the Kotigatani Series following KOBAYASHI and KATAYAMA, but at the same time it must be suggested that the plant remains in the Ômine district show a certain resemblance with those from Nariwa, though in the former the species of Dipteridaceae are very poor.

3. Yamanoi and Tubuta districts, Yamaguti pref.:—

The stratigraphical relation between the plant bearing deposits of the Yamanoi district (ÔISHI, 1932a; ÔISHI and TAKAHASI, 1936) and the Tubuta coal mine district (ÔISHI and TAKAHASI, 1936) and those in the Ômine coal bearing series is not yet settled, though *Taeniopteris minensis* Ô. is common in Kusaigawa and Tubuta, and the plant-beds of Yamanoi appear to occupy a stratigraphically somewhat higher horizon than those of Tubuta.

4. Nariwa district, Okayama pref.:—

Plant remains from the Nariwa district were first described by YOKOYAMA (1891), then ÔISHI (1932b) described more than 80 species systematically, and later ÔISHI and HUZIOKA (1938) added a certain number of new species. The direct stratigraphical relation between the plant beds (Nariwa Bed) and the Noric *Pseudomonotis ochotica* Beds (Zitô Bed) is uncertain, the two being elsewhere in juxtaposition by means of severe dislocations. But the Rhaeto- Liassic aspect of the flora as a whole is very strong as is shown in the analysis of the flora in comparison with the *Lepidopteris* and *Thaumatopteris* Zones of East Greenland studied by T. M. HARRIS (ÔISHI, 1938a).

Recently, KOBAYASI and HORIKOSI (1937) wrote, according to their own field observation, that the plant beds of the Nariwa district overlie unconformably with a basal conglomerate a Palaeozoic formation and are overlain conformably by the marine beds which contain Noric *Pseudomonotis ochotica,* and hence the so-called Rhaetic plant beds belong to the Noric stage. Unfortunately, they did not make clear the very important points, 1) whether the *Pseudomonotis* beds actually and visibly overlie the plant-beds from which ÔISHI (1932b) and ÔISHI and HUZIOKA (1938) described numerous important species of fossil plants, and 2) whether the "basal conglomerate" represents an actual basal complex of the whole Triassic formation of the district. The latter question naturally arises from the fact that the *Pseudomonotis* beds are marine while the other is a terrestrial facies. Therefore, in order to render acceptable KOBAYASHI and HORIKOSHI's view in regard to the stratigraphical relation between the marine and terrestrial deposits, it should yet be explained by them 1) whether the "basal comglomerate" is an actual basal complex of the whole Mesozoic formation of the district and not the successive product of a non-marine transgressive overlap towards the Noric deposits from the Plaeozoic mountain to the south, and 2) whether the *Pseudomonotis* beds visibly not imaginatively, overlie a well-defined plant bed.

5. Kuruma, Nagano pref. and Neiridani, Toyama pref.:—

The plant bearing beds of the Kuruma district (Kuruma Bed) are exposed along the valley of the Himekawa and are elsewhere covered thickly by volcanic ashes and agglomerates which make it difficult to settle the precise stratigraphical sequence of the Mesozoic strata of the district. The writer collected several plant remains from various localities, and some of them together with those submitted by Dr. KOBAYASHI were described in 1931 (ÔISHI, 1931f). The florule contains several species common with the plants from Nariwa, and it is highly probable that it is closely related to the Nariwa florule, though the material is still too poor to admit precise correlation.

The Kuruma Bed develop also in the upper course of the Daira River and several plant remains were collected by the writer from Neiridani, a tributary of that river, as described in the present work.*

6. Sitaka (Maizuru coal mine), Kyôto pref.:—

The plant fossils from the Maizuru coal mine (Sitaka Bed) are poor and the preservation is not satisfactory. The writer (1932) discriminated 17 distinct forms of fossil plants and described them. As already stated, the Sitaka florule is not so young as the Tetori flora and at the same time it does not contain any characteristic Triassic species by which it can safely be assigned to the Rhaetic or even Liassic. For these reasons the writer thinks it most appropriate to consider the plant bearing beds as Middle Jurassic.

* A preliminary study of the plant remains from Neiridani has been already been made by Mr. E. TAKAHASI whom the present writer wishes to express his thanks for his labour.

7. Kitakami Mountainland:—

Our knowledge on the *Dictyophyllum* flora in the Kitakami Mountainland is unfortunately very poor. MABUTI (MABUTI, 1933) reported the occurrence of *Cladophlebis, Ptilophyllum, Nilssonia, Baiera* or *Phoenicopsis* and *Equisetites* from the lower part of Niranohama Bed (Liassic). The writer once had an opportunity of examining MABUTI's material, but it is too imperfect to be described. Recently, SHIMAKURA (SHIMAKURA, 1936) described *Dadoxylon (Araucarioxylon) sidugawaense* SHIM. from Sizugawa.

8. In Tyôsen, the *Dictyophyllum* Series is represented by the Lower Daidô System or the Daidô Series and occupies separate areas in the northern, central and the southern parts of that peninsula. The Daidô Series is entirely of terrestrial origin and is characterised by the presence of abundant plant remains. KAWASAKI (1925, 1926) has already described systematically more than 45 species from the Series. In the present work, certain items of KAWASAKI's nomenclature have been altered according to the writer's view (p. 141).

B. Onychiopsis Series

This Series may be separated into three divisions, viz., the Lower, the Middle and the Upper as follows:

Upper	(iii) Monobegawa Series.
Middle	(ii) Ryôseki Series.
Lower	(i) Tetori Series.

(i) The Tetori Series

The lower division, the Tetori Series, is extensively developed throughout Honsyû from the Kitakami mountainland to the southwestern part of Honsyû, particularly occupying considerable areas in the Kitakami, Hida and Hokuroku mountainlands and in Yamaguti pref. Brief remarks follow relative to each plant-bearing deposit of the Tetori Series:

1. Ôsima, Miyagi pref.:—

Ôsima is a small island opposite the town of Kesennuma. Japanese geologists early knew of Mesozoic fossil plants in this island but they have never been described except a few by Prof. YABE (YABE, 1922). Prof. YABE once examined the material collected by S. KONDÔ from several localities in the island and maintained the transitional stage of the plant beds from the Jurassic to the Cretaceous (YABE, 1927, p. 25). The writer re-examined the material through the suggestion of Prof. YABE and arrived at the conclusion that the elements of the florule are more closely related to the Tetori flora than to the Ryôseki. Being necessary to the discussion, the names of the species listed by Prof. YABE are given below with the revised names on the right hand side:

Matonidium Goepperti SCHENK	= *Cladophlebis matonioides* sp. nov.
Coniopteris burejensis (ZAL.)	= ?
Cladophlebis sp. cfr. *Klukia exilis* PHIL.	= *C. exiliformis* (GEYL.)
C. Browniana (DKR.)	= ,,
C. distans HR.	= *C. concinna* (HR.)
Adiantites Sewardi YABE	
Leckenbya valdensis SEWARD	= *Cladophlebis osimaensis* sp. nov.
Ctenopsis latifolia (FONT.) ?	= ?
Brachyphyllum sp.	
Dichotozamites cycadopsis (FONT.) ?	= ?
Ptilophyllum cfr. *pecten* (PHIL.) ..	= *Ptilophyllum pecten* PHIL.
Zamites cfr. *megaphyllus* (PHIL.)	
Zamiophyllum Buchianum (ETT.) ..	= Cfr. *Zamites Feneonis* BRONGN.
Otozamites spp.	= *Otozamites Kondoi* sp. nov.
Nilssonia ozoana YOK.	= *Nilssonia orientalis* HR.
N. Johnstrupi HR.	= ,,
Equisetum ushimarense YOK.	= ?
Frenelopsis cfr. *Hoheneggeri* (ETT.).	= *Frenelopsis Hoheneggeri* (ETT.)
Williamsonia sp.	= *Williamsonia* sp. cfr. *W. whitbiensis* NATHORST

The above list includes no species characteristic to the Ryôseki Series except *Frenelopsis* which is a genus hitherto known only from the Cretaceous of Europe and North America. On the contrary, *Cladophlebis concinna, Adiantites Sewardi,* cfr. *Zamites megaphyllus,* cfr. *Z. Feneonis* and cfr. *Williamsonia whitbiensis* are rather Jurassic elements. It is by no means certain that the above named elements must absolutely be indicators of the Jurassic, but the balance of the common or allied species of the present florule is certainly in favour of the Jurassic or the Tetori Series rather than of the Ryôseki. Under these circumstances the writer considers it more appropriate to regard the plant bearing beds of Ôsima as one of the Tetori equivalents.

2. Ozika peninsula, Miyagi pref.:—

The plant bearing deposits of the Ozika peninsula were recently studied stratigraphically by Mr. T. TAKAHASI. The plant fossils were collected from various localities and horizons which alternate with marine beds with *Perisphinctes* spp. indicating the Upper Jurassic age. The plant fossils were first examined by TAKAHASI and later the writer had an opportunity to look over them. The florule consists chiefly of *Cladophlebis denticulata, C. argutula, C. lobifolia, C. exiliformis, Onychiopsis elongata, Sphenopteris Goepperti, Ptilophyllum pecten* etc., of which *Cladophlebis lobifolia* is an element of the Tetori Series, while the others are common to both the Tetori and the Ryôseki Series.

Thus the balance of common species is nearly equal in the two Series but the Jurassic age of the plant beds of the Ozika peninsula under consideration is certain as it is said that they alternate with marine beds carrying Upper Jurassic Ammonites.

3. Central Honsyû:—

The Upper Jurassic terrestrial deposits (Tetori Series, s. s.) in Central Honsyû are extensively developed in Isikawa, Hukui, Gihu, and Toyama prefectures and rest on the eroded surface of the Gneiss System by means of blended unconformity. The Jurassic complex is divisible into three beds, viz., the lower or basal conglomerate, the middle or fossiliferous beds and the upper or non-fossiliferous sandstones. The basal conglomerate is composed of rounded bowlders of gneiss mostly about 10 cm. in diameter sometimes attaining 30 cm. It is interesting to note that the basal complex merges gradually below towards the gneiss system without any indication of a distinct and visible erosion surface between them. The middle or fossiliferous beds are characterised by an abundance of fossil plants and in some places for instance, in Hukui and Toyama prefectures marine beds with *Perisphinctes* develop in an intimate relation with the plant beds. The upper division is composed of sandstones and conglomerates in alternation and is almost barren of fossils.

The plant fossils from the middle division have already been studied and described by GEYLER (1877) and YOKOYAMA (1889). The names of plants by these authors need revision in the light of modern knowledge; the revised names are listed on p. 132 of this work.

Numerous specimens of fossil plants have since then been collected by the writer and his colleagues (S. IMAMURA, K. HUZIOKA) from various localities in this Jurassic area, most of which are described in the present paper.

A geological description of the Jurassic areas in Central Honsyû is more or less precisely given by the writer (1933a) in a note in the Japanese language.

4. Santyû Graben in the Kwantô Mountainland (YABE, NAGAO and SHIMIZU, 1926) :—

The Jurassic deposits of the so-called Santyû Graben, equivalent to the Tetori Series in Central Honsyû are divisible into two groups, namely the lower or Miyakozawa Group and the upper or Ônosawa Group, of which the latter is composed of sandstones and shales in alternation intercalating thick layers of conglomerates. Imperfect plant remains such as *Cladophlebis, Nilssonia, Podozamites*, etc. occur frequently in several horizons but they are hardly specifically determinable.

5. Toyora district, Yamaguti pref.:

The Jurassic deposits in the Toyora district are developed in the western part of Yamaguti pref. and have been grouped under the name Toyora Series by Prof. YABE. According to the writer's view (see also ÔISHI, 1933a), the series is divisible as follows in descending order:

Yosimo-hama Shell Beds	Kiyosue Group	Toyora Series
Kiyosue Plant Beds		
Utano Bed	Tabe Group	
Nisi-Nakayama Bed		
Higasi-Nagano Bed		

Of these, the Tabe Group is the marine formation which rests unconformably on the Toyogatake Phyllites Series. The Higasi-Nagano Bed contains *Anabacia cyclolitoides* YABE and EGUCHI, *Trigonia inouyei* YEHARA and some other animal fossils: it has been attributed to the Middle Liassic. The Nisi-Nakayama Bed contains several Ammonites belonging to the genera *Hildoceras, Harpoceras, Dactylioceras, Coeloceras,* etc: it belongs, according to YOKOYAMA who studied the Ammonites, to the Upper Liassic. Plant remains rarely occur in the Bed, but the present writer discriminated *Zamites toyoraensis* Ô. (ÔISHI, 1935b), *Z. Yabei* Ô. (p. 358 of this paper), and *Brachyphyllum expansum* (p. 391 of this paper) among them.

The Kiyosue Group which is nearly equivalent to the Tetori Series comprises terrestrial deposits with many fossil plants in its lower part and some brackish molluscs in the upper. The stratigraphical relation between this Group and the Tabe Group is not settled in the field, but it is the writer's opinion that the two may have been separated by dislocation. Numerous fossil plants occur from several localities in the Kiyosue Plant Beds but they have never been described.*

As to the stratigraphical relation between the marine beds (Tabe Group) and the terrestrial beds (Kiyosue Group), TORIYAMA (1938) hold an opinion which differs from that of the writer. They maintain that the two groups which are arranged side by side in the direction of their strikes represent deposits of different facies in the same geological age, and consider the plant beds of the Kiyosue Group as Liassic in age. However, their arguments on this important stratigraphical relation appear to be wanting in clearness in some points of their explanation. The main plant elements of the Kiyosue Group are, as can be seen in the list of plants below in Chapter VIII, *Onychiopsis elongata, Cladophlebis exiliformis, Sphenopteris Goepperti, Nilssonia nipponensis, Zamiophyllum Buchianum,* etc., which can hardly be considered as Liassic elements. Therefore, in order to accept the view of TORIYAMA, it is necessary that they make clear two additional important points, viz., first that the marine beds are actually and visibly, but not

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* A preliminary study of the fossil plants from the Kiyosue Plant Beds has been made by Mr. E. TAKAHASI whom the present writer has to thank for his labour.

imaginatively, traceable laterally to the plant beds, and secondly that the plant-beds, even if they were proved to be the lateral prolongation of the marine beds, are actually synchronous to the Liassic marine beds and not the product of a non-marine transgressive overlap towards the marine water which deposited the Tabe Group. All the fossil evidences of the Kiyosue Plant Beds indicate that the Kiyosue Group, at least its plant beds, are equivalent to the Tetori Series in Central Honsyû.

6. Sikoku:—

The Tetori equivalents in the island of Sikoku are represented by a marine deposits, the Torinosu Group, in which the palnt remains are very poorly known. SHIMAKURA once described *Dadoxylon* (*Araucarioxylon*) *japonicum* SHIM. (SHIMAKURA, 1936) from the Group at Yatuzi, Kôti pref.

7. Tyôsen (Korea):—

The Korean equivalent of the Tetori Series is represented by the Rakutô Bed which develops extensively along the upper course of the R. Rakutô (the R. Naktong) in southern Tyôsen. The Bed occupies the lowest division of the Naktong Series, consisting of gray shales, dark gray mudstones and conglomerates, and rests unconformably on an eroded surface of gneiss or granite. Plant fossils are particularly abundant in the lower part of this bed. YABE (1905) has already discriminated more than a dozen species of plant remains from this bed. The area of the Naktong Series was later studied stratigraphically by TATEIWA (1929), who subdivided the Series into four subdivisions, namely, from above, Sikkoku Bed, Sinsyû Bed, Kasandô Bed and Rakutô Bed. Of these the former three are the nearest equivalents to the Ryôseki Series of the main islands of Japan while the last is the Tetori equivalent. TATEIWA (1929) listed 49 different types of fossil plants from the Rakutô Bed, some of them figured but not described. Most of the species the names of which were listed by TATEIWA have been re-examined by the writer and described in the present work.

(ii) The Ryôseki Series

The lower part of the Upper division is very familiar to Japanese geologists under the name of the Ryôseki Series. The development of this Series is very extensive throughout the Japanese Islands as far as Tyôsen: the strata are characterised by their content of abundant fossil plants bearing very close similarity with those of the Wealden Formation of Northern Europe and the Potomac Formation of North America. The writer will not venture now to give again geological sketches of the plant bearing deposits of the Series in various districts, as such have already been presented in detail by YABE (1927) in his valuable contribution to the Cretaceous Stratigraphy of the Japanese Islands. Therefore, in this place may be given only brief geological interpretations which are somewhat changed since the publication of YABE's work, together with some remarks from the geological viewpoint on the Korean equivalents of the Series entirely not mentioned by YABE.

1. The plant beds of Ôsima, Miyagi pref. were considered by YABE as transitional deposits between the Jurassic and the Cretaceous. In the present work, the plant beds are regarded as a Tetori equivalent (p. 157).

2. The plant beds of Massaki, Miyagi pref. which have been regarded by YABE as a Ryoseki equivalent are included in the Monobe-gawa Series in the present work. For reaching this view the writer owes much to the stratigraphical study by Messrs. Y. INAI and T. SEKI (unpublished) of the Tôhoku Imperial University who kindly informed the writer that the plant beds containing abundant reamins of *Cladophlebis exiliformis* almost exclusive of other species rest conformably on the marine beds with Trignoiae of the Monobegawa Series. The palaeobotanical evidence is not inconsistent with the above mentioned observation of the stratigraphy, because *Cladophlebis exiliformis* (=*C. Browniana*) together with some other elements of the Ryoseki flora occurs actually in the Monobegawa Series of Sikoku (YABE, 1927, p. 44).

3. Ozika peninsula, Miyagi pref.:—

The Mesozoic deposits of the Ozika peninsula were recently studied by T. TAKAHASI. According to him, the lower part of the deposits bearing plant remains and *Perisphinctes* in several different horizons corresponds to the Tetori Series, while the upper (the Ayukawa Bed) which contains *Nilssonia schaumburgensis, Freneïopsis Hoheneggeri,* etc. (see List, p. 177) corresponds to the Ryôseki Series.

4. Sôma District, Hukusima pref.:—

Plant-bearing deposits (Miyama Bed) of the Hukusima pref. are developed in the Sôma district occupying next higher horizon than the Torinosu Group with Tithonian Ammonites. The writer had an opportunity of examining the collection of plant fossils from the district chiefly made by Mr. Iwai and stored in the Institute of Geology and Palaeontology, Tôhoku Imperial University, together with numerous specimens collected by Prof. T. NAGAO and the present writer. Species which the writer discriminated are listed on p. 177.

5. Tyôsen (Korea):—

In Tyôsen, the upper part of the Naktong (Rakutô) Series may be regarded as equivalent to the Ryôseki Series. This part was divided by TATEIWA into three divisions, namely, from the lower, the Kasandô Bed, the Sinsyû Bed and the Sikkoku Bed. All these beds conformably succeed each other and above the Rakutô Bed of the Tetori equivalent. Plant fossils are rather rare in the Sinsyû Bed but TATEIWA discriminated *Onychiopsis elongata, Brachyphyllum japonicum,* etc. which are very common elements of the Ryôseki flora.

(iii) The Monobegawa Series

This Series comprises marine deposits of shallow sea origin widely developed in the Japanese Islands from Karahuto southwards to Sikoku and Kyûsyû. The plant beds have been recognised in the Monobegawa Series of Massaki (p. 163) of the Kitakami Mountainland and the Katuragawa district of Sikoku (YABE 1927, p. 44), from the former of which are known *Cladophlebis exiliformis, Zamiophyllum Buchianum,* and from the latter *Onychiopsis elongata, Cladophlebis exiliformis, Sphenopteris Yokoyamai, Podozamites lanceolatus, Brachyphyllum japonicum,* etc., all except *S. Yokoyamai* being common elements of the Ryôseki flora. Besides the above, OGURA (OGURA, 1927) described *Cyathocaulis naktongensis* OGURA, and SHIMAKURA (SHIMAKURA, 1937) *Podocarpoxylon woburnense* STOPES, from Kii peninsula, and the latter author (SHIMAKURA, 1937) *Dadoxylon japonicum* SHIM. from the Miyako district.

C. Angiosperm Series

Undoubted Angiosperm remains appear first in Japan at the beginning of the period represented by the Angiosperm Series. This Series is further divided into three according to the geological divisions of the Japanese standard, from the younger:

(iii) Bukkokuzi Series
(ii) Urakawa Series
(i) Gyliak Series.

(i) The Gyliak Series

This Series shows a restricted distribution in Honsyû but is more or less widely developed in Tyôsen, Hokkaidô and Karahuto. It is naturally a marine formation except in Tyôsen which is terrestrial. An occurrence of some fragments of dicotyledon leaves was recently reported by T. MATUMOTO from the Gyliak Series of Kyûsyû, but palaeobotanical knowledge of those fossils is entirely obscure.

In Tyôsen the Siragi Series which is conformable to the underlying Naktong Series is regarded by TATEIWA to be almost equivalent to the Monobegawa and Gyliak Series of the Japanese Islands. Though there is no fossil evidence whatever for referring the lower part of the Siragi Series to the Monobegawa Series, yet it is highly probable that the upper part (Taikyû Bed) of the Siragi Series approximately corresponds to the Gyliak Series, yielding a considerable number of plant fossils consisting of many dicotyledon leaves together with some conifers and Cycadophytan fronds; dicotyledons are entirely absent in the Monobegawa Series and the earlier rocks, but are particularly common in the Mihune Bed of the Gyliak epoch in Kyûsyû. Similar strata with a similar assemblage of fossil leaves which have been correlated to the Siragi Series may be found in the Eidô Series (SIMAMURA, 1927), Tin-an Series (SIMAMURA, 1925) and Sinyôdô Formation (HATAE, 1935) in Southern Tyôsen and also in the Honanri Formation and Kanposan Formation (SIMAMURA, 1929) in Northern Tyôsen. It is by no means certain that all these fossiliferous deposits belong to the Gyliak Series but at least the upper parts of the Tin-an Series (Sansuidô Bed and Takkitu Bed) and the Sinyôdô Formation, both with dicotyledon leaves, may be correlated approximately to the Gyliak Series of the Japanese Islands.

The plants of the Gyliak Series and its equivalents in Tyôsen are as follows (TATEIWA, 1929; HATAE, 1937):

Tapeinidium ? undulatum (HALL)
Equisetites sp. cfr. *E. Burchardi* (DKR.)
Ginkgoites adiantoides (UNGER)
Otozamites sp.
Zamiophyllum Buchianum (ETT.)
Brachyphyllum cfr. *spinosum* SEWARD
B. cfr. *macrocarpum* NEWB.
Cunninghamites cfr. *squamosus* HEER
Elatides cfr. *curvifolia* (DKR.)
Sequoia ambigua HEER
S. fastigiata (STERNB.)
S. obovata KNOWLT.
Frenelopsis cfr. *occidentalis* HEER.
F. cfr. *parceramosa* FONT.
Salix cfr. *proteaefolia* LESQ.
Populus cfr. *hyperborea* HR.
Maccintockia sp. ?
Nelumbo sp.
Menispermites sp. (cfr. *M. obtusiloba* LESQ.)
Cinnamonum sp.
Platanus sp. (cfr. *P. primaeva* LESQ. var. *subintegrifolia* LESQ.)
Leguminosites sp.
Ilex sp. cfr. *Ilex masoni* LESQ.)
Rhamnites sp.
Grewia sp.
Aralia sp.
Lindera cfr. *venusta* LESQ.
Viburnum cfr. *montanum* KNOWLT.

Unfortunately the plants above listed have not yet been described, but the above list and a few selected illustrations (HATAE, 1937) show that the flora is evidently of an advanced type and of an age younger than that of the Monobegawa and the Ryôseki epochs of the Japanese Islands. Thus it is quite natural to consider the above named florules to those equivalent to the Mihune Bed which is of Gyliak epoch.

(ii) The Urakawa Series

This Series is a marine formation having a wide distribution from Karahuto to Kyûsyû and is well characterised by the presence of abundant Ammonites and many other molluscan fossils.

Plant fossils occur frequently in petrified condition in this Series: especially is this so in the Upper Ammonites Bed of Hokkaidô and the equivalent beds of Karahuto. The materials have already been studied by STOPES and FUJII (1910), OGURA (1927–1933), SUZUKI (1910), SHIMAKURA (1936, 1937) and ENDÔ (1925), from the anatomical point of view. Leaf impressions occur, too, and some of them were described by ENDÔ (1925).

The Izumi Sandstone of Sikoku is particularly interesting as it contains a marine Phanerogam which KORIBA and MIKI (1931) called *Archaeozostera* suggesting its being an ancient type of modern *Zostera*. Unfortunately, that interesting fossil type is a mere impression, but the resemblance to the modern *Zostera* is certainly not slight. *Archaeozostera* was later found also in the Upper Ammonites Bed of Hokkaidô (ÔISHI, 1931g) and Karahuto (ÔISHI and MATUMOTO, 1932).

(iii) The Bukkokuzi Series

This is the uppermost division in the geological Series of Japanese Mesozoic formations. It consists of several kinds of acidic volcanic rocks with interbedded layers of tuff: it is widely distributed in Tyôsen and Tusima. The Series is entirely barren of organic remains in Tyôsen, but contains some fossil plants in Tusima (the Taisyû Series). The fossils were studied by TATEIWA (1934) who discriminated *Myrica* ?, *Quercus, Ulmus* ?, *Leguminosites, Citrophyllum, Celastrophyllum, Sterculia, Aralia,* etc. It is worthy of note that the florule consists entirely of dicotyledon leaves (p. 148).

In the accompanying table the writer has shown the correlation of the Mesozoic deposits in Japan for convenient use: it shows the approximate stratigraphical position of the plant beds the names of which have been cited in the present work. Therefore some marine beds which have little direct significance in relation to the plant beds are simplified or omitted from the table.

VII. MAJOR DIVISION OF THE JAPANESE MESOZOIC FROM THE VIEWPOINT OF FLORAL EVOLUTION

As a tentative scheme, a proposal is here advanced for a major division of the Japanese Mesozoic strata solely from the viewpoint of floral evolution. It is well known that the geological classification of all the complexes during geological history relies biologically altogether upon the faunal evolution, which by no means coincides with floral evolutions. Such major divisions of the whole geological column as Palaeophytic, Mesophytic and Cainophytic have been proposed from the viewpoint of floral evolution but have not yet been universally accepted among palaeobotanists.

But for Japanese palaeobotany, the application of such major divisions, at least in the case of the Mesozoic plants, is very convenient and useful, because of the unusual complexity of the Mesozoic strata, which have been subjected to severe dislocations in various places. Thus it is sometimes very difficult to settle the true order of succession in the field. Even the geological column established in any field is sometimes highly imaginative. When one takes into consideration the fact that the time required for floral evolution is long compared with that of certain fauna he sees that the use of subdivisions fased on flora is certainly reasonable.

The major division of the Japanese Mesozoic rocks is proposed as follows:

I. *Dictyophyllum* Series (Up. Triassic-Mid. Jurassic).
II. *Onychiopsis* Series (Up. Jurassic-Low. Cretaceous).
III. *Angiosperm* Series (Up. Cretaceous).

Characteristic elements of the *Dictyophyllum* series are the tropical to subtropical ferns such as Dipteridaceae and Marattiaceae. The characteristic genera are *Dictyophyllum, Clathropteris, Hausmannia, Thaumatopteris, Goeppertella* and *Marattiopsis*. Seed plants are also represented by several important genera and species, namely, *Pterophyllum Schenki, P. aequale, Otozamites lancifolius, O. Molinianus, O. Huzisawae, Ptilozamites Nilssoni, Nilssonia acuminata, N. Muensteri, N. brevis, Ctenis japonica, C. Yabei, Baiera paucipartita, Swedenborgia cryptomerioides,* etc. The present series would include the geological age between the Upper Triassic and the Middle

Approximate Stratigraphical Position of the Japanese Mesozoic Plant-bearing Deposits (plant-bearing deposits are marked with †).

New Major Division	European	Standard	Japanese Standard	Tyôsen (Korea)* Taikyû District	Tyôsen (Korea)* Eidô District	Tyôsen (Korea)* Tin-an District	Tyôsen (Korea)* Kenziho District	Tyôsen (Korea)* Eitoku District	Tusima	Kyûsyû	Sikoku (Kôti, Tokusima)	Southwestern Honsyû or Tyûgoku Yamaguti	Southwestern Honsyû or Tyûgoku Okayama	Kii Peninsula (Wakayama, Mie)	Central Honsyû (Isikawa, Hukui, Gihu, Toyama, Kyôto, Nagano)	Kwantô Mountainland (Santyû Graben, Tyôsi, etc.)	Abukuma Mountainland (Hukusima)	Kitakami Mountainland** Miyagi	Kitakami Mountainland** Iwate	Hokkaidô and Karahuto
Angiosperm Series	Cretaceous	Danian	Bukkokuzi Series	Bukkokuzi Series				Bukkokuzi Series	Taisyû Series †											
		Senonian	Urakawa Series							Himenoura Series, Upper Part of Ônogawa Cretaceous, etc.	Izumi Sandstone, Miyakura Sandstone			Toyazyô Bed			Hutaba Cretaceous		Kuzi Cretaceous †	Upper Ammonites Beds †
		Turonian-Cenomanian	Gyliak Series	Upper Daidô System, Siragi Series: Syusyazan Formation; Kansenri Formation; Saiyakusan Porphyrite Formation; Taikyû Bed †	Eidô Series: Senyûdô Bed	Tin-an System: Sansuidô Bed †; Takkitu Bed †	Honanri Bed †; Kamposan Bed †	Ryûhô Bed; Sinyôdô Bed †		Mihune Bed †, Gosyonoura Bed, Lower Part of Ônogawa Cretaceous, etc.				Kanaya Bed						*Trigonia* Sandstone
Onychiopsis Series		Albian-Hauterivian	Monobegawa Series	Kakubô Porphyrite Formation; Siragi Conglomerate	Kaidôri Bed	Mantokusan Bed	Goryûsan Bed	Gosendô Bed			*Trigonia* Sandstones of Sakawa, Ryôseki, Monobegawa, Katuragawa, etc.	Inkstone Series	Inkstone Series	Nisihiro Bed	*Trigonia* Sandstone	Kawarazawa Group; Isidô Group		Marine Beds of Massaki † and Ôsima		Lower Ammonites Beds
		Wealden	Ryôseki Series	Naktong (Rakutô) Series: Sikkoku Bed; Sinsyû Bed †; Kasandô Bed	Sikonri Bed †			Keiteidô Bed †		Wakino Bed	Plant Beds of Sakawa, Ryôseki, Monobegawa, Katuragawa, etc. †			Plant Beds of Yuasa, Takata and Iwakura		Siroi Group †	Miyama Bed †	Ayukawa Bed † (Ozika Peninsula)	Omoto Plant Beds †	
	Jurassic	Upper	Toyora Series: Tetori Series	Rakutô Bed †						Torinosu Group	Torinosu Group	Kiyosue Group: Yosimo Shell Beds; Kiyosue Plant Beds †		Torinosu Group	Tetori Series †	Torinosu Group: Ônosawa Group †; Miyakozawa Group	Nakanosawa Bed	Hasiura Series, Ogihama Series † (Ozika Peninsula) and Ôsima Plant Beds †		Naegawa Bed and Onisasi Bed
Dictyophyllum Series		Middle	Sizugawa Series	Low. Daidô System: Daidô Series †			Goson Bed †; Syôrinsan Bed †; Tyûdô Bed					Tabe Group: Utano Bed			Sitaka Bed †		Sugaya Bed	Sizugawa Series		
		Lower										Nisi-Nakayama Bed †; Higasi-Nagano Bed			Kuruma Bed †					
	Triassic	Rhaetic	Nariwa Series									Plant Beds of Yamanoi, ? Tubuta †	Nariwa Bed †							
		Carnic-Noric	Kôtigatani Series	Heian System ?						*Pseudomonotis* Beds	*Pseudomonotis* Beds; *Oxytoma* Beds; *Halobia* Beds	Aso Beds †; Momonoki Beds †; Hirabara Beds	*Pseudomonotis* Beds (Zitô Bed)		*Pseudomonotis* Beds; Heki Bed	*Pseudomonotis* Beds		Kôtigatani Series		
?		Skytic-Ladinic	Inai Series	? Kobôsan Series †							*Daonella* Beds; *Meekoceras* Beds	*Daonella* Beds				*Ophiceras* Limestone		Inai Series		

* Besides five districts listed below plant-bearing deposits are developed also in Heizyô (S. Heian Dô), Zinkôri (S. Kankyô Dô), Bunkei (N. Keisyô Dô), Bansyô (Kôgen Dô), Rampô (S. Tyûsei Dô), Tûsin (Keiki Dô) and some other districts. They chiefly belong to the Lower Daidô System or Daidô Series and some fossil plants derived from these beds have already been described by S. KAWASAKI during 1925–1926 (KAWASAKI, 1925, 1926).

** A stratigraphical study of the Kitakami mountainland is now working on by Messrs. Y. INAI and T. TAKAHASI. According to them, Mesozoic deposits of the Ozika peninsula are divisible into four parts, namely, form the upper, Ayukawa, Ogihama, Mano and Sizugawa Series. Ayukawa Series corresponds approximately to the Ryôseki Series, Ogihama to the Tetori Series or roughly to the Hasiura Series of Mr. S. MABUTI, while Mano is of Middle Jurassic and Sizugawa approximately corresponds to the Sizugawa Series (Liassic) in the meaning of Mr. MABUTI. Therefore the Sizugawa Series in this table and in the text, too, means a geological age inclusive Dogger and Liassic.

Jurassic or between the later phase of the Kôtigatani Epoch and the Sizugawa Epoch.

The *Onychiopsis* series is characterised by a dominant assemblage of *Onychiopsis elongata* and *Cladophlebis exiliformis* which occur throughout the whole complex of the series and from the majority of the fossil localities belonging to it. Moreover, the series is characterised by the assemblage of the following genera and species, viz., *Marchantites Yabei, Sphenopteris Goepperti, Coniopteris hymenophylloides, C. burejensis, Adiantites Sewardi, Nilssonia schaumburgensis, Zamiophyllum Buchianum, Ptilophyllum pecten,* etc. This series would include the geological age between the Tetori and the Monobegawa Epochs.

The Angiosperm series, the uppermost major division of the Japanese Mesozoic, is of special interest as undoubted Angiosperm leaves, especially those of Dicotyledons, first appeared in Japan at the beginning of this time. It is also noteworthy that *Cycadeoidea* trunks have been discovered in this series, together with many other petrified ferns suggesting a strong affinity with Cyatheaceae. The series corresponds approximately in age to the Upper Cretaceous, that is, in the Japanese standard including the whole series between the Urakawa and the Bukkokuzi Series.

As briefly mentioned above, the contrast in the constituents of the flora among these three major divisions is remarkable, and the contrast is more striking when each is compared with the other on the basis of the whole number of species in each series. For instance, the total number of species is about 120 in the *Dictyophyllum* series, about 130 in the *Onychiopsis* series and about 80 in the Angiosperm series. There are only 12 common species between the former two, namely, *Todites Williamsoni, Coniopteris hymenophylloides, Cladophlebis denticulata, C. argutula, Nissonia orientalis,* cfr. *Zamites megaphyllus, Ginkgoites sibirica, Taeniopteris Richthofeni, Czekanowskia rigida, Brachyphyllum expansum, Elatocladus tennerima* and *Podozamites lanceolatus.* Of these, *C. denticulata, N. orientalis, P. lanceolatus* are themselves aggregates of more than one species or even genera, occurring throughout all the Mesozoic deposits of Japan except the Middle and Lower Triassic rocks of which our palaeobotanical knowledge is very meagre. Accordingly, the affinity of the flora between the *Dictyophyllum* and the *Onychiopsis* series is very slight, so it seems there is no continuation of floral evolution from one to another. This is indeed an important and striking point in the geological history of the Japanese Islands: it is recognisable that this abrupt change in plant evolution occurred at the end of the Sizugawa Epoch or the Middle Jurassic.

Then a word as to the affinity of the *Onychiopsis* and the Angiosperm series. The total number of species of the latter is about 80, of which *Nilssonia orientalis* only is common to both series. If the existence of morphological resemblance between *Sphenopteris Dicksoniana* and *Onychiopsis elongata* on the one hand and between *Cladophlebis* (*Pteris*) *frigida* and *Cladophlebis denticulata* on the other be admitted, then the affinity of the two series may be closer, but the resemblance is very vague because of the uncertainty of the specific value of these fossils. Thus it is very striking that there is also an abrupt change in the constituents of the flora between the two series: this change occurred between the Monobegawa and the Siragi Epochs. The first appearance of undoubted Dicotyledon leaves in the Siragi Epoch as indicated by those in the Tin-an Series is noteworthy.

The two abrupt changes or revolutions in the plant life of the Japanese Mesozoic mentioned above are not events merely of the Japanese Islands but apparently are world-wide phenomena. Hence the approximate major subdivisions may also be applicable among the majority of the Mesozoic plant bearing deposits of the world. But the writer will not now go further in consideration of the deposits of the other countries, because of the difficulty of obtaining precise stratigraphical information of distant places on which discussions of floral evolution must be based. At least it may be suggested that in the case of the Japanese Islands the disappearance of the *Dictyophyllum* flora at the end of the Sizugawa Epoch is certainly influenced, though it may be only partially, by the period of denudation at the end of that epoch followed by an epeirogenic movement of the Japanese Islands indicated by the extensive terrestrial deposits of the Ryôseki Series now found throughout the Japanese Islands from northeastern Honsyû southwestwards to Sikoku, Kyûsyû and also to Tyôsen. In the same way, the cause of the disappearance of the *Onychiopsis* flora at the end of the Monobegawa Epoch is certainly affected by the extensive Monobegawa transgression which immersed almost all of the surface of the Japanese Islands of the present day. Caused by these two events, most of the genera and species suffered extinction or escaped to other regions while a few survived until the following Epoch.

It is noteworthy however that such severe physiographical change which caused the abrupt floral revolutions two times within the Mesozoic history of the Japanese lands did not bring forth any notable climatic change throughout the Mesozoic age. This can be seen from the evidences presented by the occurrence of a pretty large number of tropical to subtropical ferns forming floras throughout the age. This fact suggests that the two named physiographical changes did not cause so great a change of altitude as to influence the ecological condition of the former vegetation. Viewed as a whole, however, it may be suggested that the Mesozoic climate became somewhat cooler towards the end of the Mesozoic after the Triassic and Liassic when it is nearly tropical as indicated by the presence of Marattiaceae, Matoniaceae and Dipteridaceae in the *Dictyophyllum* Series, while Schizaeaceae, Gleicheniaceae, Cyatheaceae and Polypodiaceae become dominant in the *Onychiopsis* and Angiosperm Series, though some Matoniaceae and Marattiaceae are also represented in the *Onychiopsis* Series.

Lastly a word as to the flora of the Kôbôsan Series of Tyôsen. The Kôbôsan flora is very characteristic and unique comprising several species of *Gigantopteris* together with many ferns or fern-like plants, Bennettitales, Ginkgoales, Coniferales, etc. The flora differs considerably in its constituents from the next older Zidô flora which contains many species identical with the Permo-Carboniferous flora of the northern geo-botanical province. As to the geological age of the Kôbôsan flora diverse opinions now prevail among the palaeobotanists and geologists; KON'NO claimed, following HALLE, the Permian age of the flora, while YABE once maintained the basal Triassic age and later KAWASAKI supported YABE's view from his own palaeobotanical study of the Kôbôsan flora. As is obvious from KAWASAKI's work, the Kôbôsan flora differs considerably also from the ordinary older Mesozoic flora, at least from the flora of the *Dictyophyllum* Series there being absolutely no common species between them. It is of the utmost interest and necessity to make clear the exact position of the floral revolution between the Kôbôsan Series and the *Dictyophyllum* Series during the geological period between the Permian and the Triassic. The key to solve this question lies, the writer believes, in the discovery of plant beds in the Triassic deposits older than the Noric in Japan and adjacent lands.

The above is only a general outline of this view. As to more precise arguments and discussions, the present writer is now preparing a paper for Professor YABE's "Geology and Palaeontology of Japan."

VIII. LISTS OF SPECIES

The following (pp. 173–183) are lists of species hitherto figured and described by several authors from the Japanese Mesozoic formations. Some have been revised and the names altered according to the information in the latest palaeobotanical literature and also according to the writer's own view, and some specimens which were too imperfect to admit of specific or even generic determination are omitted from the lists except those which bear special significance to the palaeobotanical discussion of the flora as a whole. The lists are given for each Series according to the major divisions proposed by the present writer and to each district but not to each locality which can be seen at the end of the description of each species.

IX. SYSTEMATIC DESCRIPTION

Bryophyta

Hepaticae

The fossil records of Hepaticae are comparatively rare throughout all geological ages, and they are especially so in the Japanese Mesozoic rocks. This class comprises three Orders, namely, Marchantiales, Anthocerotales and Jungermanniales; of these the first two have a thalloid vegetative body, while the last one has both thalloid and foliose bodies.

Genus *Marchantites* BRONGNIART

Thalloid vegetative body with apparently dichotomous branching, agreeing in habit with the recent thalloid Hepaticae. Fructifications of most of the species described under this generic name are not known, however, the superficial resemblance to Marchantiales is very

Dictyophyllum Series.

Occurrence / Species	Tyôsen	Yamaguti pref.			Nariwa District, Okayama pref.	Sitaka, Kyôto pref.	Kuruma, Nagano pref., & Neiridani, Toyama pref.	Miyagi pref
		Ômine District	Yamanoi and Tubuta	Toyora-gun				
1. *Annulariopsis inopinata* ?		×			×			
2. *Lobatannularia nampoensis*	×							
3. *Neocalamites Carerrei*	×	×	×		×			
4. *N. hoerensis*					×		×	
5. *Equisetites multidentatus*					×			
6. *Marattiopsis Muensteri*	×				×		×	
7. *Todites Goeppertianus*					×		×	
8. *T. princeps*					×			
9. *T. Williamsoni*	×				×			
10. *Phlebopteris polypodioides*	×							
11. *P. Takahasii*				×				
12. *Coniopteris hymenophylloides*	×							
13. *Goeppertella varida*					×			
14. *Clathropteris elegans*					×			
15. *C. meniscoides*		×			×		×	
16. *C. obovata*	×		×		×			
17. *Dictyophyllum japonicum*		×	×					
18. *D. Muensteri*					×			
19. *D. Nathorsti*			×					
20. *D. Nilssoni*					×			
21. *D. spectabile*					×			
22. *D.* sp.							×	
23. *Hausmannia crenata*					×			
24. *H. nariwaensis*					×			
25. *H. dentata*					×			
26. *Thaumatopteris elongata*					×		?	
27. *T. Kochibei*			×		×			
28. *T. nipponica*					×			
29. *T. pusilla*					×			
30. *Sphenopteris gracilis*		×			×			

(*Continued.*)

Species \ Occurrence	Tyôsen	Yamaguti pref. Ômine District	Yamaguti pref. Yamanoi and Tubuta	Yamaguti pref. Toyora-gun	Nariwa District, Okayama pref.	Sitaka, Kyôto pref.	Kuruma, Nagano pref. & Neiridani, Toyama pref.	Miyagi pref.
31. *Cladophlebidium ? okayamaensis*					×			
32. *Cladophlebis argutula*	×							
33. *C. bitchuensis*					×			
34. *C. denticulata*	×		×		×	×	×	
35. *C. gigantea*					×			
36. *C. haiburnensis*	×	×	×		×	×	×	
37. *C. nampoensis*	×							
38. *C. nariwaensis*					×			
39. *C. nebbensis*	×	×	×		×	×	×	
40. *C. pseudodelicatula*					×		×	
41. *C. Raciborskii*	×				×			
42. *C.* ,, forma *integra*		×	×		×	×	×	
43. *C. subplectrophora*					×			
44. *C. tenue.*					×			
45. *Ctenis japonica*					×			
46. *C. Takamiana*					×			
47. *C. Yabei*					×			
48. *C. Yamanarii*	×							
49. *Nilssonia acuminata*		×			×			
50. *N. brevis*				×	×			
51. *N. Inouyei*		×	×					
52. *N. Muensteri*					×			
53. *N. orientalis*					×		×	
54. Cfr. *N. polymorpha*		×						
55. *N. simplex*			×		×			
56. Cfr. *N. tenuicaulis*	×				×		×	
57. *Otozamites Huzisawae*					×			
58. *O. lancifolius*					×			
59. *O. Molinianus*							×	
60. *O.* sp.							×	

(*Continued.*)

Species \ Occurrence	Tyôsen	Yamaguti pref. Ômine District	Yamaguti pref. Yamanoi and Tubuta	Yamaguti pref. Toyora-gun	Nariwa District, Okayama pref.	Sitaka, Kyôto pref.	Kuruma, Nagano pref. & Neiridani, Toyama pref.	Miyagi pref.
61. *Pterophyllum aequale*	×				×			
62. *P. angustum*					×			
63. *P. ctenoides*					×			
64. Cfr. *P. distans*					×			
65. *P. Jaegeri*					×		×	
66. *P. propinquum*	×						×	
67. *P. Schenki*					×			
68. *P. serratum*					×			
69. *P. yamanoiensis*			×					
70. Cfr. *Zamites megaphyllus*						×		
71. *Z. toyoraensis*				×				
72. *Z. Yabei*				×				
73. *Sagenopteris Nilssoniana*			×		×		×	
74. *Ptilozamites Nilssoni* ?					×			
75. *P. tenuis*					×			
76. *Baiera Asadai*	×							
77. *B. elegans*					×			
78. *B. filiformis*					×			
79. *B. furcata*					×			
80. *B. gracilis*	×							
81. *B. Guilhaumati*	×				×			
82. *B. Lindleyana*	×							
83. *B. longifolia*	×							
84. *B. minuta*					×			
85. *B. paucipartita*		×	×		×			
86. *B. taeniata*					×			
87. *Ginkgoites digitata* var. *Huttoni*		×			×		×	
88. *G. sibirica*	×				×			
89. *Czekanowskia rigida*			×		×	×	×	
90. *Phoenicopsis angustifolia*	×							

(*Continued.*)

Species \ Occurrence	Tyôsen	Yamaguti pref.			Nariwa District, Okayama pref.	Sitaka, Kyôto pref.	Kuruma, Nagano pref. & Neiridani, Toyama pref.	Miyagi pref.
		Ômine District	Yamanoi and Tubuta	Toyora-gun				
91. *Phoenicopsis speciosa*	×							
92. *Brachyphyllum expansum*				×				
93. *Elatocladus plana*					×			
94. *E. tennerima*					×			
95. *Pityophyllum longifolium*		×	×		×		×	
96. *Nageiopsis rhaetica*					×			
97. *Podozamites concinnus*					×			
98. *P. Griesbachi*						×		
99. *P. lanceolatus*	×	×	×		×	×	×	
100. *P. Schenki*	×	×			×			
101. Cfr. *Storgaardia spectabilis*					×			
102. *Cycadocarpidium Swabii*		×						
103. Cfr. *Leptostrobus laxiflora*			×					
104. *Stenorachis bitchuensis*					×			
105. *S. elegans*		×			×			
106. *S. (Ixostrobus) Konianus*					×			
107. *Swedenborgia cryptomerioides*					×			
108. *S. major*					×			
109. *Campylophyllum Hoermanni* ?					×			
110. *Taeniopteris Leclerei*					×			
111. *T. lanceolata*					×			
112. *T. minensis*		×			×			
113. *T. nabaensis*			×		×			
114. *T. Richthofeni*	×				×			
115. *T. shitakensis*						×		
116. *T. stenophylla*	×				×	×		
117. *T.* ? sp. nov.					×			
118. *Yabeiella* sp.					×			
119. *Dadoxylon (Araucarioxylon) sidugawaense*								×
120. *Xenoxylon phyllocladoides*	×							

Onychiopsis Series

Occurrence / Species	Lower Division or Tetori Series: Tyôsen	Lower: Yamaguti pref.	Lower: Central Honsyû	Lower: Sikoku	Lower: Ozika Peninsula	Lower: Ôsima	Middle Division or Ryôseki Series: Tyôsen	Middle: Sikoku	Middle: Kii Peninsula	Middle: Santyû (Gumma, Nagano prefs.)	Middle: Sôma district, Hukusima pref.	Middle: Ozika Peninsula	Middle: Omoto, Iwate pref.	Upper Division or Monobegawa Series: Sikoku	Upper: Kii Peninsula	Upper: Massaki	Upper: Miyako
1. *Marchantites Yabei*	×	×	×	··	··	··	··	×	×								
2. *Equisetites naktongensis*	×	··	··	··	··	··	×										
3. *E.* ,, var. *tenuicaulis*	×																
4. *E. ushimarensis*	×	··	×														
5. *Asterotheca naktongensis*	×																
6. *Nathorstia Oishii*	··	··	··	··	··	··	··	×									
7. *Todites Williamsoni*	··	··	×														
8. *Naktongia Yabei*	×																
9. *Klukia Yokoyamae*	··	··	··	··	··	··	··	×									
10. *Gleichenites nipponensis*	×	··	×	··	··	··	··	×									
11. *Phlebopteris pentaphylla*	··	··	··	··	··	··	··	×									
12. *Cyathocaulis naktongensis*	×	··	··	··	··	··	··	··	··	··	··	··	··	··	×		
13. *Coniopteris burejensis*	··	×	×														
14. *C. Heeriana*	··	··	×														
15. *C. hymenophylloides*	?	··	×														
16. *C.* sp.	··	··	×														
17. *Hausmannia* ? gen. et sp. indet.	×																
18. *Onychiopsis elongata*	×	×	×	··	··	··	··	×	×	×	×	··	×	×	··	×	
19. *Adiantites Sewardi*	×	×	×														
20. *A. toyoraensis*	··	×	··	··	··	··	··	×	?								
21. *A. yuasensis*	··	··	··	··	··	··	··	··	×								
22. *Sphenopteris elegans*	··	··	··	··	··	··	··	×	··	··	×						
23. *S. Goepperti*	··	×	×	··	··	··	··	×	×	×	×						
24. *S. Kochibeana*	··	··	×														
25. *S. nitidula*	··	··	×														
26. *S. pinnatifida*	··	··	··	··	··	··	··	··	··	··	×						
27. *S. tosana*	··	··	··	··	··	··	··	×									
28. *S. Yokoyamai*	··	··	··	··	··	··	··	··	··	··	··	··	··	×			
29. *S.* sp.	··	··	··	··	··	··	··	×	×								
30. *Cladophlebis acutipennis*	··	··	··	··	··	··	··	×	×								
31. *C. argutula*	··	··	×	··	··	··	··	×									
32. *C. concinna*	··	··	··	··	··	×											

(*Continued.*)

Occurrence / Species	Lower Division or Tetori Series						Middle Division or Ryôseki Series							Upper Division or Monobegawa Series			
	Tyôsen	Yamaguti pref.	Central Honsyû	Sikoku	Ozika Peninsula	Ôsima	Tyôsen	Sikoku	Kii Peninsula	Santyû (Gumma, Nagano prefs.)	Sôma district, Hukusima pref.	Ozika Peninsula	Omoto, Iwate pref.	Sikoku	Kii Peninsula	Massaki	Miyako
33. *C. deltifolia*	..	×															
34. *C. denticulata*	×	×	×	..	..	×	..	×	×	..	×						
35. *C. distans*	..	..	×	..	..	×	..	×	..	..	×						
36. *C. elegantissima*	..	..	..	..	..	..	..	..	×								
37. *C. exiliformis*	×	..	×	..	..	..	..	×	×	..	×	..	×	×		×	
38. *C. falcata*	..	..	..	..	..	..	..	×									
39. *C. hukuiensis*	..	..	×	..	..	..	..	..	×	..	..	..	..	×			
40. *C. isikawaensis*	..	..	×														
41. *C. koraiensis*	×																
42. *C. kuwasimaensis*	..	..	×														
43. *C. lobifolia*	..	..	×	..	..	..	..	..	..	..	×						
44. *C. matonioides*	..	..	..	..	×	×											
45. *C. osimaensis*	..	..	..	..	×	×											
46. *C. parvula*	..	..	..	..	..	..	..	×									
47. *C. shinshuensis*	..	..	..	..	..	..	×										
48. *C. Takezakii*	..	..	..	..	..	..	..	×	?	?							
49. *C. toyoraensis*	..	×															
50. *C. triangularis*	..	..	×	..	..	..	..	×									
51. *C. undulata*	..	..	..	..	..	..	..	×									
52. *Ctenis Kaneharai*	..	..	×														
53. *Nilssonia densinerve*	..	×	..	..	..	..	..	..	×								
54. *N. Kotoi*	?	..	×														
55. *N. nipponensis*	..	×	×														
56. *N. orientalis*	×	×	×	..	..	×	×	×	×	..	×						
57. *N. schaumburgensis*	×	..	..	..	..	..	..	×	×	..	×	×	..	×			
58. *N.* ,, var. *parvula*	×	..	..	..	..	..	..	×	..	..	..	..	×				
59. *N. serrulata*	×																
60. *N. wakwanensis*	×																
61. *N. Yabei*	×																
62. *N.* sp.	..	×															
63. *Pseudoctenis ? brevipennis*	..	..	..	..	..	..	..	..	..	..	×						
64. *P. Lanei*	..	..	..	..	×												

(*Continued.*)

Occurrence / Species	Lower Division or Tetori Series						Middle Division or Ryôseki Series							Upper Division or Monobegawa Series			
	Tyôsen	Yamaguti pref.	Central Honsyû	Silkoku	Ozika Peninsula	Ôsima	Tyôsen	Silkoku	Kii Peninsula	Santyû (Gumma, Nagano prefs.)	Sôma district, Hukusima pref	Ozika Peninsula	Omoto, Iwate pref.	Silkoku	Kii Peninsula	Massaki	Miyako
65. *P.* sp.	··	×															
66. *Dictyozamites falcatus*	×	×	×														
67. *D. Kawasakii*	×	··	×														
68. *D. Imamurae*	··	··	×														
69. *D. reniformis*	··	··	×														
70. *D. Tateiwae*	×																
71. *Otozamites Beani*	··	×															
72. *O. Kondoi*	··	··	··	··	··	×											
73. *O. Klipsteinii*	··	×	×	··	··	··	··	×	×								
74. *O. Sewardi*	··	··	×														
75. *Pseudocycas ? acutifolia*	··	··	×														
76. *P.* ? sp. indet.	×																
77. *Pterophyllum Lyellianum*	··	··	×														
78. *Ptilophyllum pachyrachis*	··	··	×														
79. *P. pecten*	··	×	··	··	×	×	··	×	×	··	×						
80. *P.* sp.	··	×															
81. *Williamsonia* sp. cfr. *W. whitbiensis*	··	··	··	··	··	×											
82. *W.* sp.	··	··	··	··	··	··	··	×									
83. *Zamiophyllum Buchianum*	··	×	··	··	··	··	··	×	×	×	×	··	×	··	··	×	
84. *Zamites Feneonis*	··	··	··	··	··	×	··	··	··	··	×						
85. Cfr. *Z. megaphyllus*	··	×	··	··	··	×											
86. *Z. tosanus*	··	··	··	··	··	··	··	×									
87. *Sagenopteris petiolata*	··	×															
88. *S. paucifolia*	··	··	×														
89. *S. ? inequilateralis*	··	··	··	··	··	··	··	··	×								
90. *Cycadolepis oblongiformis*	··	··	··	··	··	··	··	×									
91. *C. kiiensis*	··	··	··	··	··	··	··	··	×								
92. *Baiera Brauniana*	··	··	··	··	··	··	··	×									
93. *Ginkgoites digitata*	··	··	×														
94. *G. sibirica*	··	×	×														
95. *Ginkgoidium gracile*	×																
96. *G. Nathorsti*	×	··	×														

(*Continued.*)

Occurrence / Species	Lower Division or Tetori Series						Middle Division or Ryôseki Series							Upper Division or Monobegawa Series			
	Tyôsen	Yamaguti pref.	Central Honsyû	Sikoku	Ozika Peninsula	Ôsima	Tyôsen	Sikoku	Kii Peninsula	Santyû (Gumma, Nagano Prefs.)	Sôma district, Hukusima pref.	Ozika Peninsula	Omoto, Iwate pref.	Sikoku	Kii Peninsula	Massaki	Miyako
97. *Czekanowskia rigida*	..	×	×	..	..	..	..	?									
98. *Araucarites cutchensis*	..	×															
99. *Frenelopsis Hoheneggeri*	..	..	..	..	×	×	..	..	..	..	..	×					
100. *F. parceramosa*	×	..	..	..	..	..	×										
101. *Brachyphyllum expansum*	×	×															
102. *B. japonicum*	×	..	..	..	..	..	×	×	..	×	..	..	..	×			
103. *Elatocladus constricta*	..	×															
104. *E. obtusifolia*	..	..	..	..	..	..	..	..	..	..	×						
105. *E. tennerima*	..	..	?														
106. *Cupressinocladus koyatoriensis*	..	..	..	..	×												
107. *Nageiopsis longifolia*	..	×	..	..	..	?											
108. *N. zamioides*	..	..	..	..	..	..	..	..	×	..	×						
109. *Podozamites distantinervis*	..	×															
110. *P. Griesbachi*	..	..	×														
111. *P. lanceolatus*	..	..	×	..	..	..	..	×	×	..	×	..	..	×			
112. *P.* ,, subsp. *multinervis*	×																
113. *P. Reinii*	×	..	×														
114. *Sphenolepidium Sternbergianum*	×																
115. *Dadoxylon* (*Araucarioxylon*) *japonicum*	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	×
116. *Xenoxylon latiporosum*	×	..	×														
117. *Phyllocladoxylon heizyoense*	×																
118. *Podocarpioxylon woburnense*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×		
119. *Paracupressinoxylon* sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×
120. *Aphlebia nervosa*	..	..	×														
121. "*Geonoma*" *trinerve*	..	..	..	..	..	..	..	..	..	..	×						
122. *Pachypteris* ? sp. indet.	..	..	..	..	..	..	..	×									
123. *Taeniopteris emarginata*	..	..	×														
124. *T. Inouyei*	×																
125. *T. Richthofeni*	..	..	×														
126. *T.* ? sp. cfr. *T. auriculata*	..	..	..	..	..	..	×										
127. *Phyllites* sp.	..	..	..	..	..	..	..	×									

Angiosperm Series.

(As to the species from Bukkokuzi Series, see pp. 148 and 167.)

Occurrence / Species	Gyliak Series		Urakawa Series			
	Tyôsen	Hokkaidô	Hutaba, Hukusima	Kuzi, Iwate	Hokkaidô	Karahuto
1. *Pterosphaeria japonica*					×	
2. *Pleosporites Shirainus*					×	
3. *Protocyathea Tokunagai*			×			
4. *Fasciostelopteris Tansleii*					×	
5. *Cyathocaulis naktongensis*	×					
6. *Cyathorachis Fujiiana*					×	
7. *Yezopteris polycycloides*					×	
8. *Ciboticaulis Tateiwae*	×					
9. *Solenostelopteris loxsomoides*					×	
10. *Cibotium iwatense*				×		
11. Cfr. *Aneimia fremonti*					×	
12. *Schizaeopteris mesozoica*					×	
13. *Tapeinidium ? undulatum*	×				×	
14. *Sphenopteris Dicksoniana*					×	
15. *Cladophlebis frigida*					×	
16. *C. Torellii*					×	
17. *Nilssonia orientalis*					×	
18. *N. serotina*					×	
19. *Cycadangium compactum*					×	
20. *Cycadeoidea ezoana*					×	
21. *C. nipponica*					×	
22. *C. petiolata*					×	
23. *Cycadeoidella japonica*					×	
24. *Yezonia vulgaris*					×	
25. *Zamiophyllum Buchianum*	?			?		
26. *Glossozamites ? Imaii*					×	
27. Cfr. *Sphenozamites rogersianus*					×	
28. *Ginkgoites adiantoides*	×					×
29. *Frenelopsis parceramosa*	×					
30. *F.* cfr. *occidentalis*	×					

(*Continued.*)

Species \ Occurrence	Gyliak Series: Tyôsen	Gyliak Series: Hokkaidô	Urakawa Series: Hutaba, Hukusima	Urakawa Series: Kuzi, Iwate	Urakawa Series: Hokkaidô	Urakawa Series: Karahuto
31. *Brachyphyllum* cfr. *spinosum*	×					
32. *B.* cfr. *macrocarpum*	×					
33. *Niponophyllum cordaitiforme*					×	
34. *Yezostrobus Oliveri*					×	
35. *Dadoxylon tankoense*					×	×
36. *Cedroxylon Matsumurae*					×	
37. *C. Yendoi*					×	×
38. *C.* sp. indet.					×	
39. *Cunninghamiostrobus yubariensis*					×	
40. *Cunninghamites squamosus*	×					
41. *Elatides* cfr. *curvifolia*	×					
42. *Cryptomeriopsis antiqua*					×	
43. *C. mesozoica*					×	
44. *Planoxylon Inaii*						×
45. *Piceoxylon transiens*					×	
46. *P. scleromedullosum*					×	
47. *P.* sp. cfr. *P. antiquius*						×
48. *Piceophyllum simplex*					×	
49. *Abiocaulis yezoensis*					×	
50. *Pinus flabellifolia*					×	
51. *P. pseudostrobifolia*					×	
52. *Sciadopitys cretacea*					×	
53. *Stachycarpites projectus*					×	
54. *Phyllocladoxylon* aff. *Gothanii*						×
55. *Paracupressinoxylon cryptomeriopsoides*						×
56. *P. Solmsi*						×
57. *Taxodioxylon albertense*					×	
58. *Cupressinoxylon vectense*						×
59. *C. sachalinense*						×
60. *C.* sp. indet.		×				
61. *Sequoia Reichenbachi*					×	
62. *S. heterophylla*					×	

(*Continued.*)

Species \ Occurrence	Gyliak Series		Urakawa Series			
	Tyôsen	Hokkaidô	Hutaba, Hukusima	Kuzi, Iwate	Hokkaidô	Karahuto
63. *Libocedrus sabiniana*					×	
64. *Aptiana* ? sp. indet.					×	×
65. *Casuaroxylon japonicum*					×	×
66. *Nelumbo* sp.	×					
67. *Platanus* ? sp.	×					
68. *Populophyllum* sp.	×					
69. *Viburnum* cfr. *montanum*	×					
70. *Quercus Baueri*	×					
71. *Protophyllum obovatum*					×	
72. *Rhamnites apiculatus*					×	
73. *Trochodendroides arctica*				×	×	
74. *T. denticulata*					×	
75. *Yubaria invaginata*					×	
76. *Saururopsis niponensis*					×	
77. *Jugloxylon Hamaoanum*					×	
78. *Dryoxylon yezoense*					×	
79. *Fagoxylon hokkaidense*					×	
80. *Sabiocaulis Sakuraii*					×	
81. *Cretovarium japonicum*					×	
82. *Nyssa* sp.				×		

strong. RACIBORSKI's genus *Palaeohepatica* from the Keuper of Galicia and WALTON's *Hepaticites* from the Coal Measures of England also belong to this category; their affinity to Hepaticae is stronger than the ordinary Mesozoic *Marchantites*.

Marchantites Yabei KRYSHTOFOVICH

Pl. I, Fig. 1.

1905. *Sagenopteris bilobata* YABE var. *major* YABE: p. 41, Pl. III, fig. 6a (non 6b and 6c).

1930. *Marchantites Yabei* KRYSHTOFOVICH: p. 145, Pl. XV, fig. 3.

Diagnosis (KRYSHTOFOVICH, 1930): "Marchantites thallo taeniato, bifurcato, membranaceo, margine leviter undulato, nervo mediano latiore quam crasso, id est dorsiventraliter compresso, sub angulo acuto bifurcato; thalli ramis aliquot eodem angulo progressis postea magis divergentibus; nervis lateralibus bullis; rugulositate delicatula nervos laterales superficialiter imitanti."

Description: Many specimens from Kuwasima and several other localities were examined. Sometimes a slab of rock is covered with numerous thalloid bodies of *M. Yabei* forming a thin zone about 5 mm. thick, directly beneath which is a zone with numerous leaves of *Podozamites Reinii*. The distances between the branching of the thallus are not constant, but generally 2–4 cm. No special surface marking on the lamina are seen but fine vein-like striations diverging upwards from the midrib. These striations suggest the rhizoid of liverworts. Reproductive organs are not known.

Remarks: This species was first described by Professor YABE from the Rakutô Bed of Korea as *Sagenopteris bilobata* YABE var. *major* YABE. KRYSHTOFOVICH mentioned later, based on the investigation of the similar thalloid body from the Nikanian Series of the Far East, that YABE's var. *major* is a liverwort. Thus he renamed it together with his own specimens *Marchantites Yabei* KRYSHT. The present writer[1] examined the type specimen of var. *major* in the Tôkyô Imperial University, and proved KRYSHTOFOVICH's view to be correct.

Comparison: *M. Jimboi* KRYSHT. from the Upper Cretaceous of Russian Sachalien, *M. Zeilleri* SEW. from the Wealden of England and *M. erectus* LECK., ex BEAN MS. from the Jurassic of England are decidedly smaller type with thallus branching frequently. *M. oolithicus* FL. and BL. from the Jurassic of Nancy and *M.* ? sp. (determined as *Hausmannia ?* sp.[2]) from the Ryôseki Series of Yuasa and *M.* ? sp. from Patagonia are too fragmentary specimens to admit comparison.

Occurrence:

Yanagidani, Kuwasima	Isikawa.	Tetori Series.
Iwaidani	Gihu.	

1) S. ÔISHI (1931b), p. 150.
2) H. YABE (1927), p. 41.

Takazi Rokumambô	Yamaguti.	Kiyosue Group.
Tanzaki	Wakayama.	Ryôseki Series.
Kôbôdani ? Nisinotani	Kôti.	Ryôseki Series.
Butudôken	Tyôsen.	Rakutô Bed. (G.S.K. Coll.).

Pteridophyta

Equisetaceae

Genus *Annulariopsis* ZEILLER

Annulariopsis inopinata ZEILLER ?

1930. *Annulariopsis inopinata*? ÔISHI: p. 51, Pl. VII, fig. 1.
1932b. *Annulariopsis inopinata*? ÔISHI: p. 271, Pl. III, fig. 5; Pl. IV, fig. 3.
1936. *Annulariopsis inopinata*? ÔISHI and TAKAHASI: p. 116, Text-fig. 2.

Remarks: Unfortunately this species is represented only by some imperfect leaf whorls derived from Nariwa (ÔISHI, 1932b) and Momonoki (ÔISHI and TAKAHASI, 1936) but none of them is sufficient for definite determination.

YABE[1] described under ZEILLER's name two specimens of leaf-whorls from the Kôbôsan Series of Tyôsen. The resemblance of one of his specimens (his Pl. IV, fig. 2) to *A. inopinata* is indeed very striking, but the resemblance may not be sufficient to warrant specific identification as it resembles more closely Shansi specimens later described by HALLE[2] under the name *Annularites ensifolius* HALLE, as that writer also states. Another specimen of YABE's (his Pl. IV, fig. 3) is distinct in having linear and straight leaves and it may be now rather referable to KAWASAKI's *Lobatannularia inequifolia* (TOK.)[3].

Occurrence:

Nariwa (1, 16), Okayama. Nariwa Series.
Momonoki, Yamaguti. Momonoki Bed.

1) H. YABE (1922), p. 2, Pl. IV, figs. 2–3.
2) T. G. HALLE (1927a), p. 20, Pl. I, figs 1–5; Pl. II, figs. 1–2; Pl. III; Pl. IV, figs. 1–3.
3) S. KAWASAKI (1927), p. 12, Pl. IIIA, D, E; Pl. IV, figs. 13–15; Pl. V, figs. 16–22; Pl. IX, fig. 38; Pl. XIV; figs. 71, 74, 75.

Genus *Lobatannularia* KAWASAKI

The genus *Lobatannularia* was established by KAWASAKI[1] in 1927 for Equisetaceous articulate branches from Tyôsen morphologically intermediate between *Schizoneura* and *Neocalamites*. Almost simultaneously HALLE[2] instituted a new genus *Annularites* for a similar plant from Central Shansi. But as KAWASAKI's name was published a little earlier than that of HALLE, HALLE's genus has been erased. YABE and KOIWAI[3] claimed the generic identity of *Lobatannularia* and *Annulariopsis* ZEILLER from Tonkin,[4] but the Tonkin specimens are still unsatisfactory for maintaining this statement by them.

Lobatannularia nampoensis KAWASAKI

1925. *Schizoneura nampoensis* KAWASAKI: p. 39, Pl. XLI, fig. 115.

Remarks: The specimen described by KAWASAKI is represented by "an apparently opposite pair of large symmetrically spreading and broadly oval lobes of leaf sheath" (KAWASAKI, 1925). The occurrence of this specimen in the Lower Daidô Formation (Daidô Series) in Tyôsen is of special interest as it is the youngest representative of this genus.

Occurrence:

Hakuunzi, Tyôsen. Daidô Series. G. S. K. Coll.).

Genus *Neocalamites* HALLE

Neocalamites Carrerei (ZEILLER) HALLE

1903. *Schizoneura Carrerei* ZEILLER: p. 137, Pl. XXXVI, figs. 1–2; Pl. XXXVII, fig. 1; Pl. XXXVIII, figs. 1–8.
1908. *Schizoneura Carrerei* SEWARD: p. 85, Pl. II, fig. 1.
1908. *Neocalamites Carrerei* HALLE: p. 6.
1920. *Neocalamites Carrerei* YABE: Pl. I, figs. 2–3.
1923. *Neocalamites Carrerei* KRYSHTOFOVICH: p. 8, Pl. I, figs. 1–3.

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1) S. KAWASAKI (1927), p. 10.
2) T. G. HALLE (1927a), p. 19.
3) H. YABE and K. KOIWAI (1928).
4) R. ZELLER (1903), p. 131.

1925. *Neocalamites Carrerei* KAWASAKI: p. 37, Pl. II; Pl. III, figs. 10–12; Pl. XLIII, fig. 117a; Pl. XLIV, fig. 118; Pl. XLV, fig. 119b; Pl. XLVI, figs. 121, 122.
1927. *Neocalamites Carrerei* DU TOIT: p. 315, Pl. XVI, figs. 2–3.
1931. *Neocalamites hoerensis* SZE: p. 51, Pl. IX, fig. 4.
1932. *Neocalamites Carrerei* KRYSHTOFOVICH and PRYNADA: p. 365.
1932b. *Neocalamites Carrerei* ÔISHI: p. 269, Pl. III, figs. 1–4; Pl. IV, figs. 1–2.
1932a. *Neocalamites Carrerei* ÔISHI: p. 56.
1933a. *Neocalamites Carrerei* SZE: p. 24, Pl. V, figs. 3–4.
1936. *Neocalamites Carrerei* ÔISHI and TAKAHASI: p. 117, Pl. I, fig. 1.

Remarks: *N.* cfr. *hoerensis* described by SZE (1931) from China was later referred by him (1933a) to *N. Carrerei*, though the long and narrow internode rather recalls the former species. Some specimens described by the writer (1932) as *N.* sp. cfr. *N. Carrerei* from Shitaka are fragments specifically hardly determinable, though their resemblance to ZEILLER's species is strong.

This species appears to be very common in the Rhaetic and Liassic strata of eastern Asia. Outside Asia it has been reported from Africa by SEWARD and du TOIT, while it has not yet been known from Europe, America and Australia, though in these continents *Neocalamites* is represented mostly by *N. hoerensis*. TURUTANOVA-KETOVA[1] reported this species from the Kirghis. In Japan it is common in the Nariwa Series and its equivalent rocks, and is common also in the Daidô Series of Tyôsen.

Occurrence:

Nariwa (10, 49, 50, 54, 58)	Okayama.	Nariwa Series.	
Momonoki Kusaigawa	Yamaguti.	Momonoki Bed.	
Yamanoi (1, 13, 15) Tubuta (I, II, III)	Yamaguti.	Upper Triassic.	
Kôsei coal mine Sinkô Nampô-Hongsan	Tyôsen.	Daidô Series.	(G.S.K. Coll.).

Neocalamites hoerensis (SCHIMPER) HALLE

1869. *Schizoneura hoerensis* SCHIMPER: Tome I, p. 283.
1878a. *Schizoneura hoerensis* NATHORST: p. 24, Pl. X, figs. 6–8.

1) A. TURUTANOVA-KETOVA (1930a), p. 314, Pl. II, figs. 3,5,7; Pl. V, fig. 5.

1878. *Schizoneura hoerensis* NATHORST: p. 9, Pl. I, figs. 1–4.
?1878. *Schizoneura hoerensis* NATHORST: p. 40, Pl. VII, fig. 5.
?1892. *Schizoneura hoerensis* RACIBORSKI: p. 7, Pl. II, fig. 10.
1906. *Schizoneura hoerensis* YOKOYAMA: 29, Pl. VII, fig. 10.
1908. *Neocalamites hoerensis* HALLE: p. 6, Pls. I–II.
1915. *Neocalamites hoerensis* WALKOM: p. 33, Pl. II, fig. 1.
1922. *Neocalamites hoerensis* JOHANSSON: p. 7, Pl. VI, figs. 1–2.
1924. *Neocalamites hoerensis* WALKOM: p. 79, Pl. XV, fig. 1.
1926. *Neocalamites hoerensis* HARRIS: p. 51, Pl. IV, fig. 8; Pl. IX, figs. 1, 5; Text-fig. 1A.
?1926. *Neocalamites hoerensis* CHAPMAN and COOKSON: p. 165, Pl. XIX, figs. 3–5.
1931f. *Neocalamites hoerensis* ÔISHI: p. 229, Pl. XVI, figs. 2–3.
1931. *Neocalamites hoerensis* HARRIS: p. 22, Text-figs. 4A–B.
1932b. *Neocalamites hoerensis* ÔISHI: p. 268, Pl. II, figs. 7–9.
1932. *Neocalamites hoerensis* FRENTZEN: p. 78 (no figure).
1937. *Neocalamites hoerensis* HARRIS: p. 10.

Remarks: This species is represented by fragments of stems and leaves yielded from the plant beds of Kita-Otari and Nariwa (ÔISHI, 1931f; 1932b). They have been referred to this species for the reason that, as HALLE (1908) states, the internode is longer in comparison with the breadth of the stem and that the leaves are broader and fewer in number than in another well-known species, *N. Carrerei* (ZEILL.). Typical stems can thus be distinguished between the two species of *Neocalamites*, but it is very difficult to find morphological distinction in any way among narrow branches of these species.

As is obvious from the above synonym table, this species is widely distributed in the older Mesozoic strata of both hemispheres. However, the Polish specimen described by RACIBORSKI (1892) is represented by a single diaphram which can not be specifically determinable.

Occurrence:

Nariwa (45, 58), Okayama. Nariwa Series.
Kuruma, Nagano. Kuruma Bed.

Genus *Equisetites* STERNBERG

Equisetites multidentatus ÔISHI

(Type-specimen: ÔISHI, 1932b, Pl. II, figs. 1–2).

1932b. *Equisetites multidentatus* ÔISHI: p. 266, Pl. II, figs. 1–2

Description: (ÔISHI, 1932b): "An Equisetaceous stem of unknown length. Stem large, more than 16 cm. in length and 5 cm. in breadth, with internodes more than 10 cm. long. Surface of stem quite smooth, showing neither ridges nor grooves. Sheath about 7 mm. in height above the node, with fringed margin. Teeth numerous, more than 80 in each sheath."

Remarks: This species is unfortunately represented by only two fragments from Nariwa. It is characterised first by having numerous teeth in a leaf-sheath and secondly by the smooth surface of the stem. Comparable forms are *E. scanicus* (STERNB.)[1] and *E. veronensis* ZIGNO,[2] but none of them bear such numerous teeth to each leath-sheath. The writer believes that the present specimens belong to none of the species heretofore described.

Occurrence:

Nariwa (1, 49), Okayama. Nariwa Series.

Equisetites naktongensis TATEIWA

Pl. I, Figs. 2–4; Pl. II, Fig. 2 (all the type-specimen).

1929. *Equisetites naktongensis* TATEIWA: figs. 8, 19a–b (figures only).

Diagnosis: Stems unbranched, 2–4 mm. across: surface with longitudinal ridges 4–6 in number; internodes 1–2 cm. long; nodal region slightly swollen; sheaths 3–5 mm. long; teeth about 8 in number, elongate, with acute apices. Rhizome 2–4 mm. across; internodes 1–1.5 cm. long, with 3–4 strong longitudinal ridges; tubers one in each node, round to oval in outline, generally 1.5 cm. long and 1 cm. broad, four ridged longitudinally and lobed at the apices probably corresponding in number to the ridges; apices of lobes acuminated.

Description of specimens: Pl. I, fig. 2 shows a cluster of stems arranged in parallel. The writer examined several other specimens, but they are always unbranched. Leaf-sheaths are clearly seen elsewhere. An enlarged figure of a leaf-sheath is shown in Pl. II, fig. 2. Pl. I, figs. 3 and 4 show rhizomes with tubers. Characteristic

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1) T. G. HALLE (1908), p. 22, Pls. VI, VII; Pl. VIII, figs. 1–5; Pl. IX, figs. 16–17.

2) A. DE ZIGNO (1868), p. 64, Pl. VI.

longitudinal ridges on the surface and the apical lobes of the tubers are clearly seen in figs. 3a and 3b.

Discussion: Stems and rhizones here illustrated do not occur in organic connection, but they occur always in close association, therefore it is almost beyond doubt that they belong to the same plant.

Remarks and comparison: Comparable species is *E. Burchardi* (DKR.) from the Wealden of Germany[1] and the Potomac of North America,[2] but the present species is distinguishable from them in that the rhizomes have less number of leaves and a single tuber in each node. The rhizomes of the present species are likely identical with those of *E. ushimarensis* described by YOKOYAMA from the Tetori Series, but he does not mention anything about the surface ridges and apical lobes of tubers which characterise *E. naktongensis*. Even in the writer's own collection from the type locality of *E. ushimarensis* he did not find YOKOYAMA's rhizome, therefore it is better not to identify the present specimens to *E. ushimarensis*.

Occurrence:

Zindô, Tasseidô, Bankeidô, Renkadô, Tomudô, Ryusindô	Tyôsen.	Rakutô Bed.	(G.S.K. Coll.).
? Sinsyû,	Tyôsen.	Sinsyû Bed.	(G.S.K. Coll.).

Equisetites naktongensis **TATEIWA var.** ***tenuicaulis*** **TATEIWA**

Pl. II, Figs. 1, 1a (type-specimen).

1929. *Equisetites naktongensis* var. *tenuicaulis* TATEIWA: fig. 20 (figure only).

Remarks: TATEIWA distinguished these very narrow and slender Equisetalean stems as a variety of *E. naktongensis*. The stem is usually less than 1 mm. across with 3–4 longitudinal ridges on its surface. The internode is 0.7–1 cm. long with a slightly swollen leaf-

1) A. SCHENK (1871), p. 205, Pl. XXII, figs. 1–5.
2) E. W. BERRY (1911), p. 316, Pl. XLI, figs. 3–6.

sheath on each node; the leaves are about 7 in number in each sheath, 1–2 mm. long and acuminated at the apices.

Occurrence:

Ryûsindô, Tyôsen. Rakutô Bed. (G. S. K. coll.).

Equisetites ushimarensis (YOKOYAMA) n. comb.

1889. *Equisetum ushimarense* YOKOYAMA: p. 39, Pl. XI, figs. 1–3.
1905. *Equisetum ushimarense* YABE: p. 43, Pl. III, fig. 10.

Diagnosis (YOKOYAMA, 1889): "Rhizome ribbed; tubers roundly ovate, single or joined like beads."

Remarks: Under the name referred to above YOKOYAMA described from the Tetori Series of Usimaru some rhizomes with tubers. The writer made a collection at the type-locality, but no specimens having the same type as *E. ushimarensis* were found. YOKOYAMA comared his rhizomes with those of *E. Burchardti* (DUNKER) from the Wealden of Germany and *E. burejensis* HEER from the Jurassic of Bureja. *E. ushimarensis* may differ from the latter in the shape of tubers, but the resemblance with the former appears to be very close. Comparison with *E. naktongensis* TATEIWA has already been made in the description of the species in the present work. Rhizomes figured by YABE (1905) from the Naktong Series as *E. ushimarense* agree certainly with YOKOYAMA's specimens from Usimaru, but there is a question whether they might not represent unsatisfactorily preserved specimens of *E. naktongensis* TATEIWA.

Occurrence:

Usimaru, Hukui. Tetori Series. (Tôkyô coll.).
Butudôken, Tyôsen. Rakutô Bed. (Tôkyô coll.).

Filicales

Marattiaceae

Genus *Asterotheca* PRESL

Asterotheca naktongensis ÔISHI

(Type-specimen: ÔISHI, 1939, Pl. I, Figs. 1–2).

1939. *Asterotheca naktongensis* ÔISHI: p. 308, Pl. I, figs. 1–2.

Diagnosis (ÔISHI, 1939): "Frond large, slender and tripinnate. Rachis of moderate thickness, with longitudinal striations. Penultimate pinnae more than 10 cm. long, very slender, flexuous, overlapping each other laterally, opposite, at a wide angle to, and about 4 cm. distant on each side of the rachis and traversed by a thin axis. Ultimate pinnae slender, long and narrow, about 5 cm. long and at a wide angle to the axis. Pinnules small, long and narrow, slightly expanded at the base, distant, the space being as broad as the breadth of a pinnule, bluntly pointed at their apices, and at an angle of 45° to the pinna-axis. Margin entire. Midnerve distinct, lateral nerves indistinct. Sori circular, 0.4 mm. in diameter 5–10 in number on each side of the midnerve, each sorus consisting of 5–7 exannulate sporangia in close apposition possibly attached to a central receptacle and free at least at their apices. Spores unknown."

Remarks: The present species is certainly interesting because of its being the youngest representative of *Asterotheca* which flourished chiefly in the later phase of the Palaeozoic age. From two valid Mesozoic *Asterotheca*, namely *A. Meriani* BRONGN.[1] from the Middle Keuper of Europe and North America and *A. Cottoni* ZEILLER[2] from the Rhaetic of Tonkin, the present species is easily distinguishable in that the latter two have larger pinnules. Further remarks have already been presented in the original paper.

Occurrence:

Butudôken, Tyôsen. Rakutô Bed. (Tôkyô Coll.).

Genus *Marattiopsis* SCHIMPER

Marattiopsis Muensteri (GOEPPERT) SCHIMPER

1842. *Taeniopteris Muensteri* GOEPPERT: p. 51, Pl. IV, figs. 1–3.
1869. *Angiopteridium Muensteri* SCHIMPER: Tome I, p. 603, Pl. XXXVIII, figs. 1–6.
1874. *Marattiopsis Muensteri* SCHIMPER: Tome III, p. 514.
1878. *Marattiopsis Muensteri* NATHORST: p. 48, Pl. V, fig. 6.
?1886. *Marattiopsis Muensteri* ZEILLER: p. 457, Pl. XXIV, figs. 5–7.
1892. *Taeniopteris* (*Marattiopsis*) *Münsteri* BARTHOLIN: p. 23, Pl. IX, figs. 6, 9.
1902. *Marattiopsis Muensteri* MOELLER: p. 17, Pl. I, fig. 1.

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1) F. KRASSER (1909), p. 32.
2) R. ZEILLER (1903), p. 26, Pl. I, figs. 4–9.

1903. *Marattiopsis Muensteri* ZEILLER: p. 63, Pl. IX, figs. 6–8.
1925. *Marattiopsis Muensteri* KAWASAKI: p. 26, Pl. XVI, fig. 53; Pl. XXXVI, fig. 101; Pl. XXXVII, fig. 102.
1927. *Taeniopteris* cfr. *virgulata* KOBAYASHI: p. 63.
1931f. *Marattiopsis Muensteri* ÔISHI: p. 242, Pl. XVI, figs. 10, 10a.
1932b. *Marattiopsis Muensteri* ÔISHI: p. 272, Pl. IV, figs. 4–6.
1933. *Taeniopteris* (*Marattiopsis*) *Muensteri* PRYNADA: p. 13, Pl. III, fig. 15.

Remarks: This species is characterised by the abrupt contraction of the pinna base and this is the essential character which distinguishes this species from an allied species *M. hoerensis* (SCHIMP.) having a cordate base. HARRIS states that there is also a distinction in the length of the synangia, those of the latter being longer.

The Japanese specimens which have been referred to *M. Muensteri* all lack the base of the pinnae; therefore their exact specific identification to that species is not warranted. But the existence of somewhat broad pinnae resembling *M. Muensteri* in Tyôsen (KAWASAKI, 1925) makes it appropriate to refer the Japanese specimens also to GOEPPERT's species. It is however of course necessary to wait for a further supply of material which will make clear this point of uncertainly.

This species is not uncommon in the older Mesozoic strata of Asia and Europe. In China the occurrence has not yet been reported, though its occurrence in the widely distributed older Mesozoic strata in that country is highly probable. HARRIS[1] regards ZEILLER's *Marattiopsis Muensteri* from Tonkin as a distinct species on account of its bearing more crowded secondary nerves (in *Muensteri* and *hoerensis* they are about 10 per cm., while 15–18 per cm. in ZEILLER's *Muensteri*).

Occurrence:

Nariwa (44, 49, 90), Okayama. Nariwa Series.
Kuruma, Nagano. Kuruma Bed.
Neietu, Tyôsen. Daidô Series. (G. S. K. Coll.).

Genus *Nathorstia* HEER

In Japan, this genus is represented by a single species described by HUZIOKA (1939) from the Ryôseki Series of Kôti Pref. which he

1) T. M. HARRIS (1931), p. 65.

named *N. Oishii*. The specimens are portions of sterile fronds, but the characteristic nervation which resembles some of the species of this genus in which fertile example are known renders it probable that the specimens belong to this Marattiaceous genus. As the genus is of the Cretaceous, its occurrence in the Japanese Ryôseki Series is of special interest in supporting the current view that the Series is the nearest equivalent to the Potomac and the Wealden.

Nathorstia Oishii HUZIOKA

(Type-specimen: HUZIOKA, 1939, Pl. I, fig. 1).

Diagnosis (HUZIOKA, 1939): "Frond pinnate, more than 1 cm. long, probably linear; rachis moderately strong, 1–1.5 mm. broad, expanded at the base and confluent laterally, tapering gradually towards the acuminate apex and at a wide angle or nearly a right angle to the rachis; midrib sharply defined, straight and persisting to the tip; secondary veins at a wide angle to the midrib, branch before they reach the margin into finer tertiary and quaternary veins anastomosing to form fine, polygonal and isodiametrical meshes; between two any adjacent secondary veins is a low archaed; between two adjacent midribs finer veins spring off direct from the rachis, and branch and anastomose with tertiary and quaternary veins. Fructification unknown."

Remarks: HUZIOKA compared the Japanese species with the Patagonian species which HALLE[1] described as *N. alata* HALLE, but distinguished it from that one in possessing a distinct archaed between two adjacent secondary nerves.

Occurrence:

Nisinotani, Kôti. Ryôseki Series.

Osmundaceae

Genus *Todites* SEWARD

Todites Goeppertianus (MUENSTER) KRASSER

Pl. III, Figs. 1, 1a.

1846. *Neuropteris Goeppertiana* MUENSTER: in GOEPPERT'S Die Gattungen der fossilen Pflanzen, p. 104, Pl. VIII–IX, figs. 9–10.

1) T. G. HALLE (1913), p. 20, Pl. I, figs. 1–9.

1867. *Acrostichites Goeppertianus* SCHENK: p. 44, Pl. V, fig. 5; Pl. VII, fig. 2.
1878. *Acrostichites Goeppertianus* NATHORST: p. 43, Pl. V, figs. 7–8a.
1892. *Todea Williamsoni* RACIBORSKI: p. 1, Pl. II, fig. 15.
1896. *Todea Williamsoni* HARTZ: p. 232, Pl. XII, figs. 4, 4a.
1903. *Cladophlebis (Todea) Roesserti* ZEILLER: p. 38, Pl. II, figs. 1–7; Pl. III, figs. 1–3.
1926. *Todites* cfr. *Williamsoni* HARRIS: p. 55, Text-fig. 2F.
1931. *Todites Goeppertianus* HARRIS: p. 31, Pl. XI, figs. 3, 8; Text-fig. 7.
1932b. *Todites Roesserti* ÔISHI (non PRESL): p. 274, Pl. IV, figs. 7–9; Pl. V, figs. 1–3.

Remarks: The present writer (1932b) identified some sterile and fertile specimens from the Nariwa district with those described by ZEILLER (1903) from Tonkin under the name *Cladophlebis (Todea) Roesserti*. As stated by the writer, the Tonkin specimens to which the Nariwa specimens are identical are distinct from *Todites Roesserti* from Sweden,[1] Germany[2] and some other countries in respect to the more crowded, arching, more frequently forking secondary nerves into which the midnerve dissolves at a short distance from its origin. HARRIS[3] identified such specimens from Greenland with MUENSTER's *Neuropteris Goeppertiana*, an opinion with which the writer agrees. PRESL's type-specimen of *Todites Roesserti* (*Alethopteris Roesserti* PRESL) is an indeterminable fragment and the specimens identified with PRESL's species represent ferns quite different from *Todites Goeppertianus*.

Todites Goeppertianus is a fern very similar to or in some cases hardly distinguishable from *T. Williamsoni*. SEWARD[4] states that "specimens from the Rhaetic (*T. Goeppertianus*) may not be specifically identical with those from the Jurassic (*T. Williamsoni*); the main point is that, whether actually identical or not, both sets of fossils clearly represent the same general type of Osmundaceous fern and may for present purpose be included under the same designation." However, BRONGNIART's[5] type-specimen of *T. Williamsoni* differs at least in its sterile specimens from the type-specimen of *T. Goeppertianus*, the nervation of the former being simpler and

1) A. G. NATHORST (1878), p. 42, Pl. VIII, figs. 1–3. E. ANTEVS (1914), p. 18, Pl. II, fig. 1; Text-fig. 2. N. JOHANSSON (1922), p. 18, Pl. V, figs. 4–9.
2) W. GOTHAN (1914), p. 9, Pl. XVIII, figs. 9, 9a.
3) T. M. HARRIS (1931), p. 31.
4) A. C. SEWARD (1910), p. 341.
5) A. BRONGNIART: p. 324, Pl. CX, figs. 1–2.

less crowded; the midnerve persists nearly to the apex and the secondary nerves do not arch so strongly as those of the latter.

Recently, P'AN[1] described some imperfect specimens from Shensi as *Cladophlebis* (*Todites*) cfr. *Roesserti* ZEILLER (non PRESL).

HARRIS regards that the specimens from Poland and Sweden described by RACIBORSKI[2] and ANTEVS[3] respectively as *Todites Williamsoni* are specifically identical with *T. Goeppertianus*.

In Pl. III, fig. 1 is shown a fertile specimen from Neiridani; it is a portion of a pinna; the surface of the pinnules are covered with numerous round sporangia about 220 μ in diameter.

Occurrence:

Nariwa (33, 47, 48), Okayama. Nariwa Series.
Neiridani, Toyama. Kuruma Bed.

Todites princeps (PRESL) GOTHAN

1833. *Sphenopteris princeps* PRESL: In STERNBERG'S Versuch, Fasc. V and VI, p. 126, Pl. LIX, figs. 12–13.
1838. *Pecopteris obtusa* PRESL: Ibid., Fasc. VII, p. 155, Pl. XXXII, figs. 2, 4.
1842. *Sphenopteris princeps* GOEPPERT: Les genres des plantes fossiles, Liv. III and IV, p. 72, Pl. X, figs. 3–7.
1842. *Sphenopteris patentissima* GOEPPERT: Ibid., p. 73, Pl. X, fig. 8.
1850. *Sphenopteris princeps* UNGER: p. 119.
1869. *Pecopteris* (*Acrostichites*) *princeps* SCHIMPER: Tome I, p. 529.
1890. *Sphenopteris princeps* RACIBORSKI: p. 4, Pl. I, figs. 11–15.
1902. *Acrostichites princeps* MOELLER: p. 26, Pl. II, fig. 19.
1903. *Sphenopteris princeps* ZEILLER: p. 23, Pl. I, figs. 1–2.
1914. *Todites princeps* GOTHAN: p. 95, Pl. XVII, figs. 3–4.
1926. *Todites* cfr. *princeps* HARRIS: p. 56, Pl. XII, fig. 5; Text-figs. 2A–E.
1931. *Todites princeps* HARRIS: p. 35, Pl. XI, figs. 1, 2, 4, 9; Pl. XII, fig. 3; Text-figs. 8–9.
1932b. *Todites princeps* ÔISHI: p. 279, Pl. V, fig. 7.
1937. *Todites princeps* HARRIS: p. 15.

Remarks: It is a matter of considerable difficulty to find the distinction based on the sterile examples between this species and the Middle Jurassic species *T. modesta* LECKENBY. SEWARD[4] once

1) C. H. P'AN (1936), p. 14, Pl. IV, figs. 11–15; Pl. V, figs. 1–3.
2) M. RACIBORSKI (1892), p. 1, Pl. II, fig. 15.
3) E. ANTEVS (1914), p. 20, Pl. I, figs. 20, 21, 22?.
4) A. C. SEWARD (1900b), p. 151; (1907), p. 27.

held the opinion that the two species are specifically identical and on several occasions adopted PRESL's name for Middle Jurassic specimens. The same view was held also by ZEILLER[1] and HARRIS.[2] Later having examined the Dzungarian specimens, SEWARD[3] found that the two can be separated in respect to the shape of the pinnules and in nervation. Thus he wrote "in the rhaetic species the pinnules are more symmetrical along the long axis of the lamina and are characterised by a median vein which gives off forked lateral veins as in *Cladophlebis*. The lamina of the pinnules in LECKENBY's specimen and in the Dzungarian fern is markedly asymmetrical, the abaxial side being straighter than the adaxial edge and subdivides into lateral veins which frequently fork more than once. The edge of the lamina in *S. modesta* is irregularly notched, whereas in *S. princeps* the lobing is more regular."

The Japanese specimen referred to this species is a single one described by the writer from Nariwa, agreeing with *T. princeps* as delimited by SEWARD. This is the reason for which the writer called the Japanese specimen under PRESL's name.

As was stated before (ÔISHI, 1932b, p. 281), the species enumerated above in the synonym table do not indicate their belonging to one species, but have been so arranged only for the sake of convenience in reference.

Occurrence:

Nariwa (49), Okayama. Nariwa Series.

Todites Williamsoni (BRONGNIART) SEWARD

1828. *Pecopteris Williamsoni* BRONGNIART: Histoire, p. 324, Pl. CX, figs. 1–2.
1828. *Pecopteris whitbiensis* BRONGNIART: Ibid., p. 321, Pl. CIX, figs. 2–4.
1828. *Pecopteris tenuis* BRONGNIART: Ibid., p. 322, Pl. CX, figs. 3–4.
1833. *Neuropteris recentior* LINDLEY and HUTTON: Vol. I, Pl. LXXVIII.
1837. *Pecopteris Williamsoni* LINDLEY and HUTTON: Vol. III, Pl. CXXVII.
1837. *Pecopteris dentata* LINDLEY and HUTTON: Vol. III, Pl. CLXIX.
1835. *Pecopteris recentior* PHILLIPS: Pt. I, 2nd Ed., p. 119, Pl. VII, fig. 15.
1868. *Acrostichites Williamsoni* EICHWALD: p. 17, Pl. II, fig. 3.
1885. *Todea Williamsoni* SCHENK: p. 168, Pl. III, fig. 3.

1) R. ZEILLER (1903), p. 23.
2) T. M. HARRIS (1931), p. 35.
3) A. C. SEWARD (1911), p. 42.

1889. *Asplenium whitbiense* YOKOYAMA; p. 31, Pl. III, fig. 3; Pl. X, figs. 1, 2a.
1890. *Todea Williamsoni* RACIBORSKI: p. 1, Pl. I, figs. 7–10.
1900. *Todites Williamsoni* SEWARD: Pl. I, figs. 1–2.
1900b. *Todites Williamsoni* SEWARD: p. 87, Pl. XIV, figs. 2, 5, 7; Pl. XV, figs. 1–3; Pl. XXI, fig. 6; Text-fig. 12.
1911a. *Todites Williamsoni* SEWARD: p. 667, Pl. II, figs. 27, 27A; Pl. IV, fig. 57; Pl. VII, fig. 15.
1913. *Todites Williamsoni* HALLE: p. 11, Pl. III, figs. 1–5; Pl. VIII, fig. 1b.
1914. *Todites Williamsoni* ANTEVS: p. 20, Pl. I, figs. 20, 21, 22?.
1925. *Cladophlebis* (*Todites*) *Williamsoni* forma *whitbiensis* KAWASAKI: p. 21, Pl. IV, fig. 13.
1925. *Cladophlebis* (*Todites*) *Williamsoni* KAWASAKI; Ibid., p. 24, Pl. XXXVI, fig. 101.
1928. *Todites Williamsoni* WALKOM: p. 459, Pl., XXVI, figs. 1–2.
1931. *Cladophlebis* (*Todites*) *whitbiensis* SZE: p. 47, Pl. X, figs. 1–2.
1931. *Cladophlebis* (*Todites*) *whitbiensis* SZE: Ibid., p. 52.
1932b. *Todites Williamsoni* ÔISHI: p. 276, Pl. V, figs. 4–6.
1933a. *Cladophlebis* (*Todites*) *whitbyensis* SZE: p. 7.
1933. *Todites* (*Cladophlebis*) cf. *whitbyensis* SZE: Ibid., p. 9, Pl. VI, figs. 3–4.

Remarks: This species is characterised by having narrow and rather triangular pinnules with acute apex and bearing twice forking secondary nerves. It is sometimes difficult to distinguish this species from *Cladophlebis haiburnensis* (L. and H.), the two having pinnules with twice forking secondary nerves. But the writer thinks that in the latter the pinnules are provided with a rounded or an obtusely rounded apex instead of being acutely pointed in the former, and in the latter the pinnules are usually larger in size and moreover the secondary nerves make a wider angle to the midnerve. Such distinction on the sterile examples is artificial, yet it is necessary to retain such a name as *C. haiburnensis* for the purpose of reference as the latter type occurs frequently in the Triassic and Jurassic strata in various part of the world.

Japanese specimens referred to this species have been described by KAWASAKI (1925), YOKOYAMA (1889) and the writer (1932b), some being represented by fertile examples. Certain specimens described by YOKOYAMA[1] from China as *Todites Williamsoni* belong to a distinct form, *Cladophlebis Raciborskii* forma *integra* ÔISHI and TAKAHASI, while ANTEV's *T. Williamsoni* (1914) from Sweden is, according to HARRIS[2], specifically identical with *T. Goeppertianus*.

1) M. YOKOYAMA (1906), p. 18, Pl. III; p. 20, Pl. V, fig. 1a.
2) T. M. HARRIS (1931), p. 31.

This species is widely distributed in the Rhaetic and Jurassic strata of the northern Hemisphere. TURUTANOVA-KETOBA (1930a) described this species from the Kirghis, and Khakhlof (1929, 1931) from the Kuznetsk Basin.

Occurrence:

Nariwa (44, 49, 66), Okayama. Nariwa Series.
Kuwasima, Ozô } Isikawa. Tetori Series.
Paju, Renkari } Tyôsen. Daidô Series. (G.S.K. Coll).

Schizaeaceae

Genus *Klukia* RACIBORSKI

Klukia Yokoyamae ÔISHI

(Type-specimen: YOKOYAMA, 1894, Pl. XXV, fig. 4).

1894. *Dicksoniopteris Naumanni* YOKOYAMA (non NATHORST): p. 214, Pl. XXV, fig. 4.
1939a. *Klukia Yokoyamae* ÔISHI: p. 301.

Diagnosis: Frond slender, bipinnate: rachis thin, less than 11 mm. thick; pinnae opposite, more or less distantly placed, 60°–65° to the rachis; pinnules elongated, finger-shaped, set closely, obtusely rounded at the apex, with entire margin, and attached to the pinna-axis by the whole base somewhat decurrent downwards; midnerve first acute to the pinna-axis and then bends outward and persists to the tip of the pinnules forming a wide angle with the pinna-axis; secondary nerves simple?; sporangia solitary, 4–5 in number on each side of the midnerve and at the midway point between midnerve and margin, round, ca. 0.7 mm. in diameter and made up of a central circular area (distal face), from which radiate about 14 apical annuli of a sporangium.

Remarks: The name *Dicksoniopteris Naumanni* was first proposed by NATHORST[1] for a bipinnate frond from the Ryôseki Series of Haginotani, Kôti pref., which he considered from the form and position of sori to belong to a new genus, *Dicksoniopteris*. Yo-

1) A. G. NATHORST (1890), p. 11, Pl. V, fig. 4.

KOYAMA[1], in describing some fossil plants of the Ryôseki Series from various localities in the Japanese Islands, identified a fructified bipinnate frond from Katazi in the Ryôseki district, Kôti pref., with *Dicksoniopteris Naumanni*. The writer, who had the opportunity of examining the original specimen of *Dicksoniopteris Naumanni* of YOKOYAMA in the Geological Institute of the Tôkyô Imperial University found that the specimen represented a new species belonging to the genus *Klukia*. In regard to this, the writer[2] has already written and discussed in a separate short note (ÔISHI, 1939a). Dr. HALLE in Stockholm, to whom the sincere thanks of the writer are due, kindly advised the writer that *Dicksoniopteris Naumanni* of NATHORST is an obscure species with which better preserved material ought not to be identified. Therefore, the writer wishes to call YOKOYAMA's specimen *Klukia Yokoyamae*. If NATHORST's specimen were revealed in any way to bear the sporangia of *Klukia* type, then NATHORST's generic name *Dicksoniopteris* (1890) should be substituted for *Klukia* which was founded a year later than the former.

Comparison: In the number of apical cells of sporangium, this species agrees with *K. exilis* (PHILLIPS), but in ours the sporangium has a little larger diameter and pinnules are decidedly larger than these in the latter. A fertile specimen figured by HEER[3] from Amurland under the name *Dicksonia Saportana* represents a type very close to the present species.

Occurrence:

Katazi and Isiseki, Kôti (Tôkyô Coll.). Ryôseki Series.

Genus *Naktongia* ÔISHI

(Type-species: *N. Yabei* ÔISHI, monotypic).

Diagnosis (ÔISHI, 1939): "Sporangia arranged in a single row on each side of pina-axis, each sporangium corresponding to a single pinnule, apical annulus uniserial, with broad distal face."

1) YOKOYAMA, 1894.
2) S. ÔISHI, 1939a.
3) O. HEER (1876), p. 89, Pl. XVIII, fig. 1.

Naktongia Yabei Ôishi

(Type-specimen: Yabe, 1905, Pl. I, fig. 15).

1905. *Sphenopteris* sp. Yabe: p. 38, Pl. I, fig. 15.
1939. *Naktongia Yabei* Ôishi: p. 310, Pl. I, fig. 3, Text-fig. 2.

Diagnosis (Ôishi, 1939): "Frond bipinnate, more than 8 cm. long; rachis slender, less than 1 mm. thick, with a longitudinally continuous ridge; pinnae linear, about 2.5 cm. long and 8 mm. broad, tapering gradually towards a narrow apex, crowded, pinnately lobed, and almost at a right angle to the rachis, and at the distance of approximately 1 cm. on each side thereof; lobes or pinnules somewhat falcate, apex obtuse, directed forwards, with entire margin; nervation of *Sphenopteris* type; sporangia 1 mm. in apical diameter measured on the impression, apical annulus consisting of approximately 20 elongated cells."

Remarks:—Among fossil schizaeaceous ferns the present species resembles *Ruffordia* in respect to the Sphenopteroid habit of the frond, but in *Ruffordia* the sporangia are scattered all over the surface of the fertile segments. Further discussion and the description of specimen are seen in the original paper.

Occurrence:

Butudôken, Tyôsen. Rakutô Bed. (Tôkyô Coll.).

Genus *Aneimia* Swartz

Cfr. *Aneimia frementi* Knowlton

Pl. XLVIII, Figs. 2, 2a.

Compare with:
1917a. *Anemia fremonti* Knowlton: p. 84, Pl. XXXI, fig. 6; Pl. XXXII, figs. 1–3.

Description of specimen: In the figured specimen the pinnules are about 2 cm. long and 3 mm .broad at the base thence narrowing gradually towards acute apex and attached to the pinna-axis at an angle of about 45°. The margin is serrated, each tooth having acute apex directed forwards. The midnerve is distinct persisting to the apex, the secondary nerves are acute to the midnerve and branching.

Remarks: The present specimen was first examined by E. TAKAHASI who provisionally named it *Aneimia supercretacea* HOLLICK. Having examined more closely, the writer found that it may rather be more closely related to *Aneimia fremonti* KNOWLT. described by KNOWLTON from the Upper Cretaceous Frontier Formation of North America, though there is no evidence whatever for referring the specimen to the living *Aneimia*. In size and shape of the pinnules of the present specimen and also in marginal character it appears to differ little from KNOWLTON's species, though in ours the secondary nerves are less crowded. The specimen is not unlike *Asplenium Foersteri* DEB. and ETT. but in the latter the marginal serration of pinnules is rather irregular and deeper and the nervation is more crowded.

For a more precise determination, however, a further supply of material is desirable.

Occurrence:

Asibetu, Hokkaidô. Urakawa Series.

Gleicheniaceae

Genus *Gleichenites* GOEPPERT

Gleichenites nipponensis sp. nov.

Pl. III, Figs. 2, 3, 3a.
(Type-specimen: Fig. 3).

Diagnosis: Penultimate pinnae linear, nearly parallel-sided, converging to an obtusely rounded apex, more than 9 cm. long; axis 1–1.5 mm. thick; ultimate pinnae long and narrow, 4 cm. long and 3 mm. broad, alternate or subopposite, straight or occasionally curving upwards, and attached remotely to the axis at a wide angle, the distance being 5–7 mm. on each side of the axis; pinnules set closely, small, ± 1.5 mm. long, semicircular or shortly ovate, with broadly, sometimes obtusely rounded spex, and attached by the whole base at a wide angle or nearly perpendicularly; nervation indistinct, midnerve sends off arched secondary nerves (simple or forked ?); sori ? 1 or 2 on each side of midnerve.

Remarks: The above diagnosis is based on the type-specimen (fig. 3) derived from Kuwasima where the species is very common.

The general habit of this fern is well seen in it. It is not known whether the frond of this fern was dichotomously branched or not, as is usually the case in Gleicheniaceae, but it is clear from the figure that the frond is at least bipinnate. It is unfortunate that the type specimen is indistinct in respect to the nervation and sori. Usually the midnerve is more or less distinctly impressed, while the secondary nerves are in most cases nearly obscure. However, when the surface of the specimen is moistened with a solution of zinc-sulphocarbolate in dilute glycerine, the secondary nerves stand out occasionally and show that they are simple or forked ? and arching outwards.

There is no distinct evidence of sori, but there can occasionally be seen small round dots or depressions, one or two in number on the sides of the midnerve as if they represent sori; but they are usually very indistinct.

Comparison: Comparable species are *G. gleichenoides* OLDH. and MORRIS[1] from the Upper Gondwana of India, *G. micromera* HEER[2] from the Kome Bed of Greenland and *G. San-Martini* HALLE[3] from the Jurasso-Cretaceous rocks of Patagonia. In the first one, the pinnae are set closely and crowded, at a right angle to the axis, and the pinnules are larger than those in ours; in the second, the pinnae are set closely and crowded, though otherwise similar. The last one seems to be almost specifically identical with the present species: there is an agreement in respect to the form and size of pinnules which are set closely to the pinna-axis. However, the Patagonian species is still too imperfect to admit comparison in the habit of the frond with the present specimens: in the former it is not clear whether the pinnae are set remotely and the secondary nerves are arching as in the present specimens. As to the number and distribution of sori, the Japanese species seems to be very close to the Patagonian species.

Occurrence:

Kuwasima, Isikawa. Motiana, Hukui.	Tetori Series.

1) T. OLDHAM and J. MORRIS (1863), p. 45, Pl. XXI; Pl. XXVI, figs. 1, 3. O. FEISTMANTEL, p. 93. A. C. SEWARD and B. SAHNI (1920), p. 19, Pl. VII, fig. 67.

2) O. HEER (1874), p. 55, Pl. X, figs. 14–15.

3) T. G. HALLE (1913), p. 22, Pl. I, figs. 14–15.

Kaisekiyama } Koti. Ryôseki Series.
Tôgôdani

Tomudô } Tyôsen. Rakutô Bed. (G.S.K. Coll.).
Ryûsindô

Matoniaceae

Genus *Phlebopteris* BRONGNIART

Phlebopteris pentaphylla sp. nov.

Pl. III, Figs. 5, 5a, 6, 7.
(Type-specimen: Fig. 5).

Diagnosis: Frond petiolate, petiole being more than 1 cm. long and 1 mm. thick: pinnae five in number about 1.5 cm. long and 5 mm. broad, obtusely pointed at the apex, narrowing gradually towards the proximal portion, spreading flabellately from the somewhat thickened top of the petiole; margin pinnately lobed into segments directed forwards and subacutely pointed; the midnerve broad and well-defined but evanescent apically; fructification unknown.

Description of specimens: The above diagnosis is based on the specimens shown in Pl. III, fig. 5, the type-specimen. There are some other imperfect specimens, derived from other localities but indistinguishable from the type-specimen; they are shown in Pl. III, figs. 6 and 7. It is unquestionable that all the specimens figured here represent the same type of plant showing characteristic spreading pinnae at the top of the petiole. Unfortunately, no finer nerves other than the midnerve can be seen in any of the specimens now at hand. Such like secondary nerves appear to be present, being sent off from the midnerve at an acute angle, but this is imaginative and nothing can be said with any degree of confidence on this point.

Discussion: The reason why the present specimens have been placed in the genus *Phlebopteris* is that they represent in habit a very close similarity with some Matoniaceous ferns, especially with young fronds figured by GOEPPERT[1] as *Laccopteris Braunii* and later described by HIRMER and HOERHAMMER[2] under the name *Phlebopteris Braunii* (GOEPP.).

1) H. R. GOEPPERT (1841), Pl. V, figs. 2–5; Pl. VI, figs. 1–6.
2) M. HIRMER and L. HOERHAMMER (1936), p. 7, Pl. I, figs. 1–12; Pl. II, fig. 4.

Moreover, the reasons why the writer considered the Japanese specimens as a new species of *Phlebopteris* are that, (1) while in Europe the specimens of *P. Brauni* (GOEPP.) figured by GOEPPERT, SCHENK[1]) HIRMER and HOERHAMMER show an interesting series of frond in different stages of growth, in the Japanese specimens the size, shape and habit of the frond are fairly constant among several specimens examined, (2) specimens identical in size and form with those from the type-locality are derived also from other localities which fall in the same geological series, (3) none of our specimens show sympodial branching as represented by some of the specimens shown in HIRMER and HOERHAMMER's work, and (4) in the European specimens the number of pinnae is six in each frond, while it is always five, in those at hand.

Comparison: Swedish specimens described by NATHORST[2]) under the name *Sagenopteris undulata* NATH. very closely resemble, though it may be superficially, the present species.

Occurrence:

Komô, Tokusima. (Sendai Coll.).
Tôgôdani, Ôtani } Kôti.
} Ryôseki Series.

Phlebopteris polypodioides BRONGNIART

1925. *Laccopteris polypodioides* KAWASAKI: p. 9, Pl. XI, figs. 39–41; Pl. XII, fig. 42; Pl. XXXIV, fig. 94

1936. *Phlebopteris polypodioides* HIRMER and HÖRHAMMER: p. 34, Pl. VII; Text-figs. 2, 5.

HIRMER and HORHAMMER, 1936, give a useful list of synonyms.

Remarks: KAWASAKI described this species from the Daidô Series of Tyôsen; among several specimens figured by him one is in the fructified condition. The writer has no additional material of this species.

Occurrence:

Tongzin and Taihô Coal-mine, Tyôsen. (G. S. K. Coll.).
Daidô Series.

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1) Reproduced in HIRMER and HOERHAMMER (1936), Pls. I and II.

2) A. G. NATHORST (1878a), p. 27, Pl. II, figs. 5–7; (1886), p. 85, Pl. XIX, figs. 2–3.

Phlebopteris Takahasii HUZIOKA

1938. *Phlebopteris Takahasii* HUZIOKA: p. 145, Text-figs. A-C.

HUZIOKA (1938) defined this species as follows: "A sterile frond of unknown size and form. Pinna or frond more than 12 cm. long, with thick axis (rachis ?) 4 mm. across. Ultimate segments or pinnules long and narrow, linear, 5 mm. broad and more than 3 cm. long, somewhat expanded at the base and fused laterally, leaving narrow sinus between two adjacent ones, and at a wide angle to the axis of the pinna. Midvein prominent, straight. Lateral veins delicate, oblique at the proximal and nearly at a right angle at the distal portion, forking dichotomously once or twice, first close to the midvein and then midway or near the margin, occasionally anastomosed with cross bars; those in the fused part springing up from a low archaed running close to the axis between bases of two adjacent midveins."

Remarks: The specimen upon which the above description is based is a portion of a frond but the preservation is rather satisfactory in respect to the nervation. The thick axis and the linear pinnules characterise this species well. It may be comparable to *P. Braunii*, but HUZIOKA distinguished his species from *P. Braunii* in that the latter has longer pinnules and more crowded nervation.

Occurrence: This species was derived from the dark-gray siltstone at Isimati, Yamaguti pref., wherefrom *Zamites toyoraensis* ÔISHI[1] has been described. The rock contains *Hildoceras* of upper Liassic age, therefore, it is beyond doubt that the present species represents the same age. Nisi-Nakayama Bed.

Cyatheaceae

Genus *Coniopteris* BRONGNIART

Coniopteris burejensis (ZALESSKY) SEWARD

Pl. III, Fig 4; Pl. IV.

1904. *Dicksonia burejensis* ZALESSKY: p. 182, Pl. III, figs. 1–4; Pl. IV, figs. 1–5.
?1905. *Coniopteris Heeriana* YABE: p. 27, Pl. III, figs. 9, 14.
1912b. *Coniopteris burejensis* SEWARD: p. 22, Pl. I, figs. 1–5; Pl. III, figs. 18–21.

1) S. ÔISHI (1935b).

1912. *Coniopteris burejensis* NOVOPOKROVSKIJ: p. 20, Pl. II, figs. 2, 2a.
1914. *Coniopteris burejensis* KNOWLTON: p. 46, Pl. V, fig. 1.
1914. *Coniopteris burejensis* KRYSHTOFOVICH: p. 85, Pl. I, fig. 5; Pl. II, figs. 1–3; Pl. III, figs. 1–2.
1928. *Coniopteris burejensis* YABE and OISHI: p. 8, Pl. II, fig. 11.
1931. *Coniopteris burejensis* SZE: p. 43, Pl. VII, figs. 5–8.
1938. *Coniopteris burejensis* ÔISHI and TAKAHASI: p. 59, Pl. I, figs. 3, 3a, 3b, 4.

Description of specimens: Pl. IV, fig. 2 shows a portion of a tripinnate frond very slender in habit traversed by a delicate rachis less than 1 mm. thick with a longitudinal median ridge on its surface. The penultimate pinnae are alternate, about 2.5 cm. distant on each side of the rachis, overlapping each other laterally, elongated oval in outline, narrowing towards the apex and at a wide angle to the rachis. The ultimate pinnae are alternate and at an angle of about 45° to the axis of the penultimate axis. The pinnules are oblong, subacutely pointed at the apex, decurrent at the base and serrated or undulated at the margin. The nervation is of usual *Sphenopteris* type. The fertile pinnules are characterised by a more or less reduced lamina and by terminal sori usually one though sometimes two or three in number in each pinnule.

Pl. IV, fig. 1 shows a portion of a tripinnate (?) frond which so far as the sterile example is concerned, is identical with the preceding specimen. The fragments of pinnae in Pl. III, fig. 4 and Pl. IV, fig. 4 show doubtlessly distal portions of pinnae of this species.

The specimen in Pl. IV, fig. 3 shows a portion of a fertile frond in close association with sterile pinnae undoubtedly of the same type as the preceding specimens. The fertile specimen represents an apical portion of a frond and the pinnules are reduced to small laminae, each bearing a terminal sorus. The basal pinnules of each pinna appear to bear more than one sorus along their outer margin. The sterile pinnae in association are very slender in habit bearing oblong pinnules with marginal serration and agree very closely with the sterile segments of *C. burejensis*.

Discussion: The specimens above described agree in both the sterile and fertile segments with those described by ZALESSKY (1904) as *Dicksonia burejensis* the generic name of which was later transferred by SEWARD (1912b) to *Coniopteris* on the ground that ZALESSKY's specimens resemble too closely *Coniopteris hymenophylloides* BRONGN. to be placed in a distinct genus.

SEWARD pointed out the chief differences between *C. burejensis* and *C. hymenophylloides,* that is, in the former the sterile pinnules are larger, sometimes linear, sharply serrate and pinnatifid, instead of being broader with more rounded lobes. There is also a certain difference in the fertile segments of the two species, as SZE (1931) describes. SZE writes that in *C. hymenophylloides* the fertile segments are strongly metamorphosed, each pinnule being reduced to a stalk-like segment with terminal sorus, while in *C. burejensis* the pinnules are not so much reduced and are surrounded by several sori (less than five) arranged at their outer margin.

The above statements by SEWARD and SZE in regard to difference between *C. burejensis* and *C. hymenophylloides* accord well with the appearance of the present specimens.

Remarks: A tripinnate specimen referred by KNOWLTON (1914) to ZALESSKY's species is a type identical with that illustrated in Pl. IV, fig. 2 of this work. YABE and ÔISHI (1928) once had some doubt about KNOWLTON's identification and so did SZE in 1931, but the writer now regards KNOWLTON's identification to be correct. Although SZE[1] considered that the specimens described by YOKOYAMA[2] from Shimamura (Kuwasima) under the name *Adiantites Heerianus* YOK. as specifically identical with *C. burejensis,* the writer is of the opinion that it rather resembles a Manchurian species described by KRASSER[3] as *Dicksonia Suessi* and also described by YABE and ÔISHI[4] under the name *Sphenopteris (Coniopteris ?) Suessi* (KRASSER). In the present work, YOKOYAMA's species has been described under the name *Coniopteris Heeriana* (YOK.), while the Korean specimen described by YABE[5] as *C. Heeriana* may rather be referable to *C. burejensis,* as SEWARD[6] suggested. TURUTANOVA-KETAVA (1930a) and KHAKHLOF (1931) described this species from the Kirghis and the Kuznetsk Basin respectively.

Some fertile segments figured by ARBER[7] from New Zealand as

1) H. C. SZE (1931), p. 43.
2) M. YOKOYAMA (1889), p. 28, Pl. XII, figs. 1, 1a, 1b, 2.
3) F. KRASSER, p. 5, Pl. I, fig. 9.
4) H. YABE and S. ÔISHI (1933), p. 18, Pl. I, figs. 19–22.
5) H. YABE (1905), p. 27, Pl. III, figs. 9, 14.
6) A. C. SEWARD (1912b), p. 22.
7) E. A. N. ARBER (1917), p. 32, Pl. II, fig. 6 (figs. 1–3?); Pl. III, figs. 3–5; Text-fig. 9.

C. hymenophylloides appears, as SZE remarked, to be very closely allied to those of *C. burejensis*.

Occurrence:

Kuwasima } Isikawa. }
Yanagidani } Tetori Series.
Kowasimizu, Hukui. }
Kiyosue, Yamaguti. Kiyosue Group.

Coniopteris Heeriana (YOKOYAMA) YABE

1889. *Adiantites Heerianus* YOKOYAMA: p. 28, Pl. XII, figs. 1, 1a, 1b, 2.
1905. *Dicksonia Suessi* KRASSER: p. 5, Pl. I, fig. 9.
1933. *Sphenopteris* (*Coniopteirs*?) *Suessi* YABE and ÔISHI: p. 18, Pl. I, figs. 19–22.

This species was first described by YOKOYAMA from Kuwasima under the name *Adiantites Heerianus* YOK. while admitting the resemblance of its fructification to *Dicksonia*. Later Prof. YABE in describing some fossil plants from Korea identified a piece of fertile specimen to YOKOYAMA's species and adopted the generic name *Coniopteris* on the ground that the fructification obviously resembles "some of the recorded cases of fossil *Dicksonia* and of the living representatives of the same genus." Upon examinining YOKOYAMA's figures, the writer thought that Prof. YABE's action in altering the generic name was quite natural, and this view was much strengthened by the fact that the fertile specimens described by YABE and ÔISHI[1] from Manchuria as *Sphenopteris* (*Coniopteris* ?) *Suessi* (KRASSER) can hardly be distinguished from YOKOYAMA's species. The present writer regards that YABE's *Coniopteris Heeriana* is identical to *C. burejensis* (ZAL.).

Occurrence:

Kuwasima, Isikawa. Tetori Series.

Coniopteris hymenophylloides (BRONGNIART) SEWARD

1877. *Adiantites amurensis* GEYLER: p. 225, Pl. XXXI, figs. 2–3.
1889. *Thyrsopteris Murrayana* YOKOYAMA: p. 22, Pl. XII, fig. 5.
1889. *Thyrsopteris prisca* YOKOYAMA: p. 23, Pl. I, figs. 3, 3a, 4.

1) H. YABE and S. ÔISHI (1933), p. 18, Pl. I, figs. 19–22.

1889. *Dicksonia nephrocarpa* YOKOYAMA: p. 25, Pl. I, figs. 1, 1a.
1928. *Coniopteris hymenophylloides* YABE and ÔISHI: p. 6, Pl. I, fig. 5; Pl. II, figs. 1–10.
1929a. *Coniopteris hymenophylloides* YABE and ÔISHI: p. 103, Pl. XXI, figs. 1, 2, 2a.
1931. *Coniopteris* cfr. *hymenophylloides* PRYNADA: p. 17, Pl. I, figs. 6–7; Text-fig. 2.
1931. *Coniopteris hymenophylloides* SZE: p. 34, Pl. V, fig. 1.
1933c. *Coniopteris hymenophylloides* SZE: p. 78, Pl. XI, figs. 1–3.
1933. *Coniopteris hymenophylloides* SZE: p. 11, Pl. I, figs. 1–11; p. 27.
1933b. *Coniopteris hymenophylloides* SZE: p. 69, Pl. VIII, figs. 4–6; p. 70.
1933. *Coniopteris hymenophylloides* PRYNADA: p. 8, Pl. I, figs. 9, 9a.
1938. *Coniopteris hymenophylloides* ÔISHI and TAKAHASI: p. 58, Pl. I, figs. 1, 1a, 2.

For other references earlier than 1928, see YABE and ÔISHI, 1928.

Remarks: The list of synonymy referred to above shows how this species occurs commonly in the Jurassic strata of Eastern Asia: it has been elsewhere described, figured and discussed by several authors. Referrence should also be made to the description of *C. burejensis* (ZAL.) in the present work. TURUTANOVA-KETOVA (1930a) and KHAKHLOF (1931) described this species from the Kirghis and the Kuznetsk Basin respectively.

Occurrence:

Yanagidani, Kuwasima } Isikawa.
Okamigô, Gihu. (Tôkyô Coll.) } Tetori Series.
Heijô (Heizyô), Bansyô } Tyôsen (G. S. K. Coll.). Daidô Series.

Coniopteris sp.

Pl. V, Fig. 1.

In Pl. V, fig. 1A is shown a fertile segment representing an upper portion of a bipinnate frond or penultimate pinna of a tripinnate frond. As is clear in the figure, the habit is very slender, traversed by a thin axis about 1 mm. thick, and ultimate pinnae are attached to it alternately. Unfortunately, the pinnules are too badly preserved to give an idea as to the fructification of this segment, but careful examination shows that they are reduced to small laminae, each bearing a terminal sorus, thus very strongly resembling a fertile segment of a *Coniopteris*, for instance, *C. burejensis*. Therefore, if this alone were met with one might refer it to *C. burejensis*. However, the sterile specimen (fig. 1B) occurring in close association with it shows that it differs considerably from *C. burejensis*. The sterile segment is only a portion of a frond, but it is characterised by a thin rachis or axis to which linear pinnae are attached alternately. The pinnae are set closely narrowing gradually towards the acuminate apex and at an angle of about 45° to the axis. The pinnules are set closely, broadest at the base, narrowing gradually towards the apex, straight or slightly falcate, and attached to the pinna-axis by their whole or a slightly decurrent base. The nervation is distinct; the midnerve is well-defined, straight and persists to the tip of pinnules; the secondary nerves which are less strong than the midnerve are acute to the midnerve, 5–6 in nunmber on each side of the midnerve, forking once, branches extending at an acute angle, and the anterior branch of the basal anadromous secondary nerve sometimes forks once more.

Occurrence:

Kowasimizu, Hukui. Tetori Series.

Dipteridaceae

ÔISHI and YAMASITA[1] revised and summarised the fossil Dipteridaceae chiefly on the basis of material found in Japan, extending their view to the foreign species not yet found in that country. Recently HIRMER[2] published his new scheme of classification of the fossil Dipteridaceae. It agrees in the main with that of ÔISHI and YAMASITA, but differs somewhat in certain points, the difference being chiefly in the explanation of specimens whose preservation is somewhat unsatisfactory. According to HIRMER's argument, the arms of *Clathropteris meniscoides* var. *elegans* ÔISHI are endotrophic while other genera are all exotrophic. Laying stress on this point he established a new genus *Oishia* for *C. meniscoides* var. *elegans* from Nariwa and called the Nariwa plant *O. elegans* (ÔISHI) HIRMER. If this division of the first order in the fossil

1) S. ÔISHI and K. YAMASITA (1936).
2) M. HIRMER (1937), VI, p. 86.

Dipteridaceae be accepted, *Oishia* appears to contain some other species which have been hitherto included in *Dictyophyllum*. On this point the writer may be able to write upon another occasion.

Genus *Goeppertella* Ôishi and Huzioka

1936. *Goeppertella* Ôishi and Yamasita, p. 146.
1937. *Goeppertella* Hirmer, p. 86.

Goeppertella varida Ôishi and Huzioka (MS) sp. nov.

Pl. XXIII, Figs. 1–3, 3a (all the type-specimen).

General description: Frond of unknown size and shape, probably large, at least bipinnate; penultimate pinna linear, about 18 cm. in breadth. Axis thick and rigid, being 2–3 mm. thick with narrow longitudinal ridges probably indicating vascular courses. Ultimate pinnae long and narrow, linear, nearly parallel-sided, alternate or subopposite, set closely, and at a right angle to the axis. Pinnules variable in shape according to the position on the pinna or frond; those in the posterior portion set closely, deltoid with rounded apices directed forwards, confluent laterally at the base, with undulating outer margin; those in the anterior portion represented as mere lobes of the lamina of the pinna, the apex being also directed forwards; lamina confluent also on the axis between the adjacent pinnae. Nerves delicate; midnerve making an angle with the pinna-axis assumes a zigzag course disolving into finer veins which form polygonal meshes. Sori arranged on both sides of the midnerve and of the pinna-axis and variable in size and form, mostly round and about 0.5 mm. in diameter consisting of 5–9 (mostly 8–9) sporangia.

Description of specimens: Pl. XXIII, fig. 1 shows a portion of a fertile frond. The thick axis and the tolerably long and narrow linear pinnae which are at a right angle to the axis characterise the specimen well. In this the marginal crenulation into pinnules is deep, while in another specimen in fig. 2 it is shallow. Ôishi and Huzioka consider that the former may represent a posterior portion and the other the anterior portion of a frond. The specimen in fig. 3 shows a posterior portion of a sterile frond, in the enlarged figure of which the reticulate nervation is clearly seen (3a).

Remarks: It is still questionable whether the present specimens represent portions of a bipinnate fern as in *Goeppertella* or portions of pinnae in other genera of Dipteridaceae. However, the stout and rigid axis rather suggests the probability of their belonging to *Goeppertella*. From the only one known species of this genus, *G. microloba* (SCHENK), the present species is easily distinguishable in several points: in the specimens at hand the pinnae are more closely set, the pinnules are shorter, the lamina on the axis is less prominent, and the axis is very thick. The present specimen may also be comparable with a part of *Thaumatopteris Schenki* NATH. But in the latter the marginal lobes corresponding to the pinnules in ours are more rounded. At any rate the specimens in question are a form identical with none of the existing species in Dipteridaceae.

Occurrence:

Nariwa (88), Okayama. Nariwa Series.

Genus *Clathropteris* BRONGNIART

Clathropteris elegans ÔISHI

(Type-specimen: All the specimens described as *C. meniscoides* var. *elegans* in ÔISHI, 1932b).

1932b. *Clathroptris meniscoides* var. *elegans* ÔISHI: p. 289, Pl. XI, fig. 8; Pl. XII, figs. 3–4; Pl. XIII, figs. 1–2; Pl. XV, figs. 1.

1936. *Clathropteris meniscoides* var. *elegans* ÔISHI and YAMASITA: p. 158, Text-figs. 1, 2 (restoration).

1937. *Oishia elegans* HIRMER: p. 86.

Remarks: This species was first described by the writer from Nariwa as a variety of *C. meniscoides* BRONGN. In 1937, HIRMER established a new genus *Oishia* for this Nariwa plant, and called it *Oishia elegans* (Ô.) HIRMER,[1] while HARRIS (1937, p. 23) considered almost simultaneously that *C. meniscoides* var. *elegans* is distinct enough from *C. meniscoides* to be worthy of specific rank.

Occurrence:

Nariwa (1, 63), Okayama. Nariwa Series.

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1) HIRMER's idea is certainly worthy of attention, but at present the writer wishes to call the plant in question *Cl. elegans* as it is necessary to re-examine the specimens hitherto described under the genus *Dictyophyllum*, especially to settle points in regard to the branching of the arms. For instance, the arms of *Dictyophyllum exile* and *D. Nathorsti* as figured by NATHORST (1906) and ZEILLER (1903) respectively are certainly endotrophic.

Clathropteris meniscoides BRONGNIART

Pl. V, Fig. 4.

1825. *Filicites meniscoides* BRONGNIART: p. 200, Atlas Pls. XI, XII (cited from HARRIS, 1931, p. 88).
1931. *Clathropteris meniscoides* HARRIS: p. 88, Pl. XV, figs. 1, 9; Pl. XVI, figs. 9, 10; Pl. XVIII, figs. 3, 5, 12; Text-figs. 32–34.
?1931. *Clathropteris meniscoides* SZE: p. 4, Pl. I, fig. 3.
1938. *Clathropteris meniscoides* ÔISHI and HUZIOKA: p. 78, Pl. II, fig. 4.
For further references see HARRIS, 1931, p. 88.

Though this species is represented by imperfect pinnae from Nariwa and Neiridani (Pl. V, fig. 4), it shows a fairly close agreement with typical specimens of this well-known species referred to above. Its specific identity with *C. platyphylla* (GOEPPERT) has been maintained by several authors. Specimens described by YABE[1] as cfr. *C. meniscoides* and by KAWASAKI[2] and SEWARD[3] as *C. meniscoides* may rather be referable to *C. obovata* ÔISHI; this is especially so in YABE's specimen from Taihô-men in Tyôsen in bearing larger marginal lobes. HARRIS[4] already pointed out that the specimen may be distinct from *C. meniscoides*. Specimen from China described by SZE (1931) is a fragment which may belong to either *C. meniscoides* or *C. obovataa*.

Occurrence:

Mominoki, Yamaguti. Aso Bed.
Nariwa (1, 63), Okayama. Nariwa Series.
Neiridani, Toyama. Kuruma Bed.

Clathropteris obovata ÔISHI

(Type-specimen: ÔISHI, 1932b, Pl. XIV, fig. 1).

1907. *Clathropteris meniscoides* SEWARD: p. 20, Pl. VI, figs. 49–50; Pl. VIII, figs. 75–76.
1922. *Clathropteris* cfr. *meniscoides* YABE: p. 12, Text-fig. 8.
1925. *Clathropteris meniscoides* KAWASAKI: p. 10, Pl. XIII, fig. 45; Pl. XIV, figs. 46–49; Pl. XV, figs. 50–52.

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1) H. YABE: (1922), p. 12, Text-fig. 8.
2) S. KAWASAKI (1925), p. 10, Pl. XIII, fig. 45; Pl. XIV, figs. 46–49; Pl. figs. 50–52.
3) A. C. SEWARD (1907), p. 20, Pl. VI, fig. 49–50; Pl. VIII, figs. 75–76.
4) T. M. HARRIS (1931), p. 89.

1932b. *Clathropteris obovata* OISHI:* p. 291, Pl. XII, fig. 2; Pl. XIV, fig. 1.
1936. *Clathropteris obovata*? ÔISHI and TAKAHASI: p. 121, Pl. I, fig. 4.
1936. *Clathropteris obovata* ÔISHI and YAMASITA: p. 158.
1938. *Clathropteris obovata* ÔISHI and HUZIOKA: p. 78, Pl. III, figs. 1–2.

Diagnosis (ÔISHI, 1932b): "Pinnae crowded, closely set, overlapping each other laterally, obovate in outline, more than 12 cm. long, and 6–8 cm. broad at a short distance below the apex to which the pinnae narrow abruptly, and more gradually towards the fused base. Margin subacutely and deeply lobed, a lobe being triangular in outline, with the upper margin straight or slightly concave and the lower margin convex below. Nervation distinct. Midnerve lightly undulating and slightly curved. Secondary nerves also lightly undulating, making an approximately 70° angle with the midnerve, each ending at a tip of a marginal lobe. Tertiary nerves nearly perpendicular to the secondaries, forming reticular meshes of *Clathropteris*-type."

Remarks: The type specimen is a portion probably of a large typical frond, consisting of some large obovate pinnae characterised by deeply cut marginal lobes. Subsequent discovery of more perfect specimens from the type-locality enabled us to get a more complete idea as to the habit of this species. In the specimen illustrated in ÔISHI and HUZIOKA, 1938, Pl. III, fig. 1 which may represent a somewhat younger frond than the type-specimen the pinnae are at least eleven in number, much crowded and distinctly fused laterally at the base, the fused portion being in this specimen about 4 cm.

This species is closely allied to *C. meniscoides* (BRONGN.), but it shows a closer resemblance in habit to *Thaumatopteris rugosa* (L. and H.) in the sense of ÔISHI and YAMASITA[1], though the latter has much more crowded pinnae. The writer regards that the specimens described by YABE (1922), KAWASAKI (1925) and SEWARD (1907) under BRONGNIART's name belong to *C. obovata*. A fragment from Nagato doubtfully assigned by ÔISHI and TAKAHASI (1936) to this species may rather safely be referable to this species from the characteristic marginal lobes.

Occurrence:

Nariwa (44, 45, 49, 62, 69), Okayama. Nariwa Series.
Yamanoi (16), Yamaguti. Upper Triassic.

1) S. ÔISHI and K. YAMASITA (1936), p. 152.

Daiseizan (G. S. K. Coll.) Tongzin (G. S. K. Coll.) Naedong (G. S. K. Coll.) Wonhyon (G. S. K. Coll.) Changpa (G. S. K. Coll.). Taihô coal-mine (Sendai Coll.)	Tyôsen. Daidô Series.

Genus *Dictyophyllum* BRONGNIART

Dictyophyllum japonicum YOKOYAMA

1891. *Dictyophyllum japonicum* YOKOYAMA: p. 243, Pl. XXXIII.
1932a. *Dictyophyllum japonicum* ÔISHI: p. 58, Pl. I, figs. 2–3.
1936. *Dictyophyllum japonicum* ÔISHI and YAMASITA: p. 155.
1936. *Dictyophyllum japonicum* ÔISHI and TAKAHASI: p. 124, Pl. I, fig. 3.

Remarks: The original specimens figured by YOKOYAMA are some detached pinnae characterised by narrow pinnae with a gradual reduction of lamina towards the base. Later ÔISHI and TAKAHASI secured and figured a more perfect specimen of this species showing arms with pinnae (ÔISHI and TAKAHASI, 1936). It shows that the basal part of the pinnae without lamina is more than 2.5 cm. long as already described and figured. The present species resembles *D. exile* (BRAUNS) in respect to the gradual reduction of lamina towards the base of pinnae.

Occurrence:

Mitiiti, Yamaguti. Aso Bed.
Yamanoi (3, 13), Yamaguti. Upper Triassic.

Dictyophyllum Muensteri (GOEPPERT) NATHORST

1841. *Thaumatopteris Muensteri* GOEPPERT: Liv. I and II, p. 2, Pl. I; Pl. II, figs. 1–6; Pl. III, figs. 1–3.
1869. *Thaumatopteris Muensteri* SCHIMPER: Tome I, p. 629, Pl. XL, figs. 7–12.
1873. *Thaumatopteris Muensteri* SAPORTA: Pl. XXXV, fig. 1.

1876. *Dictyophyllum Muensteri* NATHORST: p. 29, Pl. VI, fig. 1?; Pl. XVI, figs. 17–18.
1902. *Dictyophyllum Muensteri* MOELLER: p. 41, Pl. IV; figs. 6–7.
1913. *Dictyophyllum Muensteri* MOELLER and HALLE: p. 15, Pl. II, figs. 5–8.
?1927. *Dictyophyllum acutilobum* HIRMER: p. 651, fig. 788.
1931. *Dictyophyllum Muensteri* HARRIS: p. 85, Pl. XIV, fig. 3; Pl. XVII, figs. 1–4, 10; Pl. XVIII, fig. 14; Text-fig. 31.
1932b. *Dictyophyllum Muensteri* ÔISHI (pars): p. 301, Pl. XVIII, figs. 3–6; Pl. XIX, figs. 1–3 (non Pl. XVIII, fig. 7; Pl. XIX, figs. 4–7).
1936. *Dictyophyllum Muensteri* ÔISHI and YAMASITA: p. 155.
1937. *Dictyophyllum Muensteri* HARRIS: p. 23.
1938. *Dictyophyllum Muensteri* ÔISHI and HUZIOKA: p. 82, Pl. III, figs. 3–5.

Remarks: This species is represented by many typical specimens at Nariwa some of which have already been figured by the writer in 1932 (ÔISHI, 1932b). It has already been discussed by ÔISHI and HUZIOKA (1938) who expressed their opinion that var. *pusillum* NATHORST may rather be elevated to specific rank under *Thaumatopteris*.

Occurrence:

Nariwa (49, 63, 86), Okayama. Nariwa Series.

Dictyophyllum Nathorsti ZEILLER

1891. *Dictyophyllum* cfr. *acutilobum* YOKOYAMA: p. 242, Pl. XXXII, fig. 6.
1903. *Dictyophyllum Nathorsti* ZEILLER: p. 109, Pl. XXIII, fig. 1; Pl. XXIV, fig. 1; Pl. XXV, figs. 1–6; Pl. XXVII, fig. 1; Pl. XXVIII, fig. 3.
1905. *Dictyophyllum Nathorsti* YOKOYAMA: p. 6.
1905. *Dictyophyllum japonicum* YOKOYAMA: p. 5, Pl. II. fig. 3 (non YOKOYAMA, 1891).
?1931. *Dictyophyllum cfr. Nathorsti* SZE: p. 3, Pl. I, fig. 2.
1932a. *Dictyophyllum Nathorsti*? ÔISHI: p. 57.
1933b. *Dictyophyllum Nathorsti* ÔISHI: p. 610, Text-figs.
?1933a. *Dictyophyllum Nathorsti* SZE: p. 20, Pl. II, fig. 9; p. 25, Pl. V, fig. 2.
1936. *Dictyophyllum Nathorsti* ÔISHI and TAKAHASI: p. 122, Text-fig. 3.
1936. *Dictyophyllum Nathorsti* ÔISHI and YAMASITA: p. 156.

Remarks: In Japan this species was first described by YOKOYAMA (1891) based on a fragment of pinna which he determined as *D.* cfr. *acutilobum*. A more perfect specimen showing basal portion of pinnae was later incorrectly identified by the same author (1905) as *D. japonicum* YOK. A similar specimen was obtained by the writer from Tubuta coal-mine and figured (ÔISHI, 1933b and ÔISHI and TAKAHASI, 1936).

As ZEILLER describes, this species is characterised by pinnae which have fused basal lamina. Therefore the identification of the Japanese specimens to ZEILLER's species is beyond doubt. Imperfect pinnae from China which SZE (1931, 1933a) identified to ZEILLER's species are somewhat doubtful as they do not show the base. KRYSHTOFOVICH and PRYNADA[1] reported the occurrence of this species from Ussuriland.

Occurrence:

Yamanoi (3) } Yamaguti. Upper Triassic.
Tubuta (I) }

Dictyophyllum Nilssoni (BRONGNIART) GOEPPERT

1906. *Dictyophyllum Nilssoni* NATHORST: p. 5, Pl. II; Pl. III, figs. 2–8.
1925. *Dictyophyllum* cfr. *Remauryi* AKAGI: p. 100, Pl. IV.
1928. *Dictyophyllum* cfr. *Remauryi* AKAGI: p. 1726.
1931c. *Dictyophyllum* cfr. *Remauryi* ÔISHI: p. 359.
1931. *Dictyophyllum Nilssoni* HARRIS: p. 81, Pl. XIV, fig. 4; Pl. XV, figs. 3, 5–6, 8; Pl. XVI, figs. 1–5, 7–8, 11–12; Pl. XVII, fig. 9; Text-figs. 29–30.
1932b. *Dictyophyllum Nilssoni* ÔISHI: p. 300, Pl. XVII, figs. 7–8; Pl. XVIII, fig. 2.
1936. *Dictyophyllum Nilssoni* ÔISHI and YAMASITA: p. 156.
1937. *Dictyophyllum Nilssoni* HARRIS: p. 22.
For further references see HARRIS, 1931 p. 81.

Remarks; NATHORST (1906) divided this species into three varieties viz., var. *brevilobatum*, var. *genuinum* and var. *hoerensis*, the first of which appears to be represented in Japan, though somewhat imperfect. It is known from several localities in the Nariwa district, some examples were figured and described by the writer (ÔISHI, 1932b).

Recently SZE[2] described a fragment of pinna from China as *D.* cfr. *Nilssoni*, in which the pinnules seem to be narrowed more abruptly than in the typical specimen. TURUTANOVA-KETOVA[3] figured a fragment of this species from the Kirghis.

Occurrence:

Nariwa (30, 49, 64, 87, ?68), Okayama. Nariwa Series.

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1) A. KRYSHTOFOVICH and V. PRYNADA (1932), p. 367.
2) H. C. SZE (1933), p. 58, Pl. XI, fig. 4.
3) TURUTANOVA-KETOVA (1930a), p. 317, Pl. IV, fig. 8.

Dictyophyllum spectabile NATHORST

1906. *Dictyophyllum spectabile* NATHORST: p. 4, Pl. I.
1919. *Dictyophyllum spectabile* ANTEVS: p. 298, Pl. XVII, figs. 5–6.
1932b. *Dictyophyllum spectabile* ÔISHI: p. 15.
1936. *Dictyophyllum spectabile* ÔISHI and YAMASITA: p. 157.

Remarks: This species is represented by two fragments of pinnae derived from Hayama in the Nariwa district (ÔISHI, 1932b). It is somewhat questionable whether these fragments represent a species specifically identical with *D. spectabile*, but they have been provisionally referred to that species as there is certainly a close resemblance between the Japanese and the Swedish type specimens in respect to the pinnules which are somewhat falcate wiht a lightly undulating margin.

Occurrence:

Nariwa (30), Okayama. Nariwa Series.

Dictyophyllum sp.

Pl. V, Fig. 6.

Description of specimen: Pl. V, fig. 6 shows a fragment of a leaf showing reticulate nervation. Although very small and not very distinct, very probably it represents a portion of a pinna of a fern belonging to the Dipteridaceae. It is nearly parallel-sided, more than 3 cm. long, 1.3 cm. broad, and the margin is bradly wavy. The nervation stands out very clearly in relief as is usually the case in the ferns of this group. The midnerve is distinct, but not very strong. The secondary nerves are a little finer, branch up rapidly and anastomose with each other. The tertiary nerves are finer than the secondaries, and fill up the areoles formed by the secondary nerves making fine polygonal meshes.

Remarks: As far as the character of the specimen is concerned, it may be comparable to a pinnule of *Thaumatopteris elongata* ÔISHI[1)], however, in the latter the meshes of the last order are finer than those of the specimen in hand. Another species to which there is a yet greater similarity is *Dictyophyllum spectabile*

1) S. ÔISHI (1932b), p. 295, Pl. XVI, fig. 2; Pl. XVII, figs. 1–2.

NATH.[1] In this the pinnules are usually long and narrow, sometimes nearly parallel-sided throughout the greater length and the margin is broadly undulated, just as in the present specimen. The similarity is indeed so great that it is difficult to see any difference except in the midnerve which is very strong in NATHORST's species.

Occurrence:

Neiridani, Toyama. Kuruma Bed.

Genus *Hausmannia* DUNKER

Hausmannia (Protorhipis) crenata (NATHORST) MOELLER

1879. *Protorphipis crenata* NATHORST: p. 57, Pl. XI, fig. 4.
1902. *Hausmannia (Protorhipis) crenata* MOELLER: p. 50, Pl. V, figs. 5–6.
1906. *Hausmannia crenata* RICHTER: p. 23, Pl. VII, fig. 20 (a reproduction of NATHORST's figure).
1927. *Hausmannia crenata* PRYNADA: p. 970, Pl. XLVIII, Figs. 1–2.
1927. *Hausmannia crenata* HIRMER: p. 656.
1932b. *Hausmannia crenata* ÔISHI: p. 305, Pl. XIX, fig. 8.
1936. *Hausmannia (Protorhipis) crenata* ÔISHI and YAMASITA: p. 161.

Remarks: This species is represented by a single more or less imperfect specimen. It occurs in association with many specimens of *Hausmannia nariwaensis* at Loc. 1 in the Nariwa district, therefore it is somewhat questionable whether it denotes the real existence of this European species in Nariwa. It is presumable also that the specimen may represent merely an abnormally developed or deformed type of *H. nariwaensis* with which it occurs in association. However, the coarse meshes of the lamina of the present specimen recall *H. crenata* rather than *H. nariwaensis*.

This species has not yet been reported from the Orient.

Occurrence:

Nariwa (1), Okayama. Nariwa Series.

Hausmannia (Protorhipis) nariwaensis ÔISHI

Pl. V, Figs. 2, 3.

(Type-specimen: ÔISHI, 1932b, Pl. XX, figs. 1–10).

1930. *Hausmannia nariwaense* ÔISHI: p. 52, Pl. VII, figs. 2, 2a.
1932b. *Hausmannia nariwaensis* ÔISHI: p. 303, Pl. XX, figs. 1–10.
1936. *Hausmannia nariwaensis* ÔISHI and YAMASITA: p. 163.

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1) A. G. NATHORST (1906), p. 4, Pl. I.

This species may be described as follows (ÔISHI, 1932b): "The frond is probably petiolate, the petiole being attached perpendicularly to the plane of lamina. The lamina is broadly reniform in outline, and varies considerably in diameter between 3–10 cm. At the base, the lamina makes a deep narrow sinus reaching to the center, where the petiole might have been attached. Both edges of the sinus are convex outwards and often overlap each other. Seven to twelve primary nerves radiate through the lamina from the bottom of the sinus or the top of the petiole, branching, dichotomously once or twice, and reach to the margin of the lamina. From such primary nerves finer nervelets are given off approximately at right angles, the latter subdivide and unite into numerous small square or polygonal meshes arranged more or less regularly. The margin of the lamina is almost entire in the young and small fronds, while it is broadly and regularly undulating in the larger and well-developed ones. The outer central margin is sometimes markedly crenulating. The sori are circular, about 0.5 mm. in diameter, and densely distributed on the lower surface of the lamina, possibly one in each mesh. Unfortunately the inner features of the sori can not be made out."

Remarks: Recently, specimens bearing fairly close agreement with *H. nariwaensis* were described by FERUGLIO[1] from Patagonia under a new specific name *H.* (*Protorhipis*) *de-ferrariisi* FER. FERUGLIO pointed out some differences existing between the Patagonian and the Japanese specimens, the differences being chiefly in the larger size of the lamina, deeper apical crenulation and the larger number of primary nerves in the Patagonian specimens. However, the specimen illustrated for comparison in Pl. V, fig. 2 of this work shows that the Patagonian specimens are very closely related to the Japanese species. Irrespective of their specific identity or lack of specific identity the occurrence of a closely related species in Patagonia is very interesting not only from the phytogeographical point of view but also as it is said to have derived from the Upper Jurassic strata which is considerably younger than the Nariwa Series which yielded *H. nariwaensis*. Pl. V, fig. 3 shows an example of a long petiolate lamina of this species derived from Nariwa.

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1) E. FERUGLIO (1937), p. 127, Pl. I; Pl. II, fig. 3.

A specimen with reticulate nervation which SCHENK[1] figured from Mongolia as *Clathropteris* sp. may be a fragment of a large *Hausmannia* probably identical with none of the existing species of the genus.

Occurrence:

Nariwa (1, 63, 64, 90), Okayama. Nariwa Series.

Hausmannia (Protorhipis) dentata ÔISHI

(Type-specimen: ÔISHI, 1932b, Pl. XXI, figs. 1–4, 5A; Pl. XXXV, figs. 2–3).

1930. *Dictyophyllum* sp. ÔISHI: p. 54, Pl. VII, figs. 3, 3a.
1932b. *Hausmannia dentata* OISHI: p. 306, Pl. XXI, figs. 1–4, 5A; Pl. XXXV, figs. 2–3; Text-fig. 2.
1936. *Hausmannia (Protorhipis) dentata* OISHI and YAMASITA: p. 161.

Diagnosis (ÔISHI, 1932b): "Frond petiolate, petiole being perpendicular to the plane of lamina. Laminae semi-orbicular or broadly reniform in outline, measuring 6–12 cm. in breadth and 5–11 cm. in height, with deep sinus at the base reaching to the center where petiole attached. Both edges of the sinus are convex outwards and sometimes overlap each other. Outer margin strongly sinuate-dentate, with generally 14 teeth which are also slightly undulated along the margin. Primary nerves radiating through the lamina from the bottom of the sinus, correspond in number with the marginal teeth, and end at the tip of each tooth. Secondary nerves spring up from the midnerve at an acute angle uniting with each other to form a reticulum, each mesh of which is again subdivided into finer meshes. Sori being circular in outline, approximately 1 mm. in diameter, with 6–12 (?) sporangia."

Remarks: This species is common in the plant-bed (loc. 1) in the Nariwa district. This strikingly impressive plant displays unique morphological features identical with none of the species ever previously described. It was fully dsecribed and discussed in the work on Nariwa plants in 1932 (ÔISHI, 1932b).

Occurrence:

Nariwa (1), Okayama. Nariwa Series.

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1) A. SCHENK (1883), p. 250, Pl. LI, fig. 1.

Hausmannia? gen. et sp. indet.

Pl. V, Figs. 5, 5a.

Description of specimen: In Pl. V, fig. 5 is figured a fragment of a leaf showing reticulate nervation. Although very small and fragmentary, it looks rather like a portion of a fern frond belonging to Dipteridaceae.

The specimen consists only of a portion of a lamina. A forking primary nerve gives off finer secondary nerves which form polygonal meshes filled with finer meshes.

Remarks: The scantiness of the material does not permit of a specific or even generic determination, but it has been described at this place as it is interesting having occurred in the younger Mesozoic strata. The writer wishes provisionally to call the specimen *Hausmannia* ? gen. et sp. indet. taking into consideration the fact that it reminds one somewhat of a portion of a *Hausmannia* which flourished chiefly in the younger Mesozoic age.

Occurrence:

Sindô, Tyôsen. Rakutô Bed. (G. S. K. Coll.).

Genus *Thaumatopteris* GOEPPERT

Thaumatopteris elongata ÔISHI

(Type-specimen: ÔISHI, 1932b, Pl. XVI, fig. 2; Pl. XVII, figs. 1–2).

?1931c. *Thaumatopteris Schenki* ÔISHI: p. 239, Pl. I, figs. 7, 7a, 8, 8a.
1932b. *Thaumatopteris elongata* ÔISHI: p. 295, Pl. XVI, figs. 2; Pl. XVII, figs. 1–2.
1932b. *Thaumatopteris Schenki* ÔISHI: p. 296, Pl. XVII, figs. 3–4; Pl. XVIII, fig. 1.
1932b. Cfr. *Thaumatopteris Brauniana* ÔISHI: p. 297, Pl. XXXV, fig. 4.
1936. *Thaumatopteris elongata* ÔISHI and YAMASITA: p. 149.

Description and remarks: The writer formerly figured some specimens of this species from Nariwa, but many good specimens belonging to the same species were acquired from another locality of the same district (loc. No. 88). The type-specimen was described as follows: "The pinnules are long and narrow, forming an angle of approximately 60° with the pinna-rachis, about 1 cm. in breadth at the base which is lightly contiguous laterally, narrowing gradualy towards a blunt apex; the lowest pinnule preserved measures 9 cm. in length, and the pinnules seem to shorten gradually towards the apex. The midnerve is distinctly impressed on the matrix, elevated as a ridge, while the secondary nerves are faint and indistinct, and dissolve into a reticulum consisting of very small meshes which are often overlooked by the naked eyes. The distal margins of the pinnules are lightly crenulated. The fertile pinnae are similar to the sterile; the sori are circular in outline, approximately 1 mm. in diameter and distributed on the whole surface, possibly the lower, of the pinnules; unfortunately the inner structure of the sori can not be made out on account of the unsatisfactory preservation of the fertile specimens."

The characteristic features of this species are chiefly the very fine relicular meshes of the nervation and the crenulation of the distal margin of pinnules. HARRIS[1] discussed the Japanese specimen described by the writer and mentioned that even in the Greenland specimens identified to *T. Brauniana* the meshes are very fine the finest of them being less than half a millimeter wide just as in the present specimen. If this were so, *T. elongata* may be a species very close to *T. Brauniana*. But there is another important distinction: it is the crenulation of the distal margin of the pinnules, a feature not seen in *T. Brauniana*. But as the margin becomes entire towards the distal pinnules of a frond, it may hardly be distinguishable in such case. In one of the type-specimens (ÔISHI, 1932b, Pl. XVI, fig. 2) the margin is entire in the distal pinnules while it is distinctly crenulated in the lowest pinnule in the figure. As this character is constant in all the specimens now at our disposal, it may be taken as a diagnostic character specifically distinctive from *T. Brauniana*.

A poorly preserved specimen described as cfr. *T. Brauniana*[2] from Nariwa may better be included in *T. elongata*, as there is no typical specimen of the former. In the same way, specimens identified to *T. Schenki*[3] from Nariwa should be referred to *T. elongata*, as HARRIS[4] suggested.

1) T. M. HARRIS (1937), p. 24.
2) S. ÔISHI (1932b), p. 297.
3) S. OISHI, Ibid., p. 296.
4) T. M. HARRIS (1937), p. 24.

Occurrence:

Nariwa (30, 48, 49, 69, 88), Okayama. Nariwa Series.
?Kuruma, Nagano. Kuruma Bed.

Thaumatopteris Kochibei (YOKOYAMA) ÔISHI and YAMASITA

1891. *Dictyophyllum Kochibei* YOKOYAMA: p. 244, Pl. XXXIV, figs. 1, 1a.
1896. *Dictyophyllum Kochibei* INOUYE: p. 363, Pl. XII, figs. 5, 7.
1905. *Dictyophyllum Kochibei* YOKOYAMA: p. 6, Pl. I, figs. 5, 7; Pl. II, figs. 1–2.
1932a. *Dictyophyllum Kochibei* ÔISHI: p. 59, Pl. I, figs. 4–6.
1936. *Thaumatopteris Kochibei* ÔISHI and YAMASITA: p. 150.
1938. *Thaumatopteris Kochibei* ÔISHI and HUZIOKA: p. 79, Text-fig. 3.

General description (YOKOYAMA, 1905): "Primary pinnae elongated, deeply pinnatifid. Secondary pinnae elongated, mostly inclined a little forward, but sometimes going off from the rachis nearly at right angles, rigid or slightly bent forward or even a little flexuous, mostly separated from one another by a greater or less interval, alternate or subopposite, gradually diminishing in length toward the front, until at last they become mere lobes of the primary pinnae, lobed. Lobes in the posterior pinnae ovate or ovately lanceolate with very deep incisions between them, crenate at margin, obtusely pointed at apex, while those in the anterior pinnae become shorter, with shallower incisions, entire and more blunt, so that in the most anterior ones they change into mere crenations and then finally disappear. Rachis of the primary as well as of the secondary pinnae slender. Midrib of the lobes distinct, but weak, somewhat zigzag, evanescent. Lateral veins forming polygonal nets within which there are still smaller ones. Veins in the lobed wings similar to those of the lobes of the pinnae. Fertile pinnae like sterile ones, with numerous, crowded, more or less rounded sori on the finer veins."

Remarks: This species was first described by YOKOYAMA as *Dictyophyllum Kochibei* based on a fragment from Yamanoi collected by KOCHIBE. He again described the same species collected by INOUYE from the same locality from where KOCHIBE first collected, and revised the diagnostic characters as quoted above. Specimens dealt with by YOKOYAMA were portions of pinnae, and they show neither the arms nor the base of the pinnae which characterise each distinct genus of Dipteridaceae. Subsequent collection at Yamanoi was made by the writer, but he also failed to obtain such good specimens. Specimens indistinguishable from YOKOYAMA's *Dictyophyllum Kochibei* were later obtained from the plant bed of the Nariwa district (ÔISHI and HUZIOKA, 1938), but on them also were presented portions of pinnae.

Although such was the case, the mode of pinnatification of the pinnae in all these specimens mentioned above recall *Thaumatopteris* in their general habit rather than any other genera of Dipteridaceae. Therefore ÔISHI and YAMASITA (1936) regarded YOKOYAMA's *D. Kochibei* provisionally as a species of *Thaumatopteris*.

Occurrence:

Yamanoi (3), Yamaguti. Upper Triassic.
Nariwa (63, 68), Okayama. Nariwa Series.

Thaumatopteris nipponica ÔISHI

(Type-specimen: ÔISHI, 1932b, Pl. XV, figs. 2–3).

1930. *Dictyophyllum*? sp. ÔISHI: p. 55, Pl. VII, figs. 4–5.
1932b. *Thaumatopteris nipponica* ÔISHI: p. 293, Pl. XII, figs. 5–6; Pl. XV, figs. 2–3; Pl. XXI, fig. 5B; Text-fig. 1 (restoration).
1936. *Thaumatopteris nipponica* ÔISHI and YAMASITA: p. 148.

Diagnosis (ÔISHI, 1932b): "Pinnae generally 5 in number, disposed in funnel-shape at the top of the petiole, about 13 cm. in length, elongate-ovate in outline, broadest at the middle portion, which is about 4–8 cm. in breadth, thence narrowing gradually towards both ends, and free at the base. Pinnules making a wide angle with the delicate pinna-rachis, long and narrow, alternate, subopposite or opposite, narrowing gradually from the base towards an obtuse apex, lamina being contiguous laterally at the base; pinnules at the proximal part deltoid, with rounded apex. Midnerve distinct, persisting to the tip of pinnules. Secondary nerves, occasionally bifurcating at a short distance from their origin, dissolve themselves into finer nerves forming polygonal meshes. Margin of pinnules entire or lightly undulating. Fructification not known."

Remarks: This species is one of the remarkable elements of the flora of the Nariwa Series. It occurs abundantly in splendid preservation in Loc. 1 in the Nariwa district, but has never been found in other localities. As was already fully described and discussed in the work on the Nariwa plants (ÔISHI, 1932b), the typical specimen of this species is characterised by the funnel-shaped disposition of pinnae at the top of the petiole, the general plane of the pinnae and the petiole being at a right angle to the petiole.

T. nipponica resembles *T. Schenki* NATH.,[1] but is distinguished from it in that the fronds have a less number of pinnae, slightly narrow pinnules, and in the less deeply crenulated margin of the pinnules. As compared already in the work of 1932b, there is indeed a striking resemblance between this species and the specimens described by ZEILLER[2] under the name *Dictyophyllum Remauryi* ZEILL. from Tonkin. In the size and form of the pinnae and also in the nervation in the two species the forked secondary nerves are prominent, and there is certainly a very close resemblance between them. In the Tonkin species, however, if the specimn in ZEILLER's Pl. XX, fig. 2, which represents a portion of an arm with certainly a *Dictyophyllum* aspect, may as the author says, actually belong to the same plant as the other specimens of pinnate pinnae, there is then a difference in the mode of disposition of pinnae with the Japanese specimens in which the arms are extremely reduced and the pinnae are disposed from the top of a petiole. However, the specimen in ZEILLER's Pl. XX, fig. 2 is derived from Hongay, while other specimens of pinnae with long and narrow pinnules are all derived from Kebao. Therefore there exist some doubts whether such specimens as figured in his Pl. XIX, fig. 2 and Pl. XX, figs. 3–4 actually bore the *Dictyophyllum*-like character. Under such circumstances, ÔISHI and YAMASITA[3] already substituted the genus *Thaumatopteris* for the Tonkin species taking into consideration the long and narrow pinnules resembling *T. nipponica*. Although the Tonkin species may fall into the same genus with the Japanese specimens, yet the two are distinctive specifically, the pinnules of the former being very variable in respect to the length and size, while they are rather constant in ours.

Occurrence:

Nariwa (1), Okayama. Nariwa Series.

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1) A. G. NATHORST (1907).
2) R. ZEILLER (1903), p. 101, Pl. XIX, figs. 1–2; Pl. XX, figs. 1–4; Pl. XXI, figs. 1–2.
3) S. ÔISHI and K. YAMASITA (1936), p. 148.

Thaumatopteris pusilla (NATHORST) ÔISHI and YAMASITA

1878. *Dictyophyllum Muensteri* var. *pusillum* NATHORST: p. 45, Pl. V, figs. 14–16; Pl. VIII, figs. 8–10.
1932b. *Dictyophyllum Muensteri* var. *pusillum* ÔISHI: p. 303, Pl. XVIII, fig. 7; Pl. XIX, figs. 4–7.
1936. *Thaumatopteris pusilla* ÔISHI and YAMASITA: p. 151.
1938. *Thaumatopteris pusilla* ÔISHI and HUZIOKA: p. 80, Text-figs. 4–5.

Diagnosis (ÔISHI and HUZIOKA, 1938): "Arms reduced. Pinnae more than 5 in number, lanceolate, nearly 6 cm. in length, broadest near the base, 3–4 cm. in breadth, and provided with an obtuse apex. Lamina divided into long and narrow lobes and reduced abruptly towards the base of pinna. Lobes 2–3 mm. in breadth, nearly parallel-sided, or slightly swollen near the obtusely rounded apex, lightly contracted near the fused base, distant or set closely, and making a wide angle with the pinna-rachis. Primary nerve of a pinna distinct, sending off faint secondary nerves to each lobe. Tertiary ones forming dense polygonal meshes."

Remarks: This species was first described by NATHORST (1878) from Sweden as a variety of *Dictyophyllum Muensteri* (GOEPPERT), and later transferred to the genus *Thaumatopteris* with the subsequent elevation of rank from variety to species (ÔISHI and YAMASITA, 1936). The Japanese specimens indistinguishable in any way from the Swedish ones of var. *pusillum* show a very narrow limit of variation with little morphological relation to *D. Muensteri* except that the arms are strongly reduced. Therefore, it may be appropriate to call the type *T. pusilla* (NATH.).

Occurrence:

Nariwa (1, 63), Okayama. Nariwa Series.

Polypodiaceae

Genus *Onychiopsis* YOKOYAMA

Onychiopsis elongata (GEYLER) YOKOYAMA

Pl. VI; Pl. VII, Fig. 7.

1877. *Thyrsopteris elongata* GEYLER: p. 224, Pl. XXX, fig. 5; Pl. XXXI, figs. 4–5.
1877. *Adiantites* GEYLER: p. 225, Pl. XXX, figs. 2b, 3.
1877. *Sphenopteris Goepperti* SCHENK (pars): p. 210, Pl. XXX, figs. 2, 2a.

1883. *Thyrsopteris elongata* SCHENK: p. 263, Pl. LIV, fig. 1.
1889. *Dicksonia gracilis* YOKOYAMA: p. 24, Pl. I, figs. 5, 5a; Pl. XII, fig. 13.
1889. *Dicksonia acutiloba* YOKOYAMA: p. 24, Pl. I, figs. 1b, 2, 2b.
1889. *Onychiopsis elongata* YOKOYAMA: p. 27, Pl. II, figs. 1–3, 4a–c; Pl. III, fig. 6d; Pl. XII, figs. 9–10.
1890. *Onychiopsis elongata* NATHORST: p. 4; p. 8; p. 10; p. 11, Pl. V, fig. 3; p. 12, Pl. II, fig. 6; p. 13; p. 14, Pl. VI, fig. 5.
1894. *Onychiopsis elongata* SEWARD: p. 59, Pl. II, fig. 2.
1894. *Onychiopsis elongata* YOKOYAMA: p. 215, Pl. XX, fig. 8; Pl. XXI, figs. 1, 4.
1905. *Onychiopsis elongata* YABE: p. 22, Pl. I, figs. 9–14; Pl. III, fig. 15.
1913. *Onychiopsis elongata* YABE: p. 3, Pl. I, figs. 1–5.
1916. *Onychiopsis elongata* KRYSHTOFOVICH: p. 100, Pl. VII, fig. 7; Pl. XIII, figs. 1–7.
1929. *Onychiopsis Mantelli* TATEIWA: Plate, fig. 7.
1931a. *Onychiopsis psilotoides* ÔISHI: p. 4, Pl. I, figs. 6–10.
1935a. *Sphenopteris* (*Onychiopsis*) *elongata* ÔISHI: p. 83, Pl. VI, fig. 2.

Diagnosis (YOKOYAMA, 1889): "Frond slender, bi-tripinnated, sterile pinnae alternate or rarely opposite, elongated, their length rapidly increasing towards the lower part of the frond; pinnules alternate, acutely directed forward, lanceolate or linearly-lanceolate, entire or lobed or even pinnately parted; lobes or partitions acute at apex and acutely directed forward just like the pinnules themselves. Venation obsolete, secondary veins simple, each going into a lobe. Fertile pinnules elongated, with a linear terminal sorus on both sides of the midrib."

Description of specimens: Pl. VI, fig. 6 shows a sterile frond from Yanagidani. It is bipinnate and very slender in habit. The pinnae are also slender and acute to the thin rachis. The pinnules are obovate to lanceolate, decurrent at the base, subacute at the apex, and the margin is entire in those of the anterior portion but serrated in those of the posterior. The nervation is generally very indistinctly impressed, however, it is seen that it is of *Sphenopteris* type.

Pl. VI, fig. 5 shows a sterile frond derived from Rokumambô. It is an upper portion of a frond with linear pinnae alternately attached to the rachis at an somewhat acute angle. The rapid increase of length of the pinnae towards the lower portion is clearly seen in this specimen. The pinnules are quite similar to those of the preceding specimen, but in this the pinnae in the extreme upper portion are only serrated at their margin.

Pl. VI, figs. 1 and 2 represent sterile fronds derived from Takazi. They are identical in all respect with the preceding specimens, but have been figured in order to show the slender habit of the frond and the rapid increasing of pinnae towards the lower portion of the frond. In the specimen in fig. 1 the pinnae are narrower, and also the pinnules are smaller and acuter to the pinna-axis than the usual ones. In Pl. VI, figs. 3 and 4 are shown fertile segments derived also from Takazi in association with sterile fronds described above. They are rather well-preserved but microscopical preparations could not be obtained from them. The fertile pinnules are oblong, obtusely pointed at the apex, and almost sessile or very short stalked. The midnerve is usually distinctly impressed. Pl. VII, fig. 7 shows a fertile frond from Saradô, Tyôsen. It is bipinnate and splendidly preserved. Some of the fertile pinnules are mostly obtuse or bluntly pointed and some are acuminated.

Remarks: Numerous specimens from various localities were examined. Most of them are sterile, but some are represented by fertile specimens. According to the observation on many specimens sterile and fertile, it is recognisable that this is a very elegant fern scarcely more than tripinnate and that the specimens at hand do not represent portions of a very large type such as a tree fern.

Discussion: A part of the writer's own discussion already mentioned on this species may be quoted here:[1] "The question of the specific relation between the European *O. psilotoides* and the Asiatic *O. elongata* (GEYLER) has long been disputed by several authors, some considering them as conspecific, while others consider them as specifically distinct. It is indeed very difficult to distinguish both upon sterile fronds only, and the fertile specimens discovered in Europe and Asia are also very similar in form to each other. SEWARD[2] once thought that a certain difference exists between the two types of fertile pinnules, but later[3] rather tended to the view that the two forms are specifically identical. In my opinion, however, the fertile pinnules of *O. psilotoides* and *O. elongata* can be distinguished from each other as Prof. YABE[4] has already shown

1) S. ÔISHI (1931a), p. 5.
2) A. C. SEWARD (1894), P. 41–60.
3) A. C. SEWARD (1903), p. 5.
4) H. YABE (1905), p. 25.

those of the former, as SEWARD figured, being sessile and acuminated at the apex, while those of the latter are definitely stalked and usually obtusely rounded at the apex......the sterile pinnules of *O. psilotoides*, as SEWARD once pointed out, are generally smaller than those of *O. elongata*......"

One of the chief reason which led the palaeobotanists into the confusion in regard to the specific relation between these two types is in the scarceness of well-preserved fertile specimens in the European species. Though SEWARD showed fertile segments from the British Wealden strata, yet it can not be said that they were very well preserved. Therefore, a discovery in Europe of additional fertile specimens in association with the fronds of *O. psilotoides*-type, the writer thinks, may solve this question. The writer (1931a) once described some sterile specimens derived from Takata under the name *O. psilotoides* (STOKES and WEBB) chiefly on the ground that the habit of the sterile frond especially the shape and size of pinnules resembles fairly closely the illustrations of the type-specimen of BRONGNIART rather than the specimens which have been described as *O. elongata* (GEYL.) from the Japanese Islands. However, in looking over numerous examples of *O. elongata* now at his disposal, the writer has arrived at a more reasonable conclusion that it would be better to include also the specimens from Takata in the group of *O. elongata* into which they appear to merge gradually. In this connection, the writer arrived at another difficulty in separating the two species on the sterile examples. Yet he wishes to insist on the existence of the differences quoted above in view of the slight difference in the shape of fertile pinnules between the Eastern and Western species.

Occurrence: This species is one of the commonest elements of the Ryôseki and the Tetori and their equivalent series in the Japanese Islands and Tyôsen and it has been known from the following several localities and horizons:

Takazi, Rokumambô	Yamaguti.	Kiyosue Group.
Ozô, Yanagidani, Kuwasima	Isikawa.	

Tanimura (Tôkyô Coll.)		
Hakogase (Tôkyô Coll.)		
Motiana		
Kowasimizu	Hukui.	Tetori Series.
Yambara		
Maesaka (Kyôto Coll.)		
Izuki (Kyôto Coll.)		
Iwaidani		
Okamigô (Tôkyô Coll.)	Gihu.	
Takata		
Mizutani	Wakayama.	
Tanzaki		
Sindasawa		
Isigamimura	Hukusima (Sendai Coll.).	
Iwakura, Mie.		
Ôtani		
Katazi (Tôkyô Coll.)		
Kaisekiyama (Sendai Coll.)		
Isiseki (Tôkyô Coll.)		
Ueno		Ryôseki Series.
Yakyô (Tôkyô Coll.)	Kôti.	
Kasayadani		
Kôbôdani		
Haginotani (Tôkyô Coll.)		
Nisinotani		
Tôgôdani		
Komô, Tokusima.		
Omoto, Iwate.		
Hatimanzawa, Gumma.		
Massaki, Miyagi.		
Huruke, Tokusima.		Monobegawa Series.
Sarodô		
Tomudô		
Zindô		
Ryûsindô	Tyôsen (G. S. K. Coll.).	Rakutô Bed.
Kinzandô		
Tasseidô		
Renkadô		

Genus *Tapeinidium*

Tapeinidium ? undulatum (HALL) KNOWLTON

Pl. XLVIII, Figs. 3, 3a.

1917a. *Tapeinidium? undulatum* KNOWLTON, p. 80, Pl. XXXVIII, figs. 1–4.

Description of specimens: Pl. XLVIII, fig. 3 represents an imperfect fern frond which can hardly be distinguishable from *Tapeinidium ? undulatum* described by KNOWLTON (1917a) from the Frontier Formation of North America. Characteristic long and narrow, linear pinnae are attached suboppositely to the thin axis at a right angle, and the laminae are regularly and pinnately crenulated in their margin. The nervation is usually indistinct, but in some places nerves quite similar to those in the American specimens are clearly visible.

Remarks: The present specimens were first examined by E. TAKAHASI and determined as *T. ? undulatum.* The species was first described by HALL as *Pecopteris undulata,* but later KNOWLTON suggested the generic name *Tapeinidium* for HALL's species without any evidence of reproductive organs. Fossil ferns of this type appear certainly to be represented also in the Upper Cretaceous rocks of the arctic region under the generic name *Gleichenia.* Especially *G. rotula* HR.[1] from the Kome Formation of Greenland is very close to the present type, though in the arctic species the nerves are of *Cladophlebis* type instead of being rather *Sphenopteris* type as in the present form. TATEIWA (1929) reported this species from Tyôsen (Gyliak Series).

Occurrence:

Asibetu, Hokkaidô. Urakawa Series.

Filicales Incertae Sedis

Genus *Adiantites* SCHIMPER

Adiantites Sewardi YABE

Pl. VII, Figs. 1, 5, 6.

1905. *Adiantites Sewardi* YABE: p. 39, Pl. I, figs. 1–6, 8 (non 7).
1929. *Adiantites Sewardi* TATEIWA: Plate, fig. 21 (a reproduction of figure in YABE, loc. cit., Pl. I, fig. 8).

1) O. HEER (1874), p. 48, Pl. VIII, figs. 4, 5; Pl. IX, figs. 1–4.

YABE defined this species as follows: "Frond bipinnate, rachis thin and straight; pinnules alternate to subopposite, close but rarely imbricated; rounded at the upper margin and attenuated below to a narrow base, with a short decurrent petiole. Lateral pinnules generally inequilateral, varying from subquadrilateral to fan-shaped, with inner margin parallel and very close to the rachis. Apical pinnules nearly equilateral, being broader than the others. Upper margin irregularly crenulated. Veins numerous, fine, uniform and distinct, united below at the base, widely spreading and dichotomously divided upwards."

One of the original specimens figured by YABE (1905, Pl. I, fig. 3) is reproduced in Pl. VII, fig. 6 of this work. It shows that the outer margin of the lamina is markedly and irregularly crenulated as defined by YABE but not represented in the sketch of the specimen, and moreover, the nerves are twice as dense as YABE's figure shows: the examination of the original specimen shows that the nerves are about 55 in number measured at the middle portion of each pinnule.

While YABE figured several specimens of this characteristic species from the Naktong Series of Tyôsen and the Tetori Series of Kami-utinami, Hukui pref., additional specimens were subsequently collected by the writer at Kuwasima, Isikawa pref. (fig. 5) and Iwaidani, Gihu pref. (fig. 1). The one from Kuwasima represents an apical portion of a frond with a broadly cuneate terminal pinnule with crenulate outer margin and narrowing below to the rachis 1 mm. thick. A lateral pinnule is seen at the right below. The nerves are densely crowded, numerous, diverging, forking frequently and end in the outer margin. The number of nerves is about 50 in the middle of the lamina. Another specimen from Iwaidani is represented by several pinnules, some of which are arranged in such a way as to suggest their being in the original position attached to the rachis which however can not be seen in the specimen. The shape of the pinnules, their crenulate outer margins and the densely crowded frequently forking nerves agree well to the characteristic features of the type-specimen.

KRYSHTOFOVICH and PRYNADA[1] reported the occurrence of this species from the Nikanian Series of Ussuriland with neither description nor figures.

1) A. KRYSHTOFOVICH and V. PRYNADA (1932), p. 366.

Occurrence:

Kinebasi Utinami Ôtani	Hukui (Tôkyô Coll.).	Tetori Series.
Kuwasima, Isikawa.		
Iwaidani, Gihu.		

Takazi, Yamaguti. Kiyosue Group.

Butudôken (Tôkyô Coll.) Ryûsindô (G. S. K. Coll.) Tomudô (G. S. K. Coll.)	Rakudô Bed.

Adiantites toyoraensis Ôishi

Pl. VII, Figs. 2, 2a, 3, 4, 4a.
(Type-specimen: Figs. 2 and 3).

1931. *Adiantites toyoraensis* Ôishi: p. 11 (name only).

Description: A slender pinnate frond more than 5 cm. long; rachis thin and delicate; pinnules small, opposite, short stalked, orbicular to ovate, and with serrate outer margin sometimes emerginate; nerves numerous, divergent, and repeatedly dichotomous; fructification not known.

Remarks: This species is characterised by the small, orbicular to ovate pinnules with finely serrate outer margin (fig. 2a). It differs from both *A. Sewardi* Yabe and *A. yuasensis* Yokoyama in the more elegant habit of the frond and in the smaller size of the pinnules. This species is not uncommon in the plant-bed of Takazi. There are some other imperfect specimens probably referable to this species derived from the Ryôseki Series of Takata.

Occurrence:

Takazi, Yamaguti. Kiyosue Group.

Kôbôdani, Kôti. ?Takata, Wakayama.	Ryôseki Series.

Adiantites yuasensis Yokoyama

Pl. XLVII, Figs. 6–8; Pl. XLVIII, Fig. 5.

1894. *Adiantites yuasensis* Yokoyama: p. 216, Pl. XXI, fig. 15.

Description of specimens: Pl. XLVIII, fig. 5 shows an apical portion of a fern frond bearing short stalked (?) cuneate pinnules with rounded apices. The pinnules are alternate and lightly undulating in their outer margin. The midnerve which runs near the lower margin of the pinnules is somewhat undulating and gives off secondary nerves at an acute angle dividing several times. Pl. XLVII, figs. 6–8 show detached pinnules occurred in association with the preceding specimen with which they are probably identical.

Remarks: The present specimens were collected from Tanzaki near Yuasa, the type locality of *A. yuasensis* YOK. YOKOYAMA's type-specimen is a single and somewhat imperfect specimen which he compared with *A. Tietzei* SCHENK[1] from the Rhaetic of the Albour Range. The specific identity of the present specimens with the type-specimen is somewhat questionable because of the imperfection of the latter. But as the general characters are very similar, they have provisionally been referred to that species.

Occurrence:

Mizutani (Yuasa), Wakayama } Ryôseki Series.
Tanzaki, Wakayama }

Form-Genus *Sphenopteris* BRONGNIART

Sphenopteris elegans (YOKOYAMA) n. comb.

Pl. VIII, Figs. 1–3.

1894. *Onychiopsis elegans* YOKOYAMA: p. 215, Pl. XXVIII, figs. 7, 7a.

General description (YOKOYAMA, 1894): "Frond twice pinnated; pinnae elongated, rachis slender with a terminal pinnule; pinnules tolerably close together, thin, opposite or alternate, directed forwards, lanceolate, broadest at base and gradually tapering above, entire in the lower half and coarsely toothed at the upper, with apex obtusely pointed. Veins rather numerous with distinct but evanescent midvein; lateral veins acute, simple or once forked."

Description of specimens: Pl. VIII, fig. 1 shows a specimen from Ôtani, Kôti pref. It is at least bipinnate, and an ultimate pinna is attached to an axis at an angle of about 45°. The ultimate pinna is slender in habit and is transversed by a thin pinna axis. The pinnules are oblong, slightly narrowed towards the base with decurrent lower base, with obtusely pointed apex, slightly spaced

1) A. SCHENK (1887), p. 3, Pl. II, fig. 9.

laterally, and at an angle of about 45° to the pinna axis. The margin is toothed. The midnerve is evanescent towards the apex. The secondary nerves are acute to the midnerve and once forking, the two branches forming an acute angle.

There are some other specimens which may be referable to this species. They are derived from Zusahara, Hukusima pref. and two of them are figured in figs. 2 and 3. The one in fig. 2 shows a part of a bipinnate frond consisting of a thin rachis with a longitudinal median groove probably on its upper surface. The pinnae are subopposite, narrowing towards the apex, and set at a wide angle to the rachis. The pinnules are similar to those of the preceding specimen, differing only in having more decurrent lower, and downwards bending upper, basal margins. The nervation is indistinct, however it seems to be of *Cladophlebis*-type as the preceding specimen. Another specimen in fig. 3 shows an apical part which doubtlessly represents the same species as the one in fig. 2. In this the pinnae become more acute to the rachis, and the pinnules fuse laterally forming simple teeth.

Remarks: As YOKOYAMA describes, there is no adequate reason in adopting the generic name *Onychiopsis* for the original specimen of this species, the specimen being represented by a single imperfect sterile specimen. The present specimens represent, though imperfect, a more striking resemblance to the type-specimen of *O. elegans* described by YOKOYAMA than to any other species ever described. Therefore, their specific identity is almost unquestionable. The writer adopted here the non-committal generic designation *Sphenopteris,* for the present specimens are all represented by sterile fronds.

Comparison: Allied species are *Sphenopteris Johnstrupi* HEER,[1] *S. dentata* (VEL.)[2] figured by SEWARD from the Cretaceous strata of Greenland and *Onychiopsis latiloba* (FONT.) from the Potomac Formation.[3]

Occurrence:

Ôtani, Kôti. Kaisekiyama, Kôti (Tôkyô Coll.). Zusahara, Hukusima.	Ryôseki Series.

1) A. C. SEWARD (1926), p. 84, Pl. VII, fig. 33; Pl. X, figs. 105, 106.
2) A. C. SEWARD, Ibid., p. 85, Pl. VII, figs. 39, 39A.
3) E. W. BERRY (1911), p. 273, Pl. XXXIII, figs. 1–2.

Sphenopteris (Ruffordia) Goepperti DUNKER

Pl. VIII, Figs. 4, 5.

1846. *Sphenopteris Goepperti* DUNKER: p. 4, Pl. I, fig. 6; Pl. IX, figs. 1–3.
1846. *Sphenopteris Hartlebeni* DUNKER: p. 4, Pl. IX, fig. 9.
1846. *Sphenopteris longifolia* DUNKER: p. 4, Pl. VIII, fig. 6.
1850. *Sphenopteris Goepperti* UNGER: p. 109.
1852. *Sphenopteris Jugleri* ETTINGSHAUSEN: p. 15, Pl. IV, fig. 5.
1871. *Sphenopteris Goepperti* SCHENK (pars): p. 209, Pl. XXX, figs. 2–5 (non Pl. XXX, figs. 2, 2a).
1889. *Thyrsopteris kagensis* YOKOYAMA: p. 23, Pl. I, figs. 6, 6a; Pl. XI, fig. 7.
1889. *Sphenopteris* sp. YOKOYAMA: p. 34, Pl. XIV, figs. 13, 13a.
1889. *Cladophlebis sphenopteroides* FONTAINE: p. 79, Pl. XXI, fig. 4.
1889. *Sphenopteris heteromorpha* FONTAINE: p. 136, Pl. LII, fig. 1.
1889. *Sphenopteris thyrsopteroides* FONTAINE: p. 89, Pl. XXV, fig. 3; Pl. LVIII, fig. 5.
1889. *Sphenopteris acrodentata* FONTAINE: p. 90, Pl. XXXIV, figs. 4, 4a.
1889. *Sphenopteris spatulata* FONTAINE: p. 93, Pl. L, fig. 4.
1889. *Sphenopteris pachyphylla* FONTAINE: p. 93, Pl. L, fig. 5.
1890. *Sphenopteris* cfr. *Goepperti* NATHORST: p. 11, Pl. VI, figs. 2–3.
1894. *Ruffordia Goepperti* SEWARD: p. 76, Pl. IV; Pl. V; Pl. X, figs. 1–2.
1894. *Ruffordia Goepperti* var. *latifolia* SEWARD: p. 85, Pl. VI, figs. 1, 1a.
1894. *Sphenopteris tenuicula* YOKOYAMA: p. 217, Pl. XX, fig. 11; Pl. XXI, figs. 2, 2a; Pl. XXVIII, fig. 6.
1900a. *Ruffordia Goepperti* SEWARD: p. 18, Pl. III, fig. 33.
1900b. *Ruffordia Goepperti* SEWARD: p. 133.
1905. *Ruffordia Goepperti* FONTAINE: in WARD, p. 75, Pl. XII, figs. 4–8.
1905. *Sphenopteris naktongensis* YABE: p. 38, Pl. IV, figs. 10–11.
1911. *Ruffordia acrodentata* BERRY: p. 230, Pl. XXIII, figs. 5–6.
1911. *Ruffordia Goepperti* BERRY: p. 231, Pl. XXIII, figs. 3–4.
1913. *Sphenopteris* cf. *naktongensis* HALLE: p. 31, Pl. IV, figs. 8–9.
1913. *Sphenopteris (Ruffordia?) Goepperti* HALLE: p. 25, Pl. III, fig. 9.
1913. *Sphenopteris (Ruffordia) Goepperti* HALLE: p. 30, Pl. II, figs. 4–8; Pl. IV, fig. 10.
1922. *Sphenopteris (Ruffordia) Goepperti* YABE: p. 4, Pl. III, fig. 5.
1926. *Ruffordia Goepperti* NAGAO: p. 380.
1926. *Acrostichopteris longipennis* NAGAO: Ibid., p. 380.
1927. *Sphenopteris Goepperti* YABE: p. 41.
1927. *Acrostichopteris* cfr. *longipennis* YABE: p. 41.
1931a. *Sphenopteris Goepperti* ÔISHI: p. 6, Pl. I, figs. 11–12.
1933. *Sphenopteris Goepperti* YABE and ÔISHI: p. 17, Pl. I, figs. 14–15; Pl. II, figs. 7, 7a, 7b.
?1934. *Sphenopteris Goepperti* CARPENTIER: p. 38, Pl. IV, fig. 15.

Description of specimen: The specimen shown in Pl. VIII, fig. 4 is a part of a sterile frond; it is tripinnate, delicate in habit; pinnae are subopposite; pinnules are ovate to oblong and finely dentated at their outer margin; the nervation is of usual *Sphenopteris*-type, the nerves being flabellately disposed from the narrow base of pinnule and branched dichotomously.

Remarks: *Sphenopteris Goepperti* was first described by DUNKER[1] from the Wealden of Germany based on some imperfect sterile fronds. Later SEWARD[2] pointed out the close resemblance of sterile and fertile fronds of *S. Goepperti* from the Wealden of England, which agree best with DUNKER's type-specimen and with the living *Aneimia;* he suggested the possibility of its belonging to the Schizaeaceae. Thus he instituted a new generic name *Ruffordia* for *Sphenopteris Goepperti* DUNKER. In 1913 SEWARD[3] obtained spores of *R. Goepperti* from the Wealden beds of Sussex. According to him, the spores of the fossil material measure 0.05 mm. in diameter and have triangular form provided with numerous ridges on the surface; the spores agree thus in shape and sculpturing with those of certain recent Schizaeaceous ferns.

In 1921, HALLE[4] examined some sterile and fertile fronds of *S. Goepperti* from near the village of Konstantinovskaja, the sterile fronds of which are identical with *Sphenopteris Goepperti* as figured by SEWARD: the fertile fronds are, according to HALLE, at least tripinnate, like the sterile fronds, "but the segments are much shorter and more widely outspread. The margin of the pinnules is more or less undulating and has a general appearance of crispness. In the fertile parts, the laminae are evidently reduced, but the reduction has not so much affected the breadth of the pinnae or pinnules as their length." The isolate sporangia and the place of annulus evidently show that *Ruffordia* belongs to Schizaeaceae.

Many specimens have heretofore been described under the name *Sphenopteris Goepperti* or *Ruffordia Goepperti* from Upper Jurassic to Lower Cretaceous rocks of various parts of the world. Most of them were sterile specimens. They seem to vary considerably in

1) W. DUNKER (1846).
2) A. C. SEWARD (1894), p. 76.
3) A. C. SEWARD (1913), p. 91.
4) T. G. HALLE (1921), p. 11.

size and form according to their position on the frond, variation ranging from larger and broader pinnules to elongated oval ones in one frond.

Though SEWARD[1] distinguished var. *latifolia* from typical *R. Goepperti* for the fronds with more broadly-lobed pinnules distinctly dentate for the most part of the margin, it is very difficult to distinguish these two extreme forms, because there are a large number of intermediate forms which bridge over the gap between the extreme forms. FONTAINE's *Sphenopteris acrodentata*[2] from the Potomac formation is a form identical with the type var. *latifolia*, and they both were considered by BERRY to be specifically identical; YABE and ÔISHI[3] also expressed the same view.

S. naktongensis YABE[4] from Korea, the original specimen of which is reproduced in pl. VII, fig. 5, is also a type closely allied to var. *latifolia*; it may be an extreme form of *S. Goepperti* provided with broadly-lobed pinnules. *Sphenopteris Goepperti* described by YABE and ÔISHI[5] from the Jurassic of Manchuria is also a frond of the same type.

Occurrence:

Ozô Yanagidani Kuwasima	Isikawa.	Tetori Series.
Tanimura Hakogase (Tôkyô Coll.) Kowasimizu	Hukui.	Tetori Series.
Nanami Rokumambô Takazi	Yamaguti.	Kiyosue Group.
Mizutani Takata	Wakayama.	
Horisakabasi Zusahara (Sendai Coll.)	Hukusima.	

1) A. C. SEWARD (1894), p. 85.
2) W. FONTAINE (1889), p. 90.
3) H. YABE and S. ÔISHI (1933), p. 18.
4) H. YABE (1905), p. 38, Pl. IV, figs. 10–11.
5) H. YABE and S. OISHI (1933), p. 17.

Ôtani
Ueno
Yakyô
Tôgôdani
Kaisekiyama
(Sendai and T. S. M. Coll.) } Kôti.
Hatimanzawa (Kagahara), Gumma. } Ryôseki Series.
Bankeidô
Ryûsindô } Tyôsen. Rakutô Bed.

Sphenopteris gracilis ÔISHI

Pl. VIII, Fig. 7.

1932b. *Sphenopteris gracilis* ÔISHI: p. 309, Pl. XL (XXII), fig. 1.

Remarks: The type specimen of this species from the Nariwa district, is an incomplete one belonging to an apical portion of a sterile frond. The chief characters of the original specimen were described by the present writer in the following manner; "It is more than 6 cm. in length, and is very slender in general habit, traversed by a delicate axis which is about 0.5 mm. across on the impression. The pinnae are alternate or subopposite, linear-lanceolate in outline, and make an angle of approximately 50° with the axis. The lowest pinna preserved is 4 cm. in length. The pinnules are closely set, triangular in form, narrowing from a broad base to an acute apex, and they are very oblique to the pinna-rachis. Towards the end of pinnae and higher up on the frond, the pinnules become smaller and fused laterally, and the pinnae merge gradually to pinnules, the margin of which is only lightly crenulated. The texture of lamina is very thin. The nervation is of *Cladophlebis* type rather than of *Sphenopteris,* a delicate midnerve sending off acutely once forking secondary nerves which are in the same strength with the midnerve. The margin of the pinnules is entire."

Here is reproduced another specimen from Kusaigawa in the Ômine coal-field (Pl. VIII, fig. 7), which though somewhat imperfect, agrees well with the type-specimen, differing only in that the pinnules are somewhat obtusely pointed at their apices. The writer believes that the two specimens are specifically identical with each other.

Occurrence:

Nariwa (44), Okayama. Nariwa Series.
Kusaigawa, Yamaguti. Momonoki Bed. (Sendai Coll.).

Sphenopteris Kochibeana (YOKOYAMA) n. comb.

1889. *Adiantites Kochibeanus* YOKOYAMA: p. 29, Pl. I, figs. 7, 7a.

Diagnosis (YOKOYAMA, 1889): "Frond pinnated; pinnae elongated; pinnules alternate, acutely directed forward, entire, broadly lanceolate, cuneate at base, acute at apex; veins many, equal, divergent, repeatedly dichotomous."

Remarks: This species was first described by YOKOYAMA as *Adiantites Kochibeanus* YOK. from Kuwasima (Shimamura), but it should be called under the form-genus *Sphenopteris* as the habit of the frond, especially the shape of pinnules and nervation are rather *Sphenopteris*-like than attributable to the genus *Adiantites*. The type-specimen was destroyed by the fire following the Great Kwantô Earthquake in 1923. The writer's collection from the type locality does not contain a similar fern, but it is described at this place as it seems to be a form distinct from any of the previously known species of fossil plants.

Occurrence:

Kuwasima, Isikawa. Tetori Series.

Sphenopteris nitidula (YOKOYAMA) n. comb.

Pl. VIII, Figs. 6, 6a.

1906. *Coniopteris nitidula* YOKOYAMA: p. 35, Pl. XII, figs. 4, 4a.

YOKOYAMA first described this species from China under the name *Coniopteris nitidula* defining it as follows: "Frond tripinnate. Primary pinnae elongated. Secondary pinnae also elongated, bluntly pointed, attached to the rachis at a very wide angle, close together and often touching. Pinnules short, blunt, inclined forward, very close together, united at base so as to appear like mere lobes, indistinctly and coarsely crenate. Veins few, the midvein which is fine and goes off at an acute angle from the rachis usually forks twice, so that the pinnules become three-veined."

YOKOYAMA's original specimen is represented by portions of penultimate pinnae of a frond which he considered to be tripinnate. The specimen shown in Pl. VIII, fig. 6 of the present work is a portion of a tripinnate frond derived from Kuwasima, and its general habit agrees well with YOKOYAMA's specimen. In the present specimen, the rachis or axis is 1 mm. thick; the ultimate pinnae are opposite, at a wide angle to the axis, about 1.5 cm. distant, linear, tapering distally; the pinnules are alternate, narrow, linear, 5 mm. long, 1.5–2 mm. broad, obtusely pointed at the apex, at a right angle to the pinna-axis; the pinnules are small, short, blunt at the apex, set closely, and sometimes confluent laterally, the nervation is of *Sphenopteris* type.

Remarks: The possession of small, short and blunt pinnules with a few nerves is one of the characteristic features of this species. The nerves are first sprung off from the pinna-axis at an acute angle, arch and fork just as in those of *Sphenopteris*.

This species recalls somewhat a Gleicheniaceous fern, but there is no proof of it.

Comparison: This species resembles *Todites princeps* (PRESL), an older Mesozoic species, however in the latter the laminae corresponding to the pinnae of the present species are represented by irregularly lobed laminae not differentiated into pinnules. Another comparable species is *Sphenopteris rajmahalensis* SAHNI and RAO[1] from the Rajmahal Hills of India, but in this the habit of the frond is stronger while the pinnules are more oblique to the axis and subacutely pointed.

Occurrence:

Kuwasima, Isikawa. Tetori Series.

Sphenopteris pinnatifida (FONTAINE) n. comb.

Pl. IX, Fig. 1.

1890. *Thyrsopteris pinnatifida* FONTAINE: p. 136, Pl. LI, fig. 2; Pl. LIV, figs. 4, 5, 7; Pl. LVIII, fig. 7.

Description of specimen: Pl. IX, fig. 1 represents probably the middle portion of a sterile frond, at least tripinnate, of unknown

1) B. SAHNI and A. R. RAO (1934), p. 260, Pl. XXXV, figs. 1b, 2b, 2c; Text-figs. 2 and 3.

size and form, but with a breadth of about 18 cm. The rachis is not visible in the figure being concealed under the crowded basal parts of the penultimate pinnae. These pinnae are linear, straight, nearly parallel-sided, 1.5–2 cm. broad, tapering gradually towards the apices, set closely or touching each other laterally, and attached to the rachis alternately at a wide angle. The ultimate pinnae at the proximal part of the penultimate pinnae are about 1.5 cm. long, becoming shorter apically, and at an angle of about 45° with the axis of the penultimate pinnae. The pinnules are oblanceolate or subrhombic in shape, strongly decurrent at the bases, and very oblique to the pinna-axis. The nervation is faintly indicated; the midnerve is very faintly visible in certain pinnules where it sends off some secondary nerves at an acute angle.

Discussion: BERRY[1] ventured to include several specimens from the Potomac formation which FONTAINE (1890) called under several different names such as *Thyrsopteris alata, angustiloba, densifolia, decurrens, virginica, pachyrachis, elliptica, distans, pinnatifida, varians, rhombifolia, bella, microloba, inaequipinnata, decurrens,* etc., in the synonymy of a certain specimen described by SCHENK[2] as *Sphenopteris Goepperti*; BERRY called all these specimens under the name *Onychiopsis Goepperti* (SCHENK) BERRY. However, SCHENK's specimen to which these American specimens were identified is believed in modern literature to be specifically identical with *Sphenopteris* (*Ruffordia*) *Goepperti* DUNKER which is Schizaeaceous. Therefore, a further revision is needed in respect to that action by BERRY.

If BERRY's synonym table given in the description of *Onychiopsis Goepperti* is useful one with a considerable degree of certainty, then the name *Onychiopsis elongata* (GEYLER) should be applied for the present specimen, because he included even *Thyrsopteris elongata* (= *Onychiopsis elongata*) from Japan in the synonymy of the American specimens enumerated above. However, the present writer believes that the specimen at hand differs clearly in habit from *Onychiopsis elongata* from the Japanese Islands. Thus a distinct name should be given for it.

1) E. W. BERRY (1911), p. 281.
2) A. SCHENK (1871), p. 209, Pl. XXV, figs. 2–5 (non Pl. XXX. fig. 2).

It is a matter of considerable difficulty to make a truthworthy revision on the basis of FONTAINE's figures as the figures shown in his Monograph are very largely diagrammatic and unfit for practical use. Under such circumstances, therefore, it is, the writer believes, the best way provisionally to compare the present specimen with those described as *Thyrsopteris pinnatifida* with which it appears to be almost identical. The resemblance of the present specimen to one in FONTAINE's Pl. LI, fig. 2 (*Thyrsopteris pinnatifida*) is very striking, though in ours the penultimate pinnae are somewhat longer and more linear than in those of the American specimen.

Comparison: This species is a type closely allied to *Onychiopsis elongata* described above in this work, but in the typical specimens there is a certain distinction, the habit of the frond being very delicate in the latter. In the fragments of pinnae, the two are hardly distinguishable as YABE[1] pointed out.

Occurrence:

Zusahara, Hukusima. Ryôseki Series.

Sphenopteris tosana (YOKOYAMA) n. comb.

1894. *Dicksonia tosana* YOKOYAMA: p. 213, Pl. XXV, figs. 13, 13a.

YOKOYAMA defined this species as follows: "Frond tripinnate; rachises of various orders rather slender; primary rachis bent somewhat zigzag, others nearly straight; primary pinnae elongated, distant, rising at nearly right angles to the rachis; secondary pinnae comparatively short, alternate, close together and a little overlapping, those on the back of the rachis being more acutely directed forward and bearing more elongated pinnules than those on the front pinnules, linear to elliptical, acute at apex, directed more or less forwards and close together; veins fine, few, indistinct, an evanescent midvein sending off a few simple lateral veins."

Having examined the type-specimen of *Dicksonia tosana* in the Geological Institute of the Tôkyô Imperial University, the writer found that the sketch of this species in YOKOYAMA's paper is pretty correct though in the actual specimen the rachis is less stout, the pinnules seem to have a more or less wavy margin and the secondary

1) H. YABE (1913), p. 3.

nerves were somewhat at an acuter angle. YOKOYAMA compared the specimen with one which he described from Shimamura (Kuwasima) under the name *Dicksonia acutiloba* HR., but the latter is habitually different from the present specimen and is identical with *Onychiopsis elongata* (GEYL.). However, *Sphenopteris tosana* seems to be far distant from the limit of variation of *Onychiopsis elongata,* therefore represents in itself a valid form.

More comparable species are *Pecopteris lobata* OLDHAM[1] from the Upper Gondwana of India and *Asplenium Nauckhoffiana* HEER[2] from the Cretaceous of Greenland, both of them being described also from Graham Land.[3] In the former the pinnae (pinnules by HALLE) are less deeply pinnatifid and the pinnules are obtusely pointed at their apices and nerves are more simple; in the latter the pinnules or lobes are characterised by having truncate bidentate ending, therefore there is a certain distinction between this and the present species.

Occurrence:

Tôgôdani, Kôti. Ryôseki Series.

Sphenopteris Yokoyamai YABE

1927a. *Sphenopteris Yokoyamai* YABE: p. 44 (name only).
1927. *Sphenopteris Yokoyamai* YABE: p. 223, Pl. XXIII, figs. 1–2.

YABE defined this species as follows: "Frond bipinnate, with slender straight rachis, 70 mm. long; pinnae approximate, adjacent ones partly overlapping, opposite, long and narrow (the longest one measuring 50 mm.), almost uniform in breadth throughout the length and attached to the rachis at an angle of about 45°; axes of pinnae slender, straight; pinnules opposite to subopposite, approximate, small (3–4 mm. long and 1.5–2 mm. broad), variable in outline, variation ranging from the rhomboidal ones in the proximal part of pinnae to the lanceolate ones in the apical part, obtuse at the apex, attenuated below and decurrent at the base; margin

1) T. OLDHAM and J. MORRIS (1863), p. 52, Pl. XXVIII, fig. 1; Pls. XXIX, XXX; Pl. XXXVI, fig. 3.
2) O. HEER (1880), p. 3, Pl. I, figs. 9–12.
3) T. G. HALLE (1913a), p. 22, text-fig. 5; p. 26, Pl. III, figs. 26, 26a; text-fig. 6.

entire or slightly wavy, but neither crenulated nor lobed. Nervature of *Sphenopteris* type, delicate but distinct; flabellate and occasionally forked."

Remarks: The specimen which YABE named *Sphenopteris Yokoyamai* is a portion of a sterile frond with slender habit and it is characterised by possessing small rhomboidal to lanceolate pinnules having nervation of *Sphenopteris* type. He compared the specimen with *S. virginica* FONT. from the Potomac Formation of Virginia and with "*Dicksonia*" *gracilis* HEER from Amurland. A fragment of this species is hardly distinguishable from *Onychiopsis elongata* (GEYL.), but in the typical one the distinction is possible.

Occurrence:

Huruke, Tokusima. Monobegawa Series.

Sphenopteris sp.

Pl. IX, Figs. 2, 2a, 3.

Description of specimens: In Pl. IX, fig. 2 are shown five imperfect pinnae arranged in parallel indicating that they might have arisen from a common axis which is entirely broken. The pinnae are long and narrow and appear to be very delicate. The pinnules are oblanceolate in shape with rotund apices, and at an acute angle to the pinna-axis. The nerves are of *Sphenopteris* type.

Another specimen in Pl. IX, fig. 3 shows a portion of pinna which displays a similar habit to the preceding specimen from which it differs only in having larger pinnules and more crowded nervation.

Remarks: The two specimens described above differ from each other only in regard to the size of the pinnules. They are hardly identical with any of the known species ever described. The specimen in fig. 2 appears to represent a fragment of a type of *Onychiopsis elongata* as shown in Pl. VI, fig. 5 in this work, but in the latter the pinnules are generally acuminated or subacutely pointed and not rotund or rather truncate as in the present specimen. While on the other hand, the one in fig. 3 rather resembles a pinna of *Coniopteris hymenophylloides* (BRONGN.), but in the latter the pinnules are usually lobed in their margin, therefore there is a distinction. The writer thinks that the present specimens represent a type of fern identifal with none of the species ever described. However, the material is too imperfect to admit of giving a new specific name to them.

Occurrence:

Kaisekiyama } Kôti. } Ryôseki Series.
Nisinotani
Iwakura, Mie (T.S.M. Coll.)

Genus *Cladophlebidium* SZE

Cladophlebidium? okayamaensis ÔISHI and HUZIOKA

1938. *Cladophlebidium? okayamaensis* ÔISHI and HUZIOKA: p. 83, Pl. IV, fig. 1; Text-fig. 6.

Diagnosis (ÔISHI and HUZIOKA, 1938): "A delicate fern-like linear frond, at least pinnate, more than 6 cm. long and about 3 cm. broad contracting more or less abruptly to round apex. Rachis 0.5 mm. across at the proximal broken end, decreasing upwards, with narrow leafy (or rather rigid ?) wing 4–5 mm. long and 0.6 mm. broad arranged in one plane and in two opposite rows at a regular interval on each side of the rachis. Pinnae or pinnules at an angle of about 50° to the rachis, opposite, their midnerves being given off from each of the narrow spaces between two adjacent wings, probably linear-ovate in outline, narrowing distally to an obtuse apex, and contracted at the base. Margin of the proximal pinnules sometimes deeply lobed occasionally forming deltoid lobes, while in the distal ones it is simply wavy. Midnerve distinct; secondaries indistinct, given off from the midnerve at an acute angle, then arching, dividing once or twice, each fascicle of secondaries corresponding to a single lobe. Fructification unknown."

Remarks: It is somewhat questionable whether the present specimen belongs to the category of *Cladophlebidium* founded by SZE.[1] He writes that the presence of "Zwischenfieder" is the essential character of this genus. In the Chinese specimen figured by SZE, the "Zwischenfiedern" appear to be delicate and laminar,

1) H. C. SZE (1931), p. 4, Pl. II, fig. 4.

being the decurrent modification of the lamina of the lower basal pinnules. But in the specimen at hand they exhibit a rather rigid appearance, though it cannot be stated with certainty. Therefore it has been called provisionally *Cladophlebidium* ? *okayamaensis*. As was already pointed out by ÔISHI and HUZIOKA, it is striking that it shows a certain resemblance in habit to the living *Marattia Kaulfussi* J. SMITH in the tropical region of South America.

Occurrence:

Nariwa (91), Okayama. Nariwa Series.

Form-Genus *Cladophlebis* BRONGNIART

This is an unsatisfactory but sometimes convenient genus for reference of sterile fern fronds. Many species have been described under this generic name and some have been transferred to natural genera subsequent to the discovery of fertile specimens. Therefore, *Cladophlebis* is a form-genus botanically having little significance and embracing several genera or even families of fossil ferns (probably also Pteridospermae). In dealing with the Japanese Mesozoic fossil plants the writer found numerous specimens of *Cladophlebis* which can not be attributed to any natural genera. Though it is not in the writer's mind to venture an artificial classification botanically of little importance, yet he found it in no small degree convenient for reference to divide such specimens into several typical types. He also found that such doing is, to some extent, at least possible so far as the Japanese Mesozoic plants are concerned. Under these circumstances the Japanese Mesozoic plants of *Cladophlebis* type have possibly been divided into too many "species", yet each is, the writer believes, characterised in its typical specimens. This is of course the writer's own tentative attempt and must be rectified according to the subsequent supply of material.

Cladophlebis acutipennis sp. nov.

Pl. IX, Figs. 4–6.
(Type-specimen: Fig. 6).

1894. *Thyrsopteris* sp. YOKOYAMA: p. 213, Pl. XXXIII, fig. 3 only.
1894. *Pecopteris* cfr. *virginiensis* YOKOYAMA: p. 220, Pl. XXIV, fig. 1.

Diagnosis: Frond large, at least tripinnate, contracting abruptly towards the distal end; rachis of antepenultimate pinnae (frond ?) 1.5 mm. thick; penultimate pinnae set closely, touching or slightly overlapping each other laterally, about 2.5 cm. broad and narrowing gradually towards acuminate apex, opposite, about 2 cm. distant on each side of and at a wide angle to, the rachis; the axis of the penultimate pinnae slightly thinner than that of the antepenultimate pinnae, with a longitudinal ridge at least on its upper surface; ultimate pinnae set closely or slightly spaced laterally, at an angle of about 45° to the axis of the penultimate pinnae, opposite, narrowing towards the acuminate apex, lower ones deeply pinnatifid, upper ones passing into simple pinnules; pinnules small, narrow, set closely, directed forwards, acuminate; nervation indistinct, midnerve straight, persisting to the tip of pinnules, secondary nerves simple ?; fructification not known.

Description of specimens: Pl. IX, fig. 6 shows the type-specimen from Masaki on which the above diagnosis of this new species is based. This specimen shows that the frond (antepenultimate pinnae) contracts abruptly towards the distal end: in the figure, the lowest ultimate pinna of the left hand side is about 12 cm. long, although the proximal portion is missing, while the next upper one is about 8 cm. long. The specimen shows that the pinnules of each pinna fuse laterally towards the distal portion of the frond and become a larger pinnule with entire margin.

Pl. IX, figs. 4 and 5 show fragments of ultimate pinnae derived from Tennôhama agreeing essentially with the type-specimen. The nervation is sometimes observable by the special application of light to the pinnules.

Remarks and comparison: Specimens resembling closely the present species have been described from various parts of the world under different names. They are namely, *Pecopteris Geinitzi* DKR.[1] and *P. Cordai*[2] described by DUNKER from the Wealden of Germany, *Sphenopteris onychiopsoides* SEWARD described by SEWARD[3] from the Upper Jurassic rocks of Sutherland, *Gleichenites gracilis* HR. described by HEER[4] from the Cretaceous rocks of Greenland, and

1) W. DUNKER (1846), p. 6, Pl. VIII, figs. 3, 3a, 3b.
2) W. DUNKER, Ibid., p. 6, Pl. VIII, fig. 4.
3) A. C. SEWARD (1911a), p. 672, Pl. II, figs. 22–24A; Pl. VI, fig. 10.
4) O. HEER (1874), p. 52, Pl. X, figs. 1–11.

Cladophlebis alata FONT.[1] described by FONTAINE from the Jurasso-Cretaceous rocks of North America. The writer does not here intend to discuss the specific relation among these specific types. However, some differences existing between the present species and each of the types mentioned above can be pointed out.

In *P. Geinitzi,* the pinnules are larger and distantly placed on the pinna-rachis. *P. Cordai* resembles the specimen at hand, but the type specimen is somewhat obscure. In *S. onychiopsoides* the pinnules are basally contracted. In *G. gracilis,* the penultimate pinnae are opposite, instead of being alternate as in our species, and the pinnae are more densely crowded. In *C. alata,* the habit of the frond is more stout and the pinnules are sometimes serrate at their margin.

The differences pointed out above are by no means satisfactory enough to serve as the criteria of the distinction of the taxonomic value. However, it is at the same time very difficult to identify the present specimens with any of the species mentioned above. Therefore, it is the best way at present, the writer believes, to terat the Japanese specimens as a new species bringing it near, among the allied species, to *C. alata* from North America. *Cladophlebis koraiensis* YABE described by YABE[2] from the Naktong Series of Korea is another allied species, but in this species the pinnules are larger and there is certainly a difference in the general habit of the frond. Certain specimens from North America described under the name *Pecopteris virginiensis* FONT.[3] which was later identified by BERRY[4] with *Cladophlebis Browniana* (DKR.) are also very closely allied to our species. Some imperfect specimens described by YOKOYAMA (1894) as *Pecopteris* cfr. *virginiensis* and *Thyrsopteris* sp. (1894) from Huzikawa (Fujikawa), Tokusima pref. may represent apical portions of penultimate pinnae of this species.

Occurrence:

Tennôhama } Wakayama. Ryôseki Series.
Hiromura }
Masaki, Tokusima. Monobegawa Series.

1) W. FONTAINE, in WARD (1905), p. 158, Pl. XXXIX, figs. 9–11; Pl. XL.
2) H. YABE (1905), p. 32, Pl. II, fig. 1; Pl. III, figs. 12–13.
3) W. FONTAINE, in Ward (1905), p. 552, Pl. CXVI, figs. 3–4.
4) E. W. BERRY (1911), p. 243.

Cladophlebis argutula (HEER)

Pl. X, Figs. 1, 2, 2a.

1876. *Asplenium argutulum* HEER: p. 41, Pl. III, fig. 7; Pl. XIX, figs. 1–4.
1877. *Asplenium argutulum* GEYLER: p. 225, Pl. XXXI, fig. 1.
1883. *Asplenium argutulum* SCHENK: p. 246, Pl. XLVI, figs. 2–4; Pl. XLVII, figs. 1–2.
1889. *Asplenium argutulum* YOKOYAMA: p. 32, Pl. III, fig. 1; Pl. XII, fig. 8; Pl. XIII, fig. 9; Pl. XIV, fig. 2.
1912. *Cladophlebis argutula* NOVOPOKROVSKI: p. 20, Pl. I, figs. 5, 5a.
1922. *Cladophlebis argutula* YABE: p. 15, Pl. I, fig. 5; Pl. II, figs. 4–8; text-figs. 10–11.
1925. *Cladophlebis argutula* KAWASAKI: p. 25, Pl. VI, fig. 23.
1926. *Cladophlebis argutula* KAWASAKI: p. 3, Pl. III, fig. 8; Pl. IV, figs. 12, 14.
1932. *Cladophlebis argutula* ÔISHI: p. 5, Pl. I, fig. 5.

Description of specimen (Pl. X, fig. 2): Frond bipinnate; rachis 3 mm. thick; pinnae ca. 5 cm. long and 1 cm. broad, at an angle of approximately 45° to the rachis, subopposite or alternate, set closely, touching each other laterally, linear, narrowing gradually towards blunt apex; pinna-axis slender; pinnules finger-shaped, straight or slightly falcate, set closely, slightly oblique to the pinna-axis, obtusely pointed at the apex, and attached by the whole base; midnerve straight persisting to the tip, secondary nerves indistinct; sori oblong, 3–4 in number on each side of midnerve.

Remarks: The linear sori shown in fig. 2a represent a similar type to those exhibited in a fertile specimen from Tyôsen (KAWASAKI 1926, Pl. IV, fig. 14), though there is a considerable difference in the habit of pinnae. Another specimen shown in Pl. X, fig. 1 is derived from Nisinotani and represents a frond of similar habit to the preceding, in this, however, the pinnules are subacutely pointed and the secondary nerves are once forked.

The figured specimens represent a type of fern frond very similar in habit to HEER's *Asplenium argutulum*[1] from Amurland, especially to specimens figured in his Pl. XIX, figs. 3 and 4. Though fertile specimens are not known of the specimens from Amurland, the existence of this species in Japan is highly probable. YOKOYAMA[2] already discriminated this species in the Tetori flora, and later

1) O. HEER (1876), pp. 41, 96.
2) M. YOKOYAMA (1889), p. 32.

YABE[1] and KAWASAKI[2] reported the occurrence of this species in Tyôsen.

Occurrence:

Kuwasima, Ozô	Isikawa.		Tetori Series.
Hakogase, Hukui.			Tetori Series.
Okamigô, Gihu.			Tetori Series.
Kaisekiyama, Nisinotani	Kôti.		Ryôseki Series.
Bansyô (G. S. K. Coll.), Heizyô (Sendai Coll.)	Tyôsen.		Daidô Series.

Cladophlebis bitchuensis ÔISHI

1932b. *Cladophlebis bitchuensis* ÔISHI: p. 284, Pl. VII, fig. 1.

The writer defined this species as follows (1932b): "Frond large, at least bipinnate; frond or penultimate pinna more than 40 cm. in length and 30 cm. in breadth. Rachis or axis comparatively delicate, being generally 5 mm. in breadth; the surface finely striated in the longitudinal direction. Ultimate pinnae alternate or subopposite, long and narrow, linear-lanceolate in outline, touching each other laterally and of nearly the same breadth throughout their whole length. Pinna-rachis also delicate, being 1–1.5 mm. in breadth, and sometimes flexuous possibly due to the preservation. Pinnules, with lamina of delicate texture, broadly linear in outline, the sides being nearly parallel or in short pinnules slightly converging, closely set, and attached to the pinna-rachis by the whole base making a wide angle with it, generally 70° or sometimes a right angle. Apex of pinnules bluntly pointed or obtusely rounded. Midnerve distinct but delicate; in smaller pinnules not much thicker than the secondary nerves, decurrent at the base, often bending slightly forwards in the upper half of the pinnules. Secondary nerves slightly arching and dividing three times."

1) H. YABE (1922), p. 14.
2) S. KAWASAKI (1925), p. 25, Pl. VI, fig. 23; (1926), p. 3, Pl. III, fig. 8; Pl. IV, figs. 12, 14.

Remarks: As has already been mentioned by the writer, this species is of the type of *C. haiburnensis* (L. and H.) and the general habit of the frond and the shape and size of pinnules call that species strongly to mind. But in the present species the secondary nerves are always thrice forked, a feature not seen in *C. haiburnensis*. P'AN[1] regarded the specific identity of *C. bitchuensis* and *C. gigantea*. But the two may be distinguished, because the pinnules in the former have entire margin less rounded at their apices.

Occurrence:

Nariwa (44), Okayama. Nariwa Series.

Cladophlebis concinna (HEER) n. comb.

Pl. XI, Fig. 4.

1876. *Dicksonia concinna* HEER: pp. 34 and 86, Pl. XVI, figs. 1–7.

Description of specimen: Pl. XI, fig. 4 (Sendai, Reg. No. 22129) shows an imperfect sterile frond at least bipinnate traversed by a rachis or an axis about 1 mm. thick on the impression with a median longitudinal ridge. The pinnae are alternate, set closely, oblong, about 3 cm. long, and attached to the rachis at a wide angle. The pinnules are set closely, ovate, with obtusely rounded apex, their lower basal edge decurrent downwards and oblique to the pinna-axis. The midnerve is distinct sending off secondary nerves four or five in number on each side of the midnerve and forking once.

Remarks: The figured specimen is, though somewhat unsatisfactorily preserved, identical with the specimens from Siberia and Amurland which HEER called under the name *Dicksonia concinna* HR. (HEER, loc. cit.). Especially the specimen in HEER's Pl. XVI, fig. 1 is in all respects identical with the present specimen. Thus the presence of HEER's *Dicksonia concinna* or at least a specimen very closely related to that species in Japan is highly probable. In the absence of any fertile specimen, the non-committal generic name *Cladophlebis* is substituted for *Dicksonia*.

Occurrence:

Kosyurihama in Ôsima, Miyagi. Ôsima Plant Beds.

1) C. H. P'AN (1936), p. 17.

Cladophlebis deltifolia sp. nov.

Pl. X, Figs. 3, 4, 4a.
(Type-specimen: Fig. 3).

General description: Frond tripinnate; rachis thin, with fine longitudinal striations; penultimate pinnae nearly parallel-sided throughout the greater part of the length of about 10 cm., 2 cm. broad, narrowing gradually towards the acuminate apices, crowded, alternate, touching each other laterally and at an angle of about 45° to the rachis; ultimate pinnae linear, narrowing towards acuminate or obtuse apices, and at an angle of 45° to the axis of penultimate pinnae longitudinally two-ribbed; pinnules small, deltoid, subacutely pointed or obtusely rounded at the apices, set closely, attached to the pinna-axis at a wide angle by their whole or slightly constricted bases; nervation indistinct; fructification not known.

Description of specimens: The type specimen (Pl. X, fig. 3) is a portion of frond, more than 10 cm. long, probably attaining at least 30 cm. The rachis is thin, measuring 2.5 mm. thick at the broken proximal end thence narrowing upwards. The axis of the penultimate pinnae is also very thin, but it appears to be pretty rigid. Two longitudinal ribs are seen on its surface, which may represent the vascular courses. One of the characteristic features of this species is that the pinnules are small, deltoid in shape and sometimes constricted at their bases.

Another specimen in Pl. X, fig. 4 is particularly interesting as it shows the pinnule shape clearly. Basal constriction is clearly seen in this specimen. In all of the specimens described above the nervation is indistinct, the surface being entirely obliterated. Sometimes there is a faint indication of something like a nervations of *Sphenopteris*-type, but this is only conjectural.

Remarks and comparison: In regard to the size and form of the pinnules this species is identical with the specimens described by SCHENK[1] from the Wealden of Germany as *Pecopteris Geinitzi* DKR., but there is a distinction in the habit of the frond: SCHENK's specimen in his Pl. XXIX, fig. 2 shows that the specimen is very delicate in habit and the pinna (or ultimate pinnae) are longer and distantly placed. SCHENK's figure of *P. Geinitzi* differs somewhat

1) A. SCHENK (1871), p. 215, Pl. XXIX, figs. 2, 2a.

from the original specimen figured by DUNKER[1] in that in the former the penultimate pinnae are linear and nearly parallel-sided and the pinnae are larger, while in the latter the penultimate pinnae (or frond) narrow more abruptly towards the distal end and the pinnules are smaller than those of the former. MICHAEL[2] described *Pecopteris Geinitzi* from the Wealden of Germany, but he did not refer to SCHENK's specimen, and only mentioned that the type specimen of *P. Geinitzi* is identical with specimen which bears sori of *Todites* type. One of the British Wealden specimens which SEWARD[3] first described as *Nathorstia valdensis* SEW. (SEWARD's Pl. IX, fig. 2) appears to be almost indistinguishable from this specimen of SCHENK, while another specimen in his Pl. VII, fig. 5 is an obscure specimen which rather resembles the present species.

This species may be very closely related to *Pecopteris Geinitzi* DUNKER among the known species of fossil ferns.

Occurrence:

Rokumambô, Yamaguti. Kiyosue Group.

Cladophlebis denticulata (BRONGNIART)

Pl. XLVIII, Fig. 1.

1890. *Cladophlebis* sp. NATHORST: p. 4, Pl. I, figs. 1–3.
1894. *Cladophlebis Nathorsti* YOKOYAMA: p. 220, Pl. XXVII, figs. 3, 4, 10, 11.
1905. *Cladophlebis* cfr. *denticulata* YABE: p. 32, Pl. III, fig. 11.
1922. *Cladophlebis denticulata* YABE: p. 9, Pl. I, figs. 3–4; Pl. II, figs. 1–2; Text-fig. 7.
1925. *Cladophlebis denticulata* KAWASAKI: p. 11, Pl. IX, fig. 35; Pl. X, figs. 35–38; Pl. XXXVI, fig. 100; Pl. XL, figs. 108, 109; Pl. XLVI, fig. 123.
1926. *Cladophlebis denticulata* KAWASAKI: p. 2, Pl. I, figs. 1, 1a-c.
1928. *Cladophlebis denticulata* YABE and ÔISHI: p. 5, Pl. I, figs. 3–4.
1931f. *Cladophlebis denticulata* ÔISHI: p. 233, Pl. I, figs. 5, 5a.
1932. *Cladophlebis denticulata* ÔISHI: p. 6.
1932b. *Cladophlebis denticulata* ÔISHI: p. 283, Pl. XI, figs. 3–7.
1933. *Cladophlebis denticulata* YABE and ÔISHI: p. 12, Pl. I, fig. 8.
1936. *Cladophlebis denticulata* ÖISHI and TAKAHASI: p. 118, Pl. I, fig. 2.

For further references, see YABE, 1922.

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1) W. DUNKER (1846), p. 6, Pl. VII, figs. 3, 3a, 3b.
2) F. MICHAEL (1836), p. 25, Pl. I, fig. 6.
3) A. C. SEWARD (1894), p. 147.

Remarks: The typical specimen of this species is characterised by having markedly falcate pinnules with acute apices and serrate margin and bearing only once forking secondary nerves. It is of course highly probable that the specimens called under this name belong to more than one species or even genus. But it is certainly useful for reference to group such a form under some specific diagnosis, as such specimens occur frequently, like *C. haiburnensis* and *C. nebbensis*, in the Mesozoic strata throughout the world. The above list for reference of synonymy shows how frequently the type of *C. denticulata* occurs in the Mesozoic strata of the Japanese Islands and neighbouring lands. Also SZE[1] described *C. denticulata* from several localities in China.

C. sp. figured by NATHORST (1890) and later named by YOKOYAMA (1894) as *C. Nathorsti* YOK. is nothing but a *C. denticulata.* TURUTANOVA-KETOVA (1930, 1930a) and KHAKHLOF (1931) described this species from the Kirghis and the Kuznetsk Basin respectively. In Pl. XLVIII, fig. 1 is shown a specimen of this species from Kuwasima.

Occurrence:

Nariwa (10, 16, 30, 47, 49, 50, 63, 69, 85, 88, 94), Okayama. Nariwa Series.
Tubuta (I), Yamanoi (1) } Yamaguti. Upper Triassic.
Kuruma, Nagano. Kuruma Bed.
Sitaka, Kyôto. Sitaka Bed.
Ozô, Kuwasima, Yanagidani } Isikawa. } Tetori Series.
Yambara, Maesaka } Hukui. } Tetori Series.
Takazi, Rokumambô, Nanami } Yamaguti. Kiyosue Group.
Ôsima, Miyagi. Ôsima Plant Bed.

1) H. C. SZE (1931), p. 2, Pl. I, fig. 1; p. 30, Pl. IV, fig. 4; (1933a), p. 10, Pl. VI, figs. 5–7.

Mizutani Hiromura	Wakayama.	Ryôseki Series.
Zusahara, Hukusima (Sendai Coll.).		
Kaisekiyama (Tôkyô Coll.). Ôtani ? Haginotani Katazi (Tôkyô Coll.) Isiseki (Tôkyô Coll.) Kôbôdani Ueno (after NATHORST) Tôgôdani (after NATHORST)	Kôti.	
Komô, Tokusima.		
Daiseizan Taihô Coal-mine Nampo-Hongsan Hansan Coal-mine Neietu	Tyôsen. (G. S. K. Coll.).	Daidô Series.
Butudôken (Tôkyô Coll.) Toriken (G. S. K. Coll.) Eidô (G. S. K. Coll.) Bankeidô (G. S. K. Coll.) Tomudô (G. S. K. Coll.) Ôtomen Coal-mine (G. S. K. Coll.)	Tyôsen.	Rakutô Bed.

Cladophlebis distans (HEER) em. YABE

Pl. XI, Figs. 2, 3, 3a.

1878. *Asplenium distans* HEER: p. 97, Pl. XIX, figs. 5–6, ? 7.
1889. *Asplenium distans* YOKOYAMA: p. 32, Pl. III, fig. 2; Pl. XI, fig. 4; Pl. XIV, fig. 1; ? Pl. XIII, fig. 4.
1922. *Cladophlebis distans* YABE: p. 13, Pl. I, fig. 6; Pl. II, fig. 3; text-fig. 9.

Cladophlebis distans was first described by HEER from the Jurassic of Siberia under the name *Asplenium distans* and later YOKOYAMA figured some imperfect pinnae from the Tetori Series under the same name on the basis of some sterile pinnae, the pinnules of which are characterised by more or less remote attachment to the axis and having entire margin otherwise very similar to

Cladophlebis denticulata (BRONGN.). YABE, in describing some Mesozoic plants from Japan, Tyôsen (Korea) and China in 1922, pointed out that some Japanese specimens show the pinnule margin distinctly and finely denticulated though otherwise quite indistinguishable from the type specimen of *Asplenium distans* from Siberia; thus he gave a certain qualification to the original diagnosis.

In dealing with a number of specimens of *C. distans* type from various localities in the younger Mesozoic rocks of Japan, the present writer found that YABE's qualification is quite natural, and that well-preserved specimens show in many cases fine denticulation along the margin of the pinnules. Moreover, he found that the upper basal margins of pinnules often bend downwards so as to join at the origin of the midnerve, while the lower basal margins are decurrent downwards. The writer first hesitated whether such specimens also should be included in the category of *Cladophlebis distans*. However in several cases he found that such is a feature rather common in many of the specimen examined. Accordingly there is need of the second qualification in regard to the basal character of the pinnules. In the distal pinnules of a pinna, however, the upper basal margins are mostly not bent downwards and they are attached to the axis by their whole bases.

In this work the writer figured two specimens of *C. distans* which demonstrate the characteristic features of this species. The one in Pl. XI, fig. 3 is a specimen from Kuwasima; the frond is at least bipinnate and traversed by a more or less slender axis; the surface of the rachis is smooth but sometimes with a longitudinal ridge; the pinnae are subopposite, long and narrow, lanceolate, attaining 15 cm. length or more, at an angle of approximately 50° to the rachis; the pinnules are set more or less remotely, at an angle of 40°–50° to the pinna-axis, long and narrow, somewhat narrowing proximally, acute at their apices, finely denticulated at the margin, upper basal margins are bent downwards, while the lower basal ones are lightly decurrent downwards; nervation is distinct, the midnerve is straight and sends off secondary nerves at an angle of about 45° and forks once, the branches extending at a narrow angle at their origin or at a short distance from it.

The second specimen shown in Pl. XI, fig. 2 is also derived from Kuwasima; it shows that the pinnae are opposite or subopposite.

Occurrence:

Ozô Yanagidani Kuwasima	Isikawa.	Tetori Series.
Notino Hakogase Yambara	Hukui.	
Usimaru, Gifu.		
Takinosiri and Syurihama in Ôsima, Miyagi.		Ôsima Plant Beds.
Kaisekiyama Nisinotani	Kôti.	Ryôseki Series.
Horisakabasi, Hukusima.		

Cladophlebis elegantissima sp. nov.

Pl. XI, Figs. 1, 1a, 1b (type-specimen).

Diagnosis: Frond bipinnate, small, elegant, more than 6 cm. long; rachis thin; pinnae ca. 2 cm. long, at an angle of ± 45° to the rachis, opposite, set closely, touching each other or slightly overlapping laterally, and narrowing gradually towards an apex; pinnules small, long and narrow, ca. 5 mm. long and 1 mm. broad. more or less remote, lightly decurrent at the lower margin, and at an angle of ca. 45° to the pinna-axis; margin dentate; nervation indistinct, midnerve persists to the tip, secondary nerves simple? and acute; fructification unknown.

Remarks: *C. elegantissima* is characterised by the very small size and elegant habit of the frond. There is no other Mesozoic fern ever described with which the present specimen is comparable. A certain specimen figured by SCHENK[1] from the Wealden of Germany as *Pecopteris Dunkeri* seems to be somewhat comparable, however, the pinnules are shorter than those in the present species and the margin is entire.

Occurrence:

Hiromura, Wakayama. Ryôseki Series.

1) A. SCHENK (1871), p. 214, Pl. XXVI, figs. 1, 1a, 1b.

Cladophlebis exiliformis (GEYLER) emend.

Pls. XII–XIV; Pl. XV, Figs. 2, 2a, 3.

1877. *Pecopteris exiliformis* GEYLER: p. 226, Pl. XXX, fig. 1a.
1889. *Pecopteris exilis* YOKOYAMA: p. 35, Pl. I, figs. 8, 9a, 10.
1890. *Pecopteris Geyleriana* NATHORST: p. 8, Pl. IV, fig. 1; Pl. VI, fig. 1.
1894. *Pecopteris Browniana* YOKOYAMA (pars): p. 218, Pl. XXIV, figs. 2–3.
1894. *Pecopteris Geyleriana* YOKOYAMA: p. 219, Pl. XXI, fig. 12; Pl. XXIII, figs. 1, 1a; Pl. XXVIII, fig. 5.
1905. *Cladophlebis* cf. *Dunkeri* YABE: p. 37, Pl. IV, fig. 9.
1913. *Cladophlebis Browniana* YABE: p. 4, Pl. I, figs. 6–9, ?10.
1922. *Cladophlebis Geyleriana* YABE: p. 7.
1929. *Cladophlebis Geyleriana* TATEIWA: Plate, fig. 10.
1931a. *Cladophlebis Browniana* ÔISHI: p. 3, Pl. I, figs. 2–4.

Diagnosis: Sterile frond large, at least tripinnate, its axis thick; penultimate pinnae alternate, crowded, touching each other laterally, attaining at least 30 cm. in length, linear, narrowing distally and at an angle of about 45° to the rachis; ultimate pinnae set closely, subopposite or alternate, narrowly linear, tapering gradually towards acuminate apex and at an angle of about 55° to the axis of the penultimate pinnae; pinnules set closely, linear to oblong, straight or slightly falcate, obtusely pointed at apex, attached to the pinna-axis by their whole bases at a wide angle, variable in shape according to the position on the frond, those on the proximal portion longer and broader, sometimes slightly contracted at the base and sometimes wavy or shallowly lobed at their margins, and the lower basal one broadly deltoid in shape or in many cases bilobed at apex, those in the anterior portion smaller in size, entire all round at the margins, and the lower basal pinnule simply deltoid; midnerve well-defined, secondary nerves indistinct, slightly arching, once forking, occasionally the anterior one forking once more.

Fertile frond bipinnate; rachis 1–1.5 mm. thick and narrowing upwards; pinnae alternate, narrow, linear, about 3 cm. long, slightly curving upwards, and at an angle of about 50° to the rachis; pinnules small, semi-circular, and covered with granulation probably denoting the presence of scattered sporangia.

Description of specimens: Pl. XII represents the largest specimen of this species in the collection. The above revised diagnosis on the sterile frond is chiefly based on this specimen. The present specimen shows that this might have attained a considerable dimension in its complete state. The characteristic lower basal pinnule deltoid or bilobed apically is clearly seen elsewhere in the specimen.

Pl. XIII, fig. 1 shows a portion of a tripinnate sterile frond, of which three penultimate pinnae are seen arranged in parallel and attached to the rachis which was pushed into the matrix and can not be seen from the surface of the bedding plane. This specimen may represent an upper portion of a frond, the pinnules being smaller and the lower basal pinnule in each pinna being merely deltoid and not bilobed at the apex.

Pl. XIV, figs. 2 and 3 have been figured as they show the shape of pinnules and the nervation very clearly. An enlarged figure of a part of the specimen in fig. 3 is given in Pl. XV, fig. 3 to show the nervation.

Pl. XIV, fig. 1 shows a portion of a penultimate pinna more than 40 cm. long consisting of an axis about 3 mm. thick to which pinnae are attached suboppositely. The pinnae are nearly parallel-sided, about 7 cm. long, tapering to a blunt apex, set closely or touching each other laterally and at a wide angle to the axis. The pinnules are generally 8 mm. long and 3 mm. broad, nearly parallel-sided, slightly falcate, obtusely rounded at the apex and attached to the pinna-axis at a wide angle and by the whole base. Lower basal pinnules are shorter than the rest of the pinnules and broadly deltoid in shape or bilobed at the apex. The margin is entire; in the pinnules of the proximal portion of the pinnae the margin is sometimes broadly undulating or irregularly lobed. The nerves are very indistinctly impressed; the midnerve originates at the middle of the base of pinnules and persists to the tip. The secondary nerves are unfortunately not clear, but they appear to be arching, crowded, and once forking, the anterior branch occasionally forking once more.

Pl. XIII, fig. 2 and Pl. XV, fig. 2 represent fertile fronds. In the former is seen a fertile segment on the right and sterile pinnae on the left, the two in opposite direction. In another specimen is also seen fertile and sterile fronds in association. In none of them, however, can the true sporangia be made out because of their unsatisfactory preservation.

Discussion: Although only parts of sterile and fertile fronds are known, no specimens bear both sorts of pinnae in organic connection. Therefore, the writer concludes that this fern had separate sterile and fertile fronds just as the modern *Osmunda*. And moreover, they are always in a close association. On this ground, the writer refers them to the same species.

The writer examined numerous examples which have been known among Japanese geologists under several names such as *Cladophlebis Browniana*, *C. Geyleriana*, *Pecopteris exiliformis*, etc. and found that some of the specimens referred to above in the synonym table were specifically inseparable. YOKOYAMA referred specimens from the Tetori Series to *Pecopteris exilis* and those from the Ryôseki Series to *P. Browniana*. It is indeed undeniable that these sterile specimens resemble *P. exilis* and *P. Browniana* respectively, yet these European species have been revealed to be ferns of Schizaeaceous. NATHORST[1] figured, besides sterile fronds, some imperfect specimens which he considered to be fertile pinnae of his *P. Geyleriana*. HIRMER and HOERHAMMER[2] considered that these fertile segments represent *Phlebopteris angustiloba* (PRESL). However, the writer's view is that they may be fragments of pinnae of *Gleichenites nipponensis* sp. nov. described in this work.

Suggestions: 1) The lower basal pinnules are bilobed at their apices in those of the lower portion of the frond, while simply deltoid in the middle or upper portions. It is not that this character was proved by a large frond carrying both types of pinnules, but that it was presumed that they all belonged to a single species from numerous examples derived from a single bed in the same locality; 2) the sporangial characters could not be made out, but the writer ventured to consider that the fertile fronds are Osmundaceous. This must be proved in future from better material.

Occurrence:

Kuwasima, Isikawa.	Tetori Series.	
Katazi (after NATHORST)	Kôti.	Ryôseki Series.
Torikubi (after NATHORST)		
Kaisekiyama (Tôkyô Coll.)		
Kôbôdani		
Yosidayasiki (Sendai Coll.)		
Tyôzya (Sendai Coll.)		

1) A. G. NATHORST (1890), Pl. IV, figs. 3–5.
2) M. HIRMER and L. HOERHAMMER (1936), p. 31.

Tennôhama } Wakayama.
Mizutani
Hiromura
Kayanokibasi, Hukusima. (Sendai Coll.)
Omoto, Iwate.
Massaki, Miyagi. } Monobegawa Series.
Huzikawa, Tokusima. (Tôkyô Coll.)
Tasseidô } Tyôsen. Rakutô Bed.
Tomudô

Cladophlebis falcata sp. nov.

Pl. XV, Figs. 1, 1a (type-specimen).

Diagnosis: Frond large, at least bipinnate; penultimate pinna at least 20 cm. broad; ultimate pinnae long and narrow, linear, 10 cm. long and 1 cm. broad, tapering gradually towards the apex, set closely or overlapping each other laterally, subopposite, and at a wide angle to the axis; pinnules falcate, acuminate, set closely, attached to the axis by the whole base at an angle of about 45°; midnerve distinct, persisting to the tip of the pinnules; secondary nerves arching, acute to, and in the same strength as, the midnerve, dichotomously forking once, twice or only anterior branch forking once more; margin entire or wavy; fructification not known.

Remarks: This species seems to have attained a considerable dimension in its complete frond. Very long and narrow, linear and crowded pinnae are one of the characteristic features of this species. The rachis or the axis of the penultimate pinna can not be seen on the specimen being concealed under the crowded basal pinnules of each ultimate pinnae.

Occurrence:

Haginotani, Kôti. Ryôseki Series.

Cladophlebis gigantea ÔISHI

1932b. *Cladophlebis gigantea* ÔISHI: p. 283, Pl. VII, fig. 2.

Diagnosis (ÔISHI, 1932b): "Frond at least bipinnate; frond or penultimate pinna more than 20 cm. in length, bearing a thick axis which is about 7 mm. in breadth measured on the compressed surface; surface of the axis ornamented by a series of longitudinal striations. Ultimate pinnae more than 10 cm. in length and 5 cm. in breadth at the base, thence attenuate towards the apex, touching or overlapping each other laterally, and attached to the axis sub-oppositely making an angle of about 50° with it. Pinna-rachis about 2 mm. in breadth. Pinnules, with lamina of delicate texture, subopposite, broadest at the base, thence attenuating gradually towards the bluntly rounded apex, straight, closely set, and attached to the pinna-rachis by their whole base nearly at a right angle. Nervation delicate and very crowded; from the well-defined midnerve which is straight and persistent to the apex of pinnule are sent off secondary nerves at a wide angle which are slightly arching, and forked three times, first close to the midnerve, secondly midway and lastly near the margin of pinnules, thus making a bundle of nervelets. Margin of pinnules sometimes shallowly crenulated or lobed, each marginal lobe corresponding to a bundle of nervelets. Fructification not known."

Remarks: After the publication of the work on the Nariwa plants by the writer in 1932, he came across a paper by SZE[1] in which was described *C. Halleiana*, a new species of *Cladophlebis*. SZE's species is characterised by the very crowded secondary nerves three or four times dichotomously branched; it exhibits a fairly close resemblance to *C. gigantea*. If one lay too much stress on the nervation, then the two species may be taken to represent forms very closely related to each other. So far as can be seen in the description and figures of the Chinese specimen it seems very difficult to find out any difference which separates the two specifically. Notwithstanding this, the reason why the writer wishes to separate the two, though it is provisionally, lies in the more crowded and arching secondary nerves in the Chinese species, though such are features perhaps of minute importance in the specific separation of the sterile fronds of these types.

P'AN[2] recently described *C. gigantea* from the Rhaeto-Liassic strata of Shensi. He showed a series of many specimens which he

1) H. C. SZE (1931), p. 32, Pl. VIII, figs. 1–2.

2) C. H. P'AN (1936), p. 17, Pl. VI, fig. 9; Pl. VII, figs. 1–8; Pl. VIII, figs. 1–2.

believed to connect the limit of variation of *C. gigantea* and another allied species *C. bitchuensis* ÔISHI from Nariwa and announced their specific identity. As P'AN described, the pinnules of the Chinese specimens are decidedly smaller than those of both the Japanese species mentioned above. Moreover the writer thinks that it is somewhat questionable whether the limit of variation in respect to the size of the pinnules of *C. gigantea* should be extended to such smaller pinnules as in the Chinese specimens. Therefore, the writer wishes to hold provisionally the Chinese specimens as Cfr. *Cladophlebis gigantea* ÔISHI, until better specimens which show more satisfactory evidences proving them conspecific may be obtained in either of the localities.

A *Cladophlebis* frond with similar crowded nervation is found also in the specimens described by SZE[1] as *C. fukiensis* SZE from China. This species is allied to *C. gigantea* in respect to the thrice forked secondary nerves but is distinguishable in the narrower and more acuminate pinnules.

Occurrence:

Nariwa (44), Okayama. Nariwa Series.

Cladophlebis haiburnensis (LINDLEY and HUTTON) BRONGNIART

1891. *Asplenium Roesserti* YOKOYAMA (non PRESL): p. 241, Pl. XXXII, figs. 3, 3a, 4 (non Pl. XXXII, figs. 1, 2, 5; XXXIV, fig. 2).
1905. *Cladophlebis yamanoiensis* YOKOYAMA: p. 4.
1906. *Todites Williamsoni*, YOKOYAMA (pars): p. 28, Pl. VIII, fig. 1.
1922. *Cladophlebis haiburnensis* YABE: p. 16, Pl. II, figs. 9–11, Text-figs. 12–16.
1925. *Cladophlebis haiburnensis* KAWASAKI: p. 18, Pl. V, figs. 16–20; Pl. VI, figs. 21–22.
1926. *Cladophlebis haiburnensis* KAWASAKI: p. 3, Pl. II, figs. 4–6; Pl. III, fig. 10.
1928. *Cladophlebis haiburnensis* YABE and OISHI: p. 5, Pl. I, fig. 2; Pl. III, fig. 1.
1931f. *Cladophlebis haiburnensis* ÔISHI: p. 237, Pl. II, fig. 2.
1932. *Cladophlebis haiburnensis* ÔISHI: p. 6, Pl. I, fig. 6; Pl. II, fig. 2.
1932a. *Cladophlebis haiburnensis* ÔISHI: p. 56.
1932b. *Cladophlebis haiburnensis* ÔISHI: p. 281, Pl. VI, figs. 1–3; Pl. VIII, figs. 1–2.

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1) H. C. SZE (1933), p. 48, Pl. VIII, figs. 1–3.

1933. *Cladophlebis haiburnensis* YABE and OISHI: p. 14, Pl. I, fig. 12; Pl. II, figs. 4, 4a, 5; Pl. III, figs. 1–2.
YABE, 1922, gives foreign references.

Remarks: The characteristic features of this species are the linear and oblong pinnules with rounded or obtusely rounded apices and twice forking secondary nerves. The pinnules from the distal portion of a pinna or frond are usually small in size, often falcate, secondary nerves are sometimes only once forking, thus it is hardly distinguishable from the type usually called under the name *C. denticulata* (BRONGN.). It is of course obvious that the specimens identified to *C. haiburnensis* contain more than one specific type. But it is certainly useful for reference to group such forms under a specific diagnosis, as they occur frequently in the Mesozoic strata of the Asiatic continent. The above list of references shows that many examples of fern impressions of similar habit with *Pecopteris haiburnensis* L. and H. occur in the Mesozoic, especially in the Older Mesozoic, strata in Japan, Tyôsen and Manchuria. It is noteworthy that none of the specimens referable to this species has been found from the Tetori or younger Series than it. TURUTANOVA-KETOVA (1930) and KHAKHLOF (1929, 1931) described this from Kara-Tau and the Kuznetsk Basin respectively.

Occurrence:

Nariwa (40, 44, 48, 50, 87, 88, 90), Okayama. Nariwa Series.
Kusaigawa, Yamaguti. Momonoki Bed.
Yamanoi (3), Yamanoi. Upper Triassic.
Kuruma, Nagano. Kuruma Bed.
Sitaka, Kyôto. Sitaka Bed.

Wonhyon Kôsei Coal mine Taihô Coal-mine Rensen Nampo-Hongsan Bansyô	Tyôsen. (G. S. K. Coll.). Daidô Series.

Cladophlebis hukuiensis sp. nov.

Pl. XVI, Figs. 1–4.
(Type-specimen: Fig. 3).

Diagnosis: Frond bipinnate, slender in habit; rachis thin, 1.5 mm. thick; ultimate pinnae flexuous, opposite or subopposite, 1–1.5 cm distant on each side of the rachis, closely set or overlapping each other laterally, tapering gradually from the base towards the apex and at a wide angle to the rachis; pinnules long and narrow, oblique to the pinna-axis, slightly falcate, acuminate at apex, with undulate or serrate margin, somewhat distant, basal lower margin being sometimes slightly decurrent to form a narrow wing; mid-nerve distinct persisting to the tip; secondary nerves simple or once forked, each corresponding to a single serration; sori (?) small, oblong, each at midway of a secondary nerve.

Description of specimens: Several specimens are examined. Pl. XVI, fig. 3a shows a part of a bipinnate frond upon which the above diagnosis was based except in regard to the sori which are shown in the specimen in Pl. XVI, fig. 2. Although the present species is characterised by the pinnules with undulate or serrate margin, they are sometimes almost entire especially in the upper or terminal parts of the frond. Fertile pinnae (fig. 2) are similar to the sterile; sori are unfortunately badly preserved, accordingly it is not certain whether they represent sori or a single sporangium.

Another specimen in Pl. XVI, fig. 4 is one from a different locality. It is a part of a bipinnate frond which in general habit agrees well with the preceding one: it shows that the ultimate pinnae are opposite, delicate, set closely, at a wide angle to the rachis, the pinnules are long and narrow, delicate, slightly falcate, subacutely pointed at apex, set closely or narrowly spaced and attached to the pinna-axis by the whole base. The midnerve is distinct persisting to the apex, but the secondary nerves are obscure possibly owing to the fertilization of the pinnules. The sori are similar to those of the preceding specimen, but the inner structure is unfortunately obscure.

Pl. XVI, fig. 1 shows a sterile specimen from Hiromura, Wakayama pref.; it is also a part of a bipinnate frond consisting of a thin rachis and pinnae which are subopposite, set closely or touching each other laterally, and at a wide angle to the rachis. The pinnules are similar to those of the preceding specimens, being long and narrow, tapering gradually towards acuminate apex, with undulate margin. The midnerve is well-defined, and the secondary nerves are simple or once forked in the same manner as those in the preceding specimens.

Remarks: The specimens here described and figured under a new specific name may, though they are derived from different localities and horizons, belong to a single species, the habit of the frond, especially the pinnules being similar in all these specimens.

This species may be comparable to *Polypodium oregonense* (FONT.) from the Jurassic of North America.[1] As is clear from the comparison of the Japanese specimens and the figures of *P. oregonense,* there is certainly a striking resemblance between the two forms in the general habit of the frond, in the slender axis, the shape of pinnules, the manner of serration of margin of pinnules, the nervation and in the position of sori. However, in our species the pinnules are generally smaller, the sori are also smaller and the ultimate pinnae are opposite or subopposite.

One of the specimens from the Wealden of Sussex described by SEWARD[2] under the name *Cladophlebis Browniana* (DKR.) recalls the present species.

Occurrence:

Motiana, Hukui. Tetori Series.
Hiromura, Wakayama. Ryôseki Series.
Masaki, Tokusima. Monobegawa Series.

Cladophlebis isikawaensis sp. nov.

Pl. XVII, Figs. 2, 2a (type-specimen).

Description: Frond large, tripinnate; rachis comparatively thin, being 3 mm. thick; penultimate pinnae about 13 cm. long, linear lanceolate, subopposite or alternate (at least not opposite), at a right angle to the rachis; ultimate pinnae subopposite or alternate, linear lanceolate, and at a wide angle to the axis; pinnules small, oblong, set closely, directed forward, obtusely pointed at apices, and attached by their whole bases; basal abaxial pinnules slightly larger in size and more obtusely pointed at apices; nervation indistinct, midnerve faint, persisting to the apex. Fructification unknown.

Remarks: Only a single specimen in Pl. XVII, fig. 2 has been examined. It is pretty well-preserved and deserves description as

1) W. FONTAINE, in WARD (1905), p. 63, Pl. VIII, figs. 12–15; Pl. IX; Pl. X, figs. 1–7.
2) A. C. SEWARD (1913), p. 95, Pl. XIII, fig. 1.

a new species. One of the characteristic features of this species is the thinness of the rachis in comparison with the size of the frond. It is probable that the present specimen represents a portion of a large fern more than tripinnate, but there is no evidence of it. It is certain that the penultimate pinnae are at least not opposite, but we can not say so far as the present specimen is concerned, whether they are alternate or subopposite without at least one more penultimate pinna on either upper or lower part of the rachis. Another characteristic feature is the small, oblong pinnules with obtusely pointed apices directed forwards, the basal abaxial ones being slightly larger in size.

Comparison: *C. isikawaensis* is closely related to the fern which was first described WARD under the name *Scleropteris vernonensis* and later described by BERRY[1] under the name *Dicksoniopsis vernonensis*. But in the American species the pinnules are larger and have the characteristic wavy or lobed margin. It resembles also *Cladophlebis exiliformis* described in this work, but is distinguished in having oblong pinnules with obtusely pointed apices directed forwards instead of being finger-shaped and attached nearly at a right angle to the pinna-axis as in the latter. When young or fragmental specimens are disposed it is very difficult to distinguish this species from *C. exiliformis* but in well-developed specimens the distinction is not always difficult.

Occurrence:

Kuwasima, Isikawa. Tetori Series.

Cladophlebis (Klukia ?) koraiensis YABE

Pl. XVII, Figs. 3, 3a; Pl. XIX, Fig. 3.

1905. *Cladophlebis koraiensis* YABE: p. 32, Pl. II, fig. 1; Pl. III, figs. 12, 13.
1929. *Cladophlebis koraiensis* TATEIWA: Plate, fig. 1.

YABE defined this species as follows: "Frond tripinnate in the anterior portion and quadripinnate in the posterior; main stalk longitudinally striated, rather broad and strong. Pinnae usually linear, subopposite, leaving the rachis at an angle of about 45° or more; or, as is sometimes the case, standing perpendicular to the

1) E. W. BERRY (1911), p. 237, Pl. XXVIII, figs. 3–4.

rachis; close together so as to overlap in the posterior portion of the frond. Pinnules vary considerably in size and form; those in the posterior part being generally very narrow, linear, often finger-shaped and falcate; decurrent at base, giving the rachis a slightly winged aspect; they are usually close together but sometimes quite remote from one another; serrate along the margin, the teeth gradually changing into numerous small trigonal segments. Anterior pinnules close together, varying in form from a short and more or less trigonal one to lanceolate, with the front margin usually straight and the back more or less strongly convex and with a bluntly pointed apex; attached by the whole of the broad base to the rachis. Median vein well preserved scarcely reaching to the summit of the pinnule; lateral veins very obscure, somewhat distant, oblique and with single bifurcation. Sori large in proportion to the pinnules, nearly round, very prominent, appearing as pustular elevations on the upper surface; crowded, arranged in a single row on each side of the median vein; fertile pinnules somewhat rolled up along the margin, with lateral veins quite obscure."

Description of specimens: Pl. XVII, fig. 3 shows a photograph of the original specimen in YABE's Pl. III, fig. 12. It is a part of a fertile frond with marked round soral impressions 3–4 in number, 0.5 mm. in diameter and arranged in a single row on each side of the midnerve (fig. 3a). The specimen is not preserved so satifactorily as to show the soral characters distinctly. However, a close examination of the specimen seems to show that each of the round small impressions represents a single sporangium, and not a sorus composed of several sporangia. Under the microscope in low magnitude one can often see the central depression on each round dot surrounded by something like an apical annulus the number of cells of which, however, it is not possible to make out exactly. All these features suggest that the specimen belongs to Schizaeaceae closely allied to *Klukia*. Pl. XIX, fig. 3 is a reproduction of TATEIWA's fig. 1. It shows a portion of a large tripinnate frond; the trigonal pinnules directed forwards and provided with subacute apices agree with the original specimens described by YABE.

Discussion: YABE already pointed out the resemblance of *C. koraiensis* to the well known species *Klukia exilis* (PHILLIPS). There is certainly a close resemblance between *K. exilis* and the present specimen in respect to the shape of pinnules and the size and distribution of sporangia. Accordingly, there is a possibility of the specific identity of these two species as SEWARD suggested, but further well preserved material must be found and described before the Korean species can be considered a synonym of *K. exilis*.

C. koraiensis so far as the sterile specimens are concerned seems to be hardly distinguishable from the sterile specimens of *Cladophlebis exiliformis* (GEYL.) described in this work, however, in the latter the pinnules are rather finger shaped instead of being rather triangular as in the former, therefore it is not always difficult to distinguish them among typical specimens. As *C. exiliformis* is very likely to be Osmundaceous, there is a fundamental difference between them.

TATEIWA[1] retained the name *C. koraiensis* on the basis of the original meaning as expressed by Professor YABE.

Occurrence:

Butudôken (Tôkyô Coll.) }
Ryûsindô (G. S. K. Coll.) } Rakutô Bed.

Cladophlebis kuwasimaensis sp. nov.

Pl. XVII, Fig. 1 (type-specimen).

Diagnosis: Frond bipinnate, slender, more than 10 cm. long, broadly ovate ?, contracting more or less rapidly to apex; rachis thin, 1 mm. thick, with a longitudinal median rib; pinnae slender, linear, 5 mm. broad, tapering gradually towards an acuminate apex, set closely, alternate in the proximal portion, opposite in the distal portion, and at an angle of about 45° to the rachis; pinnules rhomboidal, with a subacute apex, upper basal edge bending downwards forming a sinus, lower basal one decurrent downwards, set closely, and oblique to the pinna-axis, towards the distal end of the frond the pinnules become smaller in size and fuse laterally passing finally into teeth; nervation distinct, midnerve first acute to the pinna-axis, then bending outward persisting to the tip of pinnules and sending off simple secondary nerves, generally on each side, at an acute angle, basal abaxial one occasionally forking once. Fructification unknown.

1) I. TATEIWA (1925), p. 457.

Comparison: A single figured specimen has been examined. *C. kuwasimaensis* resembles *Dicksoniopsis vernonensis* (WARD)[1] and *Onychiopsis nervosa* (FONTAINE)[2] from the Potomac Formation of North America. In the former, however, the pinnules are lobed instead of being entire as in the present species; in the latter the ultimate pinnae become short gradually towards the distal end of the frond, are less crowded and the nervation of the pinnules is more sphenopteroid than in ours. One of the specimens described by KNOWLTON[3] from the Jurassic of Cape Lisburne, Alaska, as ? *Cladophlebis alata* FONTAINE appears to be almost identical with the present species.

Occurrence:

Kuwasima, Isikawa. Tetori Series.

Cladophlebis (Eboracia?) lobifolia (PHILLIPS) BRONGNIART

Pl. XVIII, Figs. 1–4.

1892. *Asplenium lobifolia* BARTHOLIN: p. 19, Pl. VIII, figs. 1–2.
1900b. *Cladophlebis lobifolia* SEWARD: p. 145, Pl. XV, fig. 6; Text-figs. 20–23.
1905. *Cladophlebis heterophylla* FONTAINE: p. 294, Pl. LXXI, figs. 21–25.
1922. *Cladophlebis (Eboracia) lobifolia* YABE: p. 8, Pl. I, figs. 1–2; Text-figs. 5–6.
1924. *Cladophlebis lobifolia* WALKOM: p. 81, Pl. XV, fig. 2; Text-fig. 2.
1925. *Cladophlebis (Eboracia) lobifolia* KAWASAKI: p. 8, Pl. VI, fig. 24.
1933. *Cladophlebis (Eboracia?) lobifolia* YABE and ÔISHI: p. 14, Pl. I, figs. 9, 9a.
1938. *Cladophlebis lobifolia* ÔISHI and TAKAHASI: p. 60, Pl. I, figs. 5, 5a.
SEWARD, 1900b, gives references before 1900; see also YABE, 1922.

Description of specimens: Pl. XVIII, fig. 3 shows a portion of a bipinnate frond derived from Kuwasima. It is characterised by its spreading, crowded, slender, linear pinnae bearing semiorbicular to ovate pinnules with rounded or obtusely rounded apices. The pinnules are sometimes deltoid, occasionally with anterior or posterior basal lobe and attached to the pinna-axis by their whole bases. The nervation is *C. lobifolia*-type, both the midnerve and the secondary nerves being in the same strength and the latter

1) E. W. BERRY (1911), p. 237, Pl. XXVIII, figs. 3–4; see also synonyms.
2) E. W. BERRY, Ibid., p. 279, Pl. XXXVI, figs. 1–6; see also synonyms.
3) F. H. KNOWLTON (1914), p. 49, Pl. V, figs. 3–4; Pl. VI, fig. 4.

forking and spreading. Sometimes the first secondary nerve on the proximal side is given off very low down from the decurrent part of the midnerve, therefore it appears as if it is given off direct from the pinna-axis.

In Pl. XVIII, fig. 2 is shown a specimen also from Kuwasima; Pl. XVIII, fig. 1 is from Iwaidani, while another one in Pl. XVIII, fig. 4 is derived from Zusahara. All these specimens figured at this place agree well with each other in the habit of the frond, characteristic shape of pinnules and nervation.

Remarks: This species is characterised by the shape of pinnules, especially by the lower basal pinnule which is larger in size and remarkably lobed and deltoid. In the present specimens the characteristic larger deltoid pinnule at the lower base in each pinna is less prominent than in the type-specimen of this species and some other specimens figured under this specific name. But the other features available are hardly distinguishable from *C. lobifolia* described from various parts of the world.

C. lobifolia is generally known from the Middle Jurassic, but it is certainly represented also in the Ryôseki Series and in the Lower Cretaceous strata of North America under the name *C. heterophylla* FONT. ZEILLER (1913) and COUNILLON[1] described this species from the Older Mesozoic rocks of Tonkin and Annan.

Occurrence:

Kuwasima, Isikawa. Iwaidani, Gihu.	Tetori Series.
Zusahara, Hukusima.	Ryôseki Series.

Cladophlebis matonioides sp. nov.

Pl. XIX, Figs. 4, 4a; Pl. XX, Fig. 4.
(Type-specimen: Pl. XIX, Fig. 4).

General description: Frond of unknown size and form, at least bipinnate; frond or penultimate pinna more than 12 cm. long; its axis 1.5 mm. thick on the proximal broken end; ultimate pinnae slender, 4.5 cm. long, 1 cm. broad, set closely, linear, narrowing very gradually towards the blunt apices, and at an angle of about 70° or a right angle to the axis; pinnules long and narrow,

1) H. COUNILLON (1914), p. 1, Pl. I, fig. 1.

generally 6 mm. long and 1 mm. broad, nearly straight, expanded at the bases and bluntly pointed at the apices and nearly at a right angle to the pinna-axis; midnerve sharply defined, persisting to the apices of pinnules; secondary nerves indistinct; fructification unknown.

Description of specimens: Pl. XIX, fig. 4 shows a specimen from Aritahama. Though it is somewhat imperfect, the habit of the pinnae and the size and form of the pinnules characterize well this species. As the specimen represents only one side of the axis of the frond or the penultimate pinnae it is not clear whether the ultimate pinnae are alternate, opposite or subopposite to the axis. The midnerve of the pinnules is always well-defined, while the secondary nerves are quite indistinct. The specimen in Pl. XX, fig. 4 is derived from Kosyurihama, Ôsima, and represents pinnae of quite the same habit as the preceding specimen. Unfortunately, the material from this locality is comprised entirely of fragments of ultimate pinnae, however the long and narrow pinnules which are expanded at the base and the bluntly pointed apex of the pinnules which makes nearly a right angle to the pinna-axis suggest that these specimens represent the same type, or in most probability the same species, as the preceding specimen from Aritahama. The pinnules do not show secondary nerves, the midnerve only is sharply defined.

Remarks and discussion: In respect to the size, form and mode of attachment of the pinnules, the present species may be indistinguishable from *Matonidium Goepperti* (ETT.),[1] a well-known Matoniaceous fern of the Upper Jurassic and Lower Cretaceous. However, there is a fundamental distinction in the habit of the frond, the pinnae of *Matonidium Goepperti* being disposed flabellately.

Occurrence:

Aritahama, Miyagi. Ogihama, Series.
Kosyurihama in Ôsima, Miyagi. Ôsima Plant Beds.

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1) C. v. ETTINGSHAUSEN (1852a), p. 16, Pl. V, figs. 1–7. A. SCHENK (1871), p. 220, Pl. XXVII, figs. 5, 5a; Pl. XXVIII, figs. 1, 1a–c, 2, 2a–c; Pl. XXX, fig. 3. A. C. SEWARD (1894), p. 63, figs. 7–8.

Cladophlebis nampoensis KAWASAKI

1925. *Cladophlebis nampoensis* KAWASAKI: p. 20, Pl. IV, figs. 14–15.
1926. *Cladophlebis nampoensis* KAWASAKI: p. 3, Pl. II, fig. 7.

The specimens described by KAWASAKI under this specific name are portions of sterile fronds characterised by the pinnules the margins of which are undulating and the secondary nerves are twice dichotomously forking except the basal pair which are thrice forked. This species is certainly a type of *C. haiburnensis* or *C. Williamsoni* but may be distinguished by the pinnules with wavy margin and the secondary nerves in which only the basal pair fork thrice. In typical specimens only the distinction is possible.

Occurrence:

Hakuunzi, Wonhyon, Bansyô } Tyôsen. Daidô Series. (G.S.K. Coll.).

Cladophlebis nariwaensis ÔISHI and HUZIOKA

1938. *Cladophlebis nariwaensis* ÔISHI and HUZIOKA: p. 73, Pl. II, figs. 1, 1a.

Description (ÔISHI and HUZIOKA, 1938): "Frond at least bipinnate; ultimate pinnae slender, more than 6 cm. long and 3–4 cm. broad. Axis narrow and slender, delicate, and 1 mm. across. Pinnules with laminae of thin texture, opposite or subopposite, attached to the rachis by the whole base at a wide angle, 2 cm. long and 0.7 cm. broad, straight or slightly curved upwards, broadly lanceolate in outline, set closely, broadest at the base, and provided with rounded apex. Margin markedly lobed, each lobe with rounded apex. Midnerve distinct, wavy. Secondary nerves generally six in number on each side of the midnerve, first at an acute angle to the midnerve and then arching broadly, twice or thrice dichotomously forking, thus forming a bundle of secondary nerves, each bundle corresponding to a marginal lobe. Fructification not known."

Remarks: This species may be comparable to *C. sublobata* JOHANSSON,[1] but in this the pinnules are not set so closely as in

1) N. JOHANSSON (1922), p. 21, Pl. II, figs. 7–8; Pl. III, fig. 4; Pl. VII, figs. 8–10.

ours but are placed more distantly. It is also comparable to *C. gigantea* ÔISHI and *C. Sewardi* JOHANSSON,[1] but in the former the midnerve is not wavy and the secondary nerves are thrice forking and more spreading, in the latter the marginal lobes are not rounded, nervation less crowded and the midnerve is not wavy.

Occurrence:

Nariwa (44, ?95), Okayama. Nariwa Series.

Cladophlebis nebbensis (BRONGNIART)

1891. *Asplenium Roesserti* YOKOYAMA (pars): p. 241, Pl. XXXII, figs. 1, 2, 5; Pl. XXXIV, fig. 2 (non Pl. XXXII, figs. 3–4).
1905. *Cladophlebis* sp. YOKOYAMA, p. 11, Pl. III, figs. 2, 4, 7.
1905. *Cladophlebis nebbensis* YOKOYAMA: p. 3, Pl. I, figs. 1–3.
1920. *Cladophlebis nebbensis* YABE: Pl. III, fig. 1.
1922. *Cladophlebis nebbensis* YABE: p. 14.
1925. *Cladophlebis nebbensis* KAWASAKI: p. 17, Pl. VIII, figs. 30–33.
1931f. *Cladophlebis nebbensis* ÔISHI: p. 231, Pl. I, figs. 4, 4a.
1932. *Cladophlebis nebbensis* ÔISHI: p. 5, Pl. I, fig. 4; Pl. II, fig. 3.
1932a. *Cladophlebis nebbensis* ÔISHI: p. 57.
1932b. *Cladophlebis nebbensis* ÔISHI: p. 285, Pl. VI, figs. 4–5; Pl. IX; Pl. XI, fig. 1; Pl. XII, fig. 1; Pl. XXI, fig. 5C.

For further references, see ÔISHI, 1931f.

Remarks: The pinnae of this species are usually opposite or subopposite, the pinnules are oblong or tapering towards obtusely rounded apices and the secondary nerves are always once forking. *C. nebbensis* is a type closely related to *C. denticulata,* but the pinnules are not so strongly falcate as in the latter. The pinnule margins are usually entire all round, but sometimes serrated at the distal margin.

Unfortunately our knowledge of the original specimen of *Pecopteris nebbensis* BRONGNIART is unsatisfactory, but if the identification by NATHORST,[2] ZEILLER,[3] MOELLER[4] can be relied on, the specimens from Japan and Tyôsen determined as *C. nebbensis* agree well with typical European and Tonkin specimens.

This species is confined to the Older Mesozoic strata and in Japan it has never been found from the Tetori or younger Series.

1) N. JOHANSSON (1922), p. 22, Pl. I, figs. 39–42; Text-fig. 4.
2) A. G. NATHORST (1876), p. 16, Pl. II, figs. 1–6; Pl. III, figs. 1–3.
3) R. ZEILLER (1903), p. 45, Pl. IV, figs. 2–3.
4) H. MOELLER (1902), p. 29, Pl. II, fig. 22; Pl. III, fig. 1.

TURUTANOVA-KETOVA (1930) and KHAKHLOF (1931) described this species from the Kara-Tau Chain and the Kuznetsk Basin respectively.

Occurrence:

Nariwa (1, 33, 44, 55, 62, 69, 94), Okayama. Nariwa Series.
Kusaigawa, Momonoki } Yamaguti. Momonoki Bed.
Yamanoi (1, 3, 13), Yamaguti. Upper Triassic.
Kuruma, Nagano. Kuruma Bed.
Sitaka, Kyôto. Sitaka Bed.
Kôsei Coal-mine, Changpa, Nampo-Hongsan } Tyôsen (G. S. K. Coll.). Daidô Series.

Cladophlebis osimaensis sp. nov.

Pl. XX, Figs. 1–3.
(Type-specimen: Fig. 2).

Diagnosis: Frond concressent (?), bipinnate, obovate or oblanceolate in outline, about 10 cm. long and 4 cm. broad, narrowing towards the base and more abruptly towards the blunt apex; rachis thin and delicate, less than 1 mm. thick; pinnae, opposite or alternate, narrowly linear, set closely, crowded, tapering gradually towards the apex, and at an angle of 45°–50° to the rachis; pinnules small, set closely, deltoid, bluntly pointed at the apex, and attached at a wide angle to the pinna-axis by their whole bases; nervation obscure.

Description of specimens: Pl. XX, fig. 2 (Sendai, Reg. No. 22165) shows two fronds which apparently represent a palmate disposition from a supposed common origin. As is clearly seen in this specimen, the habit of the frond is very slender, the rachis being very thin and delicate, and it narrows rather abruptly to a rounded apex. The size and form of the pinnules which characterise this species are also clearly seen in this specimen; the pinnules are usually deltoid in shape, but occasionally slightly contracted at the base as is seen in those of *Cladophlebis lobifolia* (PHILIPS). The nervation is obscure, though there is an indication something like the nervation of *Cladophlebis* type.

Another specimen in Pl. XX, fig. 1 (Sendai, Reg. No. 22165) represents three fronds which are also disposed radially from a supposed common origin. Other features are quite identical with the preceding specimen. The two specimens above described are derived from Ôsima.

In Pl. XX, fig. 3 is shown a specimen obtained from Aritahama. It is a portion of a frond very slender in habit consisting of a thin axis to which are attached narrowly linear pinnae alternately at an angle of about 45° to the axis. The pinnules are small, deltoid, subacute at their apices, set closely, and attached to the pinna-axis by their whole bases. The nervation is obscure also in this specimen.

Remarks: Though the proximal parts of the fronds are not represented in any of the specimens described above, the repeated occurrence of such specimens in the same growing habit suggests that this fern might have grown in concressence. The specimen from Aritahama represented in fig. 3 does not show this characteristic growing habit being represented by only a portion of a single frond, but the other features available show that it is identical with the specimens from Ôsima.

Comparison: A portion of the frond of this species may be almost indistinguishable from penultimate pinnae of *Pecopteris Dunkeri* (SCHIMPER) as illustrated by SCHENK[1] from the Wealden of Germany, the two being characterised by the small, deltoid pinnules with obscure nervation. However, there is a distinction in the habit of the frond; the portion in SCHENK's specimen which corresponds to the frond of the present species represents a penultimate pinnae of a tripinnate frond. In connection with this a comparison must be made with a British specimen which SEWARD[2] once called under the name *Nathorstia valdensis*. The specimens show a bipinnate (?) frond of slender habit with small pinnules which are deltoid in shape and attached to the pinna-axis by the whole of the base. The same author[3] later substituted a new generic name *Leckenbya* for *Nathorstia* because the latter generic name had already been used by HEER[4] for a distinct Cretaceous fern. In the

1) A. SCHENK (1871), p. 12, Pl. XXVI, fig. 1; Pl. XXXI, fig. 1.
2) A. C. SEWARD (1894), p. 145, Pl. VII, fig. 5; Pl. IX, figs. 2, 2a.
3) A. C. SEWARD (1895), p. 225.
4) O. HEER (1880), p. 5.

Jurassic flora of Sutherland, SEWARD[1] included *Leckenbya valdensis* in the synonymy of *Alethopteris cycadina* SCHENK[2] from the Wealden strata of Germany and described it under the name *Gleichenites cycadina* (SCHENK). Then, in his later paper on the Wealden plants of Bernissart, he[3] considered it synonymous to *Pecopteris Dunkeri* (SCHIMP.).

The above action of SEWARD shows how difficult is the nomenclature of the sterile fern fronds of this type. At the same time it must be suggested that in the case of a portion of a frond it is hardly possible to distinguish specifically between *Pecopteris Dunkeri* and the present species. Therefore, it is somewhat questionable whether the British specimens which SEWARD described under the name *Nathorstia valdensis* (*Cladophlebis Dunkeri*) are actually specifically identical with SCHENK's *Pecopteris Dunkeri* with tripinnate frond. This is especially so as the British specimens of *Nathorstia valdensis* (SEWARD, loc. cit., 1895, Pl. VII, fig. 5; Pl. IX, fig. 2) are almost identical with the Japanese specimens.

There are two other species comparable with this one. The frond figured by SAPORTA[4] from the Kimmeridgian of Orbagnoux (Ain) as *Scleropteris Zeilleri* SAP. agrees very closely with the Japanese specimens, except that the rachis appears to be very strong compared with the corresponding axis in ours; and an equally close resemblance is presented by *Dichopteris delicatula* described by SEWARD[5] from the British Wealden strata. Especially the latter species appears to be very close to the present one.

Occurrence:

Yoroizaki in Ôsima, Miyagi. Ôsima Plant Beds.
Aritahama, Miyagi. Ogihama Series.

Cladophlebis parvula sp. nov.

Pl. XIX, Figs. 2, 2a (type-specimen).

Description of specimen: Pl. XIX, fig. 2 shows an imperfect specimen of a fern frond which seems to be not identical with any

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1) A. C. SEWARD (1911a), p. 664, Pl. III, figs. 48–54A; Pl. V, figs. 87–89, 92–96; Text-fig. 5.
2) A. SCHENK (1871) p. 218, Pl. XXXI, fig. 2.
3) A. C. SEWARD (1900a), p. 24, Pl. III, figs. 35–40, 43–46, 51–52.
4) G. de SAPORTA (1891), p. 430, Pl. CCLXXXVIII.
5) A. C. SEWARD (1913), p. 98, Pl. XI, figs. 6, 6a.

species ever described. The frond is at least bipinnate, small, elegant, and is traversed by a thin rachis less than 1 mm. thick. The pinnae are linear, nearly parallel-sided, 1.5 cm. long and 4 mm. broad, tapering gradually towards an acute apex, subopposite, set closely but not touching each other laterally, at a wide angle to the rachis and pinnately lobed. The lobes or pinnules are contiguous, obtusely pointed, directed forwards, with entire margin. Upper basal pinnules are a little larger than the rest of the pinnules and semi-orbicular in shape. Nervation is of *Sphenopteris* type rather than *Cladophlebis* type: a nerve given off from the pinna-axis at an acute angle forks near its origin, the anterior one forking once more, while the posterior branch of the second occasionally forks again. Nerves in the upper basal pinnules shows monopodial branching each branch being simple.

Comparison: *C. parvula* resembles a specimen figured by FONTAINE[1] from the Potomac Formation under the name *Dryopteris heterophylla* which BERRY[2] later considered to be specifically identical with C. *parva* FONTAINE. FONTAINE did not mention in the description the peculiar development of upper basal pinnules, though the photograph of the specimen appears to indicate faintly the presence of such developed pinnules. A specimen from Oregon[3] referred to *Dicksonia acutiloba* HEER from Amurland[4] seems to be almost identical with the present species in respect to the general habit of the frond, but in this Oregon specimen the nervation is more crowded. It may be suggested that the Oregon specimen is far smaller in size than HEER's specimens, and resembles more closely the present specimen than it does the Amurland one.

Occurrence:

Nisinotani, Kôti. Ryôseki Series.

Cladophlebis pseudodelicatula ÔISHI

(Type-specimen: ÔISHI, 1932b, Pl. XI, fig. 2).

1931f. *Cladophlebis* sp. b. ÔISHI: p. 238, Text-fig. 2.
1932b. *Cladophlebis pseudodelicatula* ÔISHI: p. 288, Pl. XI, fig. 2.

1) W. FONTAINE, in WARD (1905), p. 550, Pl. CXV, fig. 8.
2) E. W. BERRY (1911), p. 250.
3) W. FONTAINE, in WARD (1905), p. 72, Pl. XI, figs. 11, 12.
4) O. HEER (1876), p. 92, Pl. XVIII, fig. 4.

Description (ÔISHI, 1932b): "Frond probably bipinnate. Ultimate pinnae very slender, more than 5 cm. in length, linear-lanceolate in outline, touching each other laterally, tapering very gradually from the base upwards to an acuminate apex, and traversed by a thin and slender pinna-rachis. Pinnules linear to elongate-lanceolate in outline, closely set, and attached to the pinna-rachis perpendicularly by their whole base. Apex of pinnules subacutely pointed. Margin entire. Midnerve distinct and straight. Secondary nerves giving off from the midnerve at an angle of approximately 45°, forking once, branches forming a narrow angle."

Remarks: Unfortunately this species is represented by an imperfect single specimen from Nariwa. A fragment described by the writer (1931f) from Kita-Otari as *C.* sp. may be this species. The material seems to be too imperfect for describing as a new species but it has been done because there is no species ever described identical with the present form. It may be comparable to *C. argutula* (HR.), which has already been taken into consideration in the paper published in 1932 (ÔISHI, 1932b).

Occurrence:

Nariwa (44), Okayama. Nariwa Series.
Kuruma, Nagano. Kuruma Bed.

Cladophlebis Raciborskii ZEILLER

1903. *Cladophlebis Raciborskii* ZEILLER: p. 49, Pl. V, fig. 1.
1925. *Cladophlebis Raciborskii* KAWASAKI: p. 15, Pl. VII, figs. 25–29; Pl. XXXIV, fig. 94.
1932b. *Cladophlebis Raciborskii* ÔISHI (pars): p. 286, Pl. X, fig. 1 (other specimens=*C. Raciborskii* forma *integra* Ô. and T.)

Remarks: This species is characterised by long and narrow pinnules with serrate margin and acuminate apices and once or twice forking secondary nerves. A specimen which accords with the original diagnosis of *C. Raciborskii* certainly exists from the plant bed of Nariwa and has been figured in ÔISHI, 1932b, Pl. X, fig. 1. On the other hand, the Japanese specimen referable to this species is associated with specimens in which the pinnules have entire margin, yet the two never occur, it seems certain, on the same frond. Thus here arises a question whether such specimens with entire margin should be included in the category of *C. Raciborskii.* ZEILLER does not describe the marginal serration as occurring unexceptionally in all the pinnules of his species. Provisionally, therefore, such specimens with entire margin have been called under the name *C. Raciborskii* forma *integra* Ô. and T. (vid. infra.).

Occurrence:

Nariwa (44), Okayama. Nariwa Series.

Heizyô, Daiseizan, Kenziho, Tongzin } Tyôsen. Daidô Series. (G.S.K. Coll.).

Cladophlebis Raciborskii ZEILLER forma *integra* ÔISHI and TAKAHASI

Pl. XIX, Figs. 1, 1a.

1906. *Todites Williamsoni* YOKOYAMA (pars): p. 18, Pl. III; p. 20, Pl. V, fig. 1a.
?1911. *Cladophlebis kamenkensis* THOMAS: p. 66, Pl. III, figs. 1–3.
1920. *Cladophlebis Raciborskii* YABE: Pl. V, fig. 3.
1931f. *Cladophlebis* cfr. *Raciborskii* ÔISHI: p. 234, Pl. XVI, figs. 6, 6a; Pl. XVII, fig. 1.
1932. *Cladophlebis* cfr. *Raciborskii* ÔISHI: p. 7, Pl. II, fig. 1.
?1932. *Cladophlebis maizurensis* ÔISHI: p. 7, Pl. II, figs. 4–5.
?1932. *Cladophlebis tenuissima* ÔISHI: Pl. III, figs. 1–2.
1932b. *Cladophlebis* cfr. *Raciborskii* ÔISHI: p. 287, Pl. VIII, fig. 3; Pl. X, figs. 3, 4.
1933a. *Cladophlebis* sp. SZE: p. 13, Pl. VI, fig. 8.
1936. *Cladophlebis Raciborskii* forma *integra* ÔISHI and TAKAHASI: p. 119.
1938. *Cladophlebis Raciborskii* forma *integra* ÔISHI and HUZIOKA: p. 73.

ÔISHI and TAKAHASI wrote in their supplementary note on the Rhaetic plants from Prov. Nagato (ÔISHI and TAKAHASI, 1936) in the following manner: "The fern-fronds in question, as mentioned in ÔISHI's previous papers on the fossil plants from Kita-Otari, Nariwa, etc., are characterised by bearing pinnules which are long and narrow in shape, slightly falcate, possessing twice forking secondary nerves which are generally arching, differing from the original specimens of ZEILLER only in the entire margin of the pinnules. As mentioned by KAWASAKI (1925), it is indeed possible that the pinnules appear to be entire all round when the margin is rolled down, and the similar view was also expressed by SEWARD in regard to the pinnules of *C. denticulata*. However, so far as the Japanese specimens are concerned, there exist two types of fronds of *C. Raciborskii* type in respect to the margin of pinnules, one those with entire margin and the other the toothed one. These types seldom occur on the same frond. All these facts render it appropriate to hold them as distinct forms, at least as one being in the rank of a variety or forma of the other. Under these reasons the present authors prefer to apply the original specific name to those specimens as figured by ZEILLER which are characterised by having toothed margin, and forma *integra* to those elsewhere described by the senior author as *C.* cfr. *Raciborskii* ZEILLER."

Recently the writer acquired a specimen derived from Momonoki, Yamaguti pref., which was, though imperfect, well preserved and seemed to be included in the category of forma *integra* described by ÔISHI and TAKAHASI. The specimen is shown in Pl. XIX, fig. 1; it is a portion of an ultimate pinna of a sterile frond and is traversed by an axis 1.5 mm. thick measured on the impression. The pinnules are linear, with the margins in the greater part almost parallel and the apex subacutely pointed; they are set rather closely, about 5 mm. broad at the base and 1.5–3 cm. long and attached to the axis at a wide angle by their whole base. The midnerve is well-defined, persisting almost to the tip and sends off numerous secondary nerves at a wide angle which divide once or occasionally twice into parallel branches. When the forking is only once, it occurs at a short distance from the origin, and when twice, it does near the margin. The margin is perfectly entire.

The figured specimen agrees in several points with the specimens figured previously by the writer under the name *C.* cfr. *Raciborskii* from Nariwa, Sitaka and Kita-Otari. The long and narrow pinnules with subacutely pointed apex characterise well this form. However, there seems to be a slight difference in respect to their nervation. In the ordinary type of forma *integra*, the secondary nerves are somewhat arching and mostly twice forking, while in the present specimen they are once forking and only occasionally twice. It is of course not the writer's purpose to insist strictly on such a difference in the specific delimitation among these specimens. However it also deserves attention as the figured specimen on the other hand closely resembles specimens known under the name *C. australis* (MORRIS) from several horizons throughout the Mesozoic in the southern Hemisphere; especially certain Neocomian specimens from New Zealand referred by ARBER[1] to this species seem to be almost indistinguishable from the present specimen.

The reasons why the writer has dared to identify the present specimen with forma *integra* notwithstanding the similarity with New Zealand specimens is that (1) the specimen itself is somewhat too imperfect to allow specific identification with the specimens from so far distant a continent, (2) there is need of a special interpretation as to the intermixture of one of the southern elements in the northern flora and that (3) the present specimen certainly is closely related to forma *integra* which is common in the Nariwa flora and its near equivalents. At any rate *C. australis* seems to be not a valid species of taxonomic value as it was named on sterile specimens and displays a considerable variation in regard to the shape of pinnules and nervation. This is also the case in *C. Raciborskii* forma *integra*. Therefore the identification of the present specimen with forma *integra* and of similar specimens from the southern Hemisphere with *C. australis* is of course artificial.

The writer (1932) once described *C. maizurensis* Ô. and *C. tenuissima* Ô. from Sitaka. However, the specimens were unfortunately portions of sterile fronds which were too imperfectly represented to be deserving of description as new species. The writer now thinks it better rather to include the Sitaka specimens in forma *integra*, though it is provisionally.

C. Raciborskii forma *integra* resembles *C. denticulata* (BRONGN.), but in the latter species the pinnules are generally shorter and the secondary nerves are almost unexceptionally only once forking.

Occurrence:

Nariwa (44, 47, 48, 49), Okayama. Nariwa Series.
Yamanoi (16), Yamaguti. Upper Triassic.
Momonoki, Yamaguti. Momonoki Bed.
Kuruma, Nagano. Kuruma Bed.
Sitaka, Kyôto. Sitaka Bed.

Cladophlebis shinshuensis TATEIWA

Pl. XX, Figs. 5, 6; Pl. XXI, Figs. 5, 5a, 5b, 6, 7 (all the type-specimen).

1929. *Cladophlebis shinshuensis* TATEIWA: Plate, fig. 24.

1) E. A. N. ARBER (1917), p. 29, Pl. IV, figs. 1, 5, ? 7 and 8; Pl. XIV.

Diagnosis: Frond bipinnate; rachis moderately thick with a median ridge; pinnae opposite or subopposite, long and narrow, slender, flexuous, tapering gradually towards narrow distal ends and making an angle of about 45° with the rachis; pinnules thin in texture, set closely, at 45°–50° to the pinna-axis and attached by the lower half of the base, the upper basal edge making a deep sinus; distal pinnules narrow, attenuating towards acute apices, with entire or broadly undulating margin; proximal pinnules linear, longer and broader, regularly lobed at the margin, each lobe with obtusely rounded apex and directed forwards; nervation distinct; midnerve first acute to the pinna-axis then bending and persisting to the tip assuming nearly a straight course; secondary nerves rather acute to the midnerve, once forking midway, anterior branch often forking once more; anadromous nerves forking usually more than once; fructification unknown.

Description of specimens: Pl. XXI, fig. 6 shows portion of bipinnate frond more than 10 cm. long consisting of rachis 3 mm. thick in its lower broken end bearing spreading pinnae which are 2.5 cm. distant and visible only in the left hand side of the rachis. Pl. XXI, fig. 5 shows a reproduction of a figure exhibited by TATEIWA; it represents a long and narrow pinna attenuating towards the apex. Shape of the pinnules is clearly seen in this specimen. Another specimen in Pl. XX, fig. 6 occurred in association with the preceding ones; it shows a proximal pinna which is traversed by a rather thick pinna-axis and bears linear pinnae pinnately and regularly lobed at their margin. Each lobe receives a single secondary nerve which sends off finer simple lateral nerves as shown in Pl. XXI, fig. 7. This last mentioned specimen appears to be quite different in habit from the other two specimens described above, but they are connected with each other by intermediate forms and it is unquestionable that they all belong to one species. The specimen in Pl. XX, fig. 5 may, although it is imperfect, give an idea on this point; it represents a portion of frond, the pinnules have a shallowly lobed margin, and the other features are all intermediate between the two extreme types described above.

Remarks: This species was already recognised as a new species by TATEIWA who named it *C. shinshuensis*. He figured it in his Geological Atlas of Tyôsen, No. 10. Slender habit of frond, especially spreading and flexuous pinnae with narrow acuminate pinnules bearing broadly undulating and lobed margin distinctively characterise the present species. TATEIWA's enlarged figure of a pinnule (his fig. 24b) shows as if it were attached by the whole base to the pinna-axis, but the writer's examination of the specimen figured by TATEIWA (his fig. 24a) and many others showed that the pinnules are attached by the lower half of the base only, thus forming a sinus in the upper half. In pinnules of the distal portion of the frond or pinnae they are usually attached by their whole bases.

Comparison: This species resembles closely *Polypodium oregonense* FONTAINE[1] from the Jurassic of Oregon, and the two appear to be almost specifically identical. But the writer deems it wise to regard them distinct as the pinnules in ours are more acuminated.

Occurrence:

Tyôzairi, Tyôsen. Sinsyû Bed.

Cladophlebis (*Osmundopsis*?) *subplectrophora* ÔISHI and HUZIOKA

1938. *Cladophlebis* (*Osmundopsis* ?) *subplectrophora* ÔISHI and HUZIOKA: p. 76, Pl. II, fig. 2; Text-fig. 2.

Diagnosis (ÔISHI and HUZIOKA, 1938): "Frond large, at least bipinnate; its size and form unknown. Penultimate pinnae more than 8 cm. broad, traversed by a rachis 4 mm. across, with longitudinal striations. Ultimate pinnae making an angle of about 45° with the axis, linear, 12.5 cm. long and 4 cm. broad in the proximal portion narrowing gradually towards the apex. Pinna-axis 1.5 mm. broad with a faint longitudinal ridge along its median line. Pinnules thin in texture, falcate, set closely, with bluntly pointed apex, and attached to the pinna-axis at an angle of about 60°. Distal margin serrate or irregularly lobed; however, in young pinnules it seems to be almost entire; in well-developed pinnules, the lower basal portion markedly lobed, the lobe being triangular in shape with pointed apex; ordinary pinnules other than the lower basal ones also sometimes with lobes at their lower base. Midnerve distinct, curving upwards

1) W. FONTAINE, in WARD (1905), p. 63, Pl. VIII, figs. 12–15; Pl. IX; Pl. X, figs. 1–7.

according to the shape of the pinnules. Secondary nerves somewhat irregularly branched; usually forking once or twice at a narrow angle, while those entering into the marginal lobes branch in the manner of monopodial branching consisting of a midnerve and unbranched lateral nerves. Fructification unknown."

Remarks: This species is characterised by the peculiar lobing at the lower basal portion of the pinnules and the characteristic monopodial branching of the secondary nerves entering into basal as well as marginal lobes. The specimen closely resembles *Osmundopsis plectrophora* HARRIS[1] from Greenland, but has been distinguished from it in that, first, the lower basal lobe is developed not only in the basal pinnules of a pinna but also in the ordinary pinnules, though this is not so very conspicuous in the latter case, secondly, the lower basal pinnule of a pinna is not so close to the rachis, and thirdly, the marginal lobing or serration is very irregular. The Japanese specimen being represented by a single sterile frond, it has been assigned to the form-genus *Cladophlebis* rather than to *Osmundopsis* founded by HARRIS on fertile examples because the name *Osmundites* has generally been used for wood of Osmundaceous affinity.

Occurrence:

Nariwa (44), Okayama. Nariwa Series.

Cladophlebis Takezakii sp. nov.

Pl. XXI, Figs. 4, 4a (type-specimen).

?1894. *Pteris* ? sp. YOKOYAMA: p. 216, Pl. XX, fig. 9; Pl. XXI, figs. 6–7.

Description (Pl. XXI, fig. 4): Frond at least pinnate; frond or ultimate pinna slender, linear, about 8 cm. broad; rachis 1–1.5 mm. thick; pinnules large, linear, 4 cm. long, 1 cm. broad at the base, narrowing gradually towards subacute apex, set closely, alternate, and attached to the rachis or axis by the whole base at a right angle; nervation densely crowded, midnerve thicker than the secondary nerves, straight, persists to the tip of the pinnules, secondary nerves first acute to the midnerve, then arching to form a broad angle, dichotomously twice branching, first close to, then at a short dis-

1) T. M. HARRIS (1931), p. 49, Text-figs. 15–16.

tance from their origin; anterior margin serrate or toothed, each tooth receiving a set of branches of a secondary nerve; fructification unknown.

Remarks: *C. Takezakii* is characterised by the tolerably large pinnules. There are three comparable species, viz., *C. longipennis* (HEER), *C. australis* (MORRIS) and *C. gigantea* ÔISHI. The first one was first described by HEER from the Cretaceous of Greenland under the name *Pteris longipennis* and later by SEWARD[1] as *Cladophlebis longipennis*: HEER stated that the pinnules were entire, while SEWARD, who examined the type-specimen, found that they were denticulated at their anterior margin. In this point the Greenland specimens agree with the present one. However, in HEER's species the pinnules are generally smaller and the secondary nerves fork only once instead of twice as in ours.

C. australis (MORRIS),[2] has been described by several authors under divergent generic names from the Mesozoic strata of the Gondwana regions. Though there is a certain resemblance between the Australian and the present species, yet the pinnules in the former are decidedly smaller than in the latter, the margin is entire and moreover the secondary nerves are generally only once forking. Therefore, there is certainly a distinction.

C. gigantea ÔISHI from Nariwa was described by the present writer[3]; the breadth of the pinnules of the species agrees with the present species, but the length is half that of the present specimen and the nervation is more crowded, the secondary nerves being thrice forked.

The specimens described by YOKOYAMA[4] from Kagahara and Yuasa as *Pteris*? sp. are very imperfect pinnules, but they seem to be fragments of *C. Takezakii*.

The specific name is dedicated to Mr. M. TAKEZAKI (now M. HIRATA), a teacher of Kagamino Primary School, Kôti pref., who kindly submitted the present specimen to the writer for study together with many others.

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1) A. C. SEWARD (1924), p. 238, Pl. B, figs. 12, 12a.
2) E. A. N. ARBER (1917), p. 29, Pl. IV, figs. 1, 5, 8; Pl. XIV.
3) S. ÔISHI (1932b), p. 283, Pl. VII, fig. 2.
4) M. YOKOYAMA (1894), p. 216.

Occurrence:

Nisinotani, Kôti. ? Yuasa, Wakayama. ? Hatimanzawa (Kagahara), Gumma.	Ryôseki Series.

Cladophlebis tenue ÔISHI and HUZIOKA

1938. *Cladophlebis tenue* ÔISHI and HUZIOKA: p. 74, Text-fig. 1.

Diagnosis (ÔISHI and HUZIOKA, 1938): "A slender fern-frond of unknown size and form at least bipinnate attaining more than 6 cm. long. Axis very thin, rigid, 1 mm. across in its broken poximal end. Pinnae subopposite, linear, set closely, approximately 1.4 cm. distant on either side of the axis, about 4.5 cm. long and 1.1 cm. broad, attached to the axis at an angle of approximately 45°. Pinnules set closely, deltoid, at about 50° to the slender pinna-axis, and subacutely pointed at the apex. Apical part often directed forwards. Margin almost entire. Midnerve springing up close to the lower basal edge of the lamina, assuming a straight course to the apex of the pinnules. Secondary nerves 5–7 in number on each side of the midnerve, forking only once and acute to the midnerve. Fructification not known."

Remarks: This species is represented by a portion of a frond, which however appears to belong to none of the species ever described. As was already described, this species is characterised by the small pinnules and the midnerve which spring up from the lower basal part of the lamina. It may be comparable to a specimen once described by the writer[1] as *C. maizurensis* ÔISHI from the Maizuru coal-mine, but there is a distinction in the form of the pinnules; in the latter the pinnules are larger, more parallel-sided, with the nerves assuming a zigzag course. It may also be comparable to *C. argutula* (HR.), but in this species the midnerve does not originate so close to the lower basal part of the lamina.

Occurrence:

Nariwa (44, ?95), Okayama. Nariwa Series.

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1) S. ÔISHI (1932), p. 7, Pl. II, figs. 4–5.

Cladophlebis toyoraensis sp. nov.

Pl. XXIII, Figs. 4, 5, 5a (all the type-specimen).

Diagnosis: Frond at least bipinnate, more than 15 cm. long; rachis or axis of penultimate pinna rigid, 5 mm. thick at the proximal part of the impression; ultimate pinnae alternate or subopposite, remote, being 3 cm. distant on each side of the axis, linear lanceolate, acuminate at apex, narrowing towards the base, broadest near the middle portion, and nearly at a right angle to the axis; pinnules long and narrow, linear, straight or slightly falcate, acuminate at the apex, set closely and attached to the pinna-axis by the whole of the base at a wide angle; margin serrate; midnerve distinct, persisting to the tip of the pinnules, secondary nerves forking only once; fructification unknown.

Remarks and discussion: This species is characterised by the open, spreading habit of the frond and by the lanceolate pinnae which are remotely attached to the axis, and moreover by the serrate margin of the pinnules.

This type of frond belongs to the group of *Cladophlebis denticulata* (BRONGN.) and it appears almost impossible to distinguish this type from the large collective form usually described under BRONGNIART's name. It is certain that the present form differs at least from the type specimen of *C. denticulata;* however, it is questionable whether the many specimens, pinnules of which are characterised by dentate margin and once forking secondary nerves known under the collective name *C. denticulata* belong to a single species differing from the present form. The writer believes that many of the imperfect specimens described under the name *C. denticulata* are almost indeterminable.

Notwithstanding this, the reason why the writer dared to give a new specific name for the present specimens is very simple. They differ considerably from the type specimen, the pinnae being lanceolate and the pinnules narrower instead of being broader and shorter as in *C. denticulata* (BRONGN.). It is of course not the writer's opinion that this difference is a decisive one, however, it seems possible to keep the present type separated from the typical type of *C. denticulata,* in respect to the difference mentioned above. The writer elsewhere described specimens under BRONGNIART's name, however they represent the pinnules shorter and broader than those of the present type, therefore they represent a type closer to the type-specimen of *C. denticulata* than to the present type.

Another species which belongs to the same group and must be brought to comparison with the present species is *C. antarctica* NATHORST described by HALLE[1] from the Jurassic rocks of Graham Land. HALLE compared the species with *C. denticulata* and *C. Oerstedi* (HR.) and distinguished it from either of them chiefly in the habit of the frond and in the nervation which is somewhat indistinctly represented in the original specimen of *C. Oerstedi.* So great was the resemblance of the Japanese specimens with *C. antarctica* that they were first provisionally classified under NATHORST'S species. However after a careful comparison with the figures and description given by HALLE, the writer found that the Japanese type is distinguished by the lanceolate ultimate pinnae narrowing gradually towards the base (fig. 5) which on the contrary in the antarctic species is broadest and tapering gradually towards the apex.

The writer believes that the present species, *C. denticulata* and *C. antarctica* are distinguishable from each other only in their typical forms, though in *C. denticulata* the pinnules usually appear to be shorter and broader than in the other two. If the pinnae of *C. antarctica* are always opposite, as HALLE described, and those of the present species are always alternate or subopposite, this feature also serves as a criterion for separating the two species.

Occurrence:

Takazi, Yamaguti. Kiyosue Group.

Cladophlebis triangularis sp. nov.

Pl. XXII, Figs. 1, 1a, 2, 2a.
(Type-specimen: Fig. 1).

1890. *Pecopteris* cf. *Browniana* NATHORST: p. 13, Pl. V, fig. 5.

Diagnosis: Frond bipinnate ?, slender in habit, linear, narrowing gradually towards the apex; rachis or axis 1 mm. thick; pinnae alternate, narrow, linear, about 2.5 cm. long, set closely, attenuated gradually towards an acuminate apex and at an angle of about 45°

1) T. G. HALLE (1913a), p. 14, Pl. I, figs. 15–23, ?24; Pl. III, fig. 6 ?.

to the rachis; pinnules triangular in shape, acutely or subacutely pointed at the apex, set closely, directed forwards, and attached to the rachis by the whole or somewhat decurrent base, the basal anadromous pinnules sometimes larger in size, while the basal pinnules in the adaxial side are smaller and decurrent strongly downwards to the rachis; midnerve well-defined, reaches the tip assuming a zigzag course; secondary nerves 3–4 in number on each side of the midnerve, acute to the midnerve, simple, the basal ones forking once; margin undulating; fructification unknown.

Description of specimens: Pl. XXII, fig. 2 shows an upper portion of a bipinnate frond which narrows very gradually towards the apex. The shape and size of the pinnules and the characteristic nervation are well seen in this specimen. Another specimen in Pl. XXII, fig. 1 represents portions of two fronds arranged in parallel, however, their proximal portions are missing. This specimen suggests that this plant may have been tripinnate, but there is no proof of it. The general habit of the frond, shape and size of pinnules, especially the characteristic basal pinnules of each pinna agree well with those of the preceding specimen. The nervation is somewhat indistinct, but it is also similar to that of the preceding one.

Discussion: The specimen described by NATHORST[1] from Yosidayasiki as *Pecopteris* cfr. *Browniana* DUNKER may be specifically identical with the present species. NATHORST states that the nervation is indistinct in his specimen, but the morphological features available in comparison with his figure justify bringing NATHORST's specimen into synonymy with the present species.

Comparison: The general habit of this species resembles an Amurland specimen described by HEER[2] under the name *Dicksonia acutiloba* HR. However, in HEER's specimen there is no metamorphism of the basal pinnules of pinnae. The American specimen which FONTAINE[3] identified to HEER's species and described under the name *Cladophlebis acutiloba* (HR.) differs somewhat from the type specimen and, to judge from his figure, bears a metamorphosed upper basal pinnule. FONTAINE's specimen, the writer believes, rather closely resembles *Cladophlebis parvula* sp. nov. described in this work. *C.*

1) A. G. NATHORST (1890), p. 13, Pl. V, fig. 5.
2) O. HEER (1876), p. 92, Pl. XVIII, fig. 4.
3) W. FONTAINE, in WARD (1905), p. 72, Pl. XI, figs. 11, 12.

kuwasimaensis sp. nov. described in this work is also a similar form, but in the former, the frond gives an appearance more rigid, the pinnae are more close, and the pinnules are shorter and smaller. There is also a certain resemblance with specimens which CARPENTIER[1] described from the French Wealden strata under the name *Sphenopteris* cfr. *Cordai* (DKR.), but in these specimens the pinnules are shorter and obtusely pointed instead of being acutely pointed as in the present species.

Occurrence:

Kuwasima, Isikawa. Tetori Series.
Yosidayasiki (after NATHORST), Kôti. Ryôseki Series.

Cladophlebis undulata sp. nov.

Pl. XXI, Figs. 1–3; Pl. XXII, Figs. 3, 4.
(Type-specimen: Pl. XXI, Figs. 1–3; Pl. XXII, Fig. 4).

Diagnosis: Frond at least bipinnate; rachis or axis 4 mm. thick with smooth surface; pinnae linear, about 5 cm. long,. 1–1.3 cm broad, tapering to an obtuse apex, set closely, overplapping each other laterally, flexuous, at a wide angle to the axis; pinna-axis slender; pinnules alternate, obovate, narrowing towards obtusely rounded apices, margin undulating, upper basal edge lightly contracting and lower downwards decurrent, and attached at a wide angle to the pinna-axis; nervation distinct, midnerve straight, sending off secondary nerves at an acute angle, and dissolving itself into secondary nerves near the apex; secondary nerves generally once forking, close to or near their origin, the branches extending at a narrow angle, occasionally anterior branch forking once more, anterior catadromous nerves pinnately subdivided. Fertile pinnules similar in shape to sterile ones, with 1–2 round sori 1 mm. in diameter on each side of midnerve; their internal structure unknown.

Remarks: Though the specimens are fragmentary, they are characterised by the shape of pinnules, nervation and the position of sori, and are not identical with any other fossil ferns ever described. The fertile specimens, Pl. XXII, fig. 3 are not in organic connection with sterile ones, but the shape and nervation of pinnules are identical with those of sterile ones.

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1) A. CARPENTIER (1927), p. 51, Pl. III, fig. 1; Pl. XII, fig. 5; Text-fig. 20.

Comparison: Comparable species is *Dicksonia oregonensis* FONTAINE[1] from Oregon, especially specimens in Pl. VII, fig. 4 and an enlarged figure in fig. 8 seem to be very closely allied to the present specimen in respect to the undulate margin of the pinnules and to the position of sori. However in the present specimens the marginal undulation seems to be more prominent, and the nervation is more crowded. In small pinnules the marginal undulation is less prominent.

Occurrence:

Nisinotani, Kôti. Ryôseki Series.

Seed Plants

Cycadophyta

Cycadales

Genus *Ctenis* LINDLEY and HUTTON

Ctenis japonica ÔISHI

(Type-specimen: ÔISHI, 1932b, Pl. XXX).

1905. *Anthrophyopsis ?* sp. YOKOYAMA: p. 12, Pl. III, fig. 6.
1931c. *Ctenis fallax* ÔISHI: p. 6.
1931e. *Ctenis fallax* ÔISHI: p. 359.
1932b. *Ctenis japonica* ÔISHI: p. 343, Pl. XXIX, figs. 5–7; Pl. XXX; Pl. XXXI, fig. 1.

Diagnosis (ÔISHI, 1932b): "Frond of unknown size, being incomplete at both base and apex. Frond pinnate, more than 35 cm. in length and 24 cm. in breadth. Rachis 5 mm. across at the lowest and 3 mm. at the uppermost broken end, with no particular surface ornamentation. Pinnae long and narrow, parallel-sided, approximately 2.5–2.8 cm. in breadth, attached laterally at a wide angle or nearly right angle to the rachis, expanded but not confluent laterally at the base, with entire margin. Nature of apex not known. Nerves anastomosed, with meshes about 2 mm. wide elongated in the longitudinal direction. Fructification not known."

Remarks: After the publication of the Nariwa plants by the

1) W. FONTAINE, in WARD (1905), p. 55.

writer in 1932, he came across a paper by KRYSHTOFOVICH and PRYNADA[1] published in the same year; in this they described two species of *Ctenis*, namely, *C. latiloba* K. & P. and *C. Yokoyamai* K., the two derived from the Nikanian Series of Ussuriland. Of these two species of *Ctenis*, the former shows a fairly close resemblance to the present species and there appears to be no important distinction in looking through its diagnosis and illustration, though the specimen is somewhat unsatisfactorily represented in the figure. If the two are specifically identical, then the specific name *latiloba* published a little earlier than *japonica* should be used for these specimens. However, taking chiefly into consideration the fact that *C. latiloba* is an element of the Nikanian Series (Upper Jurassic) while the present species is one of the striking plants of the Nariwa Series (Rhaetic), the writer wishes to retain the name *japonica* for the Japanese specimens.

Occurrence:

Nariwa (21, 30), Okayama. Nariwa Series.

Ctenis Kaneharai YOKOYAMA

Pl. XXIV, Fig. 1.

1906. *Ctenis Kaneharai* YOKOYAMA: p. 29, Pl. IX, figs. 1, 1a.
1933. *Ctenis Kaneharai* YABE and ÔISHI: p. 32.

Description of specimen: Pl. XXIV, fig. 1 shows a *Ctenis* frond. It is bipinnate, more than 14 cm. long, and is traversed by a thick rachis 5 mm. across on the compressed impression and with longitudinal continuous striations possibly indicating vascular courses. The pinnae are set closely or narrowly spaced, parallel-sided, slightly directed forwards, opposite or subopposite, more than 7 cm. long and 2 cm. broad, and slightly contracted at the base. The apex of the pinnae is not known. The nerves are numerous, parallel except near the base where they are somewhat divergent, and ending at the basal margins, about 15 in number per cm., often forking, and are reticulate forming elongate meshes.

Remarks: The present specimen agrees with the type-specimen

1) A. KRYSHTOFOVICH and V. PRYNADA (1932), p. 368, Pl. II, fig. 1.

figured by YOKOYAMA[1] from Nien-tsu-kou, Manchuria except that in the former the rachis is thinner, the pinnae are narrower and the nervation is less crowded than in the latter. These differences may, the writer thinks, be due to the difference of position of the specimens on a frond.

Occurrence:

Kuwasima, Isikawa. Tetori Series.

Ctenis Takamiana ÔISHI and HUZIOKA

(Type-specimen: ÔISHI and HUZIOKA, 1938, Pl. V, fig. 4).

1938. *Ctenis Takamiana* ÔISHI and HUZIOKA: p. 92, Pl. V, figs. 4–6.

Diagnosis (ÔISHI and HUZIOKA, 1938): "Frond probably simple, spatulate in outline, ± 8 cm. long, widening gradually upwards from the narrow base, attaining 2 cm. in maximum breadth; apex not known. Rachis 1.3 mm. across at the proximal end narrowing apically, with a longitudinal median ridge on its upper side. Pinnae in the middle and apical portions a little longer than broad, those in the proximal portion about as long as broad and those in the extreme basal region shorter than broad and sometimes triangular with upper margin straight and the lower curving upwards to form a gentle curve with the outer margin which is nearly parallel to the rachis. Nerves parallel to each other and to the lateral margins of the pinnae, ending at the outer margin, simple or forked at variable distances from their origin and sometimes having cross connection forming a loose reticulum; density 27–30 per cm."

Remarks: The superficial resemblance of this species to *Anomozamites minor* (BRONGN.) and *Nilssonia fallax* NATH. and the distinction from *C. chaoi* SZE from China have already been pointed out by ÔISHI and HUZIOKA (1938, p. 92).

Occurrence:

Nariwa (50), Okayama. Nariwa Series.

Ctenis Yabei ÔISHI

(Type-specimen: ÔISHI, 1932b, Pl. XXXI, figs. 2–3).

1932b. *Ctenis Yabei* ÔISHI: p. 345, Pl. XXXI, figs. 2–3.

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1) M. YOKOYAMA (1906), p. 29, Pl. IX, fig. 1.

Diagnosis (ÔISHI, 1932b): "Frond of unknown size. Frond pinnate, with large terminal segment. Rachis persisting to the tip of the frond, slender, 2–3 mm. across in the lowest broken end, with two longitudinal ridges on its surface, which become indistinct towards the apex. Pinnae ovate in form, closely set or overlapping each other laterally, contracted at the base and at right angle to the rachis. Nerves prominent, elevated as a ridge from the general surface of the lamina of pinna, divergent, simply forking near the proximal end and anastomosing near the distal margin of the pinna forming elongated polygonal meshes. Terminal segment broadly elliptical, traversed by the elongation of the rachis; nerves given off at approximately an angle of 50° with the rachis, nearly parallel to each other, forking and anastomosing just as in the ordinary pinnae."

Remarks: This species is certainly a striking one amongst the *Ctenis* hitherto described. Though the specimens are fragmentary, the short and broad, and somewhat oval to wedge shaped pinnae and prominent nerves which stand out distinctly as a ridge from the general surface of the lamina of the pinnae are unique characteristic features of this species being identical with none of the *Ctenis* species previously described.

Occurrence:

Nariwa (50), Okayama. Nariwa Series.

Ctenis Yamanarii KAWASAKI

1925. *Ctenis* sp. KAWASAKI: p. 43, Pl. XXXVIII, fig. 105.
1926. *Ctenis Yamanarii* KAWASAKI: p. 20, Pl. V, fig. 18; Pl. VI, fig. 19.

Remarks: KAWASAKI compared this species with *C. orovillensis* FONT.,[1] *C. grandifolia* FONT.[2] from the Jurassic of North America and *C. Kaneharai* YOK.[3] from the Jurassic of China, but distinguished it from them in that the present species possesses narrower pinnules and denser nerves. The writer thinks that the resemblance

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1) W. FONTAINE, in WARD (1905), p. 115, Pl. XXVII, figs. 1–5; Pl. XXVIII, fig. 1.
2) W. FONTAINE, Ibid., p. 116, Pl. XXVIII, figs. 2–8.
3) M. YOKOYAMA (1906), p. 29, Pl. IX, figs. 1, 1a.

to *C. grandifolia* is fairly close. *C. Renaulti* ZEILLER[1] from Siberia appears to be almost identical with *C. Yamanarii.*

Occurrence:

Bansyô, Tyôsen. Daidô Series. (G. S. K. Coll.).

Genus *Nilssonia* BRONGNIART

Nilssonia acuminata (PRESL) GOEPPERT

1833. *Zamites acuminatus* PRESL: p. 199, Pl. XLIII, fig. 2.
1833. *Zamites heterophylla* PRESL: p. 199, Pl. XLIII, figs. 4–5.
1914. *Nilssonia acuminata* GOTHAN: p. 35, Pl. XXVI, fig. 1; Pl. XXVIII, figs. 2–3; Pl. XXXI–XXXII, figs. 2–3; Pl. XXXIII, fig. 4; Pl. XXXIV, figs. 2, 4.
1932b. *Nilssonia acuminata* ÔISHI: p. 338, Pl. XXVIII, figs. 3–4.
1933. *Nilssonia acuminata* SZE: p. 40, Pl. X, figs. 1–3; p. 52, Pl. V, figs. 2–6.
GOTHAN, 1914, gives some more references.

Remarks: This species is not rare in the Nariwa district; two of the specimens, hardly distinguishable from the typical specimens, were figured by the writer in 1932. SZE (1933) figured and described this species from China; in that paper he maintained the specific identity of *N. acuminata* and *N. nipponensis* YOKOYAMA, but this action is not correct as discussed below in the description of the latter species.

A specimen figured by HALLE[2] from Szechuan as Cfr. *Ctenopteris sarrani* ZEILLER may, as SZE (1933) says, be this species. PRYNADA[3] described *N. acuminata* from Central Asia.

Occurrence:

Mominoki, Yamaguti. Aso Bed.
Nariwa (21, 66), Okayama. Nariwa Series.

Nilssonia brevis BRONGNIART

Pl. XXVI, Fig. 7.

1909. *Nilssonia brevis* NATHORST: p. 12, Pl. I, figs. 2–35; Pls. II–IV; Pl. V, figs. 1–5; Pl. VI, figs. 14–22; Pl. VII, figs. 1–15; Pl. VIII, figs. 1–11.

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1) R. ZEILLER (1928), p. 135.
2) T. G. HALLE (1927), p. 19, Pl. V, fig. 9 (non fig. 10).
3) V. PRYNADA (1931), p. 27, Pl. III, fig. 32; Pl. IV, figs. 34, 35, 39; Pl. VI, fig. 64.

1938. *Nilssonia brevis* ÔISHI and HUZIOKA: p. 90, Pl. XI, figs. 2–3.
For further references, see NATHORST, 1909.

Description of specimen: Pl. XXVI, fig. 7 shows an impression of the upper surface of an imperfect *Nilssonia* frond. As it is unfortunately broken on both ends and the lateral margins are imperfect the size of the frond is uncertain. The rachis upon which the lamina is attached is 3 mm. thick on the impression. So far as the lamina preserved is concerned it is not cleft transversely. The characteristic transverse folding of the lamina is clearly seen in the accompanying figure; it shows that the folds occur at a regular interval and there are 6–7 folds in a centimeter, each ridge and furrow of the fold containing two nerves respectively; hence the nerves are about 25 in number per cm.; they meet on the median line of the rachis.

Remarks: Though the specimen above described is imperfect, the characteristic folds of the lamina recall strongly those in the lamina of *Nilssonia brevis*, so the specific identity of the specimen with *N. brevis* seems to be quite possible.

ÔISHI and HUZIOKA[1] once described *N. brevis* from Nariwa; though the specimens were not satisfactorily large enough to show the general habit of the frond of this species, yet the characteristic folds of the lamina showed that the specimens also belong to this interesting species of *Nilssonia*.

Occurrence:

Nariwa (88), Okayama. Nariwa Series.
Higasi-Nagano, Yamaguti. Higasi-Nagano Bed.

Nilssonia densinerve (FONTAINE) BERRY

Pl. XXIV, Figs. 2–4.

1889. *Platypteridium densinerve* FONTAINE: p. 169, Pl. XXX, fig. 8; Pl. XXXI, figs. 1–4; Pl. XXXII, figs. 1–2; Pl. XXXIII, fig. 1; Pl. XXXIV, fig. 1; Pl. XXXV, figs. 1–2.
1889. *Platypteridium Rogersianum* FONTAINE: p. 171, Pl. XXXI, fig. 2; Pl. XXXIII, fig. 2; Pl. XXXIV, fig. 2.
1905. *Platypteridium densinerve* FONTAINE: in WARD, p. 521, Pl. CXII, fig. 8.
1911. *Nilssonia densinerve* BERRY: p. 362, Pls. LVII and LVIII.

1) S. ÔISHI and HUZIOKA (1938), p. 90, Pl. XI, figs. 2–3.

Description of specimens: Pl. XXIV, fig. 2 shows a portion of a large frond derived from Outi. It is 14 cm. long and 9 cm. broad, tapering gradually towards the proximal end. The rachis is stout and 4 mm. thick. The laminae cover the upper surface of the rachis, leaving a narrow ridge along the longitudinal median line of the rachis, to which they are deeply cleft into segments 1.5–2 cm. broad with the upper margin nearly straight or slightly concave and the lower margin slightly convex forming a broad angle towards the outer margin. The nerves are unbranched, parallel to the lateral margins and number 18–22 per cm.

Pl. XXIV, figs. 3 and 4 show specimens from Tanzaki, the former being the middle and the other the basal parts of a frond. The nerves are indistinct, though they appear to be a little denser than those in the preceding specimen.

Remarks: This species was originally described by FONTAINE (1889) as *Platypteridium densinerve* FONT. from the Potomac formation. Later BERRY (1911) substituted the genus *Nilssonia* for *Platypteridium*, on the basis that the "segments are inserted on the upper surface of the rachis in conformity with the generic diagnosis" of *Nilssonia*.

One of the Japanese specimens figured in fig. 2 represents a striking agreement in all respects with the specimens of *Platypteridium densinerve* from the Potomac formation. Therefore, so far as the present specimen is concerned, their specific identity is almost questionable. The specimens from Tanzaki differ in size only from that from Takazi, though the nerves appear to be a little denser. They may probably be young fronds of this fern.

Comparison: *Nilssonia princeps* (OLDH. and MORR.)[1] agrees with the specimen at hand in size and form of the frond and in the mode of segmentation of the laminae, but the nerves are often forked and anastomosed. *N. compta* (PHILLIPS) is another allied species, in which the frond is generally far smaller except a specimen figured by SEWARD in his Jurassic Flora, Pt. 1, p. 229; the writer thinks that the large frond agrees more closely in habit with *N. princeps*.

Occurrence:

Outi, Yamaguti. Kiyosue Group.
Tanzaki, Wakayama. Ryôseki Series.

1) A. C. SEWARD (1912), p. 29, Pl. III, fig. 33; Pl. IV, figs. 35–38; Text-fig. 5.

Nilssonia Inouyei YOKOYAMA

1905. *Nilssonia Inouyei* YOKOYAMA: p. 9, Pl. I, fig. 4; Pl. II, fig. 4.
1911. *Nilssonia Inouyei* THOMAS: p. 86, Pl. VI, figs. 4, 4a, 5.
1932a. *Nilssonia Inouyei* ÔISHI: p. 64.

Diagnosis (YOKOYAMA's original diagnosis was slightly modified in ÔISHI, 1932a): "Frond simple, elongated, narrow, more than 9 cm. long and 1.2 cm. broad, nearly parallel-sided or widening gradually from the base upwards and tapering to an obtuse apex. Rachis moderately strong. Nerves mostly simple, nearly at a right angle to the rachis, and numbering 20–23 per cm."

Remarks: A glance at this species reminds one of *N. simplex* ÔISHI from Nariwa, in which, however, the lateral nerves fork occasionally close to their origin or rarely near the margin, instead of being mostly simple as in the present species. PRYNADA[1] described this species from the Liassic rocks of Transcaucasia.

Occurrence:
Mitiiti, Yamaguti. Aso Bed.
Yamanoi (3), Yamaguti. Upper Triassic.

Nilssonia Kotoi (YOKOYAMA) n. comb.

Pl. XXV, Figs. 3, 3a; Pl. XLIV, Fig. 3B.

1889. *Dioonites Kotoei* YOKOYAMA: p. 44, Pl. VII, figs. 1a, 1b, 1c, 1e; Pl. XIV, fig. 14.
?1905. *Dioonites?* sp. YABE: p. 14, Pl. III, fig. 7.
?1905. *Ctenophyllum?* sp. YABE: p. 15, Pl. IV, fig. 7.

YOKOYAMA defined the species as follows: "Leaf pinnated; segments opposite or alternate, lightly curved and more or less directed forward, long, linear-lanceolate, acute, inserted on the rachis with the whole base; veins fine, equal, parallel, 7–14 in number."

Remarks: YOKOYAMA (1889) reported the occurrence of this species from Kuwasima (Shimamura) and Tanimura and figured several specimens from the former locality. Though YOKOYAMA described the characteristic features of this species in detail, yet there is an important feature not mentioned in YOKOYAMA's paper: in all the specimens belonging to this species now at our disposal, the nerves run obliquely downwards in the grooved surface of the

1) V. PRYNADA (1933), p. 20, Pl. IV, figs. 4, 11.

rachis to its median line and are not perpendicular to the rachis as YOKOYAMA described (YOKOYAMA's Pl. VII, fig. 1e shows the oblique running). It is unfortunately impossible to examine the type specimen and to compare the present material with it, but it is almost without doubt that the type specimen also bore a similar character in regard to the origin of the nerves, because the specimens subsequently collected from the type-locality show without a single exception a downwards running of the nerves to the median groove of the rachis.

Though YOKOYAMA[1] later thought that his *Dioonites Kotoi* was specifically identical with *Dioonites Brongniarti* (MANTEL) from the European Wealden, the writer is of the opinion that the two are distinct because of the fact that in *D. Brongniarti* the nerves run straight in the surface of the rachis, if the figure by SCHENK[2] was correctly drawn, instead of being bent downwards as in the former.

There is another species which seems to be almost specifically identical with the present one. It is *Nilssonia sinensis* YABE and ÔISHI[3] from the Jurassic of Manchuria. So far as the superficial characters are concerned the two species agree in all respects, and even in the characteristic downward bending of the nerves to the median groove of the rachis they agree with one another. Now, the writer wishes to quote here several lines of description of *Nilssonia sinensis* YABE and ÔISHI concerning the discussion of the specific relation between *N. sinensis* and *N. Kotoi*; "Then, there remains a question on the specific relation between *D. kotoi* from the Tetori Series and *N. sinensis* from Manchuria. It is indeed certain that *D. Kotoi* resembles *N. sinensis* in the superficial characters of the fronds, especially in the nature of the nerves as mentioned above, but nothing is known of the epidermal structures of the former. Unfortunately, the type-specimens of *D. Kotoei* were all destroyed by the fire following the Great Kwantô Earthquake of Sept. 1, 1923, when they were stored in the Imperial Geological Survey of Tôkyô, and it is now hopeless to try to know more in detail of this species than is written in YOKOYAMA's description. We once tried to prepare cuticles from specimens of *D. Kotoi* derived from a dark gray sandstone of the Tetori Series at Kuwasima and now stored in the

1) M. YOKOYAMA (1906), p. 33, Pl. XI, figs. 1, 2.
2) A. SCHENK (1871), p. 236, Pl. XXXII, figs. 2, 2a.
3) H. YABE and S. ÔISHI (1933), p. 30, Pl. IV, figs. 7–9, 9a; Pl. VI, fig. 2.

Institute of Geology and Palaeontology in Sendai, but the process failed owing to the unsatisfactory preservation of the specimens. Under these circumstances, we want tentatively to hold the Manchurian specimens separate from *D. kotoi* from the Tetori Series of Central Japan giving a new name *N. sinensis* for it, until their specific identification is proved by more reliable evidence" (YABE and ÔISHI, 1933, p. 31).

It is very unfortunate that until the present day the knowledge about the characters of *D. kotoi* from the Tetori Series does not progress more than described by YABE and ÔISHI. Therefore it is the best way, the writer believes, to retain for a while the Manchurian specimens as a distinct species.

As to several specimens elsewhere described by KRYSHTOFOVICH[1] under the name *D. kotoi* it is not certain whether they are specifically identical with the type-specimen of *D. kotoi*, however they may perhaps from the geographical position of the localities be referable to *N. sinensis*.

Occurrence:

Kuwasima, Isikawa.
Tanimura, Hukui. } Tetori Series.
Okamigô, Gihu.
?Butudôken, Tyôsen (Tôkyô Coll.). Rakutô Bed.

Nilssonia Muensteri (PRESL) SCHIMPER

1838. *Zamites Muensteri* PRESL: p. 199, Pl. XLIII, figs. 1, 3.
1850. *Pterophyllum Muensteri* ÜNGER: p. 291.
1872. *Pterophyllum Muensteri* SCHIMPER: p. 145.
1894. *Nilssonia (Pterozamites) Muensteri* BARTHOLIN: p. 91, Pl. I, fig. 13; Pl. II, figs. 1–2.
1903. *Nilssonia* cf. *Muensteri* MOELLER: p. 22, Pl. II, figs. 20–23.
?1909. *Nilssonia Muensteri* NATHORST; p. 26, Pl. VI, figs. 26–28.
?1925. *Nilssonia pterophylloides* KAWASAKI: p. 42, Pl. XXII, fig. 67.
?1926. *Nilssonia Muensteri* KAWASAKI: p. 20.
1932b. *Nilssonia Muensteri* ÔISHI: p. 340, Pl. XXVIII, fig. 5; Pl. XXIX, figs. 1–2.

Discussion: A discussion has already been published in the work on the Nariwa plants (ÔISHI, 1932b, p. 342) in regard to the incor-

1) A. KRYSHTOFOVICH (1916), p. 108, Pl. X, figs. 1, 2; (1928), p. 28.

rectness of ZEILLER's[1] identification of the Tonkin specimens to *Pterophyllum Muensteri* (PRESL). SZE[2] also treated this problem, but he thought ZEILLER's generic identification to be correct, and he named some fragments from Kiangsi *Pterophyllum pseudomuensteri* SZE bringing one (Pl. XLV, fig. 4) of the Tonkin specimens into its syonymy. As the writer pointed out, ZEILLER limited, as obvious from his description, the genus *Nilssonia* only to fronds, the lamina of which are irregularly divided into segments with the nerves always simple, and he assigned the fronds with regularly divided segments and forking nerves to the genus *Pterophyllum*. Therefore it is because of the latter feature that ZEILLER assigned the Tonkin specimens to *Pterophyllum*. As is also clear from his illustrations, the one in his Pl. XLV, fig. 3a, which is the upper surface of a leaf, shows that the nerves actually meet on the longitudinal median line of the rachis. Therefore, at least the named specimen is a *Nilssonia*. Thus if all the Tonkin specimens figured in ZEILLER's Pl. XLV have the nervation as in fig. 3, and if the Chinese specimens described by SZE as *Pterophyllum pseudomuensteri* SZE be a true *Pterophyllum* (the pinnae of the genus are attached to the lateral sides of the rachis and not to the upper surface), then SZE's name should be retained only for the Chinese specimens, and a new name should be given to the Tonkin specimens which certainly differ from PRESL's species in having forking nerves. Therefore the writer proposes the name *Nilssonia Zeilleri* sp. nov. for the Tonkin specimens referred by ZEILLER to PRESL's species. At least two (figs. 1 and 3) of the Tonkin specimens distinctly show in the photographs the nerves which meet on the median line of the rachis. The writer cannot make any statement about the nature of the nerves of the Chinese specimens on the basis of SZE's illustration, but it is obvious that they resemble one of the Tonkin specimens (fig. 4) as SZE has pointed out. Specimens which resemble *N. Muensteri* were described by SZE[2] from China, as *N. linealis* SZE.

Occurrence:

Nariwa (33, 48, 49, 50), Okayama. Nariwa Series.

1) R. ZEILLER (1903), p. 183, Pl. XLV, figs. 1–5.
2) H. C. SZE (1931), p. 12, Pl. II, figs. 2–3.
3) H. C. SZE (1933), p. 32.

Nilssonia nipponensis YOKOYAMA

Pl. XXVII, Figs. 1–4.

1889. *Nilssonia nipponensis* YOKOYAMA: p. 42, Pl. VI, fig. 8d; Pl. VII, figs. 2–7, 8a; Pl. XII, fig. 6; Pl. XIII, fig. 1.
?1905. *Nilssonia nipponensis* FONTAINE: in WARD, p. 94, Pl. XVII, figs. 8–10.

Diagnosis (YOKOYAMA, 1889): "Leaf petioled, segmented, incisions sharp; segments opposite or alternate, acute, more or less concave in the upper margin, convex in the lower, upper ones longer, with the uppermost shortened, lower ones short and triangular with the upper margin straight, veins dense, simple, parallel, equal, rising at right angle to the rachis."

Description of specimens: In Pl. XXVII, fig. 1 are shown fronds covering the surface of a slab of rock exclusive of other fossil plants. They are petiolate, oblong in shape, and characterised by the dissection of the laminae into irregular segments with the upper margin nearly straight or slightly concave, and the lower margin strongly convex forming a broad gentle curve towards the outer margin ending in a subacute outer upper margin; thus the shape of the segments becomes triangular, and especially so towards the basal segments. The nerves are parallel, simple, at a wide angle to the rachis and number about 30 per cm.

In Pl. XXVII, figs. 2–4 are shown some imperfect fronds the laminae of which are somewhat abnormally dissected into segments. The one in fig. 2 is derived from Kuwasima where typical specimens of this species are found frequently. It strongly reminds one of *Nilssonia schaumburgensis* (DUNKER), but the habit of the frond, the manner of dissection of laminae into segments, and the shape of the segments are rather closely allied to *N. nipponensis*. The writer thinks that the specimen represents a young frond of this species. The other specimens in figs. 3 and 4 are derived from Takazi. The manner of dissection is very irregular and the shape of segments is also inconstant. However, the dense nervation (about 28 per cm.) and the deltoid segments as seen in the specimen in fig. 4 rather recall *N. nipponensis*. The specific identity of these three specimens mentioned above with *N. nipponensis* is, the writer believes, almost unquestionable.

Remarks: In describing this species in 1889, YOKOYAMA pointed out the resemblance existing between this species and *N. acuminata*

(PRESL), while SZE[1] considered the two species as specifically identical. The writer examined a good number of specimens of this species derived from Kuwasima (Simamura), the type-locality, and found that the figures of this species are incorrectly drawn in YOKOYAMA's work in respect to the density of the nerves. He said that they are "ca. 3 falling in a millimeter", while the figures show that the density is 15–20 per cm. This probably led SZE to consider the present species to be specifically identical with *N. acuminata* in which the nerves are coarser than in *N. nipponensis*. The examination of the specimens now at hand shows that the density is usually 30 per cm.

The American specimens which FONTAINE (1905) identified with *N. nipponensis* have coarser nerves (about 15 per cm., measured on his figures), and are distinct from *N. nipponensis*.

Occurrence:

Kuwasima, Yanagidani, Togadani } Isikawa.; Okamigô, Gihu. } Tetori Series.
Takazi, Yamaguti. Kiyosue Group.

Nilssonia orientalis HEER

Pl. XXVI, Figs. 1–5.

1878. *Nilssonia orientalis* HEER: p. 18, Pl. IV, figs. 5–9.
1889. *Nilssonia orientalis* YOKOYAMA: p. 40, Pl. XIV, figs. 4–9.
1889. *Nilssonia ozoana* YOKOYAMA: p. 41, Pl. X, figs. 2b, 11–14.
1890. Cfr. *Nilssonia orientalis* NATHORST: p. 5, Pl. I, fig. 4–5.
1897. *Nilssonia orientalis* NATHORST: p. 24, Pl. I, figs. 18–19.
1905. *Nilssonia orientalis* FONTAINE: in WARD, p. 90, Pl. XVI, figs. 3–9.
1905. *Nilssonia orientalis* FONTAINE: in WARD, p. 92, Pl. XVI, figs. 10–13.
1905. *Nilssonia orientalis* YABE: p. 13, Pl. III, figs. 1–5.
1905. *Nilssonia* sp. YABE: p. 14, Pl. III, fig. 6.
1907. *Nilssonia orientalis* SEWARD: p. 12, Pl. II, fig. 21.
1911a. *Nilssonia orientalis* SEWARD: p. 695, Pl. I, figs. 60, 63–65; Pl. IX, figs. 34, 42; Pl. X, fig. 46.
1911. *Nilssonia orientalis* THOMAS: p. 86, Pl. VII, fig. 1.
1912a. *Nilssonia orientalis* SEWARD: p. 30, Pl. III, fig. 46.
1913. *Nilssonia orientalis* THOMAS and BANCROFT: p. 192.

1) H. C. SZE (1933), p. 41.

1914. *Nilssonia orientalis* GOTHAN: p. 41, Pl. XXIV.
1925. *Nilssonia* cf. *Johnstrupi* ENDÔ: p. 10, Pl. VI, figs. 5, 20.
1925. *Nilssonia* cfr. *orientalis* ENDÔ: p. 9, Pl. IV, figs. 12, 16, 18, 19.
1929. *Nilssonia orientalis* TATEIWA: Plate, fig. 3.
1931. *Nilssonia orientalis* PRYNADA: p. 25, Pl. V, fig. 50.
1932b. *Nilssonia orientalis* ÔISHI: p. 336, Pl. XXVII, figs. 5–6; Pl. XXVIII, figs. 1–2.
1933. *Nilssonia* cfr. *orientalis* SZE: p. 57, Pl. IX, fig. 4.

Description of specimens: Pl. XXVI, fig. 4, shows a *Nilssonia*-frond derived from Kuwasima; it is obovate in outline, widening gradually upwards and contracting abruptly to the rounded apex. The laminae evidently cover the upper surface of the rachis and the nerves which are simple, densely crowded and curving upwards meet at the median line of the rachis, the density being about 30 per cm.

Another specimen in Pl. XXVI, fig. 5 represents the distal portion of a frond, which though imperfect, agrees essentially with the preceding one. Pl. XXVI, figs. 2 and 3 are of specimens from Ôsima stored in the Institute of Geology and Palaeontology in Sendai and labelled as *N. Johnstrupi*. Pl. XXVI, fig. 1 is a specimen from Neiridani. It shows coarser lateral nerves than in the usual case of this species, and rather recalls *Nilssonia princeps* from the Indian Jurassic, but has been included in the present species as the specimen occurred in association with a typical form of *N. orientalis* (fig. 5). In Japan there is no typical representative of the Indian species.

Remarks: *N. orientalis* seems to display a considerable variation in the size of frond and the number of nerves in a unit distance. The frond is as a whole, however, obovate or long and narrow, and increases in breadth gradually from the base upwards and contracts abruptly to the rounded apex, where it is sometimes notched.

This species is characterised by the densely crowded nervation, though there are some exceptional cases. In the Japanese specimens referred to this species, those described by YABE (1905), YOKOYAMA (1889) and the writer (1932b) represent the typical forms, while those described by ENDÔ (1925) from the Upper Cretaceous rocks of Hokkaidô as *N.* cfr. *orientalis* have a coarser nervation. Specimens from the Tetori Series described by YOKOYAMA seem to have coarser nerves so far as shown in his figures, but in the description he mentions that there are four nerves in 1 mm. As the original specimens by YOKOYAMA from the Tetori Series were destroyed by the fire following the Great Kwantô Earthquake of Sept. 1, 1923, it is now impossible to examine them. Specimens described by ENDÔ (1925) from Hokkaidô under the name *N.* cfr. *Johnstrupi* HEER are identical with the present species.

N. orientalis is a species common through the Mesozoic rocks of the Northern Hemisphere while it has never been described from the Southern Hemisphere. *N. taeniopteroides* HALLE[1] from the Jurassic of Graham Land displays a striking resemblance in size and form to *N. orientalis,* however, it seems to differ, as HALLE pointed out, in having coarser nerves (15–20 in the former and 30–40 in the latter).

N. ozoana YOKOYAMA (1889) from the Tetori Series is said by YOKOYAMA to be distinguished from *N. orientalis* in having narrower and more elongated frond and nerves which are at a right angle to the rachis. Though the writer could not examine the type specimen, yet from the same locality from where *N. ozoana* was derived he collected some imperfect specimens which are identical with YOKOYAMA's species. The material collected by the writer shows that *N. ozoana* can hardly be distinguished from the small type of *N. orientalis* and perhaps falls within the limit of variation of the latter. SEWARD[2] has already commented elsewhere about the specific identity of the two species.

Alaskan specimens described by HOLLICK (1930, p. 42) as *Nilssonia yukonensis* is a type very close to *N. orientalis* differing only in the possession of coarser lateral nerves.

Occurrence:

Nariwa (44), Okayama. Nariwa Series.
Neiridani, Toyama. Kuruma Bed.

Ozô	Isikawa.	Tetori Series.
Yanagidani ?		
Kuwasima		
Hakogase (Tôkyô Coll.)	Hukui.	
Motiana		
Yambara		
Izuki (Kyôto Coll.)		

1) T. G. HALLE (1913a), p. 47, Pl. V; VI, figs. 1–7; Text-fig. 11.
2) A. C. SEWARD (1912a), p. 31; (1907), p. 13; (1917), p. 576.

Takazi	Yamaguti.	Kiyosue Group.
Nanami		
Ôsima, Miyagi.		Ôsima Plant Beds.
Kaisekiyama	Kôti.	Ryôseki Series.
Kôbôdani		
Tôgôdani		
Tanzaki	Wakayama.	
Hiromura (Kyôto Coll.)		
Iwakura, Mie.		
Horisakabasi	Hukusima.	
Zusahara (Sendai Coll.)		
Sindasawa (Sendai Coll.)		
Hakobuti gorge	Hokkaidô.	Urakawa Series.
Upper course of the Asibetu-gawa		
Upper valley of Wenhorokabetu		
Ryûsindô (G. S. K. Coll.)	Tyôsen.	Rakutô Bed.
Butudôken (Tôkyô Coll.)		
Sinsyû (G. S. K. Coll.), Tyôsen.		Sinsyû Bed.

Cfr. *Nilssonia polymorpha* SCHENK

Pl. XXVI, Fig. 6.

Compare with:

1867. *Nilssonia polymorpha* SCHENK (pars): p. 127, Pl. XXIX, figs. 1–9; Pl. XXX, fig. 1.
1869. *Nilssonia polymorpha* SCHIMPER (pars): p. 489, Pl. XLV, fig. 9.
1876. *Nilssonia polymorpha* NATHORST: p. 40, Pl. VIII, figs. 2–15; Pls. IX–XI.
1878. *Nilssonia polymorpha* NATHORST: p. 17, Pl. II, figs. 6–7.
1879. *Nilssonia polymorpha* NATHORST: p. 72, Pl. XV, figs. 3–5.
1887. *Nilssonia polymorpha* SCHENK: p. 7, Pl. I, fig. 3; Pl. V, fig. 22 (right).
1909. *Nilssonia polymorpha* NATHORST: p. 10, Pl. V, figs. 9–13; Pl. VI, figs. 9–13; Pl. VII, fig. 20; Pl. VIII, figs. 12–18.

Description of specimen: Pl. XXVI, fig. 6 shows a portion of a linear frond more than 7 cm. long and 3 cm. broad, traversed by a rachis about 1 mm. thick. The segments into which the laminae are dissected appear to be inserted to the lateral sides of the rachis, but this may be due to the fact that the specimen is represented by an impression of the back surface of a frond. The segments are at a wide angle to the rachis, with the upper margin nearly straight or slightly concave and the lower margin with a gentle broad curve towards the outer margin. The outer upper margin is obtusely pointed. The nerves are parallel, unbranched, and number about 20 in each segment which is nearly 1 cm. broad.

Remarks: This species is often very difficult to distinguish in its external appearance from a certain type of *N. acuminata* (PRESL) in which the segments are short and broad, though in this species the segments bear sometimes transverse foldings as in those of *N. brevis* BRONGN. and the cleft of the laminae into segments is sometimes shallow, often becoming entire all round as in *Taeniopteris*. Moreover, GOTHAN (1914, p. 126) wrote in describing *N. acuminata* from Nuernberg that "Abgesehn von der bei *Nilss. polymorpha* vorhandenen Faltung der Blaetter (also aehnlich wie bei *N. compta*) treten bei *polymorpha* die Blaettchen in viel engerem Zusammenhang auf, sind oft ganz verwachsen, so dass das Blatt dann im ganzen *Taeniopteris* aehnlich ist, oder teilweise verwachsen, was bei unserer Art nie der Fall ist." Under such circumstances, the reason why the writer provisionally refers the present specimen to *N. polymorpha* is that the segments are not truncated in their outer margin as is clearly represented by PRESL's original specimens (PRESL, 1838, Pl. XLVIII, fig. 2) of *Nilssonia acuminata* (PRESL) and also by some of Nuernberg specimens figured by GOTHAN (1914).

The writer wishes provisionally to call the present specimen Cfr. *Nilssonia polymorpha* SCHENK, awaiting additional material which may lead to more satisfactory ground for identifying it with certainty.

This species has previously been known only from the Rhaetic and lower Liassic strata chiefly of northern Europe. SCHENK (1887) described it from Persia (Iran), and PRYNADA (1931) from Central Asia.

Occurrence:

Mominoki, Yamaguti. Aso Bed.

Nilssonia schaumburgensis (DUNKER) NATHORST

Pl. XXVII, Figs. 5–11; Pl. XXVIII, Fig. 2.

1846. *Pterophyllum schaumburgense* DUNKER: p. 15, Pl. I, fig. 7; Pl. II, fig. 1; Pl. VI, figs. 5–10.

1871. *Anomozamites schaumburgense* SCHENK: p. 231, Pl. XXXIII, figs. 1–9.

1890. *Nilssonia* cfr. *schaumburgensis* NATHORST: p. 5, Pl. I, figs. 6–9a; p. 9; p. 13.
1894. *Nilssonia schaumburgensis* YOKOYAMA: p. 227, Pl. XX, figs. 12, 14; Pl. XXI, fig. 14; Pl. XXII, figs. 5–7.
1895. *Nilssonia schaumburgensis* SEWARD: p. 53, Text-fig. 3.
1905. *Nilssonia schaumburgensis* FONTAINE: in WARD, p. 303, Pl. LXXII, figs. 17–21.
1927. *Nilssonia schaumburgensis* YABE: Pl. I, fig. 8.
1936. *Nilssonia schaumburgensis* MICHAEL: p. 53.

Description of some specimens: In Pl. XXVII, the specimen in fig. 11 shows a proximal portion of a frond more than 8 cm. long and narrowing gradually towards the base. The rachis is prominent. The lamina is dissected into segments up to the rachis, the segments being unequal in breadth, quadrilateral, outer margin nearly straight or broadly rounded, lower distal edge rounded. The nerves are fine, dense, about 30 per cm. Fig. 7 shows several imperfect fronds impressed on a slab of rock. They are narrower than the preceding specimen, the breadth being more or less 1 cm. The lamina is dissected into quadrilateral segments with truncated outer margin. This specimen agrees essentially with those figured by NATHORST (1890) from Tôgôdani. Figs. 5, 6, 9 and 10 represent fragments of the same species which show characteristic prominent rachis, segmented lamina and the fine nerves.

Remarks: The first occurrence of this species in Japan was reported by NATHORST from the Ryôseki Series of Tôgôdani under the name *Nilssonia* cfr. *schaumburgensis* which he thought to be almost specifically identical with *Pterophyllum schaumburgense* figured and described by DUNKER from the Wealden of Germany. However, NATHORST recognized a slight difference in the segments which in the Japanese specimens are set more closely than in those of the type-specimen.

Later YOKOYAMA figured several specimens derived from the various localities of Kôzuke, Kii and Tosa under the name *N. schumburgensis* and believed also that NATHORST's specimens from Tôgôdani are specifically identical with DUNKER's species. In 1913, YABE[1] described from Omoto long and narrow, linear Nilssonian fronds with entire margin which are very closely related to *N.*

1) H. YABE (1913), p. 6, Pl. I, figs. 13–16.

parvula described by FONTAINE[1] from the Jurassic of Oregon and he called the Omoto specimens *N. schaumburgensis* var. *parvula*.

The writer examined a good number of specimens of this species derived from various localities in the Japanese Islands belonging to the Ryôseki Series and found that they demonstrate a considerable variation in respect to the size of fronds and in the manner of dissection of lamina into segments. For instance, a frond in fig. 11 is 2 cm. broad at its upper broken end, while in the fronds as represented in figs. 6 and 7 the breadth is less than 1 cm. The nerves are also variable; in the specimen in fig. 11 they are about 30 per cm., while in that in fig. 10, they are about 45 in the same interval, and yet all these specimens are hardly morphologically separable.

A question which arises in connection with the variability of the density of nerves is that in the type-specimen of *N. schaumburgensis*, DUNKER made no mention of the number of nerves in a unit length, while SCHENK said that they are 9–15 in a segment. If SCHENK's enlarged figure (Pl. XXXIII, fig. 3a), which seems to be twice magnified, represents the exact density of the nerves, then the nerves may have been about 30 per cm., hence nearly in the same density as in the specimen in our fig. 11.

Under such circumstances as the Japanese specimens referable to this species are considerably variable, particularly in the size of frond and in the number of nerves in unit length, it is the best way, the writer believes, provisionally to refer all the specimens as figured in this work to DUNKER's species, although there is a slight difference, as suggested by NATHORST, in the form of the segments which in the Japanese specimens are less rounded in their lower distal corner. In other features, the Japanese specimens are hardly distinguishable from the type-specimen.

KRYSHTOFOVICH and PRYNADA (1932, p. 370) records *N.* cfr. *schaumburgensis* from the Nikanian Series of Ussuriland.

Occurrence:

Tennôhama Mizutani (Kyôto Coll.) Hiromura	Wakayama.
Ayukawa, Miyagi.	Ayukawa Bed.

2) W. FONTAINE, in WARD (1905), p. 92, Pl. XVII, figs. 1–7.

Horisakabasi, Zusahara, Sindasawa (Sendai Coll.)	Hukusima.	Ryôseki Series.
Ôtani, Kaisekiyama, Haginotani, Kôbôdani, Nisinotani, Tôgôdani, Aburaisi	Kôti.	Ryôseki Series.
Komô (Sendai Coll.), Tokusima.		Ryôseki Series.

Huruke, Tokusima. Monobegawa Series.
Ôtômen Coal-mine, Tyôsen. Rakutô Bed.

Nilssonia schaumburgensis (DUNKER) NATHORST var. *parvula* YABE

Pl. XXVI, Figs. 9, 10.

1913. *Nilssonia schaumburgensis* var. *parvula* YABE: p. 6, Pl. I, figs. 13–16.
1929. *Nilssonia schaumburgensis* TATEIWA: Plate, fig. 18.

Description of specimen: Pl. XXVI, fig. 9 shows a proximal portion of a narrow Nilssonian frond about 4 mm. broad narrowing gradually towards the base. Its rachis is prominent and impressed on the matrix as a deep groove. The lamina has entire outer margin. There is a faint indication of nerves, but their number per unit length can hardly be made out.

Remarks and discussion: YABE under the name *N. schaumburgensis* var. *parvula* distinguished from the typical form of *N. schaumburgensis* an Omoto specimen having a very narrow frond with entire margin and very fine, densely crowded nerves. As to the Japanese specimens referable to this Wealden species, *N. schaumburgensis*, which are particularly common in the rocks of the Ryôseki series throughout Japan, they are considerably variable in respect to the size of fronds and in respect to the number of nerves in a unit length, so that it is somewhat difficult to settle their limit of variation. However, the lamina of *N. schaumburgensis* is in most cases irregularly but deeply dissected into segments. Therefore, it may be convenient to some extent to distinguish such narrow form with entire margin as figured by YABE as a variety of *schaumburgensis* as was maintained by YABE.

The specimen figured in fig. 9 agrees essentially with those figured by YABE as var. *parvula*, though there is a probability that it represents an extreme form, or probably a young frond, of *N. schaumburgensis*. TATEIWA (1929) figured this type of fronds from the Naktong Series of Tyôsen as *N. schaumburgensis*. TATEIWA's specimen is refigured in Pl. XXVI, fig. 10 in this work.

This variety is closely related to *N. parvula* figured by FONTAINE[1] from Oregon which he identified with *Taeniopteris parvula* HEER from Siberia. However, HEER's specimen is, according to NATHORST,[2] not a *Nilssonia*, therefore a new specific name should be given for FONTAINE's specimens, if the latter is specifically distinct from the present Japanese specimens.

Occurrence:

Omoto, Iwate. } Ryôseki Series.
Haginotani, Kôti. }
Eidô, Tyôsen (G. S. K. Coll.). Rakutô Bed.

Nilssonia serotina HEER

Pl. XXV, Figs. 1, 2.

1878. *Nilssonia serotina* HEER: p. 19, Pl. II, figs. 1a, 2–5.
1918. *Nilssonia serotina* KRYSHTOFOVICH: p. 38.
1925. *Nilssonia serotina* ENDO: p. 8, Pl. VI, figs. 1, 3, 6, 7, 10, 17.
1927. *Nilssonia serotina* YABE: Pl. VI, fig. 3.
1930. *Nilssonia serotina* HOLLICK: p. 43, Pl. IV, figs. 1–7; Pl. V, figs. 1–5a; Pl. VII, figs. 6a, 6b, 10a; Pl. XXIX, figs. 3b, 5a; Pl. XXX, figs. 2a, 3b.

Discussion: It is exceedingly surprising that this Upper Cretaceous plant agrees in many morphological characters with *N. nipponensis*, one of the commonest elements of the Tetori flora described in this work. Specimens undoubtedly identical with this plant were already described by ENDO from the Hakobuti Sandstone (Senonian) of Hokkaidô under the name *N. serotina*, originally described by HEER from the "Miocene" of Russian Sakhalin which later was attributed by KRYSHTOFOVICH to the Upper Cretaceous. The

1) W. FONTAINE, in WARD (1905), p. 92, Pl. XVII, figs. 1–7.
2) A. G. NATHORST (1909), p. 27.

original specimens which HEER figured are characterised by the unequal and asymmetrical dissection of lamina into segments, but as similar plants are known also from the lower horizons of the Mesozoic formations under such names as *N. acuminata* PRESL, *N. nipponensis* YOK., etc., the specific delimitation by the degree of dissection of lamina into segments or the density of lateral nerves per cm. among these allied plants becomes very difficult without an idea in the difference of the geological ages, unless the distinction is aided by more reliable features.

On the other hand, it is almost beyond doubt that the present plant is identical with HEER's *N. serotina* from Russian Sakhalin which is derived from rocks almost equivalent to the Hakobuti Sandstone of Hokkaidô. Therefore, it may thus be mentioned that a type of *N. nipponensis* of the Tetori Series existed far up to the Senonian beyond the Ryôseki Series in which fronds of *N. nipponensis* type are entirely absent being replaced by an allied form, *N. schaumburgensis* (DKR.). The writer now wishes provisionally to call the present specimens under HEER's name taking into consideration the difference of the geological ages awaiting a further supply of material which may make clear the specific distinction, which the writer thinks to exist, between these geologically younger and older types.

Remarks: In Pl. XXV, fig. 1 is shown a slab of gray sandstone the surface of which is covered with many fronds of this plant. The comparison of this specimen with that of *N. nipponensis* in Pl. XXVII, fig. 1 shows that they are apparently almost indistinguishable. The density of the lateral nerves in the two species is nearly equal, that of *N. serotina* from Hokkaidô being about 25 per cm. and a little less than in *N. nipponensis*. In the original specimens from Russian Sakhalin the lateral nerves are said to be 1/2 mm. distance, therefore, about 20 per cm., moreover HEER describes that there is an indication of an interstitial which can not be seen in numerous Japanese specimens that the writer examined. HOLLICK (1930) figured many beautiful specimens from the Upper Cretaceous rocks of Alaska as *N. serotina* HR.

Occurrence:

$$\left.\begin{array}{l}\text{Hetonai}\\ \text{Hakobuti}\\ \text{Asibetu-gawa}\end{array}\right\}\ \text{Hokkaidô. Urakawa Series.}$$

Nilssonia serrulata **sp. nov.**

Pl. XXVI, Figs. 8, 8a (type-specimen).

Remarks: The specimen in Pl. XXVI, fig. 8 was already recognised by TATEIWA as a new species of *Nilssonia* and was named by him *Nilssonia serrata* sp. nov. as a manuscript name. But as the same name was given by PRYNADA[1] for a specimen from Central Asia, a new name *N. serrulata* is proposed for the present specimen, which may be defined as follows: Leaf elongated obovate, petiolate, the petiole being comparatively thick, 8 mm. long and about 2 mm. thick, 3.5 cm. long and 1.4 cm. broad in the broadest portion, notched at the apex; margin of the lamina distinctly serrate except the proximal part where it is almost entire; lateral nerves are simple, curving upwards, and about 15 in number per 1 cm.

This species is characterised by the shape of the frond, thick rachis and serrate margin of the lamina. As the lamina clearly covers the upper surface of the rachis, it is unquestionable that the specimen belongs to *Nilssonia*. A specimen from Central Asia named *N. serrata* by PRYNADA is a very fragmental one with which the present one can hardly be compared. There is also a considerable difference in the geological age of the strata which yielded PRYNADA and the writer's specimens, *N. serrata* being from the Lower Liassic strata while ours is from the Naktong Series. Therefore it is better, the writer thinks, to hold the present specimen distinct from *N. serrata*. THOMAS[2] described *N. denticulata* THOMAS from Kamenka, but it differs considerably in habit from the specimen at hand. *Taeniopteris Nilssonioides* ZEILLER[3] from Tonkin has also dentate margin, but it presents very large fronds. Similar marginal serration of the lamina can be seen also in an imperfect specimen described by the writer[4] from Nariwa as *Taeniopteris* ? sp., however, it has finer and regular serration.

Occurrence:

Kinzandô, Tyôsen. Rakutô Bed.

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1) V. PRYNADA (1931), p. 24, Pl. IV, figs. 36–37.
2) H. H. THOMAS (1911), p. 88, Pl. VII, figs. 3–5.
3) R. ZEILLER (1903), p. 78, Pl. XV, figs. 1–4.
4) S. ÔISHI (1932b), p. 333, Pl. XXVI, figs. 5, 5a.

Nilssonia simplex ÔISHI

(Type-specimen: ÔISHI, 1932b, Pl. XXVI, figs. 7–9;
Pl. XXVII, figs. 1–4).

1932b. *Nilssonia simplex* ÔISHI: p. 334, Pl. XXVI, figs. 7–9; Pl. XXVII, figs. 1–4.
1936. *Nilssonia simplex* ÔISHI and TAKAHASI: p. 127, Pl. I, fig. 9.

Diagnosis (ÔISHI, 1932b): "Frond simple, petiolate, long and narrow, linear-lanceolate, more than 17 cm. in length, broadest near the middle, where it measures 1.52 cm. in breadth, thence tapering very gradually towards both ends. Apex obtusely rounded. Rachis narrow but rigid, about 1–1.5 mm. across measured at the base, narrowing gradually upwards, with narrow longitudinal furrows on the median line of the upper surface. Nerves simple or once forking close to the rachis or rarely near the margin, parallel to each other, straight or slightly curved, with the concave side upwards, nearly at right angle to the rachis, at the proximal end running obliquely downwards in the furrow of the rachis to its median line, and numbering approximately 23 per cm. at the margin. Margin entire."

Remarks: A fragment of this species was later described from Yamanoi (ÔISHI and TAKAHASI, 1936).

Occurrence:

Nariwa (1), Okayama. Nariwa Series.
Yamanoi (17), Yamaguti. Upper Triassic.

Cfr. *Nilssonia tenuicaulis* (PHILLIPS) FOX-STRANGWAYS

Pl. XXXIV, Fig. 4.

Description of specimen: Pl. XXXIV, fig. 4 shows a portion of a Cycadophytan frond derived from Kuruma. It is more than 7 cm. long and is traversed by a rachis 1.5 mm. thick with a longitudinal median ridge. The pinnae are about 4 cm. long and 8 mm. broad, expanded at the base, slightly spaced laterally, nearly at a right angle to the rachis, and narrow towards the subacute apex. The nerves seem to be densely crowded, but their number can not be counted exactly.

The appearance of the specimen strongly resembles Jurassic *Nilssonia*, *N. tenuicaulis* (PHILLIPS). So great was the resemblance, especially to specimens figured by SEWARD[1] from Yorkshire as *N. mediana* which is synonymous to *N. tenuicaulis*, that the writer once inclined even to adopt PHILLIPS' name for the figured specimen. However, since there is a probability that the present specimen represents an impression of the back surface of a frond, it is not certain whether the pinnae are attached to the side of the rachis, as in *Pterophyllum* or to the upper surface as in *Nilssonia*. Therefore, it is now most appropriate to call the present specimen Cfr. *Nilssonia tenuicaulis*, awaiting further material which may prove its assignment to *Nilssonia* or *Pterophyllum* or to some other genera.

A similar frond but with pinnae more closely set has been described by ÔISHI and HUZIOKA[2] from Nariwa as *Pterophyllum* ? sp. aff. *N. tenuicaulis*. KAWASAKI,[3] YABE and ÔISHI[4] described from Tyôsen small fronds with narrower pinnae as Cfr. *N. tenuicaulis*.

Occurrence:

Nariwa (44), Okayama. Nariwa Series.
Kuruma, Nagano. Kuruma Bed.
Bansyô, Tyôsen. Daidô Series. (G. S. K. Coll.).
Taihô Coal-mine, Tyôsen. Daidô Series. (Sendai Coll.).

Nilssonia wakwanensis sp. nov., ex TATEIWA MS.

Pl. XXVIII, Figs. 3, 4, 4a (all the type-specimen).

Diagnosis: Frond small and slender, linear, about 4 cm. long and 1.5 cm. broad, narrowing towards the distal end; lamina deeply dissected into long and narrow segments about 1 mm. broad with obtusely or subacutely pointed apices and expanded at their bases; nerves simple (?), and 3–5 in number in each segment.

Description of specimens: Pl. XXVIII, fig. 3 is by no means a perfect specimen but shows the general habit of the frond. As this represents an impression of the back surface of the frond the lamina appears to be attached to the lateral sides of the rachis. Another specimen in Pl. XXVIII, fig. 4 shows an impression of the

1) A. C. SEWARD (1900b), p. 227, Pl. IV, figs. 1–4.
2) S. ÔISHI and K. HUZIOKA (1938), p. 87, Pl. IV, fig. 3.
3) S. KAWASAKI (1926), p. 19, Pl. V, fig. 15.
4) H. YABE and S. ÔISHI (1929), p. 86, Pl. XIX, fig. 1.

upper surface where it can be seen that the lamina fairly covers the upper surface of the rachis. In these two specimens the nerves are unfortunately not distinct, but they are in most cases likely to be simple. In some cases there are indications of branching, but the feature is very indistinct.

Remarks and comparison: This species was recognised as a new one by TATEIWA who provisionally named it *N. wakwanensis*, but the name was never published. Therefore, it is quoted here as a manuscript name. This species resembles *Ptilophyllum pecten* in habit, but the mode of segmentation does not represent pinnae like those in *Ptilophyllum*.

A similar *Nilssonia* has been described by GOTHAN[1] from the Liassic of Germany as *N. minima* GOTHAN; it shows certainly a similar habit, but the segments are falcate and their apices are fairly rounded.

Occurrence:

Tomudô, Tyôsen. Rakutô Bed.

Nilssonia Yabei TATEIWA

Pl. XXVIII, Fig. 1 (type-specimen).

1929. *Nilssonia Yabei* TATEIWA: Plate, fig. 4.

Description of specimen: Pl. XXVIII, fig. 1 shows probably a proximal portion of a *Nilssonia* frond narrowly linear in outline and more than 13 cm. long traversed by a rachis 5 mm. thick on the impression. The lamina which covers the upper surface of the rachis is deeply cleft up to the rachis into linear rather irregular segments expanded at their bases and directed somewhat forwards. Apices of segments are all missing, but it seems as if they gradually narrow. The nerves are simple as far as can be seen and number about 15 per cm.

Remarks: This species was recognised as a new species by TATEIWA, named *Nilssonia Yabei* by him and figured in his Geological Atlas of Tyôsen, No. 10 (TATEIWA, 1929). The writer who re-examined the original specimen found that the specimen was cer-

1) W. GOTHAN (1914), p. 128, Pl. XXIV, figs. 4–5; Pl. XXXVIII, fig. 1.

tainly a *Nilssonia*, but the specimen was somewhat imperfect for giving a new name for it. However, as the specimen is considerably different in segmentation of the lamina and shape of the segments from the known species of this genus, the present writer wishes provisionally to hold it as new species. The present species resembles *N. princeps* (OLDH. and MORRIS)[1] from India.

Occurrence:

Ryûsindô, Tyôsen. Rakutô Bed.

Nilssonia sp.

Pl. XXIX, Fig. 9.

Description of specimen: Pl. XXIX, fig. 9 shows a proximal part of a *Nilssonia* frond which narrows gradually towards the base. The lamina fairly covers the upper surface of the rachis and leaves a narrow space along the longitudinal median line of the rachis. The nerves are simple, about 35 per cm. and slightly oblique to the rachis. The margin of the lamina is entire.

Remarks: The present specimen is characterised by the very gradual reduction of the lamina towards the base, however, it is too imperfect to determine specifically. Somewhat comparable species are *Nilssonia simplex* ÔISHI[2] from Nariwa, *N. elegans* ARBER,[3] *Taeniopteris Thomsoniana* ARBER[4] from New Zealand, and *N. nigracollensis* WIELAND[5] from North America. However, it is not possible with certainty to identify the specimen at hand with any of these species. Afghanistan specimens described by SEWARD[6] as *N. saighanensis* SEW. is another comparable species.

Occurrence:

Takazi, Yamaguti. Kiyosue Group.

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1) A. C. SEWARD and B. SAHNI (1920), p. 29, Pl. III, fig. 23; Pl. IV, figs. 35–38; Text-fig. 5.
2) S. ÔISHI (1932b), p. 334, Pl. XXVI, figs. 7–9; Pl. XXVII, figs. 1–4.
3) E. A. N. ARBER (1917), p. 52, Pl. VIII, fig. 8; Pl. IX, figs. 1, 3.
4) E. A. N. ARBER, Ibid., p. 47, Pl. VI, fig. 4; Pl. VIII, figs. 4, 7.
5) G. R. WIELAND, in WARD (1905), p. 319, Pl. LXXIII, figs. 15a–d.
6) A. C. SEWARD (1912a), p. 29, Pl. III, figs. 47–49; Pl. VII, figs. 89, 90.

Genus *Pseudoctenis* SEWARD

Pseudoctenis brevipennis sp. nov.

Pl. XXVIII, Figs. 5–7.
(Type-specimen: Fig. 5).

Diagnosis: Frond probably short; rachis narrow, slender; pinnae set closely, oblong, sometimes ensiform, about 2.5 cm. long, 5–7 mm. broad, slightly contracted at the base, lower base lightly decurrent downwards, with rounded apex, and attached to the sides of the rachis at a wide angle; nerves prominent, parallel, forking at or near their origin, and 8–10 in number in each pinna.

Description of specimens: Three specimens from the Sôma district are at hand, of which two shown in Pl. XXVIII, figs. 5 and 6 are the best ones. They represent apical portions of fronds and are characterised by a very narrow and slender rachis and short pinnae with very prominent nerves. Another specimen in fig. 7 on the same plate shows a fragment which agrees in all respects with the preceding specimens.

Comparison: The present species resembles *P. crassinervis* SEWARD[1] from Sutherland in having prominent nerves, but in the latter the pinnae are longer and the apex is acuminated. Specimens described by SZE[2] as *Pseudoctenis* cf. *crassinervis* from China may be close to the present species, but the Chinese specimens are too imperfect to admit the comparison. Swedish specimens determined by ANTEVS[3] as cfr. *Ctenopteris cycadea* (BERGER) resemble ours more or less.

Occurrence:

Zusahara, Isigamimura } Hukusima. Ryôseki Series.

Pseudoctenis Lanei THOMAS

Pl. XXIX, Figs. 1–3.

1913. *Pseudoctenis Lanei* THOMAS: p. 242, Pl. XXIX, fig. 4; Pl. XXVI.

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1) A. C. SEWARD (1911a), p. 693, Pl. IV, fig. 69; Pl. VII, fig. 17.
2) H. C. SZE (1931), p. 59, Pl. V, figs. 5–6.
3) E. ANTEVS (1914), p. 35, Pl. IV, figs. 30–34.

THOMAS defined this species as follows: "Rachis 3 to 8 mm. broad, and marked with faint longitudinal striations. The pinnae appear to arise laterally from it at an angle of about 45°; they may reach a length of 10 cm. and a breadth of 9 mm; they are linear or linear lanceolate in shape, becoming shorter and narrower towards the apex of the frond. The margins are entire, the apex acuminate, while the pinnae taper slightly also towards the base. The lower (abaxial) margin is markedly decurrent at the base. The lamina is traversed by numerous fine parallel veins, ten of which occupy a width of about 6 mm."

Description of specimen: Pl. XXIX, fig. 1 shows a portion of a delicate frond more than 12 cm. long tapering towards the apex. The rachis is slender, about 2 mm. thick and its surface is smooth. The pinnae are linear, nearly parallel-sided, about 5 mm. broad in the middle portion of the pinnae, thence narrowing gradually both towards the base and the acuminate apex, spaced laterally, decurrent at the lower basal margin, and attached to the lateral sides of the rachis at an angle of about 50°. The nerves are parallel, and about 13 in each pinna. Another specimen in Pl. XXIX, fig. 2 and 3 shows the distal parts of a frond bearing pinnae with acuminate apices (fig. 3). Although the specimens above described do not show any organic connection, it is highly probable that they represent the same plant, because they are impressions of fronds of the same habit and were obtained from a single slab of rock.

Remarks: The present specimens appear to be almost identical with those described by THOMAS[1] from the Jurassic strata of Yorkshire as *Pseudoctenis Lanei* THOMAS. In the general habit, size and form of the frond, especially in the shape and mode of attachment of the pinnae to the rachis the present specimens agree well with the British ones, though in the latter the nerves are a little coarser than in ours and though THOMAS stated that he found only one indication of anastomosis which appears to be absent in our specimens. The specimens described by FEISTMANTEL[2] under such names as *Pterophyllum Kingianum* FEIST., *P. distans* MORR., *P. Morrisianum* OLDH. and *P. Carterianum* OLDH. represent plants having similar habit, though specifically or perhaps generically not identical. Pre-

1) H. H. THOMAS (1913), p. 242, Pl. XXIV, fig. 4; Pl. XXVI.
2) O. FEISTMANTEL (1877a), pp. 13–15.

sent specimens resemble also *Pterophyllum Footeanum* FEIST.[1] from the Madras Coast.

Occurrence:

Koyatori, Miyagi. Ogihama Series.

Pseudoctenis sp.

Pl. XXIX, Fig. 6.

Description of specimen: Pl. XXIX, fig. 6 shows a portion of a Cycadophytan frond; its external morphological features remind a person of the genus *Pseudoctenis*. The preserved portion of the rachis is 5 cm. in length, 1.5 mm. thick, and the pinnae are attached to the lateral sides of the rachis at an angle of about 45°. The pinnae are set closely, long and narrow, tapering very gradually towards an obtusely pointed apex, slightly narrowed at the base, and decurrent to the rachis. The breadth of pinnae is about 3 mm. and there are ± 13 parallel nerves in each pinna.

Remarks and comparison: The single figured specimen is examined. The specimen may belong to the genus *Pterophyllum* in the wide sense, but the lateral attachment of the pinnae to the rachis by the narrowed base rather recalls the habit of *Pseudoctenis*. It is striking that the present specimen agrees very closely with the Jurassic species, *P. eathiensis* (RICHARDS),[2] the only difference being in the size, ours being just one-half that of the Jurassic species. As the present specimen is smaller than any of those referred to RICHARDS' species the writer hesitates to identify it to them. The Japanese specimen may represent a distinct type of plant allied to *P. eathiensis*.

Occurrence:

Takazi, Yamaguti (Tôkyô Coll.). Kiyosue Group.

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1) O. FEISTMANTEL (1879), p. 209, Pl. VI, figs. 1–6; Pl. VIII, fig. 1; Pl. XVI, fig. 9.

2) A. C. SEWARD (1917), p. 584, fig. 627; Wealden Flora, Pt. II, p. 89, fig. 5.

Bennettitales

Genus *Dictyozamites* OLDHAM

Dictyozamites falcatus (MORRIS) OLDHAM

1889. *Dictyozamites indicus* var. *distans* YOKOYAMA: p. 53, Pl. X, figs. 4–10; Pl. XI, fig. 5.
1889. *Dictyozamites indicus* var. *grossinervis* YOKOYAMA: p. 55, Pl. VII, fig. 10.
1905. *Dictyozamites falcatus* YABE: p. 11, Pl. II, figs. 2–5 (non figs. 6–7, which may belong to *D. Tateiwae* ÔISHI).
1933. *Dictyozamites falcatus* SAHNI and RAO: p. 195.
1936. *Dictyozamites falcatus* ÔISHI: p. 26.

For further references, see YABE, 1905.

Remarks: YABE regards that *D. indicus* FEIST. is synonymous to *D. falcatus*, a view which the writer follows, while SAHNI and RAO retained the name *D. indicus* for fronds with pinnae similar in form to those of *D. falcatus* but much smaller in size and the meshes also much smaller. The Japanese specimens are not sufficient to allow comments on these points.

Occurrence:

Rokumambô, Yamaguti. Kiyosue Group.
Kuwasima, Yanagidani, Ozô — Isikawa. — Tetori Series.
Usimaru, Gihu. — Tetori Series.
Butudôken, Tyôsen. Rakutô Bed. (Tokyô Coll.).

Dictyozamites Kawasakii TATEIWA

Pl. XXIX, Figs. 4, 5.
(Type-specimen: TATEIWA, 1929, fig. 6).

1929. *Dictyozamites Kawasakii* TATEIWA: Plate, figs. 6a, 6b (no description).
1929. *Dictyozamites Kawasakii* TATEIWA var. *grossinervis* TATEIWA: p. 2 (list only.
1936. *Dictyozamites Kawasakii* ÔISHI: p. 27, Pl. IX, fig. 4; Text-fig. 2.

Diagnosis (ÔISHI, 1936): "Frond pinnate, large, linear, more than 12 cm. long and 11 cm. broad. Rachis 3 mm. thick. Pinnae alternate, reniform, about 5 cm. long and 3 cm. broad, with broadly rounded apex, and attached by a very short stalk or a narrow portion 4–5 mm. broad in the middle of the base to the side (or upper surface ?) of the rachis. Nerves numerous, being 25 per cm., divergent, anastomosed, the reticulum consisting of polygonal meshes 2 mm. long."

Description of specimen: Pl. XXIX, fig. 4 shows a detached pinna of *Dictyozamites*, more or less orbicular in outline, 4 cm. long and 3 cm. broad, with broadly rounded apex and with a narrow basal portion which may have passed into a petiole, if any, or with which it might have attached to the rachis. The nerves are numerous, divergent, anastomosed, and end in the whole of the outer margin. Another specimen in fig. 5 on the same plate represents also a detached pinna from Tyôsen.

Remarks: It seems almost beyond doubt that the figured specimens belong to *D. Kawasakii*, a characteristic species of the Naktong flora. It agrees with a pinna figured by ÔISHI[1] from Tomudô (ÔISHI, 1936).

This species resembles *D. reniformis* ÔISHI[2] from the Tetori Series, but is distinguished from it in that the pinnae of the latter are much shorter and more markedly cordate at the base. The existence of *D. Kawasakii* in the Tetori Series is thus almost unquestionable.

Occurrence:

Kami Usaka-mura, Hukui. Tetori Series. (T. S. M. Coll.).
Tomudô, Ryûsindô } Tyôsen. Rakutô Bed. (G. S. K. Coll.).

Dictyozamites Imamurae ÔISHI

1936. *Dictyozamites Imamurae* ÔISHI: p. 27, Pl. IX, figs. 2, 2a; Text-fig. 1.

Remarks: This species was described upon a somewhat imperfect specimen from Kuwasima which is however distinct in the shape of pinnae from the previously known species of *Dictyozamites*. The characteristic features of this species are more or less linear

1) S. ÔISHI (1936), p. 29, Pl. IX, fig. 4.
2) S. ÔISHI, Ibid., p. 29, Pl. IX, figs. 1, 1a.

pinnae and the rounded apex with densely crowded reticulate nervation.

Occurrence:

Kuwasima, Isikawa. Tetori Series.

Dictyozamites reniformis ÔISHI

1936. *Dictyozamites reniformis* ÔISHI: p. 29, Pl. IX, figs. 1, 1a.

Remarks: This species is a remarkable and very striking one as the pinnae are reniform as in *D. Kawasakii* and have a distinct short stalk. In regard to the pinnae, the writer described them as follows: "the pinnae are reniform in outline, 2.5–3.5 cm. in diameter, convex in their upper surface, short stalked, the stalk being about 5 mm. long and 3 mm. thick, set closely, and filled with reticulum consisting of fine meshes with their longer axis. 1 mm. long radiating from the top of the stalk and distributed in almost equal density over the lamina."

The specimen strongly suggests *Chiropteris*. But as pinnate specimens of the genus are not yet known to the writer, it is appropriate to use the generic name *Dictyozamites* for the present specimen.

Occurrence:

Yambara, Hukui. Tetori Series.

Dictyozamites Tateiwae ÔISHI

1905. *Dictyozamites falcatus* YABE (pars): p. 11, Pl. II, figs. 6–7 (non figs. 2–5).
1936. *Dictyozamites Tateiwae* ÔISHI: p. 28, Pl. IX, fig. 3; Text-fig. 3.

Description (ÔISHI, 1936): "Frond of unknown size and shape; pinnate, traversed by a strong rachis 5 mm. broad. Pinnae sessile, alternate, set closely, elongated triangular in form, upper margin straight, the lower convex, abruptly curving upwards at the distal portion, ± 6 cm. long, ± 2.5 cm. broad at the base, tapering towards the bluntly pointed apex, attached at a wide angle to the upper surface of the rachis by a narrow portion slightly above the middle of the base. Basal free portion nearly straight, its upper and lower margins rounded and not prominently auriculate. Nerves dense, divergent, ending in outer margin, and anastomosed, meshes in the median central region being 5–10 mm. long and 0.7 mm. broad, becoming shorter and narrower towards the margin."

As was already discussed, this species is similar to *D. falcatus* in shape, but more than twice as large as that species. Although the limit of variation of *D. falcatus* is not yet known, the comparatively large number of specimens figured under the name of *D. falcatus* display the existence of only a little variation in regard to the size of the pinnae. Therefore it may be better to hold the present specimen as distinct from *D. falcatus*.

Occurrence:

Tomudô } Tyôsen. Rakutô Bed,
Eidô }

Genus *Otozamites* F. W. BRAUN

Otozamites Beani (LINDLEY and HUTTON) BRONGNIART

Pl. XXIX, Figs. 7, 8a.

1832. *Cyclopteris Beani* LINDLEY and HUTTON: Pl. XLIV.
?1864. *Otopteris mediana* LECKENBY: p. 78, Pl. X, fig. 2.
1875. *Otozamites Beani* SAPORTA: p. 128, Pl. XXV, fig. 2.
1875. *Otozamites marginatus* SAPORTA: p. 168, Pl. XXXIX, figs. 1, 1a, 1b.
?1881. *Otozamites Trevisani* ZIGNO: p. 99, Pl. XXXVII, figs. 7–8.
1900b. *Otozamites Beani* SEWARD: p. 207, Pl. I, figs. 3–4; Pl. II, fig. 3.

Description of specimens: Some detached pinnae are examined. Pl. XXIX, fig. 8a shows broad deltoid pinnae, 2 cm. long and 2 cm. broad, with rounded apex. The bases are somewhat asymmetrical, but not so strongly auriculate as is usually the case in the genus *Otozamites*. Nerves originating from the point of attachment about 2 mm. broad are often forking, straight, numerous, and radiate to the margin of the lamina. Another specimen in fig. 7 is an imperfect pinna which is indistinguishable in its characteristic form from the preceding ones.

Remarks: The Japanese specimens agree with a certain specimen of *O. Beani* from Yorkshire figured by SEWARD in his Jurassic

Flora, Pt. II, Pl. I, fig. 4. The existence of this species in Japan is thus almost unquestionable.

Occurrence:

Takazi, Yamaguti. Kiyosue Group. (Tôkyô Coll.).

Otozamites Huzisawae ÔISHI and HUZIOKA

1938. *Otozamites Huzisawae* ÔISHI and HUZIOKA: p. 89, Pl. V. figs. 1, 1a.

Diagnosis (ÔISHI and HUZIOKA, 1938): "Frond large, but of unknown size and shape, probably oval and 12 cm. broad measured in the middle portion of the preserved specimen. Rachis 4 mm. thick measured at the broken distal end. Pinnae long and narrow, nearly 7 cm. long and 5 cm. broad, straight or slightly falcate, tapering gradually towards an obtusely pointed apex and making a wide angle to the rachis. Base of pinnae asymmetrical, inserted on the upper side of the rachis by a part of the base, that of opposite and lateral pinnae overlapping. Anterior basal part lightly auriculate; posterior basal part round and non-auriculate, with a broad gentle curve towards the inner side. Nerves densely crowded, divergent, forking frequently at variable distances from the base, and numbering 20–25 at the middle of each pinna."

Remarks: This species is represented by a single specimen from the Nariwa district, but is distinctively characterised by the tolerably large frond and the remarkable long and narrow pinnae. Comparable species are *O. latior* SAP. and *O. pterophylloides* BRONGN. a comparison with which has already been made by ÔISHI and HUZIOKA (1938, p. 89).

Occurrence:

Nariwa (47), Okayama. Nariwa Series.

Otozamites Kondoi sp. nov.

Pl. XXX, Figs. 1, 2a, 3, 4.

(Type-specimen: Fig. 1).

Diagnosis: Frond long and narrow, linear, attaining more than 30 cm. in length and 3 cm. in breadth; rachis narrow, about 2 mm. thick; pinnae alternate, short and broad, about 1.5 cm. long and slightly broader than 1 cm., the shape varying from oval with bluntly rounded apex in the distal portion to broadly oval with rounded apex in the proximal portion of the frond, set closely, and obliquely inserted on the upper surface of the rachis; the base almost symmetrical, being not conspicuously auriculated; nerves spreading from the broad point of attachment into the lamina, nearly parallel, almost undivided except near their origin, and ending in the outer margin.

Description of specimens: Pl. XXX, fig. 1 (Sendai, Reg. No. 22117) represents the type-specimen on which the above diagnosis is based. It measures 30 cm. long, though both the ends are broken; (the lower half of the specimen has been omitted in the photograph as that part is badly preserved for reproduction as a photograph). Therefore, it might have attained at least 40 cm. long in its complete state.

Figs. 2a (Sendai, Reg. No. 22119), 3 (Sendai, Reg. No. 22119) and 4 (Sendai, Reg. No. 22120) on the same plate represent portions of linear fronds which can not be distinguishable from the preceding specimen.

Remarks: The tolerably long, narrow and linear habit of the frond is one of the characteristic features of this species. Another characteristic feature is the considerably broad point of attachment of the lamina to the rachis, therefore, the nerves take nearly parallel courses towards the outer margin of the pinna and are not so divergent as is usually the case in most species of the genus *Otozamites*. The presence of calosity is not clear in the specimen.

Comparison: Certain specimens of *Otozamites Molinianus* ZIGNO[1] from the Italian Jurassic somewhat resemble the present specimens differing however in that the pinnae, if correctly drawn, are auriculated and imbricated at their bases, and the nerves are more crowded. The present species is not unlike *O. Beani* (L. and H.), but in the latter the nerves are more divergent and crowded.

The specific name is dedicated to Dr. S. KONDÔ, the collector of the specimen. *O. Canossa* ZIGNO[2] agrees, in the form of the frond, in its oblong pinnae and also in the nervation, with *O. Molinianus* ZIGNO.

1) A. de ZIGNO (1873–85), p. 92, Pl. XXXVI, figs. 1–5.
2) A. de ZIGNO, Ibid., p. 95, Pl. XXXVII, figs. 3–4.

O. Kondoi is a species morphologically close to the genus *Zamites* in the sense of HALLE, because the base of the pinnae is almost symmetrical, the development of auricle is very weak and the nerves are nearly parallel to each other.

Occurrence:

Ôsima, Miyagi. Ôsima Plant Beds. (Sendai Coll.).

Otozamites Klipsteinii (DUNKER) SEWARD

Pl. XXIX, Fig. 8b; Pl. XXX, Fig. 6; Pl. XXXI, Fig. 2.

1846. *Cyclopteris Klipsteinii* DUNKER: p. 11, Pl. IX, figs. 6–7.
1871. *Aneimidium Klipsteinii* SCHENK: p. 213, Pl. XXXI, fig. 6.
1895. *Otozamites Klipsteinii* SEWARD: p. 60, Pl. I, figs. 3–4; Pl. VII.
1913. *Otozamites Klipsteinii* SEWARD: p. 99, Text-fig. 5.
1917. *Otozamites Klipsteinii* SEWARD: p. 544, fig. 608.
1932. *Otozamites* spp. ÔISHI: p. 9, Pl. III, figs. 3–4.

Description of specimens: A good number of detached pinnae are examined. Pl. XXX, fig. 6 shows an oblong pinna 6 cm. long and 1.5 cm. broad with broadly rounded apex. The base is slightly asymmetrical with broadly rounded edges. The nerves are numerous, forking at variable distances from their origin, straight, radiating from the point of attachment about 4 mm. broad to the margin of the lamina. The density is about 18 per cm. in the middle portion. Another specimen in Pl. XXXI, fig. 2 represents a larger pinna imperfect in its lower apical portion. It is more than 7 cm. long, possibly attaining at least 8 cm. and 3.5 cm. broad. The base is slightly asymmetrical, but not so conspicuously auriculate, like the preceding specimen. The nerves are just like the preceding specimen.

Remarks: As SEWARD[1] pointed out, the pinnae of this species are subjected to a considerable variation in respect to the size and in the relation of breadth to length. SEWARD recognised two varieties, namely, var. *superba* and var. *longifolia*, besides the typical form.

The Japanese specimens referred to this species also vary considerably particularly in size, and two extreme forms have been figured in Pl. XXX, fig. 6 and Pl. XXXI, fig. 2. Two imperfect detached pinnae of *Otozamites* described by the writer (1932) as

1) A. C. SEWARD (1895), pp. 65–68.

Otozamites spp. from Sitaka may be the present species. *O. giganteus* THOMAS[1] from the Jurassic of Kamenka is a species very closely allied to the present one.

O. Klipsteinii is the characteristic Wealden species in Europe, while in Japan it seems to occur also from a slightly lower horizon.

Occurrence:

Takazi, Yamaguti. Kiyosue Group. (Tôkyô Coll.).
? Kuwasima, Isikawa. Tetori Series.
Tanzaki, Wakayama. } Ryôseki Series.
Ueno, Kôti. }

Otozamites lancifolius ÔISHI

1932b. *Otozamites lancifolius* ÔISHI: p. 318, Pl. XXIV, figs. 6, 6a.

Diagnosis (ÔISHI, 1932b): "Frond elongate-ovate in outline, broadest at a short distance below the apex towards which it contracts rather abruptly and towards the base gradually. Pinnae closely set, alternate, elongate-lanceolate in outline, straight or slightly falcate, with the upper margin concave and the lower proximally straight and distally convex, ending at a subacute apex. Base of pinnae asymmetrical, inserted on the upper side of the rachis by a part of base, sometimes with callosity, that of opposite and lateral pinnae overlapping. Anterior basal part markedly auriculate, with its inner side nearly straight and the upper margin gently curved upwards; posterior basal part gently subacutely rounded. Nerves densely crowded, divergent, forking frequently at variable distances from the base, numbering approximately 14 per 1/2 cm. at the middle of pinnae."

Remarks: This species is represented by a single nearly complete frond attaining about 20 cm. in length. It resembles *O. Huzisawae* Ô. and H. which occurs in association with this species, but in that species the pinnae are more linear and the nervation is denser.

Suggestion: In the Nariwa district, *Otozamites* fronds occur in a single locality (47) and are never found in any other localities

1) H. H. THOMAS (1911), p. 84, Pl. VI, figs. 1–2.

of the district; the following species have been discriminated from that locality, namely *O. lancifolius* ÔISHI, *O. Molinianus* ZIGNO, *O. Huzisawae* ÔISHI and HUZIOKA and *O.* sp. The writer regards it certain that each represents a distinct type, at least so far as the present materials are concerned, except the last one specifically indeterminable, but it may be suggested at the same time that each might represent a type of different stage of growth of one species. But this is merely imaginative. A further supply of material from the same locality may solve this question.

Occurrence:

Nariwa (47), Okayama. Nariwa Series.

Otozamites Molinianus ZIGNO

Pl. XXXI, Figs. 3, 3a, 4.

1885. *Otozamites Molinianus* ZIGNO: p. 92, Pl. XXV, figs. 1–3; Pl. XXXVI, figs. 1–5.
1894. *Otozamites obtusus* BARTHOLIN: p. 93, Pl. II, figs. 6, 6a; Pl. III, figs. 2, 2a.
?1907. *Otozamites* sp. cf. *O. obtusus* var. *ooliticus* SEWARD: p. 11, Pl. I, fig. 13.
1932b. *Otozamites indosinensis* ÔISHI (non ZEILLER): p. 319, Pl. XXIV, fig. 7.

Description of specimens: Frond linear lanceolate, more than 8 cm. long, 2.5 cm. broad, tapering gradually towards the apex obtusely rounded; pinnae alternate, short, ovate, upper margin nearly straight, lower convex and rounded off at the apex; base of pinnae asymmetrical, inserted on the upper surface of the rachis by a part of base forming a wide angle with the rachis, that of opposite and lateral pinnae set closely, anterior basal edge lightly auriculate, posterior basal edge rounded; nerves densely crowded, divergent from a part of the base, forking frequently at variable distances from their origin, numbering approximately 25 at the middle of pinnae.

Remarks: The above description was based on the specimen in Pl. XXXI, fig. 3 which is the best one in the collection. Another specimen in Pl. XXXI, fig. 4 shows a proximal portion of two fronds arranged side by side, of which the left one shows that the fronds narrow proximally.

The present specimens can not be distinguished in several points from Oolitic species described by ZIGNO[1] under the name *Otozamites Molinianus* ZIGNO. The habit of the frond and size and form of pinnae in the present specimens agree well with the type specimens. Cases described by ZIGNO[2] as *O. Feistmantelli* seems to be hardly distinguishable from *O. Molinianus,* though it is smaller in size than the latter.

O. Molinianus ZIGNO has been described by MOELLER[3] from Bornholm; the specimens, though somewhat fragmental, agree well with the type-specimen of ZIGNO and also with the present specimens. An imperfect specimen described by SEWARD[4] from Caucasia under the name *Otozamites* sp. cf. *O. obtusus* (L. and H.) var. *ooliticus* SEWARD seems to be almost indistinguishable from *O. Molinianus*. A specimen described by THOMAS[5] from Kamenka as *O. iziumensis* is a species closely allied to the present one. The writer thinks that a fragment described from Nariwa as *O. indosinensis* ZEILL. (ÔISHI, 1932b) is rather referable to *O. Molinianus* because it resembles more closely the apical portion of the specimen in Pl. XXXI, fig. 3 than *O. indosinensis* which is imperfectly known.

Occurrence:

Neiridani, Toyama. Kuruma Bed.

Otozamites Sewardi sp. nov.

Pl. XXXI, Figs. 1, 1a (type-specimen).

1895. *Otozamites Goeppertianus* SEWARD (non DUNKER): p. 70, Pl. I, figs. 1–2; Text-fig. 4.
1917. *Otozamites Goeppertianus* SEWARD (non DUNKER): p. 544, fig. 603,A.

Description of specimen: Pl. XXXI, fig. 1 shows an *Otozamites* frond, of which the distal and apical portions are missing. It is more than 12 cm. long and 4 cm. broad, linear, and is traversed by a strong rachis. The pinnae are long and narrow, straight or oc-

1) A. de ZIGNO (1873–85), p. 92, Pl. XXXV, figs. 1–3; Pl. XXXVI, figs. 1–5.
2) A. de ZIGNO, Ibid., p. 90, Pl. XXXIV, figs. 6–8.
3) H. MOELLER (1903), p. 17, Pl. III, figs. 3–5; Pl. IV, figs. 7–10.
4) A. C. SEWARD (1907), p. 11, Pl. I, fig. 13.
5) H. H. THOMAS (1911), p. 83, Pl. V, fig. 11.
6) W. DUNKER (1846), p. 14, Pl. II, fig. 5.

casionally falcate, set closely, tapering towards an acuminate apex, the base is asymmetrical, the upper basal edge being slightly auriculate, and the lower rounded, and attached to the middle of the upper surface of the rachis. The nerves are radiating outwards from the base and number about 13 at the middle of the pinnae.

The specimen is fairly well preserved, however, the basal region along the rachis is somewhat obscure. It is very possible that the auriculation of the upper basal edge is not very strong. Therefore, it seems that the pinnae are not overlapping at their bases even though they are set pretty closely.

Remarks and discussion: The present new species appears to be specifically identical with the British Wealden specimens which SEWARD (1895) identified to *Otozamites Goeppertianus* (DUNKER), a species originally described by DUNKER from the German Wealden as *Pterophyllum Goeppertianum* DKR. In his Wealden flora, Vol. II, SEWARD figured some *Otozamites* fronds which he believed to be specifically identical with *Pterophyllum Goeppertianum* DUNKER, but he employed the generic name *Otozamites* on the ground that the British specimens which apparently are indistinguishable from the German specimens represent the characteristic features of *Otozamites*.

Recently, MICHAEL[1] wrote, upon the basis of additional material, that DUNKER's species does not belong to the genus *Pterophyllum* but to *Nilssonia* and he called DUNKER's species *Nilssonia Goepperti* (DUNKER). Unfortunately, MICHAEL and SEWARD do not seem to have examined the type-specimen of *Pterophyllum Goeppertianum*, therefore, it is somewhat questionable whether the type-specimen belongs actually to the genus *Nilssonia*, although it appears that MICHAEL examined a specimen indistinguishable from the drawing of the type-specimen.

Therefore, the best way is to give a new specific name for the present specimens with which *Otozamites Goeppertianus* figured by SEWARD appears to be almost identical. The only difference to which any importance could be attached is that the pinnae of the Japanese specimen is set closely and the base seems to be less auriculated than in the British specimens. Only a specimen figured in SEWARD's Fossil Plants, Vol. III, p. 538, fig. 603A shows a close

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1) F. MICHAEL (1936), p. 54.

resemblance with the present specimen in regard to the closely set pinnae.

In connection with this view, attention must be given to *O. latior* SAPORTA,[1] a Rhaetic species. It is habitually very closely allied to the present species, and it seems to be very difficult to separate the two species. However, in SAPORTA's species, if the figures are correctly drawn, the upper basal edge of the pinnae is strongly auriculated and the lower is nearly straight, and moreover the nerves are spread out from the lower edge of the base. The writer believes that the two are specifically distinct, though very closely related to each other.

Occurrence:

Simoyama (associated with *Perisphinctes*), Hukui. Tetori Series. Coll. by R. NAKAMURA.

Otozamites sp.

Pl. XXX, Fig. 5.

Description of specimen: Two specimens are examined of which the one is the counterpart of the other. Pl. XXX, fig. 5 shows a portion of an *Otozamites* frond consisting of a stout rachis 4 mm. across measured on the flattened impression, on the upper surface of which are inserted pinnae obliquely. The pinnae are set closely, alternate, linear, 2 cm. long, 8 mm. broad, nearly parallel-sided, the upper margin being nearly straight, the lower slightly convex forming a gentle curve towards the acute distal margin. The basal character is unfortunately not clearly represented in the specimen, however, the base is, so far as can be seen, not so strongly auriculated, accordingly not conspicuously asymmetrical. The nerves are numerous, diverging, frequently forking, ending at the margin of the lamina and about 25 in number at the middle of each pinna.

Remarks: The present specimen, though fragmentary does not appear identical with any known species of *Otozamites* at least those described from the Japanese Mesozoic rocks. It is not unlike the specimens identified with *O. Molinianus* ZIGNO described in this work, but in those the pinnae are shorter and the rachis is slender.

1) G. de SAPORTA (1875), p. 130, Pl. XCVII, figs. 1–6; Pl. XCVIII, figs. 1–3.

Among the exotic species, the present specimens seem to be closely allied to those figured by ZIGNO[1] as *Ptilophyllum grandifolium* ZIGNO. Though ZIGNO brought the specimens to the genus *Ptilophyllum*, the enlarged figure represented in his work (his Pl. XXXII, fig. 5) shows that the nerves are numerous and divergent ending in the margin of the lamina. The writer can not make any further statement as to the generic affinity of the specimens without examining the type-specimens, however the features pointed out above show that ZIGNO's species are more suggestive of the genus *Otozamites* than of *Ptilophyllum*.

Occurrence:

Neiridani, Toyama. Kuruma Bed.

Genus *Pseudocycas* NATHORST

Pseudocycas? acutifolia sp. nov.

Pl. XXXIII, Figs. 2, 3, 3a.
(Type-specimen: Fig. 3).

Description: Frond of unknown form, reaching probably a considerable size; rachis 1 mm. thick in the apical portion and becoming thicker proximally, with faint longitudinal striation on its surface; pinnae long and narrow, straight, rigid, acuminated at apex, set apart, the distance being about 1 cm. on each side of the rachis, lower basal margin strongly decurrent downward, opposite or alternate, and attached at an acute angle to the lateral sides of the rachis; nerves prominent, 2–3 at their origin, parallel, straight, and rarely forking.

Discussion: The generic position of this curious plant is not certain. The writer has placed it provisionally in the genus *Pseudocycas* taking into consideration the general habit of the frond and the nerves of the pinnae which are 2–3 in number, in *Cycadites* uninerved.

The present specimen looks also like a coniferous plant. However, the decurrent bases and the lateral insertation of the pinnae to the rachis recall a Cycadophyta rather than a Conifer.

Comparison: So far as the writer is aware there is no other

1) A. de ZIGNO (1873–85), p. 62, Pl. XXXII, figs. 3–5.

species comparable to the present form. Somewhat comparable forms are *Cycadites Rumpfii* SCHENK as figured by COMPTER[1] and a curious plant which SEWARD[2] described from the British Wealden formation under the new generic name *Becklesia* with a monotypic species *B. anomala* SEWARD. As to the former the author can not make any statement regarding the generic discussion based on COMPTER's illustrations, but it is quite obvious that COMPTER's specimens differ at least specifically from the present specimen in having pinnae far distantly placed. *Becklesia* is a peculiar plant of coniferous affinity. It is said to have a stout axis to which stout and stiff branches are attached in different positions, either laterally or on the surface, and at irregular intervals. Such mode of attachment of branches differs fundamentally from that of the present specimens which accordingly do not belong to the category of *Becklesia*.

Finally, the most closely allied plant is *Dichotozamites cycadopsis* (FONTAINE) described by FONTAINE[3] as *Sequoia cycadopsis* from the Potomac Formation of North America and later considered by BERRY[4] as a new genus, *Dichotozamites* BERRY, which he regarded to be a Cycadophytan frond. It is indeed striking that the present specimens resemble *Dichotozamites cycadopsis* in general habit, expecially in respect to the shape and mode of attachment of pinnae and several other points, differing only in the nervation; BERRY says that in *Dichotozamites* there are short, simple secondary nerves given off from the midnerve at nearly a right angle and persisting to the margin of the pinnae. Though the general features agree very closely between these American and the Japanese specimens, in respect to the secondary nerves alone there is an important difference. The writer thinks that this distinction is of generic value, and hesitates to apply BERRY's generic designation to the present specimen. The author wishes provisionally to call the specimens *Pseudocycas ? acutifolia*.

Occurrence:

Kowasimizu, Hukui. Kuwasima, Isikawa.	Tetori Series.

1) G. COMPTER (1874), p. 8, Pls. XVI–XVII, figs. 5–7.
2) A. C. SEWARD (1895), p. 179, Pl. XIV, figs. 2–3.
3) W. FONTAINE (1889), p. 243, Pl. CXII, figs. 9–11; Pl. CXIII, figs. 1–3: in WARD (1905), p. 489, Pl. CIX, fig. 11.
4) E. W. BERRY (1911), p. 364.

Pseudocycas? sp. indet.

Pl. XLVIII, Fig. 6.

The specimen in Pl. XLVIII, fig. 6 is very similar to *Pseudocycas*, but it is somewhat too imperfect for generic determination. As may be seen in the figure, the pinnae which are nearly at a right angle to the rachis are long and narrow and linear, being more than 2 cm. long and 1.5–2 mm. broad, and attached to the comparatively broad rachis at a right angle. It is unfortunate that the characteristic double midrib of the genus *Pseudocycas* is not clear, only a well-defined midrib being seen in each pinna. As NATHORST wrote, the "double midrib" in *Pseudocycas* is often hardly recognisable on the direct surface of the specimen unless they are favourably preserved or are macerated. The specimens from the Lower Cretaceous rocks of Manchuria which the writer recently obtained through the courtesy of Prof. UWATOKO appear as if there were only a single midrib as in *Cycadites*, but macerating in SCHULTZ's solution the writer obtained beautiful cuticular preparations showing the characteristic double midrib. Such being the case, the probability of the present specimens being *Pseudocycas* is not weakened merely on the ground that the midrib is apparently simple. It may be suggested that among the known fossil plants, the present specimen is very close to *P. pumilio* NATH. from the Cenomanian of Greenland.[1)]

Occurrence:

Tomudô, Tyôsen. Rakutô Bed. (G.S.K. Coll.).

Genus *Pterophyllum* BRONGNIART

Pterophyllum aequale (BRONGNIART) NATHORST

1824. *Nilssonia? aequale* BRONGNIART: p. 219, Pl. XII, fig. 6.
?1878. *Pterophyllum aequale* NATHORST: p. 18, Pl. II, fig. 13; p. 48, Pl. VI, figs. 8–11.
?1879. *Pterophyllum aequale* NATHORST: p. 67, Pl. XV, figs. 6–10.
?1883. *Pterophyllum aequale* SCHENK: p. 247, Pl. XLVIII, fig. 7.
1903. *Pterophyllum aequale* ZEILLER: p. 194, Pl. LXIX, figs. 4–7.
1919. *Pterophyllum aequale* ANTEVS: p. 27, Pl. III, figs. 5–6.
1920. *Pterophyllum aequale* YABE: Pl. V, fig. 11.

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1) A. G. NATHORST (1907b), p. 7, Pl. I, figs. 6, 7.

1926. *Pterophyllum aequale* KAWASAKI: p. 27, Pl. VIII, fig. 24.
1929. *Pterophyllum aequale* YABE and ÔISHI: p. 93, Pl. XVIII, fig. 4; Pl. XX, fig. 3.
1931. *Pterophyllum aequale* SZE: p. 11, Pl. II, fig. 5.
1933a. *Pterophyllum aequale* SZE: p. 20, Pl. IV, figs. 2–7.
1938. *Pterophyllum aequale* ÔISHI and HUZIOKA: p. 85, Pl. IV, figs. 4, 4a.

Remarks: Though Cycadophytan fronds agreeing in general habit with BRONGNIART's *Nilssonia*? *aequale* are rather common in Asia and several such specimens have been called under the name *Pterophyllum aequale* (BRONGN.), it may sometimes be difficult to distinguish specific types among such and some other specimens described under the names *P. contiguum* SCHENK, *P. Schenki* ZEILLER and *P. Jaegeri* BRONGNIART on their external characters. HARRIS' recent investigation of cuticle of *Pterophyllum*-fronds from Greenland[1] suggests strongly this point. However, it may generally be seen that *P. contiguum* which is sometimes considered to be specifically identical with *P. Nathorsti* SCHENK has a coarser nervation and *P. Schenki* has typically broader and rather quadrate pinnae, compared with *P. aequale*. Specimens described by JOHANSSON[2] from Sweden as *P. aequale* are, according to HARRIS (1937, p. 51) who examined the cuticle, identical with *P. Schenki*; he regards also that some of the specimens described by NATHORST (1978 and 1979) from Sweden as *P. aequale* may be *P. Schenki*. SZE (1931, 1933a) described *P. aequale* from China, and a similar plant was described by KAWASAKI (1925, p. 41) from Tyôsen as cfr. *Anomozamites Nathorsti* (SCHENK).

Occurrence:

Nariwa (47, 50), Okayama. Nariwa Series.
Hakuunzi, Tyôsen. Daidô Series. (G. S. K. Coll.).

Pterophyllum angustum (BRAUN) GOTHAN

1914. *Pterophyllum angustum* GOTHAN: p. 134, Pl. XXVI, fig. 3.
1919. *Pterophyllum angustum* ANTEVS: p. 30, Pl. IV, figs. 3–7.
1929. *Pterophyllum angustum* YABE and ÔISHI: p. 96, Pl. XVIII, fig. 5; Pl. XIX, figs. 5, 5a, 6.
1938. *Pterophyllum angustum* ÔISHI and HUZIOKA: p. 85, Pl. IV, figs. 5–6.
For further references see GOTHAN (1914) and ANTEVS (1919).

1) T. M. HARRIS (1932a).
2) N. JOHANSSON (1922), p. 33, Pl. V, figs. 15–17; Pl. VIII, figs. 22–23.

Remarks: This species is better known under the name *P. Braunianum* GOEPPERT which is, according to GOTHAN (1914) and ANTEVS (1919), synonymous to *P. angustum*. The Japanese specimens identified to this species are derived from Nariwa (ÔISHI and HUZIOKA, 1938) and represented by very fragmentary specimens. The known morphological features agree well with Swedish specimens figured by ANTEVS as *P. angustum* and it is very difficult to find any differences between them except that the transverse wrinkles on the rachis are wanting in the present specimens.

A few years ago the writer[1] described cfr. *Pterophyllum angustum* (BRAUN) from Tung-ning in Manchoukuo. The specimens are represented by several well-preserved fronds which are hardly distinguishable from typical specimens of *P. angustum* figured by ANTEVS from Sweden. The chief reason for which the writer hesitates to refer the specimens directly to BRAUN's species is that the Manchurian specimens were derived from strata which are regarded to be approximately Upper Jurassic. The absence of transverse wrinkles on the rachis is another point which does not agree with the Swedish specimens.

Occurrence:

Nariwa (89), Okayama. Nariwa Series.

Pterophyllum ctenoides ÔISHI

(Type-specimen: ÔISHI, 1932b, Pl. XXIII, figs. 1–3; Pl. XXIV, fig. 1).

1932b. *Pterophyllum ctenoides* ÔISHI: p. 314, Pl. XXIII, figs. 1–3; Pl. XXIV, fig. 1.

Diagnosis (ÔISHI, 1932b): "Frond of unknown size, being more than 15 cm. in length and 12 cm. in breadth. Rachis nearly 1 cm. across in the lower portion of frond, measured on the flattened surface, narrowing gradually upwards to 1 mm. in breadth near the apex; surface of rachis with longitudinal striations. Pinnae attached to the lateral sides of the rachis, nearly at right angles at the distal and oblique at the apical portion of the frond, closely set, nearly uniform in breadth, which is 1 cm. as a whole, or narrowing gradually towards the base but expanding slightly just before join-

1) S. ÔISHI (1935a), p. 88, Pl. VIII, fig. 1A; Text-fig. 5.

ing the rachis. Nervation coarse; nerves, about 1 mm. apart, forking occasionally near the rachis but never anastomosing, lamina between the nerves elevated as ridge directing convex side upwards."

Remarks: Among the additional material of fossil plants from Nariwa, the writer found a specimen in which the pinnae are at least 10 cm. in length, but their apices are lacking. Therefore the frond might have attained a considerable dimension in breadth as well as in length. The comparison with allied species, namely, *P. Medlicottianum* OLDH. and MORRIS and *Pseudoctenis ensiformis* HALLE has already been made in 1932 (ÔISHI, 1932b).

Occurrence:

Nariwa (46), Okayama. Nariwa Series.

Cfr. *Pterophyllum distans* MORRIS

1932b. Cfr. *Pterophyllum distans* ÔISHI: p. 315, Pl. XXIII, fig. 4.

Remarks: The example provisionally identified to this Indian Jurassic species[1)] is represented by a single imperfect specimen derived from Nariwa, consisting of a rachis and linear pinnae narrowing gradually towards a narrow apex and distantly attached to the sides of rachis nearly at a right angle. It is by no means certain that this rare Indian species really is represented in the Nariwa flora but the writer dared provisionally to assign the specimen to that species as the resemblance is closer than to any other species of *Pterophyllum* ever described.

Occurrence:

Nariwa (62), Okayama. Nariwa Series.

Pterophyllum Jaegeri BRONGNIART

1850. *Pterophyllum Jaegeri* UNGER: p. 287.
1851. *Pterophyllum Jaegeri* BRONN and ROEMER: Pt. III, p. 37, Pl. XII, fig. 1.
1865. *Pterophyllum Jaegeri* HEER: p. 52, Pl. III, fig. 2.
1872. *Pterophyllum Jaegeri* SCHIMPER: p. 134, Pl. LXX, fig. 7.
1875. *Pterophyllum Jaegeri* SAPORTA: p. 43, Pl. LXXX, fig. 1.

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1) O. FEISTMANTEL (1877a), p. 176, Pl. V, fig. 1; Pl. VI, fig. 1.

1877a. *Pterophyllum Jaegeri* HEER: p. 79, Pl. XXXI, figs. 1–4; Pl. XXXII, figs. 1–2.
1903. *Pterophyllum Jaegeri* LEUTHARDT: p. 14, Pl. V, figs. 1–3; Pl. VI, figs. 1–2; Pl. X, fig. 1.
1929. *Pterophyllum Jaegeri* YABE and ÔISHI: p. 95, Pl. XIX, fig. 4; Pl. XX, fig. 4.
1931f. *Pterophyllum Jaegeri* ÔISHI: p. 246, Pl. III, fig. 3.
1932b. *Pterophyllum Jaegeri* ÔISHI: p. 312, Pl. XXII, figs. 8–12.

Remarks: This species was described by the writer from Nariwa (1932b) and Kita-Otari (1931f). Specimens derived from Nariwa agree well with *P. Jaegeri* as figured by HEER and LEUTHARDT from Swiss Keuper beds, while a single specimen from Kita-Otari is fragmentary. A typical specimen of this species is characterised by long and narrow, linear pinnae which are laterally spaced and attached to the lateral sides of the rachis nearly perpendicularly.

Occurrence:

Nariwa (44, 47, 50), Okayama. Nariwa Series.
Kuruma, Toyama. Kuruma Bed.

Pterophyllum Lyellianum DUNKER ?

Pl. XXXIII, Figs. 4, 4a.

1846. *Pterophyllum Lyellianum* DUNKER: p. 14, Pl. VI, figs. 1–2.
1871. *Pterophyllum Lyellianum* SCHENK: p. 230, Pl. XXXIV, figs. 1–2.
1895. *Anomozamites Lyellianus* SEWARD: p. 91, fig. 6.
1936. *Pterophyllum Lyellianum* MICHAEL: p. 44, Pl. III, fig. 5; Pl. IV, fig. 8.

Description of specimen: A single imperfect specimen is examined. It is shown in Pl. XXXIII, fig. 4. The rachis is about 1.5 mm. thick measured on the impression. The pinnae are long and narrow, linear, straight, set closely, 2 mm. broad and slightly longer than 2 cm., with subacute apex and attached to the rachis at a wide angle. It is not clear whether the pinnae are attached to the lateral sides or cover the upper surface of the rachis, but so far as can be seen in the present specimen they seem to be attached to the sides unless the impression represents the back side of the frond. There is a faint indication of some parallel nerves, but the exact number in each pinna can hardly be made out.

Remarks: Unfortunately the specimen is too imperfect for any precise comparison with known species, but the superficial characters observable show that it is very closely allied to *Pterophyllum Lyel-*

lianum (DKR.). Especially it can hardly be distinguished from the type-specimen (DUNKER, 1846, Pl. VI, fig. 1) and a specimen figured by SCHENK (SCHENK, 1871, Pl. XXXIV, fig. 1).

SEWARD (1895) figured a small frond with pinnae provided with blunt apex from the Wealden of Ecclesbourne which he thought probably to represent a young frond. A specimen figured by SEWARD in his Fossil Plants, Vol. III, p. 557 under the name *Pterophyllum* (*Anomozamites*) *Lyellianum* bears distantly placed pinnae with obtusely pointed apex and gives quite a different aspect compared with the type-specimen. KRYSHTOFOVICH and PRYNADA[1] reported the occurrence of this species in the Nikanian Series of Ussuriland accompanied by neither description nor figure.

Occurrence:

Kuwasima, Isikawa. Tetori Series.

Pterophyllum propinquum GOEPPERT

1916. *Pterophyllum propinquum* LOZANO: p. 11, Pl. VI, figs. 3–4.
1919. *Pterophyllum propinquum* ANTEVS: p. 28, Pl. III, figs. 7–19; ?Pl. IV, figs. 18–21.
1929. *Pterophyllum* aff. *propinquum* YABE and ÔISHI: p. 91, Pl. XVIII, fig. 6.
1931f. *Pterophyllum propinquum* ÔISHI: p. 245, Pl. III, figs. 1–2.
1933. *Pterophyllum propinquum* YABE and ÔISHI: p. 33, Pl. V, fig. 2.
ANTEVS, 1919, gives more references.

Remarks: Specimens identified by YABE and ÔISHI (1929, 1933) and ÔISHI (1931f) are imperfect, but show a fairly close agreement with those figured by ANTEVS (1919) from Sweden. Greenland specimens determined by HARRIS[2] as *P. Schenki* ZEILLER have similar habit of fronds.

Occurrence:

Kuruma, Nagano. Kuruma Bed.
Taihô-men, Tyôsen (Sendai Coll.). Daidô Series.

Pterophyllum Schenki ZEILLER

1886. *Anomozamites Schenki* ZEILLER: p. 460, Pl. XXIV, fig. 9.
1903. *Pterophyllum* (*Anomozamites*) *Schenki* ZEILLER: p. 181, Pl. XLIII, fig. 7.

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1) A. KRYSHTOFOVICH and V. PRYNADA (1932), p. 369.
2) T. M. HARRIS (1932a), p. 49, Pl. VI, figs. 1–2; Text-figs. 22–24.

1926. *Pterophyllum Schenki* HARRIS: p. 88, Text-figs. 16A-H.
1932a. *Pterophyllum Schenki* HARRIS: p. 49, Pl. VI, figs. 1–2; Text-figs. 22–24.
1932b. *Pterophyllum Schenki* ÔISHI: p. 310, Pl. XXII, figs. 2–7.
1937. *Pterophyllum Schenki* HARRIS: p. 51.

Remarks: This species is very variable in respect to the size of the pinnae, but they are generally at a right angle to the rachis in the greater part of the frond and are nearly rectangular in shape, the outer margin being truncated parallel to the rachis. Though the Japanese specimens are imperfect and smaller than the typical ones, their specific identity with *P. Schenki* seems almost beyond question. HARRIS (1932a) figured a series of variable forms of the pinnae of this species from East Greenland.

Occurrence:

Nariwa (1, 55, 63), Okayama. Nariwa Series.

Pterophyllum serratum ÔISHI and HUZIOKA

(Type-specimen: ÔISHI and HUZIOKA, 1938, Pl. IV, fig. 8).

1938. *Pterophyllum serratum* ÔISHI and HUZIOKA: p. 86, Pl. IV, figs. 8–9.

Description (ÔISHI and HUZIOKA, 1938): "Frond probably small, not much longer than 6 cm., obovate in outline, about 4–5 cm. broad near the apex, thence contracting abruptly to the apex and narrowing gradually towards the base. Rachis about 0.7 mm. across, with a median groove and transverse wrinkles probably on its upper side. Pinnae set closely, or somewhat distant at the proximal portion, 3–4 mm. broad at their bases, widening apically, with rounded apex; apical pinnae sometimes much broader. Apical margin serrated. Nerves 7–9 at their origin, sometimes more in number in broader pinnae, simple or forking, and diverging."

Remarks: This is a characteristic species of *Pterophyllum*, the outer margin of pinnae being distinctly serrated. ÔISHI and HUZIOKA carefully examined the marginal character of the pinnae and found that the serration is not due to marginal damage but is a natural one.

Occurrence:

Nariwa (63), Okayama. Nariwa Series.

Pterophyllum yamanoiensis ÔISHI and TAKAHASI

1936. *Pterophyllum yamanoiensis* ÔISHI and TAKAHASI: p. 125, Pl. I, fig. 6; Text-fig. 4.

Diagnosis (ÔISHI and TAKAHASI, 1936): "Frond of unknown size and form, being more than 7 cm. in length and 4 cm. in breadth. Rachis 2 mm. across in the proximal broken end narrowing upwards, the surface with longitudinal striations. Pinnae into which the lateral lamina is dissected are ovate to obovate, ± 1 cm. in breadth, closely set laterally or lightly overlapping, and attached by the whole or slightly contracted base to the lateral side of the rachis at a wide angle or almost perpendicularly. Nerves nearly parallel or slightly diverging, they fork in most cases close to, or at variable distances from their origin, and number approximately 15–20 at the distal part. Only in a single case is there a cross connection of the nerves."

Remarks: The general habit of the frond, especially the shape of the pinnules of this species resembles *Nilssonia bindrabunensis* SEWARD and SAHNI[1] from India, but it has been treated as a distinct species since there is no essential character for referring the present specimen to *Nilssonia* and moreover the nerves fork more frequently than in the Indian species. The presence of a single case of cross connection of nerves is another noteworthy feature of the Japanese specimen. Another comparable species is *Pterophyllum astartense* HARRIS[2] from Greenland.

Occurrence:

Yamanoi (1), Yamaguti. Upper Triassic.

Genus *Ptilophyllum* MORRIS

Ptilophyllum pachyrachis sp. nov.

Pl. XXXIII, Fig. 1; Pl. XXXIV, Figs. 1–3 (all the type-specimen).

Diagnosis: Frond large, probably attaining 1 m. in maximum length, and 12 cm. in max. breadth, linear, apex unknown, narrowing gradually towards the proximal portion; rachis stout, 1.5 cm.

1) A. C. SEWARD and B. SAHNI (1920), p. 31, Pl. III, figs. 31–32.
2) T. M. HARRIS (1932a), p. 44, Pl. IV, fig. 10; Text-figs. 19–21.

thick at the basal part, smooth; pinnae long and narrow, parallel-sided, straight or slightly falcate, set closely, generally 3–4 mm. in breadth, subacute at the apex, those in the proximal portion slightly broader and obtuse at the apex, and attached to the upper surface of the rachis at a wide angle or nearly at a right angle; the bases of pinnae on both sides of the rachis generally meet at the longitudinal median line of the rachis, but proximally they are separated by a zone of a part of the surface of the rachis; nerves distinct, parallel, about 13 in the interval of 4 mm.

Description: Pl. XXXIII, fig. 1 shows a part of the apical portion of probably a young frond. It clearly shows that the pinnae on both sides of the rachis are attached to the upper surface thereof and meet at the longitudinal median line of the rachis as is the case in *Ptilophyllum*. The one in Pl. XXXIV, fig. 3 shows probably the proximal portion of a frond. In this, the pinna bases do not entirely cover the upper surface of the rachis, but leave a zone of the surface of the rachis between the bases of the pinnae on both sides. In this specimen, the pinna-apex is also clearly seen.

In Pl. XXXIV, fig. 2 is shown also a proximal portion of a frond which agrees with the preceding one. In this specimen the pinnae appear to be considerably narrower and spaced laterally, but that is owing to the rolling back of the lamina along the margin.

The specimen in Pl. XXXIV, fig. 1 is quite interesting as it represents the upper surface of the basal portion of a frond. It is striking that the rachis is very thick and becomes free from pinnae proximally. The pinnae certainly narrow in length and become broader in breadth proximally and provided with a rounded apex; they are inserted distinctly on the upper surface of the rachis and cover a part of it, in conformity with the genus *Ptilophyllum*.

Remarks: This species is characterised by the large size of the frond traversed by a very thick rachis. Though only portions of the fronds are at our disposal, it is presumable that the frond might have attained at least 1 meter in length in its complete state.

Comparison: A fragment of this species is hardly distinguishable from *Ptilophyllum pecten*, especially from a large frond of the species. However in the typical one the two are distinguishable, the rachis of the latter being far less strong.

Occurrence:

Motiana, Hukui. Tetori Series.

Ptilophyllum pecten (PHILLIPS) MORRIS

Pl. XXXII, Figs. 1–6; Pl. XXXV, Figs. 1, 3.

1890. *Ptilophyllum* cf. *cutchense* NATHORST: p. 12, Pl. IV, fig. 8.
1890. An indeterminable fragment by NATHORST: p. 10, Pl. II, fig. 4.
1894. *Ptilophyllum* cf. *cutchense* YOKOYAMA: p. 229.
1894. *Nilssonia pterophylloides* YOKOYAMA: p. 228, Pl. XXII, figs. 8–10; Pl. XXV, fig. 7.
1927. *Ptilophyllum cutchense* YABE: Pl. I, fig. 3.

Remarks: Several specimens of this species are illustrated. Of these, Pl. XXXII, figs. 1 and 2 show photographs of the original specimens of YOKOYAMA's *Nilssonia pterophylloides* (YOKOYAMA, 1894, Pl. XXII, figs. 1 and 8 respectively) which is identical with *Ptilophyllum pecten*. Specimens in Pl. XXXII, figs. 3 and 4 and Pl. XXXV, fig. 1 agree also with *P. pecten*, while those in Pl. XXXII, figs. 5 and 6 and Pl. XXXV, fig. 3 represent a type agreeing with *P. acutifolium* (O. and M.).[1] The writer has a large frond obtained from the plant bed of Ôyagawa, Miyagi pref.: it is more than 40 cm. long, and it possesses pinnae 6 cm. long and 5 mm. broad in its proximal end. The writer first considered it a distinct species, but after closer examination he found that it is connected by many intermediate forms with small fronds with shorter and narrower pinnae as shown in Pl. XXXII, figs. 3 and 4 and Pl. XXXV, fig. 1. The specimen in Pl. XXXII, fig. 5 occurred at Ôyagawa associated with the large specimen mentioned above and represents an intermediate form between two extreme types in respect to the size of the frond.

Discussion: The name *P. pecten* is here used more or less in a comprehensive sense including also the Indian Jurassic species described as *P. cutchense*, and *P. acutifolium*, because in the collection of the Japanese specimens of *Ptilophyllum* that the writer examined there are several gradation in respect to size and shape of the pinnae between the different fronds or even in two extreme types which appear surely to be distinct from each other and it seems to the writer impossible to distinguish any well defined characters deserving specific diagnosis on the basis of such specimens. Therefore the assignment of the Japanese specimens to *P.*

1) B. SAHNI (1934), p. 263, Pl. XXXVII, fig. 11.

pecten is only provisional. In the specimens at hand there is no characteristic downward bending of the lower base of the pinnae as is illustrated in the Indian specimens. SEWARD[1] once considered that *P. pecten* and the Indian species are specifically identical and adopted the former name which was early published. Later he and SAHNI[2] distinguished *P. pecten* from the Indian species in view of the differences of cuticular structure. Specimens described by YOKOYAMA (1894) from Yuasa as *Nilssonia pterophylloides* YOK. are undoubtedly *P. pecten* as NATHORST[3] has already suggested, though FONTAINE[4] considered it as synonymous to *Nilssonia californica* FONT. of the Shasta Group. PRYNADA[5] figured some fronds of this type from Transcaucasia as *P. cutchense*.

Occurrence:

Outi Takazi	Yamaguti.	Kiyosue Group.
Ôyagawa, Miyagi.		Ogihama Series.
Ôsima, Miyagi.		Ôsima Plant Beds.
Kaisekiyama Nisinotani Katazi (Tôkyô Coll.) Isiseki (Tôkyô Coll.) Haginotani Kôbôdani	Kôti.	Ryôseki Series.
Tennôhama Mizutani Tanzaki Hiromura	Wakayama.	
? Iwakura, Mie.		
Zusahara Sindasawa Isigami-Mura Kami Mano-mura (Sendai Coll.)	Hukusima.	

1) A. C. SEWARD (1900), p. 190.
2) A. C. SEWARD and B. SAHNI (1920), p. 20.
3) A. G. NATHORST (1909), p. 31.
4) W. FONTAINE, in WARD (1905), p. 96.
5) V. PRYNADA (1933), p. 25, Pl. II, figs. 3, 11; Pl. III, figs. 3, 14.

Ptilophyllum sp.

Pl. XXXV, Fig. 2.

Description of specimen: In Pl. XXXV, fig. 2 is shown Cycadophytan fronds which differ considerably from the specimens referred to *P. pecten* in this work. The pinnae are short in proportion to the breadth and are provided with rounded apices. The pinnabases are not fused laterally as in *Nilssonia* but are isolate and attached to the upper surface of the rachis as in the genus *Ptilophyllum*. The nerves are unfortunately not distinct, but they are numerous and parallel. This occurred in association with *P. pecten*, therefore there is a probability that it represents the same species.

Occurrence:

Outi, Yamaguti. Kiyosue Group. (Tôkyô Coll.).

Genus *Williamsonia* CARRUTHERS

Williamsonia sp. cfr. *W. whitbiensis* NATHORST

Pl. XXXVI, Figs. 2, 2a.

Compare with:

1911. *Williamsonia whitbiensis* NATHORST: p. 9, Pl. II, figs. 1–15; Pl. III, figs. 2–7.

Remarks: In Pl. XXXVI, fig. 2 is shown an expanded bract certainly of a *Williamsonia* but unfortunately it is determinable specifically only with difficulty. It consists of more than 10 linear apparently acuminate segments fusing basally and radiating from a central area 2.5 cm. in diameter which is suddenly bent downwards at a right angle to the general plane of the bract, forming a shallow cup-like depression the surface of which has numerous radiating striations. As the margins of the segments are somewhat rolled back, they appear to be narrower than natural. Unfortunately the preservation of this interesting specimen is not satisfactory but the resemblance to the whorls of the microsporophylls of *Williamsonia* described by NATHORST from the Lower Estuarine Series of Whitby as *W. whitbiensis* is very strong. There is likely to be a faint indication of a series of oval impressions on each side of the median line of each segment suggesting the presence of such objects as synangia in the microsporophylls of *W. whitbiensis* but this is rather imaginative. There is also a great resemblance to an Indian specimen described by SEWARD and SAHNI[1] as *W.* sp. cf. *W. setosa* NATH., but in this the number of microsporophylls is larger.

The present specimen came from the Ôsima plant beds, together with *Ptilophyllum pecten*, and has already been figured by YABE as *Williamsonia* sp. in his Cretaceous Stratigraphy of the Japanese Islands, p. 25, Pl. I, fig. 2. A reproduction of a photograph of YABE's specimen itself is figured in Pl. XXXVI, fig. 2 in this work.

Occurrence:

Ôsima, Miyagi. Ôsima Plant Beds.

Williamsonia sp.

The annexed text-figure shows a drawing carefully made by the writer a few years ago from the actual specimen stored in the Geological Institute of the Tôkyô Imperial University. On the occasion of his recent visit to the Institute, the writer looked for the specimen again for the purpose of photographing, but it was not to be found being misplaced some where.

Williamsonia sp.
Nagano, Koti. Ryôseki Series.
×1.

The specimen consists of at least seven oblong segments radiating from a central circular area 1 cm. in diameter, apparently partly free at the base and fused on the other, and there can be seen no more surface markings than faint indications of longitudinal wrinkles on the segments.

The present specimen shows a fairly close resemblance to one described by FONTAINE[2] from the Potomac Formation as *W. virginiensis* in the shape and number of segments, but the Potamac species differs in the larger size and bearing conspicuous hairs.

Occurrence:

Nagano, Kôti. Ryôseki Series.

1) A. C. SEWARD and B. SAHNI (1920), p. 27, Pl. VI, figs. 59a–c.
2) W. FONTAINE (1889), p. 273, Pl. CXXXIII, figs. 5–7; Pl. CLXV, fig. 5.

Genus *Zamiophyllum* NATHORST, emend ÔISHI[1]

1890. *Zamiophyllum* NATHORST, p. 6.
1939b. *Zamiophyllum* ÔISHI, p. 209.

Diagnosis (ÔISHI, 1939b): "Large pinnate frond; rachis thick, smooth; pinnae long and narrow, tapering gradually towards the base, and attached to the upper surface of the rachis by concave semi-amplexicaul base with callosity, the plane of the pinnae making an angle with the flank of the rachis; nerves parallel."

The genus *Zamiophyllum* was established by A. G. NATHORST[2] in 1890 for some large Cycadophytan fronds derived from Tôgôdani, Kôti pref. in Sikoku Island which he thought specifically identical with an Urgonian species described by ETTINGSHAUSEN[3] from Germany as *Pterophyllum Buchianum* ETT. The chief reason for which he founded the new genus was that the pinnae narrow gradually towards the base which is somewhat thickened. He stated also that the pinnae are attached to the lateral sides of the rachis.

The close examination of a good number of specimens at hand derived from the type-locality, Tôgôdani, and some other localities in the Japanese Islands revealed that the attachment of the pinnae is not to the lateral sides of the rachis but to the upper surface with a semi-amplexicaul base. Accordingly, the plane of the pinnae makes an angle with flank of the rachis, thus forming an angle with the bedding plane, even if the general surface of the frond is parallel to it. This is, the writer believes, the essential character of *Zamiophyllum* having morphological importance.

The writer thinks that the genus *Zamiophyllum* is for the present monogenic, comprising only the one species, *Z. Buchianum*. SCHUSTER[4] considers that *Pterophyllum saxonicum* REICH and *P. eretosum* REICH represent two additional distinct species of *Zamiophyllum*. However, the present writer is not yet able to refer to the original paper of REICH, and it is doubtful whether they belong certainly to the category of generic diagnosis of *Zamiophyllum* revised by that writer.

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1) S. ÔISHI: (1939b), p, 209.
2) A. G. NATHORST (1890), p. 6.
3) C. von ETTINGSHAUSEN (1852a), p. 21, Pl. I, fig. 1.
4) J. SCHUSTER (1932).

Zamiophyllum Buchianum (ETTINGSHAUSEN) NATHORST

Specimens cited below are considered to be specifically identical with the type specimen.

1852. *Pterophyllum Buchianum* ETTINGSHAUSEN: p. 21, Pl. I, fig. 1.
1869. *Pterophyllum Buchianum* SCHENK: p. 8, Pl. III, fig. 5.
1890. *Zamiophyllum Buchianum* NATHORST: p. 6, Pl. II, figs. 1–2; Pl. III; Pl. V, figs. 2; p. 9.
1890. *Zamiophyllum Naumanni* NATHORST: p. 7, Pl. V, fig. 1.
1894. *Zamiophyllum Buchianum* YOKOYAMA: p. 223, Pl. XX, fig. 1; Pl. XXII, figs. 1–2; Pl. XXIII, fig. 6; Pl. XXVIII, figs. 1–2; (non Pl. XXVII, figs. 5 a, b).
1894 *Zamiophyllum Buchianum* var. *angustifolium* YOKOYAMA: p. 224, Pl. XXV, fig. 5; Pl. XXVIII, figs. 8–9;? Pl. XXII, fig. 4.
1894. *Zamiophyllum Naumanni* YOKOYAMA: p. 225, Pl. XXII, fig. 3; Pl. XXVI.
1913. *Zamiophyllum Buchianum* YABE: p. 7, Pl. I, figs. 17–19.
1922. *Zamiophyllum Buchianum* YABE: p. 19, Pl. III, figs. 1–2; (non figs. 3, 4).
1939b. *Zamiophyllum Buchianum* ÔISHI: pp. 210–220, Pls. XII–XIII.

Specimens which have been identified to ETTINGSHAUSEN's *Pterophyllum Buchianum* but whose character of pinna-base is obscure or which do not appear exactly to coincide with *Z. Buchianum* as redefined by the writer.

1889. *Dioonites Buchianus* FONTAINE: p. 182, Pl. LXVIII, fig. 1; Pl. LXIX, figs. 1, 3; Pl. LXX, figs. 2–3; Pl. LXXI, fig. 1; Pl. LXXII, figs. 1–2; Pl. LXXIII, figs. 1–3; Pl. LXXIV, figs. 1–3.
1889. *Dioonites Buchianus* var. *obtusifolius* FONTAINE: p. 184, Pl. CLXVIII, fig. 3.
1889. *Dioonites Buchianus* var. *angustifolius* FONTAINE: p. 185, Pl. LXVII, fig. 6; Pl. LXVIII, fig. 4; Pl. LXXI, fig. 2.
1895. *Zamites Buchianus* SEWARD: p. 79, Pl. III, figs. 1–5; Pl. IV; Pl. VIII, fig. 1.
1911. *Dioonites Buchianus* BERRY: p. 332. Pls. LI and LII; Text-fig. 10.
1911. *Zamites Buchianus* SEWARDS: p. 693, Pl. X, fig. 47.
1932. *Zamiophyllum Buchianum* SCHUSTER: Ueber *Zamiophyllum* in der unteren Kreide des Libanon.
1936. *Zamiophyllum Buchianum* MICHAEL: p. 46.

Diagnosis (ÔISHI, 1939b): "Frond large, probably attaining at least 1 m. in length, its general outline unknown; rachis thick, smooth; pinnae long and narrow, separate, attaining more than 30 cm. in length, 1 cm. in breadth, narrowing gradually towards the thickened base, acuminated at apex, opposite, subopposite or alternate, and attached to the upper surface of the rachis by the concave semi-amplexicaul base; those of the lower portion remote and at a wide angle, while those of the upper portion are set closely and at acute angle, to the rachis; nerves parallel, forking at their origin, densely crowded, about 25 in number per cm."

Remarks: The writer examined a good number of specimens of this species derived from several localities in the Japanese Islands, and has already figured (ÔISHI, 1939b) and discussed them, therefore there is no need of repeated description.

This species is a very characteristic one both morphologically and stratigraphically, being known only from the Wealden and the Lower Cretaceous strata of Europe and North America, while in Japan it appears to occur even from a slightly lower horizon (Kiyosue Group). Some doubtful specimens were described by TURUTANOVA-KETOVA (1930) from the Middle Jurassic rocks of the Chain Kara-Tau as *Zamites buchianus* ETT.

Occurrence:

Takazi, Yamaguti.		Kiyosue Group.
Tennôhama		
Mizutani	Wakayama.	
Hiromura		
Tanzaki		
? Iwakura, Mie.		
Isigami-mura, Hukusima.		
Torikubi		
Kaisekiyama		
Katazi		
Irino		Ryôseki Series.
Isiseki		
Tôgôdani	Kôti.	
Ueno		
Ôtani		
Haginotani		
Kôbôdani		
Nisinotani		
Hatimanzawa, Gumma.		
Omoto, Iwate.		
Massaki, Miyagi.		Monobegawa Series.
? Kuzi district, Iwate.		Urakawa Series.
? Wazyun district, Tyôsen.		Siragi Series. (G. S. Coll., after TATEIWA).

Genus *Zamites* BRONGNIART

Cfr. *Zamites Feneonis* BRONGNIART

Pl. XXXVI, Fig. 1; Pl. XXXVIII, Fig. 1.

Compare with:

1852. *Zamites Feneonis* ETTINGSHAUSEN: p. 9, Pl. III.
1872. *Zamites Feneonis* SCHIMPER: p. 152, Pl. LXXI, fig. 2.
1875. *Zamites Feneonis* SAPORTA: p. 99, Pls. LXXXVIII–XCI; Pl. XCII, fig. 1.

Description of specimens: The specimen in Pl. XXXVI, fig. 1 is derived from Ôsima. It is an upper portion of a large linear frond more than 23 cm. long, about 10 cm. broad tapering gradually towards the apex. The thickness of the rachis is somewhat obscure, since it is concealed by the pinna-base. However, it may be 4–5 mm. thick on its lowest broken end. The pinnae are nearly parallel-sided, slightly falcate, set closely, alternate, contracted and rounded at the base which is symmetrical, narrowing gradually towards an acuminate apex and attached at a wide angle to the upper surface of the rachis. The nerves are unfortunately obscure, but it can be seen by a special application of light that they are rather coarse and number about 20 in the middle of each pinna.

Another specimen in Pl. XXXVIII, fig. 1 is derived from near Kayanokibasi. It shows a portion of a frond more than 8 cm. long consisting of a rachis about 3 mm. thick on the upper surface of which pinnae are attached alternately at a wide angle. The pinnae are imperfect distally, but they are at least 4 cm. in length, rounded at the base, gradually widening towards the apex, straight, about 6 mm. in breadth at 2 cm. distance from the base. The nerves are parallel probably forking near their origin, and number about 22 in an interval of 5 mm.

Remarks: It may be considered beyond doubt that the present specimens belong to the genus *Zamites* as the pinna-base is rounded, symmetrical and attached to the upper surface of the rachis. Among the known species of this genus, the present specimens may be comparable with a well known Jurassic species, *Z. Feneonis* BRONGN. as profusely figured by SAPORTA in his Plantes jurassiques (1875). The writer cannot find any difference between them in respect to the habit of the frond, nor to the shape and size of the pinnae, except in the nervation which is unfortunately not distinct in one of the present specimens (Pl. XXXVI, fig. 1). In another specimen in Pl. XXXVIII, fig. 1 the pinnae are imperfect distally. In spite of these, the writer wishes to refer the specimens to *Z. Feneonis* provisionally taking the tolerable resemblance of the general habit of the frond mentioned above into especial consideration.

Another comparable species is *Zamites recta* (TATE) originally described by TATE[1] as *Palaeozamia recta* from the Wealden strata in South Africa and subsequently figured by SEWARD[2] from the Uitenhage Series of Cape Colony. SEWARD[3] wrote that "the rachis of this species shows some peculiar features in the form of two rows of alternate cushions. If this alone be the essential character of *Zamites recta,* it is very difficult to distinguish *Z. recta* from *Z. Feneonis* in other features, the two being otherwise almost indistinguishable. *Z. toyoraensis* ÔISHI[4] from the Nisi-Nakayama bed is also an allied form, but in that species the nerves are more densely crowded than in ours. *Zamites Weberi* SEW. described by SEWARD[5] from the Jurassic of Caucasia represents another similar type.

Occurrence:

Ôsima, Miyagi. Ôsima Plant Beds.
200 m. west of Kayanokibasi, Hukusima (Sendai Coll.). Ryôseki Series.

Cfr. *Zamites megaphyllus* (PHILLIPS) SEWARD

Pl. XXXIV, Fig. 5.

1932. Cfr. *Zamites megaphyllus* ÔISHI: p. 8, Pl. III, fig. 5.

Description of specimen: Pl. XXXIV, fig. 5 shows a portion of a long and broad pinna probably identical with the species described by SEWARD from the Jurassic of England as *Zamites megaphyllus.* It is at least 14 cm. long and 3.5 cm. broad at one broken end and narows gradually towards another broken end 1.8 cm. broad.

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1) R. TATE (1867), p. 144, Pl. V, figs. 7a, 7b.
2) A. C. SEWARD (1903), p. 21, Pl. III; Pl. VI, figs. 8–12.
3) A. C. SEWARD (1917), p. 534.
4) S. ÔISHI (1935b), p. 97, text-fig. 1.
5) A. C. SEWARD (1907), p. 11, Pl. II, fig. 19; Pl. III, fig. F.

The nerves are parallel to each other and to the lateral margins of the pinna and number about 25 per cm.

Remarks: The present specimen can not be distinguished from one described by the writer from Sitaka as Cfr. *Z. megaphyllus*. The Japanese specimens appear to be almost identical with *Z. megaphyllus* from England, but are too imperfect for precise comparison, neither base nor apex being known. Similar but somewhat narrower pinnae occur also in the Kiyosue Group at Takazi, Yamaguti.

Occurrence:

Ôsima, Miyagi. Ôsima Plant Beds.
Sitaka, Kyôto. Sitaka Bed.
Takazi, Yamaguti. Kiyosue Group.

Zamites tosanus sp. nov.

Pl. XXXV, Figs. 4, 4a (type-specimen).

Description (Pl. XXXV, fig. 4): Frond of unknown size and form, being more than 4 cm. long and 6 cm. broad; pinnae alternate, set closely, at a wide angle to the rachis, linear, straight, 2.5 cm. long and 2.5 mm. broad, obtusely pointed at the apex, rounded at the base, and attached to the upper face of the rachis; nerves forking at their origin or rarely near the apex, parallel to each other except at the base where they are somewhat divergent to the lateral margin of the pinnae, and number 5–6 at the middle of each pinna.

Remarks: Unfortunately this species is represented by only a single imperfect specimen. A specimen figured by SAPORTA[1] as *Zamites pumilio* resembles ours, but in the latter the base of the pinnae is indistinctly represented. A specimen from the Cretaceous rock of China referred by YOKOYAMA[2] to *Glossozamites Hoheneggeri* (SCHENK) shows a similar habit to the present specimen, though in the Chinese one the frond is larger, and the pinnae are longer and broader and more distantly attached to the rachis. The Chinese specimen represents certainly a *Zamites*, though not specifically

1) A. de SAPORTA (1875), p. 109, Pl. XXII, fig. 4.
2) M. YOKOYAMA (1906), p. 36, Pl. XII, figs. 1, 1a.
3) H. C. SZE (1933a), p. 21, Pl. IV, fig. 9.

identical with the present one. An obscure specimen which seems to be close to *Z. tosanus* has been described by SZE[1] from Szechuan, China, as Cfr. *Glossozamites* sp.

Occurrence:

Kôbôdani, Kôti. Ryôseki Series.

Zamites toyoraensis ÔISHI

1935. *Zamites toyoraensis* OISHI: p. 98, Text-figure.

Diagnosis (ÔISHI, 1935): "Frond of unknown size and form, more or less linear, more than 14 cm. long, and 7 cm. broad at the broken distal end, narrowing gradually towards the base. Pinnae closely set or somewhat distant, linear, straight or slightly falcate, gradually tapering towards the acuminate apex, and attached to the upper face of the thick rachis 5 mm. across on the impression by a rounded symmetrical and non-auriculate base with callosity, at an angle of 60°–80°. Nerves slender, dense, bifurcating frequently, parallel to each other except at the base where are somewhat divergent and number 25–30 at the basal broadest portion."

Comparison: This species represents a type allied to *Z. Feneonis* BRONGN. but has been distinguished as it has denser nerves.

Occurrence:

Tarai, near Nisi-Nakayama, Yamaguti. Nisi-Nakayama Bed.

Zamites Yabei sp. nov.

Pl. XXXVII, Fig. 6 (type-specimen).

1922. Cfr. *Zamiophyllum Buchianum* YABE: p. 21, Pl. III, fig. 3.

Diagnosis: Frond large, broad; rachis about 5 mm. thick with longitudinal striations; pinnae long and narrow, linear, nearly parallel-sided throughout the greater part, narrowing gradually towards the apex, slightly falcate, alternate, set closely or spaced very narrowly laterally and attached to the upper surface of the rachis at an angle of about 70°; nerves parallel, about 15 ? in each pinna.

Remarks: It is unfortunate that the whole size and form of this plant is unknown. However it is presumable that it may have attained considerable dimensions in its complete state. In none of the pinnae is the apex preserved, but it appears that they narrow gradually towards acuminate apices. The extreme bases of the pinnae are not preserved, though it is obvious that they are attached to the upper surface of the rachis. However, there is a strong tendency for their bases to be symmetrical and neither auriculate as in *Otozamites* nor meeting on the median line of the rachis as in *Ptilophyllum* or *Nilssonia*.

Discussion: The present specimen was derived from the Nisi-Nakayama bed of Yamaguti pref. and has already been described by Prof. YABE[1] as Cfr. *Zamiophyllum Buchianum* (ETT.). The writer thinks that Prof. YABE is certainly careful in not identifying the specimen directly to *Z. Buchianum*. The writer examined the original specimen in Sendai and observed the following points in regard to the morphology of the specimen, viz., 1) the pinnae are attached obviously to the upper surface of the rachis, 2) the pinnae are separate and not continuous laterally, 3) the pinnae narrow gradually from the base towards the apex and 4) the plane of the pinnae is parallel, and does not form an angle with the flank of the rachis and the bedding-plane.

The genera with which the present specimen is comparable in strong possibility are *Ptilophyllum, Nilssonia, Zamites, Otozamites* and *Zamiophyllum*. However, the tolerably long and narrow isolate pinnae of the present species do not accord at least with the essential character of *Ptilophyllum* and *Nilssonia*. In *Otozamites*, the pinnae are always asymmetrical and auriculate at the base, while in ours they do not seem so. Also the feature mentioned above as 4) does not accord with the definition of the genus *Zamiophyllum* as revised by the writer. Thus the morphological features available in this specimen show that it should be placed in the genus *Zamites* in the sense of HALLE[2] rather than in any other genera mentioned above.

Comparison: Apparently this species reminds one of *Zamiophyllum Buchianum* (ETT.), however, in the latter the pinnae narrow gradually towards the base and the mode of attachment is semi-

1) H. YABE (1922).
2) T. G. HALLE (1913), p. 55.

amplexicaul, thus the plane of the pinnae forms an angle with the flank of the rachis. It resembles also *Pseudoctenis Lanei* THOMAS described in this work, however, in the latter species the pinnae are attached to the lateral sides of the rachis.

Occurrence:

Maruyama near Nisi-Nakayama, Yamaguti. Nisi-Nakayama Bed.

Caytoniales

Genus *Sagenopteris* PRESL

Sagenopteris petiolata sp. nov.

Pl. XXXVII, Figs. 1, 2 (all the type-specimen).

Description: Leaflets long petiolate, the petiole being 5 mm. in length and less than 1 mm. in thickness, obovate to oblong, 2.5 cm. long and 1.5 cm. broad, with obtuse to rounded apex, and contracting gradually or more or less abruptly towards proximal portion; margin entire; midnerve distinct, evanescent apically and dissolving into lateral nerves; lateral nerves spreading and anastomosing.

Remarks and discussion: Although the specimens are all represented by isolated leaflets as illustrated in Pl. XXXVII, figs. 1 and 2, they are well characterised by having a distinct petiole with which they might have attached to the main stalk.

About half a dozen species of *Sagenopteris* are recognisable in the world but none of them show distinct petiole in each leaflet just as seen in the present specimens. Especially a certain type of leaflet in *S. paucifolia* appears to be indistinguishable from the Japanese form, but in that the leaflets are not petiolate .Some imperfect leaflets described by YOKOYAMA[1] from Ozô as *Sagenopteris* sp. somewhat resemble the present species, though without petiole in the leaflets it is difficult to distinguish this species from *S. paucifolia* or *S. rhoifolia*. SEWARD[2] once with some hesitation referred YOKOYAMA's fragments to *S. Mantelli* (DKR.)

Occurrence:

Rokumambô, Yamaguti. Kiyosue Group.

1) M. YOKOYAMA (1899), p. 38, Pl. X, figs. 3, 3a.
2) A. C. SEWARD (1894), p. 130; (1900a), p. 9.

Sagenopteris Nilssoniana (BRONGNIART) WARD

Pl. XXXVII, Fig. 3.

1824. *Filicites Nilssoniana* BRONGNIART: p. 218, Pl. XII, fig. 1.
1932a. *Sagenopteris Nilssoniana* HARRIS: p. 5, Pl. I, fig. 11; Text-figs. 1, 2A–F.
1933. *Sagenopteris Nilssoniana* HARRIS: Pl. IV, fig. 7.
1936. *Sagenopteris Nilssoniana* ÔISHI and TAKAHASI: p. 132, Text-fig. 6.
For further references see HARRIS, 1933.

Description of specimen: Pl. XXXVII, fig. 3 shows a very imperfect specimen doubtlessly of a leaflet of *Sagenopteris*. As the outer margin is broken all round, the size and form of the specimen is unknown. There is a distinct but evanescent midnerve which gradually dissolves into lateral nerves towards the apex. The lateral nerves are first acute to the midnerve and then arching and anastomosing.

Remarks: This species is very unsatisfactorily represented in the Japanese Mesozoic rocks. ÔISHI and TAKAHASI (1936) recently figured a stalked leaf with four leaflets oval-lanceolate in outline from Nagato under the name *Sagenopteris Nilssoniana*, but the specific identification of this specimen by means of its external form is pretty difficult as it resembles, on the other hand, also, the Jurassic species, *S. paucifolia*.

Under the name *S. Nilssoniana* (= *S. rhoifolia*) are described several specimens from Liassic and Rhaetic rocks of various parts of Europe and North America, and its occurrence has recently become known to us also in the *Thaumatopteris*-Zone of East Greenland.[1] Fragments of leaflets described by YOKOYAMA[2] and ÔISHI and HUZIOKA[3] from Nariwa and Nagato respectively as *Sagenopteris* sp. may perhaps represent this species though SEWARD[4] expressed an opinion that YOKOYAMA's specimen can not be distinguished from *S. Phillipsi*.

Occurrence:

Yamanoi (1), Yamaguti. Upper Triassic.
Nariwa (90), Okayama. Nariwa Series.
Kuruma, Nagano. Kuruma Bed.
Neiridani, Toyama. Kuruma Bed.

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1) T. M. HARRIS (1932a).
2) M. YOKOYAMA (1905), p. 11, Pl. III, fig. 3.
3) S. ÔISHI and K. HUZIOKA (1938), p. 100, Text-fig. 8.
4) A. C. SEWARD (1912a), p. 11.

Sagenopteris paucifolia (PHILLIPS) WARD

Pl. XLI, Figs. 6, 7.

1829. *Pecopteris paucifolia* PHILLIPS: p. 148, Pl. VIII, fig. 8.
1830. *Glossopteris Phillipsi* BRONGNIART: p. 225, Pl. LXI bis. fig. 5; Pl. LXIII, fig. 2.
1833. *Glossopteris Phillipsi* LINDLEY and HUTTON: Pl. LXIII.
1835. *Otopteris cuneata* LINDLEY and HUTTON: Pl. CLV.
1892. *Sagenopteris Phillipsi* BARTHOLIN: p. 13, Pl. V, fig. 8.
1900b. *Sagenopteris Phillipsi* SEWARD: p. 162, Pl. XVIII, figs. 2–4; Text-figs. 24–26.
1905. *Sagenopteris paucifolia* WARD: p. 85, Pl. XV, figs. 1–3.
1913. *Sagenopteris paucifolia* HALLE: p. 8, Pl. I, figs. 1–5.

For further references, see SEWARD, 1900b.

Description of specimens: Pl. XLI, fig. 7 shows a detached leaflet more or less oblanceolate in shape but its apex is missing. It is at least 6 cm. long and about 2 cm. broad, and narrows gradually towards the base. There appears to be a very short stalk. The midnerve is prominent only in the lower part, evanescent upwards and dissolves into lateral nerves. The lateral nerves are spreading and arching and anastomosing. Another specimen in Pl. XLI, fig. 6 is important as it preserves the apex which is acutely pointed. The leaflet is broadest at a little below the apex and thence narrows gradually towards the base. The nervation is quite similar to that of the preceding specimen.

Remarks: This species is rather well-known under the name *S. Phillipsi* (BRONGN.) and has been recorded from the Jurassic strata of various parts of the world. Though the figured specimens are imperfect, yet they show a striking resemblance to the specimens as figured by WARD[1] and HALLE[2] from Oregon and Graham Land respectively under the name referred to above. Therefore the existence of this species in the Japanese Mesozoic rocks is beyond doubt.

S. paucifolia is very like *S. Nilssoniana* and sometimes the two are hardly distinguishable in their external morphology. However, in their cuticular structures they are said to be easily dis-

1) L. F. WARD (1905), p. 85.
2) T. G. HALLE (1913). p. 8.

tinguishable.[1] YOKOYAMA[2] figured some fragments of leaflets from Ozô as *S.* sp.

Occurrence:

Motiana, Hukui. Tetori Series.

Sagenopteris ? inequilateralis sp. nov.

Pl. XLVII, Figs. 3–5.
(Type-specimen: Fig. 3).

General description: Frond with four leaflets; leaflets obovate, inequilateral, about 2 cm. long and 1.5 cm. broad in their broadest portion, having distinct straight midnerve; lateral nerves obscure; margin appears to be almost entire.

Description of specimens: In Pl. XLVII, fig. 3, the type-specimen, the general habit of the leaf, size and form of the leaflets are clearly seen. One of the most characteristic features of this species is the leaflets which are divided by the midnerve into two unequal halves. Similar but less perfect specimens are shown in figs. 4–6. In all these specimens the lateral nerves are entirely obscure probably owing to the coarseness of the matrix on which the specimens are impressed. The margin of the lamina appears to be almost entire all round, but in the type-specimen and the left specimen in fig. 4 the outer margin of the lamina seems to be slightly serrated or broadly undulating, but this feature is somewhat indistinct.

Discussion: As the lateral nerves are entirely obscure the assignment of the present specimens to the genus *Sagenopteris* is provisional, but the shape and size and the arrangement of the leaflets suggest their being *Sagenopteris*. The writer provisionally considered that the speciemn in fig. 3 having four leaflets is the typical one, and the others are imperfect. But as the number of leaflets is variable in most species of this genus it can not necessarily be said that the specimens with two leaflets are always incomplete. In a majority of cases, however, the species of *Sagenopteris* have four leaflets, sometimes three or two. The inequilateral lamina may be seen in other species of this genus, too, for instance, in *S. Goep-*

1) T. M. HARRIS (1932a), p. 10.
2) M. YOKOYAMA (1889), p. 38, Pl. X, figs. 3, 3a.

pertiana ZIGNO,[1] *S. variabilis* VEL. (*Thinnfeldia variabilis* by VELENOVSKY[2]), etc., but such is a case rarely met with in these named species. It may also be suggested that the inequilateral lamina and the characteristic arrangement of the leaflets in our specimens show that the leaflets may have been petiolate, and that the petioles in each pair are united below to form common branches into which the top of the stalk might have probably been divided.

Occurrence:

Tanzaki, Wakayama. Ryôseki Series.

Cycadophyta Incertae Sedis

Genus *Ptilozamites* NATHORST

Ptilozamites Nilssoni NATHORST?

1932b. *Ptilozamites Nilssoni?* ÔISHI: p. 322, Pl. XXV, fig. 4.

Remarks: The Japanese specimen referred to this species is a fragment of frond from Nariwa found in association with *P. tenuis* ÔISHI. Though the specimen is imperfect, it has provisionally been assigned to this species as the resemblance is close to the typical specimen of *P. Nilssoni* figured by ANTEVS, NATHORST and HARRIS rather than to *P. tenuis* Ô. This species was first described by NATHORST (1878) from Sweden. Subsequently the species was again described from the same country by ANTEVS (1914) and JOHANSSON (1922). The recent investigation of this species from Greenland by HARRIS (1932) is important as it has much increased the available knowledge on the epidermal structures of this species. ANTEVS (1914) and HARRIS (1932) give useful lists of synonymy of *P. Nilssoni*.

Occurrence:

Nariwa (50), Okayama. Nariwa Series.

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1) A. de ZIGNO (1856–68), Pl. XXII, fig. 1.
2) J. VELENOVSKY (1885), Pl. II, figs. 1, 3.

Ptilozamites tenuis ÔISHI

(Type-specimen: ÔISHI, 1932b, Pl. XXV, figs. 1–3: ÔISHI AND HUZIOKA, 1938, Pl. VI, figs. 2, 2a).

1931e. *Pterophyllum contiguum* ÔISHI: p. 359.
1932b. *Ptilozamites tenuis* ÔISHI: p. 321, Pl. XXV, figs. 1–3.
1938. *Ptilozamites tenuis* ÔISHI and HUZIOKA: p. 93, Pl. VI, figs. 2, 2a.

Diagnosis (ÔISHI and HUZIOKA, 1938): "Frond pinnate, slender; its rachis also thin and delicate, forking once at least, with small, close and rounded tubercles on the surface, bearing pinnae both below and above the point of forking. Pinnae (or pinnules) about 1 cm. long and 1.5–2 mm. broad, nearly parallel-sided, narrowing gradually towards an obtuse to rounded apex; pinnae in the inner side of a fork become shorter and smaller towards the point of forking. Nerves parallel, simple or forking, numbering 4–7 in each pinna."

Remarks: This species was first described by the writer in 1932 based on some portions of frond, and the assignment to the *Ptilozamites* of the specimens was justified by the later discovery of a portion of a distinct forked frond which was misplaced upon the occasion of the description in 1932. Thus the original diagnosis of this species was altered in 1938 as above.

This species resembles very closely *P. Nilssoni* NATH. but has been distinguished from it as the pinnules are nearly parallel-sided with obtuse to rounded apex in comparison with the latter's having pinnules broader compared with the length, with upwards strongly curved lower margin provided with acuter apex. HARRIS[1)] and ANTEVS (1914) showed that *P. Nilssoni* varies considerably in the size of the leaf and in the shape of the pinnules, but the material at hand does not appear to be in the limit of variation of that species. The writer wishes, therefore, to hold it distinct from *P. Nilssoni*. A fragment which shows a close agreement with typical *P. Nilssoni* has provisionally been referred to NATHORST's species (vid. supra).

Occurrence:

Nariwa (50), Okayama. Nariwa Series.

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1) T. M. HARRIS (1932), p. 75.

(Protective Organs belonging to Cycadophyta)

Genus *Cycadolepis* SAPORTA

Cycadolepis oblongiformis sp. nov.

Pl. XXXVIII, Fig. 2 (type-specimen).

Description: A convex scale-leaf or bract, oblong, 11 cm. long, 3.5 cm. broad at the broadest portion a little higher than the middle; base narrow; apex obtuse; surface (outer ?) traversed by numerous fine nerves first spreading radially from the base and going parallel to each other and to the lateral margin of the bract and ending in distal margin.

Description of specimen: A single specimen is examined. It is an impression of a convex scale-leaf or bract as shown in Pl. XXXVIII, fig. 2. Therefore, the specimen itself is represented as a concave impression. One of the characteristic features of this specimen is the narrow inrolled base about 5 mm. broad with which it may have attached to a supporting organ functioning as a protective organ.

Remarks: The texture of the fossil may have been leathery and probably it was very thick so that it was preserved in the matrix almost in its original state. The size and form and the very narrow base distinctively characterise this specimen. *Cycadolepis Jenkinsiana* (TATE) from the Uitenhage Series of South Africa resembles ours but differs in the orbicular form of the bract and in having a broader base.

It is perhaps beyond doubt that bract like objects known under the generic designation *Cycadolepis* are some structures which may have served as a protective organ covering young or unexpanded vegetative leaves or fertile shorts of Cycadophyta. Cycadophytan fronds associated with *C. oblongiformis* are *Nilssonia schaumburgensis* (DKR.), *N. orientalis* HR. and *Zamiophyllum Buchianum* (ETT.), however, it is questionable to which of these types of fronds or even whether to any other form of Cycadophytan fronds the present type of *Cycadolepis, C. oblongiformis,* belonged. It is interesting to note that *Cycadolepis Toyamae* ÔISHI[1] was found in close association with *Nilssonia pecten* ÔISHI in Manchuria.

1) S. ÔISHI (1935a), p. 87, Pl. VI, figs, 3, 3a, 3b; Text-fig. 4.

Comparison: A structure described by NATHORST[1] from Bjuf as *Cycadospadix integra* NATH. represents a similar type which is however broader and has narrower apex.

Occurrence:

Tôgôdani, Kôti. Ryôseki Series.

Cycadolepis kiiensis sp. nov.

Pl. XXXVII, Figs. 4 and 5.
(Type-specimen: Fig. 5).

Description of specimens: Pl. XXXVII, fig. 5 shows a convex scale-leaf or bract more or less oblong in shape acutely pointed at the apex ad provided with a narrow straight base. It is ca. 2.5 cm. long and 1.2 cm. broad at the widest middle portion. There are faint indications of parallel nerves or striations originating at the straight base, running parallel to each other and to the lateral margins of the specimen, and they seem to converge towards the apex just as in *Podozamites* leaves. As the specimen bears strong convexity, it is almost unquestionable that it represents a protective organ and not an ordinary leaf.

Another specimen in Pl. XXXVII, fig. 4 represents an apical portion of *Cycadolepis* of the same type as the former, however, somewhat larger. It is acuminated at the apex and bears parallel nerves or longitudinal striations.

Remarks: Though it is not certain to what kind of plant the present specimens belonged, it is at least highly probable that they represent a kind of protective organ such as scale-leaf or bract probably of Bennettitales. The former specimen was derived from Tennôhama associated with the following Bennettitalean fronds, namely, *Nilssonia schaumburgensis* (DKR.), *Ptilophyllum pecten* (PHILLIPS) and *Zamiophyllum Buchianum* (ETT.), while the latter was derived from Tanzaki in association with the following species, namely, *Nilssonia orientalis* HR., *N. densinerve* (FONT.), *Ptilophyllum pecten* (PHILLIPS), *Otozamites Klipsteinii* (DKR.) and *Zamiophyllum Buchianum* (ETT.).

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1) A. G. NATHORST (1879), p, 80, Pl. XVII, fig. 7.

Occurrence:

Tennôhama } Kii. Ryôseki Series.
Tanzaki }

Ginkgophyta

Genus *Baiera* F. W. BRAUN

Baiera Asadai YABE and ÔISHI

1925. *Baiera concinna* KAWASAKI (non HEER): p. 48. Pl. XXVII, figs. 80a, b, d.
1928 *Baiera Asadai* YABE and ÔISHI: p. 9, Pl. III, fig. 2.

Remarks: This specific name was given by YABE and ÔISHI for a petiolate Ginkgoalean leaf, from the Fang-tzu coal-field, with semi-orbicular lamina with straight base and several times deeply dissected dichotomously into crowded long and narrow, linear ultimate segments. Its cuticle was examined by the present writer.[1] This species is very closely related to *B. Muensteriana* (PRESL) but in this the ultimate segments are narrower. Specimens from Tyôsen described by KAWASAKI (1925) as *B. concinna* belong to this type as SZE (1933, p. 29) suggested. An imperfect leaf which YABE and ÔISHI (1929, p. 160) described in their supplementary note on the Jurassic Plants from the Fang-tzu coal-field as *B.* cfr. *Asadai* Y. and Ô. differs from the type-specimen in having a less number of ultimate segments.

Occurrence:

Daiseizan (G. S. K. Coll.) } Tyôsen. Daidô Series.
Taihô Coal-mine (G. S. K. Coll.) }

Baiera Brauniana (DUNKER) BRONGNIART

Pl. XXXVIII, Fig. 4.

1846. *Jeanpaulia Brauniana* DUNKER: p. 11, Pl. V, figs. 2, 4.
1871. *Jeanpaulia Brauniana* SCHENK: p. 224, Pl. XXIV, figs. 9–11.
1911. *Baiera Brauniana* SEWARD: p. 680, Text-fig. 9B.
1936. *Baiera Brauniana* MICHAEL: p. 41.

1) S. ÔISHI (1933), p. 4.

Description of specimen: Pl. XXXVIII, fig. 4 shows an imperfect leaf with a spreading lamina deeply dissected into two halves, each subsequently dividing dichotomously into narrow and linear ultimate segments. Their apices are entirely imperfect. Each ultimate segment carries 2–3 nerves. The stalk is more than 1 cm. long.

Remarks: Only a single figured specimen is examined. Although the outer margin of the lamina is imperfect, the size of the leaf, and mode of dissection of the lamina into narrow and linear ultimate segments are fairly closely comparable to the characteristic features of this Wealden species.

Comparison: Comparable species are those described by YABE and ÔISHI (1933) from the Jurassic strata of Manchuria under the names *B. manchurica* YABE and ÔISHI and *B. minima* Y. and Ô., however, in respect to the shape of the ultimate segments the resemblance may be closer to the former. But in the Manchurian species the shape of the lamina is semi-circular or orbicular and the nerves in an ultimate segment about 6 in number.

Occurrence:

Kôbôdani, Kôti. Ryôseki Series.

Baiera elegans ÔISHI

(Type-specimen: ÔISHI, 1932b, Pl. XXXI, figs. 6-11).

1932b. *Baiera elegans* ÔISHI: p. 352, Pl. XXXI, figs. 6–11; Text-fig. 4 (restoration).

Diagnosis (ÔISHI, 1932b): "Lamina semi-circular or wedge-shaped with rounded outer margin, 2–3 cm. high, deeply divided dichotomously four times into segments, which increase in breadth gradually from the proximal end upwards to 1.5–2.5 mm. breadth near the apex. Apex of each segment shallowly cleft into lobes. Nerves forking, 2–4 in number at the middle of the segments, ultimate lobe receiving a single nerve."

Remarks: A considerable number of specimens derived from Loc. 50 in Nariwa were examined. The illustrations of a series of specimens of this species (ÔISHI, 1932b) collected from a single locality indicate that it presents little variation in regard to the size and form and the manner of dissection of the lamina and the number of ultimate segments. A fairly close resemblance of this species to *Baiera minuta* NATH. from Sweden has already been pointed out by the writer (ÔISHI, 1932b). HARRIS' illustration of *B. minuta* from Greenland[1] shows that the species displays a considerable variation in regard to the size of the leaf, and shows also that NATHORST's species may be distinguished from *B. elegans* in the larger number of ultimate segments, as HARRIS wrote.

Occurrence:

Nariwa (50, ?47), Okayama. Nariwa Series.

Baiera filiformis ÔISHI

1932b. *Baiera filiformis* ÔISHI: p. 349, Pl. XXXII, fig. 4.

Remarks: The type-specimen is unfortunately imperfect. It resembles *B. Lindleyana* (SCHIMP.) but has a larger number of nerves in each segment. Therefore the writer thinks that it differs, at least, from SCHIMPER's species. The writer formerly stated that the leaf may be petiolate, but the presence of a distinct petiole is not probable because the lamina gradually narrows proximally and ends in a slightly expanded end which appears to be a clean-cut base of the leaf. SZE[2] figured a similar but smaller leaf from China as *B.* cfr. *Lindleyana* (SCHIMP.).

Occurrence:

Nariwa (33, 58), Okayama. Nariwa Seires.

Baiera furcata Heer

1865. *Sclerophyllina furcata* HEER: p. 55, Pl. II, fig. 9.
1877. *Baiera furcata* HEER: p. 84, Pl. XXIX, figs. 30, 31; Pl. XXX, fig. 4c; Pl. XXXVI, fig. 4, 5.
1903. *Baiera furcata* LEUTHARDT: p. 7, Pl. II, figs. 1–4; Pl. III, figs. 1–5; Pl. IV, fig. 1.
1931c. *Baiera furcata*? ÔISHI: p. 6.
1932b. *Baiera furcata* ÔISHI: p. 348, Pl. XXXII, figs. 2A and 3.

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1) T. M. HARRIS (1935), p. 11, Pl. I, fig. 7; Text-fig. 5.
2) H. C. SZE (1933), p. 29, Pl. VII, fig. 8.

Remarks: Specimens from Nariwa referred to this Keuper species are unfortunately very incomplete but have been provisionally identified to that species as the resemblance with those described from Switzerland is very close. It is striking that the present specimen resemble also the particular specimen of *Baiera spectabilis* with finely divided lamina as figured by HARRIS from Greenland (HARRIS, 1935, p. 27, fig. 13c). SZE (1933, p. 29, Pl. VII, fig. 8) figured a similar leaf from China as *B.* cfr. *Lindleyana* (SCHIMP.).

Occurrence:

Nariwa (47), Okayama. Nariwa Series.

Baiera gracilis BUNBURY, ex Bean MS.

1851. *Baiera? gracilis* BUNBURY: Pl. XII, fig. 3.
1900b. *Baiera gracilis* SEWARD: p. 263, Pl. IX, figs. 3, ?5.
1906. *Baiera gracilis* YOKOYAMA: p. 30, Pl. IX, fig. 2a.
1908. *Baiera gracilis* YABE: p. 5, Pl. I, fig. 3c; Pl. II, fig. 5c.
1922. *Baiera gracilis* YABE: p. 25, Pl. IV, figs. 6, 14, 15; ? Text-fig. 25.
1933. *Baiera gracilis* SZE: p. 16, Pl. VII, figs. 1–3, ?4.

SEWARD, 1900b, gives further references.

Remarks: It was elsewhere noted by the writer (ÔISHI, 1932b, pp. 347, 354) that the Korean specimens referred to this species by KAWASAKI (1925, 1926) belonged in certain aspects to *B. Guilhaumati* ZEILL. and in others to *G. sibirica* (HR.). YABE figured three specimens of this species, one from Taihômen, Tyôsen and the others from China. The one from Tyôsen is a type of this species, but the other two from China are decidedly larger in size than the typical form.

Occurrence:

Taihômen, Tyôsen. Daidô Series.

Baiera Guilhaumati ZEILLER

1903. *Baiera Guilhaumati* ZEILLER: p. 205, Pl. L, figs. 16–19.
1914. *Baiera Guilhaumati* COUNILLON: p. 19, Pl. III, figs. 3–4.
1925. *Baiera gracilis* KAWASAKI (pars): p. 46, Pl. XXV, figs. 75–77; Pl. XXVI, figs. 78, 79.
1931. *Baiera Guilhamati* SZE: p. 37, Pl. VI, figs. 1–6; p. 57.
1932b. *Baiera Guilhaumati ?* ÔISHI: p. 353, Pl. XXXV, fig. 5.

Remarks: This species is very imperfectly represented in the Nariwa flora. The material which the writer determined as *B. Guilhaumati* ZEILL. ? is an imperfect specimen, the apices of the segments being all broken. Without the apices of the segments this species is hardly distinguishable from a Middle Jurassic species *B. gracilis* BUNB., those of the former being obtusely rounded or rounded while those of the latter are acuminated, though otherwise similar. Notwithstanding this, the reasons why the writer dared to identify the imperfect specimen from Nariwa to ZEILLER's species, though it is tentatively, are, first, in the Japanese Mesozoic floras there seems to be no typical representative of this species (KAWASAKI's *B. gracilis* from Tyôsen is partly *B. Guilhaumati* and partly *Ginkgoites sibirica*, YABE's *B. gracilis* from Tyôsen is somewhat distinct from the typical one in having larger lamina), secondly the Daidô Series of Tyôsen containing *B. Guilhaumati* is but slightly younger than the Nariwa Series, while *B. gracilis* is a Middle Jurassic species.

Occurrence:

Nariwa (33), Okayama. Nariwa Series.

Kôsei Coal-mine } Tyôsen. Daidô Series. (G. S. T. Coll.).
Taihô Coal-mine }

Baiera Lindleyana (SCHIMPER) SEWARD

1838. *Solenites ? furcata* LINDLEY and HUTTON: p. 209, Pl. CCIX.
1900b. *Baiera Lindleyana* SEWARD: p. 266, Pl. IX, figs. 6, ?7; ?Text-fig. 46.
1925. *Baiera Lindleyana* KAWASAKI: p. 49, Pl. XLIII, fig. 117b.
1933. *Baiera Lindleyana* SZE: p. 17, Pl. VII, fig. 7.
SEWARD, 1900b, gives further reference.

*Remarks*s The specimen described by KAWASAKI from Tyôsen as *B. Lindleyana* is a splendid one identical with the type-specimen from Yorkshire. SZE (1933) also figured a specimen of this species from Shansi, China, and YABE and ÔISHI (1929a, p. 105) described a somewhat imperfect specimen from Shantung as Cf. *B. Lindleyana*. A specimen from the Nikanian Series of Ussuriland described by KRYSHTOFOVICH and PRYNADA[1] as *Baiera Ahnertii* may be either this or *B. Asadai* Y. and Ô.

Occurrence:

Myongam near Nampô, Tyôsen. Daidô Series. (G.S.K. Coll.).

1) A. KRYSHTOFOVICH and V. PRYNADA (1932), p. 371, Pl. I, fig. 4.

Baiera longifolia (POMEL) HEER

1873. *Jeanpaulia longifolia* SAPORTA: p. 464, Pl. LXVII, fig. 1.
1876. *Baiera longifolia* HEER: p. 52, Pl. VII, figs. 2–3; Pl. VIII; Pl. IX, figs. 1–11; Pl. X, figs. 6–7; Pl. XV, fig. 11b.
?1877. *Baiera longifolia* HEER: p. 39, Pl. VIII, fig. 6.
1880a. *Baiera longifolia* HEER: p. 11, Pl. I, figs. 10a, 11a; Pl. II, figs. 4a–b; Pl. IV, figs. 1–2; Pl. V, figs. 1b, 3b–c.
1905. *Baiera longifolia* KRASSER: p. 18, Pl. I, fig. 16.
?1913. *Baiera longifolia* THOMAS: p. 243, Pl. XXV, figs. 3–4.
1926. *Baiera longifolia* KAWASAKI: p. 31, Pl. IX, figs. 26–27; Pl. X, fig. 28; Pl. XI, figs. 29–30.

Remarks: Korean specimens determined by KAWASAKI (1926) as *B. longifolia* are splendid ones identical with HEER's Siberian specimens so beautifully illustrated. Yorkshire specimens described by THOMAS (1913) under HEER's name have narrower ultimate segments rather resembling *B. angustiloba* HR.

Occurrence:

Hakuunzi, Tyôsen. Daidô Series (G. S. K. Coll.).

Baiera minuta NATHORST

1878a. *Baiera minuta* NATHORST: p. 12.
1878a. *Sphenopteris ? baieraeformis* NATHORST: p. 28, Pl. I, fig. 3.
1879. *Sphenopteris baieraeformis* NATHORST: p. 55, Pl. XIII, figs. 1–2.
1886. *Ginkgo minuta* NATHORST: p. 93, Pl. I, fig. 3; Pl. XIII, figs. 1–2; Pl. XX, figs. 14–16.
1918. *Baiera minuta* LUNDQVIST: p. 439, Pl. IX; Text-figs. 1–5.
1926. *Baiera Muensteriana* HARRIS: p. 101, Text-fig. 24.
1932b. *Baiera Muensteriana* ÔISHI: p. 346, Pl. XXXII, fig. 1.
1935. *Ginkgoites minuta* HARRIS: p. 11, Pl. I, fig. 7; Text-fig. 5.

Remarks: The writer first (ÔISHI, 1932b) identified several specimens from Nariwa to *Baiera Muensteriana* (PRESL), but now thinks that they may rather be referable to *B. minuta* NATH. The reason is that our specimens of which only one is shown in ÔISHI, 1932b, Pl. XXXII, fig. 1 agrees well with the specimens of *Ginkgoites minuta* NATH. exhibited by HARRIS (HARRIS, 1935, p. 12, text-fig. 5), rather than with PRESL's species. Therefore the existence of this species in the Nariwa Series is more probable than that of *B. Muen-*

steriana. In Greenland, the occurrence of *B. minuta* is confined to the *Lepidopteris* Zone; in Loc. No. 1 of the Nariwa district the present specimen occurs in association with *Neocalamites hoerensis*, and *Pterophyllum Schenki* which are elements of the *Lepidopteris* Zone, without mixture with any species restricted to the *Thaumatopteris* Zone. This fact verifies at least that locality No. 1 in the Nariwa district is most probably equivalent to the *Lepidopteris* Zone of East Greenland. Specimens from Locs. Nos. 16 and 50 referred in the writer's work in 1932b to *B. Muensteriana* are thus likely to be referable to *B. minuta*.

Occurrence:

Nariwa (1, 16, 50), Okayama. Nariwa Series.

Baiera paucipartita NATHORST

Pl. XXXVIII, Fig. 5.

1886. *Baiera paucipartita* NATHORST: p. 94, Pl. XX, figs. 7–13; Pl. XXI; Pl. XXII, figs. 1–2.
1891. *Baiera*? sp. YOKOYAMA: p. 246, Pl. XXXIV, fig. 6.
1894. *Baiera paucipartita* BARTHOLIN: p. 95, Pl. XI, fig. 4.
1896. *Baiera paucipartita* INOUYE: p. 363, Pl. XII, fig. 6.
1905. *Baiera paucipartita* YOKOYAMA: p. 9, Pl. II, fig. 5.
1932b. *Baiera paucipartita* ÔISHI: p. 351, Pl. XXXII, fig. 6.
1932a. *Baiera paucipartita* ÔISHI: p. 65, Pl. I, figs. 10–11.

Description of specimen: Pl. XXXVIII, fig. 5 shows a cuneate lamina about 8 cm. high, dichotomously divided into more than 11 narrow ultimate parallel nerves forking near the base. The apex of the segments is obtusely rounded. The very base of the lamina is missing.

Remarks: The specimens figured by NATHORST (1886) from the Rhaetic of Sweden are characterised by the absence of any definite petiole, the leaves being attached by a narrow basal portion to a short axis which is covered with scale-leaves. Unfortunately, the Japanese specimens previously referred to this species were all wanting in the basal part, but all the vegetative characters otherwise observable are almost indistinguishable from the Swedish specimens, the only difference being in the less number of nerves in some of the Japanese specimens: in the specimens in Pl. XXXVIII, fig. 5 in this work and in ÔISHI, 1932b, Pl. I, fig. 10 the nerves are less than 4, while in the Swedish ones they are 4–8; one of the Japanese specimens figured by YOKOYAMA (1905, Pl. II, fig. 5) from Nagato has 7 or 8 nerves as in the type-specimens.

Occurrence:

Nariwa (44), Okayama. Nariwa Series.
Yamanoi (1, 3, 15), Yamaguti. Upper Triassic.
Momonoki, Yamaguti. Momonoki Bed. (Sendai Coll.).

Baiera taeniata BRAUN

1914. *Baiera taeniata* GOTHAN: p. 62, Pl. XXIX, fig. 2; Pl. XXXI/XXXII, fig. 1; ?Pl. XXIX, fig. 4 and Pl. XXXIII, fig. 3.
1919. *Baiera taeniata* ANTEVS: p. 44, Pl. V, figs. 20–24; Pl. VI, fig. 43.
1922. *Baiera taeniata* JOHANSSON: p. 46, Pl. IV, figs. 7–8; Pl. VIII, fig. 12.
1932b. *Baiera taeniata* ÔISHI: p. 350, Pl. XXXII, fig. 5.

Remarks: The species identified to *Baiera taeniata* is represented by a single specimen from Nariwa. It has already been stated that the Japanese specimen agrees with the Swedish specimens figured by ANTEVS (1919) and JOHANSSON (1922) under the name referred to above. Moreover, HARRIS[1] who recently examined slides of cuticles of Swedish specimens tentatively referred some of the specimens figured by these two authors as *B. taeniata* to *Gingkoites Hermelini* (HARTZ). If it were proved in any way that the Swedish specimens may be actually referable to *G. Hermelini*, then the Japanese specimen should thus naturally be identified to that species. Therefore the reference of the Japanese spcimen to *B. taeniata* is provisional. The present specimen differs from the Greenland specimens identified to *B. taeniata* (*Ginkgoites taeniata*) in that the latter have notched ultimate segments, and it resembles even more closely those identified to *Ginkgoites Hermelini*.

Occurrence:

Nariwa (66), Okayama. Nariwa Series.

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1) T. M. HARRIS (1935), p. 13.

Genus *Ginkgoites* SEWARD

Ginkgoites adiantoides (UNGER) SEWARD

Pl. XXXVIII, Fig. 6.

1878. *Ginkgo adiantoides* HEER: p. 21, Pl. II, figs. 7–10.
1935. *Ginkgo adiantoides* SHAPARENKO: pp. 1–25.
1937. *Ginkgoites adiantoides* HATAE: p. 5, Pl. IX, figs. 45–47 (figures only).
For references see SHAPARENKO, 1935.

Description of specimen: Pl. XXXVIII, fig. 6 shows a specimen obtained from the Upper Ammonites Beds near the Kawakami coal-mine, Karahuto. It is a petiolate leaf with semiorbicular lamina the base of which is straight and shallowly lobed at the outer margin. As the inner edges of the lamina of the lobe are overlapping each other, the lamina appears to be almost entire in the margin. The nerves issue flabellately from the two primary branches at the top of the petiole running close to the lower edges of the lamina, and fork frequently.

Remarks: Leaves indistinguishable from UNGER's *Salisburia adiantoides* have been recorded from various localities in the world throughout several geological horizons since the Jurassic. Recently SHAPARENKO (1935) revised and summarized this species and gave a useful list of reference to it.

It is striking that this species resembles fairly closely the living species of *Ginkgo*, *G. biloba* L., but there is no evidence whatever for referring the fossil specimens to the living species any more than the external morphology of the leaves. Recently the writer[1] examined cuticular structures of some Tertiaty specimens identical in leaf-form with *G. adiantoides* and arrived at the conclusion that the cuticles differ in the two, that is, in the fossil leaves the stomata are distributed on both sides of the lamina and the ordinary cell walls are more sinuous than in *G. biloba*. But the differences are, the writer thinks, not great. Such leaves described as *Ginkgo laramiensis* WARD[2], *G. Dawsoni* KNOWLTON,[3] *G. pseudoadiantoides* HOLLICK[4] from North America or Alaska can hardly be discerned from *G. adiantoides*.

1) S. ÔISHI (1938).
2) A. HOLLICK (1930), p. 49, Pl. XII, figs. 3, 4.
3) F. H. KNOWLTON (1919), p. 302.
4) A. HOLLICK (1930), p. 49, Pl. III, fig. 7b; Pl. XIII, figs. 8–12; Pl. XXVIII, fig. 4a.

Occurrence: The occurrence of *Ginkgo* leaves of this type is not uncommon in the Tertiary desposits of Japan, but in the Mesozoic rocks it is exceedingly rare. The figured specimen is derived from the Upper Ammonites Beds (Senonian) at the Kawakami coal-mine, Karahuto; Senonian. It occurs also from the Sinyôdô Bed of Tyôsen (Hatae, 1937).

Ginkgoites digitata (BRONGNIART) SEWARD

Pl. XXXVIII, Figs. 7–9.

1830. *Cyclopteris digitata* BRONGNIART: p. 219, Pl. LXI, figs. 2–3.
1884. *Salisburia digitata* SAPORTA: p. 294, Pl. CLX, figs. 1–2.
1889. *Ginkgo digitata* YOKOYAMA: p. 59, Pl. XIII, fig. 2.
1894. *Ginkgo digitata* BARTHOLIN: p. 96, Pl. IV, fig. 1.
1894. *Ginkgo Huttoni* BARTHOLIN: p. 97, Pl. IV, figs. 2–3.
1897. *Ginkgo digitata* NATHORST: p. 15.
1900. *Ginkgo digitata* SEWARD: p. 23, Pl. II, fig. 5.
1900b. *Ginkgo digitata* SEWARD: p. 258, Pl. IX, figs. 1, 9 (non 2, 10).
1905. *Ginkgo digitata* KRASSER: p. 16, Pl. II, fig. 3.
1907. *Ginkgo digitata* SEWARD: p. 29, Pl. VII, figs. 53–55.
1907. *Ginkgo digitata* STOPES: p. 375, figs. A, B.
1910. *Ginkgo digitata* KRYSHTOFOVICH: p. 13, Pl. III, fig. 1.
1911. *Ginkgo digitata* THOMAS: p. 73, Pl. IV, fig. 7; Pl. VIII, fig. 2.
1912a. *Ginkgo digitata* SEWARD: p. 23, Pl. IV, fig. 51.
1914. *Ginkgo digitata* KNOWLTON: p. 55, Pl. VI, fig. 5; Pl. VII, figs. 3–5.
1917. *Ginkgo digitata* WALKOM: p. 8, Pl. I, figs. 3–5.
1918. *Ginkgo digitata* ZALESSKY: Pl. XXVII, fig. 2; Pl. XLII, figs. 4–5; Pl. XLVIII, figs. 3–4.
1919. *Ginkgo digitata* WALKOM: p. 38, Pl. I, figs. 3–4.
1919. *Ginkgoites digitata* SEWARD: p. 14, fig. 634.
1927. *Ginkgoites digitata* du TOIT: p. 370, Text-fig. 16, B.
?1927. *Ginkgoites digitata* CHAPMAN: p. 138, Pl. XI, fig. 29.
1929. *Ginkgo digitata* KHAKHLOF (pars): p. 17, figs. 19, 20.
1930. *Ginkgo digitata* HOLLICK: p. 48, Pl. XI, figs. 2–7a, 8.
1935. *Ginkgoites digitata* TOYAMA and ÔISHI: p. 69, Pl. III, figs. 4–5.

Description of specimens: In Pl. XXXVIII, figs. 7–9 are shown three *Ginkgoites* leaves, the laminae of which are cuneate and 2–2.5 cm. high and divided by a shallow sinus into two halves with truncated (figs. 7 and 8) or irregular margins (fig. 9); one of the specimens has a petiole 1.5 cm. long. The nerves are divergent and fork occasionally.

Remarks: The type of leaves which the writer has here called *Ginkgoites digitata* (BRONGN.) includes all the leaves of *Cyclopteris* *digitata* type of BRONGNIART, the laminae of which are almost entire or shallowly lobed and the apex of each segment is more or less truncated or broadly rounded instead of being rather obtusely rounded. For leaves of similar size and outline to *G. digitata* but with deeply-lobed laminae generally four in number, each bearing an obtusely rounded apex, has been proposed the name *G. digitata* var. *Huttoni* SEWARD (SEWARD, 1919, p. 15). Therefore, such specimens as figured by FONTAINE (in WARD, 1905, p. 121) from the Jurassic of Oregon as *G. digitata* the laminae of which are deeply divided into several segments do not belong to the category in the writer's sense but belong to *G. digitata* var. *Huttoni* (ÔISHI, 1931f, p. 247). The above list of synonymy represents only the leaves which may be regarded to belong to *G. digitata* in the writer's sense.

YOKOYAMA (1889) once figured a typical leaf of this species from Okamigô as *Ginkgo digitata*. Alaskan specimens described by HOLLICK (1930) as *Ginkgo minor* are morphologically identical with *G. digitata*.

Occurrence:

Yanagidani, Kuwasima	Isikawa.	Tetori Series.
Motiana, Kowasimizu	Hukui.	
Okamigô, Gihu.	(Tôkyô Coll.)	

Ginkgoites digitata (BRONGNIART) var. *Huttoni* SEWARD

Pl. XXXVIII, Fig. 10.

1833. *Cyclopteris digitata* LINDLEY and HUTTON: p. 179, Pl. XLIV.
1884. *Salisburia Huttoni* SAPORTA: p. 299, Pl. XXXI, figs. 4–5; Pl. XXXII, fig. 8.
1900b. *Ginkgo digitata* forma *Huttoni* SEWARD: p. 259, Pl. IX, figs. 2, 10 (?).
1905. *Ginkgo digitata* FONTAINE: in WARD, p. 121, Pl. XXX, figs. 1–7.
1905. *Ginkgo Huttoni* FONTAINE: in WARD, p. 123, Pl. XXX, figs. 8–12; Pl. XXXI, figs. 1–3.
1905. *Ginkgo sibirica* FONTAINE (pars): in WARD, p. 125, Pl. XXXIII, figs. 5–7.
1919. *Ginkgoites digitata* var. *Huttoni* SEWARD: p. 15, fig. 633.
1922. *Ginkgo sibirica* YABE (pars): Pl. IV, fig. 10.
1925. *Ginkgoites sibirica* KAWASAKI (pars): p. 44, Pl. XXIII, figs. 68, 71 (non figs. 69, 70).
1929. *Ginkgo digitata* KHAKHLOF (pars): p. 17, fig. 18 only.

1930a. *Ginkgoites Huttoni* TURUTANOVA-KETOVA: p. 329, Pl. IV, fig. 1.
1931. *Ginkgo digitata* KHAKHLOF: p. 18, fig. 19.
1931f. *Ginkgoites digitata* var. *Huttoni* ÔISHI: p. 247, Pl. XVIII, figs. 1B, 4.
1932a. *Ginkgoites digitata* var. *Huttoni* ÔISHI: p. 64, Pl. II, fig. 9.
1933. *Ginkgoites digitata* var. *Huttoni* YABE and ÔISHI: p. 20.
1938. *Ginkgoites digitata* var. *Huttoni* ÔISHI and HUZIOKA: p. 94.

Description of specimen: Pl. XXXVIII, fig. 10 shows a broadly cuneate lamina 4 cm. high deeply divided into four ultimate segments with rounded apex, the segment at the extreme right being repeatedly shallowly cleft. There are 15–18 nerves in each ultimate segment, forking occasionally.

Remarks: The figured specimen agrees with the specimens figured by FONTAINE (in WARD, 1905) from Oregon under the name *G. digitata*, especially it is identical with one of FONTAINE's specimens (his Pl. XXX, fig. 4).

The writer (1931b) has already stated a wish to group specimens with laminae of *G. digitata*-type, but more deeply dissected into usually four or five broadly lanceolate segments, as *G. digitata* var. *Huttoni*, following SEWARD. This view was followed also in this work. The above list of synonymy represents the specimens which belong to the category in the present sense.

This variety thus considered may naturally include the specimens from the Jurassic of Oregon assigned by FONTAINE to *G. digitata* and certain specimens described by the same author as *G. sibirica* from the same district. *G. Huttoni magnifolia* FONTAINE (in WARD, 1905, p. 124) from Oregon differs from *G. digitata* var. *Huttoni* only in having greater width and length of segments, though WALKOM[1] and DU TOIT[2] wish to retain *magnifolia* with the rank of a species. Some Chinese specimens described by SZE[3] as *G. Hermelini* (NATH.) from Suiyuan seem to be very close to the present variety. HARRIS[4] states that these Chinese specimens may not be *G. Hermelini*.

Occurrence:

Nariwa (66), Okayama, Nariwa Series.
Kuruma, Nagano. Kuruma Bed.
Kusaigawa, Yamaguti. Momonoki Bed.

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1) A. B. WALKOM (1917), p. 9.
2) A. L. DU TOIT (1927), p. 370.
3) H.C. SZE (1933), p. 28, Pl. VII, figs. 5–6.
4) T. M. HARRIS (1935), p. 19.

Ginkgoites sibirica (HEER) SEWARD

Pl. XXXVIII, Fig. 11; Pl. XXXIX, Fig. 1.

1876. *Gingko sibirica* HEER: pp. 61, 116, Pl. VII, fig. 6; Pl. IX, fig. 5b; Pl. XI; Pl. XXII, fig. 3.
1877. *Ginkgo sibirica* GEYLER: p. 231, Pl. XXXI, fig. 6.
1889. *Ginkgo* cf. *lepida* YOKOYAMA: p. 60, Pl. XIV, fig. 10.
1889. *Ginkgo sibirica* YOKOYAMA: p. 60.
1905. *Ginkgo lepida* FONTAINE: in WARD, p. 125, Pl. XXXII, figs. 3–8.
1905. *Ginkgo sibirica* FONTAINE: Ibid., p. 125, Pl. XXXIII, figs. 1–4, 8, 19 (non figs. 5–7, which are *G. digitata* var. *Huttoni*: see ÔISHI, 1931f, Mes. Plants from Kita-Otari, p. 248).
1906. *Ginkgo lepida* YOKOYAMA: p. 31, Pl. IX, fig. 2b.
1906. *Ginkgo flabellata* YOKOYAMA: p. 27, Pl. VII, figs. 6–9.
1906. *Ginkgo* sp.: Ibid., p. 34, Pl. XI, figs. 5–7.
1906. *Ginkgo Schmidtiana* forma *parvifolia* KRASSER: p. 604, Pl. II, figs. 4–5.
1907. *Ginkgo sibirica* SEWARD: p. 30, Pl. VII, figs. 56–57.
1908. *Ginkgo lepida* YABE (pars): p. 8, Pl. II, figs. 4, 5d.
1911a. *Ginkgoites sibirica* SEWARD: p. 679, Text-fig. 9A.
1916. *Ginkgo sibirica* KRYSHTOFOVICH: p. 116, Pl. X, figs. 6–7; Pl. XX, fig. 1.
1922. *Ginkgo sibirica* YABE (pars): p. 23, Pl. IV, fig. 11; Text-figs. 22–24.
1925. *Ginkgoites sibirica* KAWASAKI: p. 44, Pl. XXIII, figs. 69, 70.
1925. *Baiera gracilis* KAWASAKI (pars): p. 46, Pl. XXIV, fig. 72.
1926. *Ginkgoites sibirica* KAWASAKI: p. 21, Pl. VI, fig. 20.
1926. *Baiera gracilis* KAWASAKI (pars): p. 31, Pl. IX, fig. 25.
1928. *Ginkgo sibirica* YABE and ÔISHI: p. 9.
1930. *Ginkgoites sibirica* TURUTANOVA-KETOVA: p. 154, Pl. II, fig. 19.
1930a. *Ginkgoites sibirica* TURUTANOVA-KETOVA: p. 326, Pl. V, figs. 1, 3.
1930a. *Ginkgoites lepida* TURUTANOVA-KETOVA: p. 328, Pl. III, fig. 9.
1930a. *Ginkgoites* cf. *pusilla* TURUTANOVA-KETOVA: p. 328.
1931. *Ginkgo sibirica* KHAKHLOF: p. 16, fig. 22.
1931. *Ginkgo Schmidtiana* KHAKHLOF: p. 29.
1932b. *Ginkgoites sibirica* ÔISHI: p. 347, Pl. XXXI, figs. 4–5.
1933. *Ginkgoites* cfr. *sibirica* YABE and ÔISHI: p. 20, Pl. II, fig. 8; Pl. III, figs. 4–7, 8b.
1933b. *Ginkgo* cf. *lepida* SZE: p. 70, Pl. X, figs. 1–2.
1935. *Ginkgoites sibirica* TOYAMA and ÔISHI: p. 70, Pl. III, fig, 6; Pl. IV, fig. 2.

Description of specimens: Pl.XXXIX, fig. 1 shows an imperfect semi-orbicular lamina which appears to be divided dichotomously into more than ten lanceolate ultimate segments with obtusely pointed apex. Each ultimate segment bears about 7 parallel nerves. Another specimen in Pl. XXXVIII, fig. 11 shows apparently a cuneate lamina about 5 cm. high which is dichotomously divided into at least six lanceolate ultimate segments provided with obtusely pointed apex. Each ultimate segment has 7–8 parallel nerves forking near the base.

Remarks: The name *Gingkoites sibirica* (HEER) is here applied more or less in a wide sense to cover all the leaf-impressions including types of *G. sibirica, G. flabellata, G. pusilla, G. lepida,* and *G. Schmidtiana* described by HEER from the Jurassic of Siberia. Many specimens have been figured and described under these specific names, but the specific distinction of these leaf-types based on the form and size of the leaves, the number of dissections of lamina into ultimate segments and number of nerves is somewhat unreliable in view of the considerable variation in the vegetative characters, mentioned above, in the modern species. The species listed above in the synonym table represent specimens which are morphologically hardly separable as distinct species. Some of them, or perhaps many of them, might be proven structurally distinct if the cuticular preparations were available, but it is best at present to include all these types of leaf-impressions into one species calling them under the familiar name *G. sibirica.* Among the specimens of *G. sibirica* group, only a specimen from Manchuria described by YABE and ÔISHI[1] and one from Sweden determined by JOHANSSON[2] as *G.* cfr. *sibirica* (HR.) show cuticular structures, though HARRIS[3] regard JOHANSON's specimen as possibly *Ginkgoites Hermelini* (HARTZ). A leaf resembling *G. sibirica* but with more acuminate ultimate segments from Tyôsen was referred by KAWASAKI (1925, p. 45; 1926, p. 21) to *Baiera Phillipsi* NATH.

Occurrence:

Nariwa (21, 45, 49), Okayama. Nariwa Series.
Kuwasima, Isikawa. } Tetori Series.
Hakogase, Hukui. (Tôkyô Coll.) } Tetori Series.
Takazi, Yamaguti. Kiyosue group.
Gabisan
Wonhyon
Kôsei Coal-mine (G. S. K. Coll.)
Roseiri (Tôkyô Coll.)
} Tyôsen. Daidô Series.

1) H. YABE and S. ÔISHI (1933), p. 3, Pl. I, figs. 1–2; Pl. IV, figs. 2–4.
2) N. JOHANSSON (1922), p. 43, Pl. III, fig. 5; Pl. VI, fig. 26; Pl. VIII, figs. 7–9.
3) T. M. HARRIS (1935), p. 16.

Genus *Ginkgoidium** YOKOYAMA

Ginkgoidium gracile TATEIWA

Pl. XXXVIII, Fig. 3.
(Type-specimen: TATEIWA, 1929, fig. 16).

1929. *Ginkgodium gracile* TATEIWA: Plate, figs. 16a–b.

This species was already recognised by TATEIWA as a new species of *Ginkgoidium*; he showed the figures but without description. The writer examined the type-specimen. The diagnosis follows: Leaf small, spatulate, rounded at apex, narrowing below; nerves parallel, ± 10 in number, issuing from basal lateral thickened margin and converging towards apex.

Discussion: This species is like *Podozamites* but may be distinguished from it by the presence of basal marginal thickening.

Remarks: This species is characterised by the small size of the leaf. The margin is always entire among the specimens available and not bi-lobed as in another species of this genus, *G. Nathorsti* YOK. The species is common in the plant bed of Toriken, and it is fairly constant in regard to the shape and size of leaves. PRYNADA[1] described a similar but somewhat broader leaf from the Lower Jurassic of Central Asia as *Ginkgodium zerauschanicum*.

Occurrence:

Toriken, Ryûsindô } Tyôsen. Rakutô Bed. (G. S. K. Coll.).

Ginkgoidium Nathorsti YOKOYAMA

Pl. XXXIX, Figs. 2–5.

1877. ?*Podozamites* GEYLER: p. 230, Pl. XXXII, fig. 3.
1889. *Ginkgodium Nathorsti* YOKOYAMA: p. 57, Pl. II, fig. 4e; Pl. III, fig. 7; Pl. VIII; Pl. IX, figs. 1–10; Pl. XII, figs. 14, 15.
1911. *Ginkgodium Nathorsti* THOMAS: p. 75, Pl. IV, figs. 9–11; Pl. VIII, fig. 3.
1929. *Ginkgodium Nathorsti* TATEIWA: Plate, fig. 17.

Diagnosis (YOKOYAMA, 1889): "Leaf coriaceous, gradually attenuated below into a short petiole, entire or lobed; apex obtuse.

*) The name *Ginkgoidium* was suggested by HARRIS (1935) in preference to *Ginkgodium* YOKOYAMA.

1) V. PRYNADA (1931), p. 31, Pl. II, fig. 19; text-fig. 4.

Longitudinal veins dense, simple, parallel; interstitial veins very fine, simple."

Description of specimens: Numerous specimens from Kuwasima and some other localities are examined. Pl. XXXIX, fig. 4 shows a proximal portion of a leaf which is more than 8 cm. high, probably attaining at least 12 cm., and about 6 cm. broad at the distal broken end of the specimen. It narrows gradually below to a short petiole about 1 cm. long. The lamina is bi-lobed into two equal halves, the fused part being 5.5 cm. The nerves are distinct, parallel, springing from the petiole and the marginal thick nerves which are particularly prominent in the lower two-thirds of the margin, and mostly simple except near their origin. The number of nerves is about 60 in each half of the lamina. Fig. 5 shows a similar specimen with a large lamina representing a middle portion. The specimen in figs. 2 and 3 is interesting because of the narrow type of their leaves, and the former is particularly interesting as it shows the petiole attached to a branch. The expanded base of petiole is clearly seen in these last two specimens.

Remarks: YOKOYAMA's illustrations show that this species is considerably variable in respect to the size of the leaves. The writer's collection shows that the size varies from long and narrow leaves, the length being 5 cm. and the breadth in the middle portion 1.5 cm., to longer and broader ones with length 15 cm. and the breadth 5 cm. (Pl. XXXIX, fig. 5). Through all the specimens, however, the following characters seem to be consistent: the petiole is short; even in large leaves it hardly exceeds 1.5 cm. in length; the lamina is as YOKOYAMA also pointed out, always bi-lobed, though in the very young or small leaves they are often simple; the nerves do not converge below towards the petiole but meet with the thick marginal nerves as can be seen in the modern *Ginkgo*.

Comparison: Unfortunately the writer has not yet been able to make any cuticular preparation of this species in spite of the richness of the material, the preservation being unsatisfactory. *Ginkgoites obovata* (NATH.) and *Baiera boeggildiana* HARRIS from the *Lepidopteris* Zone of East Greenland resemble small leaves of this species, but there is a difference in the nervation, as HARRIS[1] pointed out.

1) T. M. HARRIS (1935), pp. 3 and 28.

THOMAS (1911) described this species from the Jurassic rocks of Kamenka. Certain specimens of *Baiera spectabilis* NATH. described by NATHORST[1] resemble the present species, though it may be only apparently.

Occurrence:

Kuwasima } Isikawa. } Tetori Series.
Yanagidani
Kowasimizu, Hukui.
Okamigô, Gihu.
Toriken, Tyôsen. Rakutô Bed.

Genus *Czekanowskia* HEER

Czekanowskia rigida HEER

Pl. XXXIX, Figs. 6, 7.

1876. *Czekanowskia rigida* HEER: p. 70, Pl. V, figs. 8–11; Pl. VI, fig. 7; Pl. X, fig. 2a.

1878. *Czekanowskia rigida* HEER: pp. 7, 26, Pl. I, figs. 16–17; Pl. V, figs. 3b–c.
1879. ?*Czekanowskia rigida* SCHMALHAUSEN: p. 36, Pl. V, figs. 2c, 6a, 7; p. 86, Pl. XV, fig. 3a; Pl. XVI, figs. 16–17.
1880a *Czekanowskia rigida* HEER: p. 19, Pl. VI, figs. 7–12.
1883. *Czekanowskia rigida* SCHENK: p. 251, Pl. L, fig. 7; p. 262, Pl. LIV, fig. 2a.
1885. *Czekanowskia rigida* SCHENK: p. 14, Pl. XV, fig. 13.
1886. *Czekanowskia rigida* NATHORST: p. 96, Pl. XX, fig. 6.
1889. *Czekanowskia rigida* ? YOKOYAMA: p. 61, Pl. XII, fig. 11; Pl. XIII, fig. 10.
1900. *Czekanowskia rigida* ZEILLER: p. 253, fig. 181.
1906a. *Czekanowskia rigida* NATHORST: p. 11, Pl. I, fig. 8; Pl. II, figs. 2–15.
1907. *Czekanowskia rigida* SEWARD: p. 31, Pl. VIII, figs. 62–63.
1908. *Czekanowskia rigida* ? YABE: p. 10, Pl. II, fig. 1c.
1910. *Czekanowskia rigida* KRYSHTOFOVICH: p. 14, Pl. III, fig. 6.
1911. *Czekanowskia rigida* THOMAS: p. 76, Pl. IV, fig. 13.
1911. *Czekanowskia rigida* SEWARD: p. 48, Pl. IV, fig. 46.
1911. *Czekanowskia rigida* SEWARD and THOMAS: p. 30, Pl. II, fig. 14.
1918. *Czekanowskia rigida* ZALESSKY: Pl. XXXI, figs. 1, 2, 5.
1919. *Czekanowskia rigida* ANTEVS: p. 47, Pl. V, figs. 28–29.
1922. *Czekanowskia rigida* JOHANSSON: p. 49, Pl. VIII, fig. 6; Text-fig. 5.
?1924. *Czekanowskia rigida* CHOW: p. 12, Pl. II, fig. 9.

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1) A. G. NATHORST (1906a), p. 4, Pl. I, figs. 1 and 4.

1928. *Czekanowskia rigida* YABE and ÔISHI: p. 10, Pl. III, figs. 3–5; Pl. IV, fig. 1.
1931. *Czekanowskia rigida* PRYNADA: p. 34.
1931. *Czekanowskia rigida* SZE: p. 58.
1931f. *Czekanowskia rigida* ÔISHI: p. 249, Pl. X, fig. 2a.
1932b. *Czekanowskia rigida* ÔISHI: p. 355, Pl. XXXII, figs. 8, 8a.
1933. *Czekanowskia rigida* ? YABE and ÔISHI: p. 28, Pl. III, fig. 8c; Pl. V, fig. 6.

Description of specimen: Pl. XXXIX, figs. 6 and 7 show slabs of rock derived from Takazi with clusters of needle-like leaves about 1 mm. broad forking occasionally. Each leaf seems to carry one or two forking nerves, but they are somewhat indistinctly marked on the impression.

Remarks: The above list shows how frequently the narrow needle-like leaves generally called *Czekanowskia rigida* have been recorded from the Mesozoic rocks of various parts of the world. It is not of course certain that all the specimens described under this specific name were botanically conspecific. However, it is not by any means warranted to record the occurrence of such leaves which differ considerably in morphological features from many of the fossil leaves, and it is especially so now that the cuticles of certain specimens of the generic type of *Czekanowskia* are known which indicate in no small degree the Ginkgoacean affinity, although superficially they appear to be needle-like leaves in Coniferales.

C. rigida is often difficult to distinguish from detached coniferous leaves, but in the latter the leaves are unbranched, with a single nerve and give a rigid appearance. Of course in the imperfect specimens it is impossible to distinguish them by the external morphology only.

Occurrence:

Nariwa (1, 21, 44, 47, 69), Okayama. Nariwa Series.
Kuruma, Nagano. Kuruma Bed.
Sitaka (*C.* sp.), Kyôto. Sitaka Bed.
Yamanoi (1) (*C.* ? sp.), Yamaguti. Upper Triassic.
Ozô, Isikawa. Tetori Series.
Takazi, Yamaguti. Kiyosue Group.
Ueno (*C.* ? sp.), Kôti. Ryôseki Series.

Genus *Phoenicopsis* HEER

Phoenicopsis angustifolia HEER

1876. *Phoenicopsis angustifolia* HEER: p. 51, Pl. I, fig. 1d; Pl. II, fig. 3b.
1878. *Phoenicopsis angustifolia* HEER: p. 6; p. 23, Pl. VII, figs. 3–8.
1905. *Phoenicopsis angustifolia* KRASSER: p. 22, Pl. III, figs. 2–4.
1907. *Phoenicopsis angustifolia* SEWARD: p. 32, Pl. VIII, figs. 69, 70.
1911. *Phoenicopsis angustifolia* var. *media* SEWARD: p. 50, Pl. III, figs. 32–36, 38A; Pl. VI, fig. 66.
1922. *Phoenicopsis angustifolia* forma *media* YABE: p. 27, Pl. IV, figs. 4, 5.
1930. *Phoenicopsis angustifolia* TURUTANOVA-KETOVA: p. 156, Pl. V, fig. 36.
1930a. *Phoenicopsis angustifolia* TURUTANOVA-KETOVA: p. 341, Pl. III, fig. 4; Pl. IV, fig. 6.

TURUTANOVA-KETOVA (1930, 1930a) gives additional references.

Remarks: The leaves of this species are about 4 mm. broad and have 6–8 nerves without interstitial. A specimen closely allied to this species but with interstitials was described by YABE and ÔISHI (1933, p. 26) from the Jurassic of Manchuria as *Phoenicopsis* sp. nov. which was later named *P. manchurica* Y. and O.[1] Somewhat imperfect specimens probably identical with this species were described by NATHORST[2] from the Arctic region. SZE[3] described *P.* cfr. *angustifolia* from Shensi, China. Similar examples but almost impossible to identify specifically have been described by the writer from Sitaka (1932, p. 252) and Nariwa (1932b, p. 355). This species is common in the Jurassic formation of Eastern Asia and the descriptions by several authors have been accompanied by figures of beautiful specimens.

Occurrence:

Kenziho
Taihô Coal-mine } Tyôsen (G. S. K. Coll.). Daidô Series.

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1) S. ÔISHI (1935), p. 76, Pl. V, fig. 2.
2) A. G. NATHORST (1897), p. 16, Pl. I, figs. 1–3; (1900), p. 14, Pl. I, figs. 39–41; Pl. II, figs. 1–6; (1907a), p. 6, Pl. I, figs. 14–19.
3) H. C. SZE (1933a), p. 82, Pl. XII, fig. 10.

Phoenicopsis speciosa HEER

1876. *Phoenicopsis speciosa* HEER: p. 112, Pl. XXIX; Pl. XXX.
1905. *Phoenicopsis speciosa* KRASSER: p. 21, Pl. III, fig. 5.
1925. *Phoenicopsis speciosa* KAWASAKI: p. 50, Pl. XXIX, figs. 83, 84.

Remarks: This species is distinguishable from *P. angustifolia* in the larger number of nerves and in possessing an interstitial. HEER's original specimens are beautiful ones. In one of his specimens about twenty leaves are borne on a single shoot in a cluster. KAWASAKI figured some fragments of leaves from Tyôsen as *P. speciosa.*

This species appears to be entirely a Jurassic species of Eastern Asia, but the occurrence is not very frequent.

Occurrence:

Taihô Coal-mine, Tongzin, Nampo } Tyôsen (G. S. K. Coll.). Daidô Series.

Coniferales

Araucarineae

Genus *Araucarites* PRESL

Araucarites cutchensis FEISTMANTEL

Pl. XXXIX, Figs. 8, 9.

1876. *Araucarites cutchensis* FEISTMANTEL: p. 62, Pl. VII, fig. 7; Pl. VIII, figs. 2–6; Pl. IX, figs. 1–3; Pl. XII, fig. 10.
1877b. *Araucarites cutchensis* FEISTMANTEL: p. 16, Pl. XIV.
1879. *Araucarites cutchensis* FEISTMANTEL: p. 27, Pl. XIV, figs. 6–9; Pl. XV, fig. 1; Pl. XVI, fig. 15.
1913. *Araucarites cutchensis* HALLE: p. 72, Pl. VIII, figs. 3–10; Text-fig. 16.

Description of specimens: Pl. XXXIX, fig. 8 shows a cone scale cuneate in form with a narrow base and a narrow, spinous distal appendage. It carries only one seed ovoid in shape, with the thicker end towards the apex of the scale. Another specimen in Pl. XXXIX, fig. 9 differs from the preceding one in the larger size and more broadly triangular shape of the scale. The distal appendage is not preserved as the portion is imperfect. There is also a single ovoid seed.

Remarks: The specimens are rather common in the palnt-bed of Takazi, and display a considerable variation in size and form of scales. It is not certain that they all belong to one and the same species, but it seems almost impossible to draw any line which separates specifically the types of the present specimens. Pl. XXXIX, figs. 8 and 9 shows two extreme types of such scales from Takazi. There can be no doubt that the present cone scales show a very close agreement with those of the living Araucarineae. Among the fossil examples, the present specimens agree closely with the Indian specimens described by FEISTMANTEL (1877b, 1879) as *Araucarites cutchensis* FEIST. and some Antarctic specimens referred by HALLE (1913) to this species. HALLE recognised the presence of a ligule in some of the Antarctic specimens, which, however, is not recognisable in the Japanese ones. The larger scale in fig. 9 may probably be referable to *A. macropterus* FEIST.,[1] however, in the present work such type also has been included in *A. cutchensis,* because in the Japanese specimens the two extreme types are connected by a series of many intermediate forms which make it difficult to draw a line between them.

Occurrence:

Takazi, Yamaguti. Kiyosue Group.

Coniferales Incertae Sedis

Genus *Frenelopsis* SCHENK

Frenelopsis Hoheneggeri (ETTINGSHAUSEN) SCHENK

Pl. XXX, Fig. 2b; Pl. XL, Figs. 2–4.

1852a. *Thuites Hoheneggeri* ETTINGSHAUSEN: p. 25, Pl. I, figs. 6–7.
1871. *Frenelopsis Hoheneggeri* SCHENK: p. 13, Pl. IV, figs. 5–7; Pl. V, figs. 1–2; Pl. VI, figs. 1–6; Pl. VII, fig. 1.
?1874. *Frenelopsis Hoheneggeri* HEER: p. 73, Pl. XVIII, figs. 5–8.
1922. *Frenelopsis* cfr. *Hoheneggeri* YABE: p. 27, Pl. III, figs. 6–7; Text-fig. 26.

1) O. FEISTMANTEL (1877a), p. 24, Pl. VIII, figs. 9–12; (1879), p. 28, Pl. XIV, figs. 13–14; Pl. XVI, fig. 11.

Prof. YABE first reported the occurrence of this interesting plant from Syurihama and Takinosiri on the island of Ôsima and described the examples as follows: "Ultimate branches cylindrical (?), alternate; very long and slender, the branches of 1 mm. breadth usually attaining more than 50 mm. in length; internodes variable in length, but in general ranging between 3 and 5 mm.; with one (?) small appressed triangular leaf at each node. Penultimate branches (or stems ?) also cylindrical (?) and jointed; usually broader than the ultimate ones and composed of relatively short internodes. Branching at internodes. Both branches longitudinally striated (punctated ?) on the surface."

Pl. XXX, fig. 2b shows an example derived from Ôsima possibly from Takinosiri and occurring on the same slab of rock with *Otozamites Kondoi* sp. nov. described (above) in this work.

The specimen in Pl. XL, fig. 3 shows a fragment which is nothing but a portion of a shoot of *Frenelopsis*. The manner of branching and the length of internodes agree fairly closely with the preceding specimen and there is slight doubt of their specific identity.

Remarks: As Prof. YABE states, the occurrence of this species in Japan is particularly interesting because it is the first occurrence reported from the Asiatic continent, genus *Frenelopsis* being hitherto known only from the Wealden and Lower Cretaceous strata of Europe and North America.

Comparison: This species is comparable to *F. ramoissima* FONTAINE[1] from the Potomac Formation, but, according to BERRY,[2] the latter is distinguishable from the former in the crowded habit and the short internodes. The last mentioned character may not serve as the criterion of specific separation, because in some of the specimens figured by SCHENK the internodes are rather short as in the American species, but the comparison of the typical specimens as figured by SCHENK and FONTAINE and BERRY shows that the branches in the American species are decidedly very much more crowded than *Hoheneggeri*..

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1) See E. W. BERRY (1911), p. 422, Pl. LXXI, LXXII; Text-fig. 14.
2) E. W. BEERY, Ibid., p. 425.

Occurrence:

Takinosiri in Ôsima, Miyagi. Ôsima Plant Beds.
Ayukawa, Miyagi. Ayukawa Bed.

Frenelopsis parceramosa FONTAINE

Pl. XL, Figs. 1, 5–8.

1889. *Frenelopsis parceramosa* FONTAINE: p. 218, Pl. CXI, figs. 1–5; Pl. CXII, figs. 1–5; Pl. CLXVIII, fig. 1.
1905. *Frenelopsis parceramosa* FONTAINE: in WARD, pp. 544, 584.
1911. *Frenelopsis parceramosa* BERRY: p. 425, Pl. LXX, figs. 1–5.
1929. *Frenelopsis* cfr. *parceramosa* TATEIWA: Plate, figs. 26a–c.

Description of specimens: Pl. XL, fig. 6 shows a linear ultimate branch more than 6 cm. long, 6 mm. broad, with internodes 0.6–1 cm. long and slightly constricted. The surface of the branch has fine numerous longitudinal ridges and furrows in alternation (approximately 40 ridges are counted on the surface of the impression, therefore there are about 80 of them in total). Each ridge has a row of minute tubercles. The leaves are unfortunately not obvious because of the unsatisfactory preservation at the node.

Remarks: The rows of minute tubercles on the ridges which are very clearly seen in the present specimens were also recognised by FONTAINE on the American examples. Though FONTAINE did not mention the number of ridges on the branch, certain figures of American *F. parceramosa* show, if they were rightly drawn, that it agrees in that respect with ours except for the slightly less number in the American examples.

Comparison: This species resembles *F. Hoheneggeri* (ETT.) but differs from it in the broader branches and shorter internodes and, moreover, in the less number of leaves.

Occurrence:

Ryûsindô, Eidô, Zizindô } Tyôsen. Rakutô Bed.
Gyoindô, Ryûzyôdô, Hukodô } Tyôsen. Taikyû Bed. (G. S. K. Coll.).

Genus *Brachyphyllum* BRONGNIART

Brachyphyllum expansum (STERNBERG) SEWARD

Pl. XXXIX, Figs. 10, 11; Pl. XL, Fig. 9.

1823. *Thuites expansus* STERNBERG: p. 38, Pl. XXXVIII, figs. 1–2.
1876. *Echinostrobus* (*Thuites*) *expansus* FEISTMANTEL: p. 60, Pl. IX, figs. 6–9; Pl. X, figs. 3–4.
1877b. *Echinostrobus expansus* FEISTMANTEL: p. 17, Pl. XI, figs. 4, 5, 5a.
1919. *Brachyphyllum expansum* SEWARD: p. 317, figs. 754–755.
1928. *Brachyphyllum expansum* SAHNI: p. 20, Pl. II, figs. 28,–29; Pl. III, fig. 38.

SAHNI, 1928, gives additional references.

Description of specimens: The figured specimens show sterile coniferous shoots with pinnate branching. The general habit of the plant is somewhat strong. The primary branch is 3–4 mm. thick and the secondary ones are slightly thinner than it, about 3–4 cm. long, straight, and make an angle of approximately 40°–50° with the primary branch. The surface of the branches is covered with the impressions of small appressed broadly triangular leaves with subacute apices and make a prominent relief on the impression. No other surface markings are recognisable. Cones are unknown.

Remarks and comparison: The preservation of the specimens is not satisfactory. However, the pinnate ramification and other features agree with those of the sterile shoots hitherto described under the name *Brachyphyllum expansum* (STERNB.). Especially, a specimen from Oxfordshire[1] appears to be almost indistinguishable from the Japanese ones.

Occurrence:

Isimati, Yamaguti. Nisi-Nakayama Bed.
Takazi, Yamaguti. Kiyosue Group.
Tasseidô, Tyôsen. Rakutô Bed.

Brachyphyllum japonicum (YOKOYAMA) n. comb.

Pl. XLII, Figs. 2, 3, 3a.

1894. *Cyparissidium* ? *japonicum* YOKOYAMA: p. 229, Pl. XX, figs. 3a, 6, 6a, 13; Pl. XXIV, fig. 4.

1) A. C. SEWARD (1919), p. 319, fig. 756.

Diagnosis (YOKOYAMA, 1894): "Branches copious, alternate, rising at an acute angle, slender, and cord-like, straight or very slightly curved, ultimate branches about 1 mm. in breadth; leaves imbricated, closely appressed, acute at apex, with a longitudinal ridge on their backs."

Description of specimen: Many specimens are examined, but they are all sterile. Pl. XLII, fig. 3 shows a sterile Coniferous shoot from Nisinotani, with crowded branches. The general habit of the shoot is very slender. The primary axis is slightly broader than 1 mm. across, the secondary and ultimate ones are narrower. The leaves are triangular, with acute apex, closely appressed and in spiral phyllotaxy. Another specimen in Pl. XLII, fig. 2 shows also a sterile shoot derived from the Rakutô Bed of Rakusandô. The general habit is very slender and the branches are crowded. The leaves are narrowly triangular, with acute apex, and closely appressed to the axis just as in the preceding specimen.

Remarks: YOKOYAMA first described this species from the Ryôseki Series of Kagahara, etc. under the name *Cyparissidium* (?) *japonicum* YOK. His examples were fragmental. The more complete specimen in Pl. XLII, fig. 3 thows the general habit of this plant.

Discussion: YOKOYAMA provisionally adopted the generic name *Cyparissidium* for this plant on account of its great resemblance to *C. gracile* HEER described by HEER[1] from the Cretaceous rocks of Greenland. He also pointed out the similarity of the vegetative shoot with FONTAINE's *Arthrotaxopsis*[2] from the Potomac Formation. The specimens now at hand are all sterile, and indeed it is somewhat difficult to distinguish the impressions of the sterile shoots described under the generic names *Cyparissidium*, *Arthrotaxopsis* and *Widdringtonites*, yet each is characterised by having a characteristic cone. Therefore in the present state it is the best way, the writer thinks, to use a non-committal generic designation such as *Brachyphyllum* proposed by BRONGNIART for "sterile branches characterised by pinnate branching in one plane

1) O. HEER (1874), p. 74, Pl. XVII, figs. 5b, c; Pl. XIX; Pl. XX, figs. 1e; Pl. XXI, figs. 9b, 10d.
2) E. W. BERRY (1911), p. 438.

and spirally disposed appressed leaves with a thick lamina of triangular, conical, or hexagonal form.[1]"

Comparison: As YOKOYAMA states, the present species resembles HEER's *C. gracile* from Greenland, but in ours the ultimate branches seem to be more crowded: *Arthrotaxopsis expansa* FONTAINE from the Potomac Formation has longer penultimate branches; *Widdringtonites ramosus* (FONTAINE) BERRY[2] from the same formation has longer ultimate branches; in these two American species the leaves are longer, more acuminated at the apex and somewhat free at their apical part. A French Wealden specimen described by CARPENTIER[3] as cf. *Cyparissidium gracile* HEER also resembles the present species.

Occurrence:

Nisinotani, Kôti.		Ryôseki Series.
Huzikawa, Tanno	Tokusima.	Ryôseki Series.
Hatimanzawa (Kagahara), Gumma.		Ryôseki Series.
Sindô, Tôtôri, Rakusandô	Tyôsen.	Rakutô Bed.
Sinsyû, Tyôsen.		Sinsyû Bed.

Genus *Elatocladus* HALLE

Elatocladus constricta (FEISTMANTEL) n. comb.

Pl. XXXIX, Fig 12; Pl. XLI, Figs. 2–5.

1879. *Cycadites constricta* FEISTMANTEL: p. 25, Pl. VII, fig. 10.
1920. *Torreyites constricta* SEWARD and SAHNI: p. 35, Pl. VII, figs. 78, 78a.

Description of specimen: Several specimens were examined. Pl. XLI, fig. 4 shows a branched shoot with thin axis 1 mm. thick. The linear leaves are 2.5 cm. long and 2–2.5 mm. broad, acuminate at their apices, and arranged spirally and distantly around the axis by their narrowly constricted and decurrent bases. The midnerve

1) A. C. SEWARD (1919), p. 315.
2) E. W. BERRY (1911), p. 428, Pl. LXXIII, figs. 1–6.
3) A. CARPENTIER (1927), p. 72, Pl. XX, fig. 3; Pl. XXII, fig. 21.

is more or less well-defined, and on each side of it is seen a narrow line which may represent the stomatal band. Pl. XLI, figs. 2 and 3 show also portions of shoots which bear somewhat broader and longer leaves than the preceding one, though otherwise indistinguishable. In these specimens the torsion and the downward bending of the base of the leaves are clearly seen. The specimen in Pl. XXXIX, fig. 12 shows a shoot with narrower and shorter leaves probably representing a somewhat young shoot; a portion of the specimen is shown in Pl. XLI, fig. 5 being thrice magnified.

Remarks: The present specimens are hardly distinguishable from *Cycadites constricta* FEIST. from India. FEISTMANTEL (1879) first considered that the Indian specimen was a Cycadean frond, while SEWARD and SAHNI (1920), who examined the type-specimen and in which they found that the leaves are spirally arranged and the lamina has a stomatal band on each side of the midnerve, revealed that it was a coniferous shoot and not a Cycadean frond. NATHORST[1] had already expressed his view that the Indian specimen might be a Conifer. SEWARD and SAHNI employed the generic designation *Torreyites* for the Indian specimen in view of the striking agreement in habit and in the surface features of the lamina between the specimen and the recent species *Torreya Myristica*. However, in the present work, the writer has employed the more appropriate generic name *Elatocladus*.

E. constricta, as FEISTMANTEL also pointed out, closely resembles *E. zamioides* (LECKENBY, ex BEAN MS.[2]) originally described by LECKENBY[3] from the Oolite of Yorkshire under the name *Cycadites zamioides*, though the type-specimen of the latter is very indistinctly represented and unsatisfactorily described.

Occurrence:

Outi, Takazi, Nanami } Yamaguti. Kiyosue Group.

1) A. G. NATHORST (1907b), p. 5.
2) A. C. SEWARD (1919), p. 431.
3) J. LECKENBY (1864), p. 77. Pl. VIII, fig. 1.

Elatocladus obtusifolia sp. nov.

Pl. XLI, Figs. 1, 1a (type-specimen).

Diagnosis: Sterile coniferous shoot with pinnate (?) branching; habit slender; primary branch about 2 mm. thick, the branchlets narrower; leaves deltoid, with an obtuse apex, and a dorsal keel decurrent at the base, crowded, sometimes recurved, arranged in spiral, and at a wide angle to the axis, the lamina being free except the base.

Description of specimen: Pl. XLI, fig. 1 shows the best specimen of this species in the collection. At the left side of the figure is seen a main branch from which branchlets are disposed apparently pinnately. Other part of the rock is occupied by impressions of the fragments of many branchlets. The leaves are dorsiventral and in one plane in the greater part of the branch and branchlets, but radial and overlapping in the distal part of the latter.

Remarks: The generic name *Elatocladus* has been applied for the present specimen because of the absence of cones which would permit the discovery of a closer affinity of this plant and moreover in conformity with HALLES's original view in establishing the non-committal genus *Elatocladus*. *Brachyphyllum* and *Pagiophyllum* are also genera established for sterile coniferous shoot, however, in the former the leaves are fleshy and appressed to the axis and in the latter they are usually four-sided and falcate.

The present vegetative shoot shows fairly close resemblance with that of *Sphenolepidium Sternbergianum* (DKR.),[1] a well known Wealden or Lower Cretaceous Conifer, the resemblance being so great that the writer was at first inclined even to refer the Japanese specimen to DUNKER's species. However, upon careful comparison of the specimen at hand with the figures and descriptions of the above mentioned species reported from various areas of the world it was seen that the leaves of the foreign species are always longer and narrower and acuminated at the apex instead of being rather broadly triangular in shape and obtusely pointed at the apex as in ours. Therefore the writer regarded the Japanese specimen as distinct from DUNKER's.

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1) A. C. SEWARD (1895), p. 205, Pl. XVI, figs. 4–6. E. W. BERRY (1911), p. 435, Pl. LXXV, figs. 1–2. A. CARPENTIER (1927), p. 70, Pl. XX, figs. 4–5.

The Japanese form also resembles *Sequoites concinna* (HEER),[1] an Antarctic Cretaceous species, but in it also the leaves are acuminated at the apex and so far as the vegetative shoots only are concerned, it rather resembles DUNKER's species.

At any rate, the present species is a form which very closely resembles *Sphenolepidium Sternbergianum* (DKR.). The further discovery of any kind of cones associated with the present sterile shoot might throw light on some closer affinity of the present plant.

Occurrence:

Kami Mano-mura, Hukusima. Ryôseki Series.

Elatocladus plana (FEISTMANTEL) SEWARD

1879. *Taxites planus* FEISTMANTEL: p. 31, Pl. XIII, figs. 1–8; Pl. XIV, figs. 1, 2, 4, 5; Pl. XI, fig. 2.
1882. *Taxites planus* FEISTMANTEL: p. 48, Pl. II, figs. 7–9, 11.
1917. *Taxites planus* WALKOM: p. 25, Pl. IX, fig. 4.
1919. *Elatocladus planus* WALKOM: p. 43, Pl. II, figs. 4–5.
1919. *Elatocladus plana* SEWARD: p. 431, fig. 802.
1928. *Elatocladus plana* SAHNI: p. 11, Pl. I, fig. 9.
1932b. *Elatocladus plana* ÔISHI: p. 359, Pl. XXXIII, fig. 7.

Remarks: Coniferous shoots which appear to be almost indistinguishable from the species referred to above occur commonly in Loc. No. 1 in the Nariwa district; one of them has already been shown in the writer's work on the Nariwa plants in 1932 as *Elatocladus plana*.

Occurrence:

Nariwa (1), Okayama. Nariwa Series.

Elatocladus tennerima (FEISTMANTEL) SAHNI

1877b. *Taxites ? tennerima* FEISTMANTEL: p. 98, Pl. X, figs. 6–11 (non Pl. VIII, figs. 6–8; Pl. X, fig. 5).
1928. *Elatocladus tennerima* SAHNI: p. 14, Pl. I, figs. 10–15.
1932b. *Elatocladus tennerima* ÔISHI: p. 360, Pl. XXXIII, figs. 8–10.

Remarks: Specimens referable to this Indian species are somewhat common in the Nariwa district where they occur in asso-

1) A. C. SEWARD (1926), p. 102, Pl. IX, figs. 69, 72, 73, 79. 80.

ciation with those identified to *E. plana* (FEIST.) in this work. The distinction on the basis of the morphology of the leaves among the sterile coniferous shoots described as *E. plana, E. tennerima, E. conferta,* etc. is by no means trustworthy, but the writer followed SAHNI in referring the Japanese specimens to *E. tennerima* as it is impossible in dealing with such fragmentary specimens as ours to form any opinion better than that of SAHNI who had more perfect and well-preserved specimens from India. YOKOYAMA[1] described a fragment similar to the present species from the Tetori Series as *Palissya* sp.

Occurrence:

Nariwa (1), Okayama. Nariwa Series.
?Kuwasima, Isikawa (Tôkyô Coll.). Tetori Series.

Genus *Cupressinocladus* SEWARD

This generic designation was instituted by SEWARD[2] as a non-committal generic term for Cupressinous shoots that do not afford satisfactory evidence of relationship to any particular recent genus. In this meaning he placed several Mesozoic and Tertiary coniferous vegetative shoots described under the generic names, *Libocedrus, Thuya, Thuites, Juniperus* or *Juniperites* in his new genus. This action of SEWARD is related to that of HALLE[3] who instituted a new genus *Elatocladus* for sterile coniferous branches of the radial or the dorsiventral type, which do not show any characters that permit them to be included in one of the genera instituted for more peculiar forms. It is certainly convenient to use such genera for certain fossil shoots. In Japan there is a single species which no doubt belongs to the category of this genus of SEWARD. It may be described under the name *C. koyatoriensis* sp. nov.

Cupressinocladus koyatoriensis sp. nov.

Pl. XLII, Figs. 1, 1a (type-specimen).

Diagnosis: Branched shoots with leaves in decussate pairs; penultimate branches alternate, about 2 cm. long, ultimate branches

1) M. YOKOYAMA (1889), p. 64, Pl. IX, fig. 11.
2) A. C. SEWARD (1919), p. 307.
3) T. G. HALLE (1913), p. 82.

opposite, about 1 cm. long; leaves small, spatulate, about 2 mm. long, 1 mm. broad, keeled dorsally with obtuse apex; leaves in one pair appressed to the axis, while the other which is at a right angle to the former is free except at the base, with a narrow band (stomatal band?) on each side of the dorsal keel.

Description of specimen: Pl. XLII, fig. 1 represents a sterile shoot derived from Koyatori. As can be seen in the figure, an axis of the primary order which is about 3 mm. thick sends off branches of the second order (penultimate branches) 2 cm. long which give off the ultimate branches about 1 cm. long oppositely. The leaves are well characterised by the arrangement in decussate pairs (fig. 1a). It is certain that the leaves in one pair are free from the axis except at their bases forming an angle of approximately 50° to it while those of the other pair appear to be appressed to the axis. Unfortunately it is very difficult to decide the true orientation or the mode of attachment of leaves in such a specimen in fossil state. But the careful examination of some well-preserved specimens shows that the characteristic arrangement of leaves described above is almost beyond doubt. Another characteristic feature of this specimen is the presence of a narrow band on each side of the median keel of the leaves, the band being marked as a somewhat indistinct ridge or groove or sometimes as an area with a different colour than the surrounding area. These bands seem to indicate the stomatal bands as is characteristic to the leaves in *Fitzroya*, but there is no decisive evidence that they do actually represent that feature.

Remarks: This species shows the same morphological feature as *Thujopsis dolabrata*, now living in Japan, the leaves in one pair being appressed to the axis while those in the other pair are free except at the base. It shows also the same morphological feature as the vegetative shoot of *Fitzroya*, but in this the leaves are free from the axis except at the bases usually in both pairs.

Comparison: There is no known species with which the present specimens are identical. Somewhat comparable species are *Libocedrus cretacea* HEER described by HEER[1] from Greenland, and a very fragmentary specimen described by SEWARD[2] from Greenland under

1) O. HEER (1882), p. 49, Pl. XXIX, figs. 1, 2; Pl. XLIII, fig. 1d.
2) A. C. SEWARD (1926), p. 100, Text-fig. 13.

the name *Cupressinocladus cretacea* (HEER). From *Cupressinocladus* (?*Thuites*) *Walkeri* SAHNI[1] and *C. burmensis* SAHNI[2] described by SAHNI from the Rhaetic or Jurassic strata of Burma the present species differs in many points.

Occurrence:

Koyatori } Miyagi. Ogihama Series.
Ôyagawa }

Genus *Pityophyllum* NATHORST

Pityophyllum longifolium (NATHORST) MOELLER

1876. *Cycadites ? longifolius* NATHORST: p. 47, Pl. XIII, figs. 1–3.
1878. *Taxites longifolius* NATHORST: p. 50, Pl. VI, figs. 6–7.
1894. *Taxites longifolius* BARTHOLIN: p. 99, Pl. IV, figs. 5–6.
1903. *Pityophyllum longifolium* MOELLER: p. 40, Pl. VI, figs. 9–11.
1931f. *Pityophyllum longifolium* ÔISHI: p. 252, Pl. II, fig. 7.
1932a. *Pityophyllum longifolium* ÔISHI: p. 66.
1932b. *Pityophyllum* (*Pityocladus*) *longifolium* ÔISHI: p. 358, Pl. XXXIII, figs. 3–6.
1935a. *Pityophyllum longifolium* ÔISHI: p. 93.
1936. *Pityophyllum longifolium* ÔISHI and TAKAHASI: p. 128.

Remarks: *P. longifolium* was first described by NATHORST from the Rhaetic of Sweden as *Cycadites ? longifolius* and afterwards as *Taxites longifolius,* and later MOELLER, in his memoir of the Liassic flora of Bornholm, adopted NATHORST's generic designation *Pityophyllum.*

The name *P. longifolium* is applied for long and narrow Coniferous detached leaves tapering towards both ends traversed by a single nerve and with lamina sometimes bearing transverse wrinkles. Several leaves are found naturally attached to a short shoot covered with scale-leaves; such specimens were shown by SEWARD and the writer (1932b). Fragmental specimens of this species can sometimes hardly be distinguishable from *P. Nordenskijöldi* HR. but in the latter the leaves are broader and have a rounded base.

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1) B. SAHNI (1928), p. 26, Pl. IV, figs. 52–57; Pl. V, fig. 60.
2) B. SAHNI, Ibid., p. 28, Pl. IV, figs. 58–59.

Occurrence:

Nariwa (1, 21, 30, 33, 44, 45, 46, 49, 50, 55, 58, 63, 65, 69, 85, 89), Okayama. Nariwa Series.
Kusaigawa, Momonoki } Yamaguti. Momonoki Bed.
Tubuta (I), Yamanoi (1) } Yamaguti. Upper Triassic.
Kuruma, Nagano. Kuruma Bed.

Genus *Nageiopsis* FONTAINE

Nageiopsis longifolia FONTAINE

Pl. XLIII, Figs. 1, 2.

1889. *Nageiopsis longifolia* FONTAINE: p. 195, Pl. LXXV, fig. 1; Pl. LXXVI, Figs. 2–6; Pl. LXXVII, figs. 1–2; Pl. LXXVIII, figs. 1–5; ? Pl. LXXIX, fig. 7; Pl. LXXXV, figs. 1–2, 8–9.
1911. *Nageiopsis longifolia* BERRY: p. 384, Pl. LXI.

The original diagnosis was revised by BERRY (1911) as follows: "Branching leafy twigs of large size, stout and thick, apparently branched in approximately one plane. Leaves linear-lanceolate, often slightly curved, somewhat inequilaterally narrowed to the acute or subacute tip. Length 8 to 20 cm.; width 5 mm. to 1.3 cm. The leaves are not crowded and usually appear opposite or sub-opposite as if inserted on the lateral margins of the stem although at times they seem to be attached to its upper or lower side. As previously remarked none of the material is conclusive in regard to the phyllotaxy. Veins 9 to 12 in number, usually 10, forking only at the base and running parallel until they abut against the leaf margin, about 0.7 mm. apart, somewhat coarser in calibre than in the other members of the genus, distinct on both surfaces of the lamina and apparently not immersed. Leaf substance not coriaceous."

Description of specimens: The specimen in Pl. XLIII, fig. 1 consists of a part of an axis 4 mm. thick to which are attached linear-lanceolate leaves nearly at a right angle. The phyllotaxy is not clear, though the leaves are apparently attached to the side of the axis. The leaves may be about 8 cm. long, though the tip is missing, and about 7 mm. broad in the greater part of the length and narrowed gradually towards the apex and more abruptly towards the base. The nerves are unfortunately indistinct, however they seem to be ± 10 in each leaf.

In Pl. XLIII, fig. 2 is shown a very imperfect long and narrow leaf derived from Syurihama of Ôsima. It is stored in the Institute of Geology and Palaeontology, Tôhoku Imperial University, and labelled as Cfr. *Nageiopsis longifolia* FONT. It is at least 15 cm. long and about 1.5 cm. broad at the lower broken end from which it narrows gradually upwards. The nerves appear to be very coarse and about 15 in number.

Remarks: It is questionable whether the specimen in fig. 2 belongs to *Nageiopsis*, no positive evidences referring it to this genus being represented. It is therefore only provisional to call the specimen *Nageiopsis longifolia* ? as it resembles strikingly one of the detached leaves which FONTAINE[1] figured as *N. longifolia* from the Jurasso-Cretaceous rocks of Alaska. But another specimen in fig. 1 agrees with the specimens described by FONTAINE (1889) and BERRY (1911) from the Cretaceous of North America under the name *N. longifolia.* It is not unlike some larger leaves of *N. zamioides,* but in the latter the leaves are more abruptly contracted towards the base and more rounded in outline as BERRY described. *N. crassicaulis* FONTAINE[2] which BERRY considered to be synonymous to *N. longifolia* is represented by several fragments of detached leaves except one of the specimens, and is specifically almost indeterminable.

Occurrence:

Outi, Yamaguti. Kiyosue Group.
?Syurihama in Ôsima, Miyagi. Ôsima Plant Beds.
(Sendai Coll.).

Nageiopsis rhaetica ÔISHI

(Type-specimen: OISHI, 1932b, Pl. XXXIV, figs. 1–2).

1932b. *Nageiopsis rhaetica* ÔISHI: p. 366, Pl. XXXIV, figs. 1–2.

Description (ÔISHI, 1932b): "Vegetative shoot consisting of thick stem bearing leaves. Stem 8 mm. across, with many striations

1) W. FONTAINE, in WARD (1905), p. 171, Pl. XLV, fig. 5.
2) W. FONTAINE, Ibid., p. 198, Pl. LXXIX, figs. 2, 6; Pl. LXXXI, fig. 1; Pl. LXXXIV, figs. 3, 9, 11.

on its surface running continuously in the longitudinal direction. Leaves very shortly stalked; lamina broadly lanceolate, with a length of 10 cm. and a maximum breadth of 2.5 cm., broadest near the base, narrowing gradually to an acute apex and rather abruptly to the base, and attached to the rachis by a very short narrow stalk. Mode of arrangement of leaves on the stem not clear. Nerves numerous, distinct, simple except at the base, parallel to each other and to the lateral margins of the leaf, converging towards the apex, and numbering approximately 25 at the broadest part."

Remarks: This species is represented by two specimens as figured in the writer's work on the Nariwa plants in 1932. The tolerably thick and strong axis or stem suggests that this plant is woody and different in aspect from the usual types of vegetative shoots of *Podozamites*. As already stated, this species may be comparable to *N. zamioides* FONT. and *Podozamites distantinervis* FONT. from the Potomac Formation but it differs from those two in having more nerves.

Occurrence:

Nariwa (1), Okayama. Nariwa Series.

Nageiopsis zamioides FONTAINE

Pl. XLIII, Figs. 3, 3a.

1889. *Nageiopsis zamioides* FONTAINE: p. 196, Pl. LXXIX, figs. 1, 3; Pl. LXXX, figs. 1, 2, 4; Pl. LXXXI, figs. 1–6.
1889. *Nageiopsis heterophylla* FONTAINE: p. 201, Pl. LXXXIV, fig. 4; Pl. LXXXVI, figs. 6–7; Pl. LXXXVIII, figs. 2, 5.
1894. *Podozamites* sp. YOKOYAMA: p. 223, Pl. XXV, figs. 8–12.
1895. *Nageiopsis* cf. *N. heterophylla* SEWARD: p. 211, Pl. XII, fig. 3.
1905. *Nageiopsis heterophylla* FONTAINE: in WARD, p. 561, Pl. CXVII, fig. 6.
1911. *Nageiopsis zamioides* BERRY: p. 386, Pl. LXII, figs. 1–2; Pl. LXIII.

For further references of synonymy, see BERRY, 1911.

Description and Remarks: BERRY (1911) revised many specimens described by FONTAINE under the generic name *Nageiopsis*, and included several forms which FONTAINE described under different specific names in the species referred to above. BERRY defined this species as follows: "Leaves ovate-lanceolate, proportionally shorter and wider than in *N. angustifolia* and much shorter and more rounded in outline than in *N. longifolia;* broadest toward the rounded base, the maximum width observed being 1.5 cm. although the average width is much less and may be put at 1 cm. or slightly less; very variable in size, tip generally acute although an occasional specimen may be obtuse. The greatest length observed is 8 cm. but the average length is much less than this and may be placed at 3 to 4 cm. Occasional twigs like the solitary specimen described as *N. decrescens* or the specimens referred to *N. microphylla* may be much smaller than the above. The latter are however of the same general shape while in the former case the fact that the larger leaves at the base of the specimen are replaced by very minute leaves indicates that the specimen is an abnormal twig. Veins fine in calibre, somewhat remote, generally 6 to 9 in number, forking at the base and diverging rapidly at first, then parallel until they abut upon the margin."

The Japanese species identified to this species is represented by two specimens from Tanzaki of which one is shown in Pl. XLIII, fig. 1. It is a distal part of a vegetative shoot more than 5 cm. long with ovate-lanceolate leaves which are about 2 cm. long, 4–5 mm. broad at the broadest middle portion, acuminated at the apex and more or less abruptly contracted at the base. The mode of attachment of the leaves to the axis is somewhat indistinct, but they seem to be attached by short and narrow bases oppositely and apparently to the side of the axis. The nerves are parallel and simple except near their origin and 9–11 in number in each pinna.

Comparison: The Japanese specimens are smaller in size of shoot than the specimens originally figured by FONTAINE from the Potomac formation, but agree well with one of the specimens figured by FONTAINE (1889, p. 201) as *N. heterophylla* FONTAINE and also with the specimens figured by SEWARD (1894) and BERRY (1911) as *Nageiopsis* cf. *heterophylla* and *N. zamioides* respectively. BERRY considered FONTAINE's *N. heterophylla* as conspecific with *N. zamioides*, a view which the writer has followed.

N. zamioides seems, according to BEERY's revision, to be very variable in size of leaves ranging from larger ones attaining 6 cm. long and 1 cm. broad (FONTAINE, 1890, Pl. LXXIX, fig. 1) to the very small ones such as the specimen in FONTAINE, 1890, Pl. LXXXVIII, fig. 2 (described as *N. heterophylla*). If BERRY's view of considering even *N. recurvata* FONTAINE and *N. microphylla* as synonymous to *N. zamioides* may be admitted, then the range in variation in size of leaves becomes larger.

The Japanese specimens seem to be allied also to *N. longifolia* FONTAINE, in which the leaves are generally longer and more linear than in *N. zamioides* and they narrow more gradually towards the base. KRYSHTOFOVICH and PRYNADA (1932, p. 372) record this species from the Nikanian Series of Ussuriland, and HOLLICK (1930, p. 51) describes a fragment from the Upper Cretaceous of Alaska as *Nageiopsis zamioides?*.

Occurrence:

Tanzaki, Wakayama. } Ryôseki Series.
Zusahara, Hukusima. }

Genus *Podozamites* F. W. BRAUN

Podozamites concinnus ÔISHI and HUZIOKA

(Type-specimen: ÔISHI and HUZIOKA, 1938, Pl. VI, figs. 4–7).

1938. *Podozamites concinnus* ÔISHI and HUZIOKA: p. 59, Pl. VI, figs. 4–7.

Diagnosis (ÔISHI and HUZIOKA, 1938): "Shoot small, slender, more than 8 cm. long, probably longer. Axis very thin and delicate, being 0.7 mm. across. Leaves probably spirally arranged around the axis at an acute angle, those in the proximal portion 1.3 cm. long, those in the distal portion 2.5 cm. long, club-shaped, with rounded apex, broadest slightly below the apex, where the breadth is 3–4 mm., thence tapering gradually towards narrow base. Nerves delicate, parallel, forking near their origin, converging towards the apex, and numbering 12–13 in the middle of each leaf."

Remarks: Without nerves and apices of leaves it may be pretty difficult to distinguish the species from *P. Schenki*. The characteristic features of *P. concinnus* are the club-shaped leaves with rounded apex and crowded parallel nerves. The gradual tapering in breadth of leaves towards the base is another characteristic feature.

Occurrence:

Nariwa (63), Okayama. Nariwa Series.

Cfr. *Podozamites distantinervis* FONTAINE

Pl. XLIII, Fig. 4.

Compare with:

1889. *Podozamites distantinervis* FONTAINE: p. 179, Pl. LXXIX, fig. 9; Pl. LXXXII, fig. 4; Pl. LXXXIII, figs. 1–2, 6–7; Pl. LXXXIV, figs. 1–2, 8, 10, 14–15; Pl. LXXXV, figs. 12, 16.
1889. *Podozamites pedicellatus* FONTAINE: p. 180, Pl. LXXVI, fig. 1; Pl. LXXVIII, fig. 7; Pl. LXXXII, fig. 5.
1911. *Podozamites distantinervis* BERRY: p. 340, Pl. LIII, figs. 8–9.

Description of specimen: Pl. XLIII, fig. 4 shows two detached elongate-elliptical ? leaves arranged side by side; they are at least 10 cm. long and 3 cm. broad at a point a little above the base from where they taper gradually towards the apex and abruptly towards the narrow base. Their apices are imperfect. The nerves are distinct, parallel to each other and to the lateral margins of the leaves, forking at or near the base, and about 30 in number at the broadest part.

Remarks: The figured specimens, though imperfect, agree strikingly with *P. distantinervis* and *P. pedicellatus* described by FONTAINE (1889) from the Potomac formation in respect to the size and form of the leaves. The only difference is that the present specimen has more nerves: in the drawing of a specimen figured by FONTAINE as *P. pedicellatus* which is, according to BERRY, synonymous to *P. distantinervis,* the number of nerves is 23. The limit of variation in number of the nerves of this species being yet uncertain, the writer prefers to holds the present specimen as cfr. *P. distantinervis* FONT.

The present specimen is also like *Zamites tenuinervis* FONTAINE,[1] but in the latter the leaves contract to a broader concave base.

Occurrence:

Outi, Yamaguti. Kiyosue Group. (Tôkyô Coll.).

Podozamites Griesbachi SEWARD

1889. *Podozamites lanceolatus* var. *latifolia* YOKOYAMA: p. 48, Pl. V, fig. 1 (non Pl. IV, fig. 1c and Pl. VI, fig. 1.)

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1) W. FONTAINE (1889), p. 171. See also E. W. BERRY (1911), p. 345.

1912a. *Podozamites Griesbachi* SEWARD: p. 36, Pl. IV, fig. 58; Pl. VI, fig. 79.
1932. *Podozamites Griesbachi* ÔISHI: p. 12, Pl. III, fig. 12.

Remarks: The specimen identified to *P. Griesbachi* is a shoot, derived from Sitaka, bearing a slender axis to which are attached short stalked ovate leaves about 4 cm. long and 1.7 cm. broad at the broadest portion. The nerves are distinct and number 20–23 at the broadest portion of each leaf. YOKOYAMA (1889) figured numerous types of *Podozamites* from the Tetori Series, of which certain specimens identified as *P. lanceolatus* var. *latifolia* HR. are identical in shape of leaves and density of nervation with *P. Griesbachi*. This species resembles *P. Reinii* GEYLER but has coarser nervation.

Occurrence:

Sitaka, Kyôto. Sitaka Bed.
Kuwasima, Isikawa. Tetori Series.

Podozamites lanceolatus (LINDLEY and HUTTON)

Pl. XLIV, Figs. 4, 5.

Remarks: The name *P. lanceolatus* is used in the wide and comprehensive sense including various varieties named by HEER. The type is very common throughout the majority of the Mesozoic plant-bearing strata of Japan, and several specimens have been figured and described by various authors.[1] KAWASAKI described *P. distans*[2] and cf. *P. gracilis* ARBER[3] from Tyôsen. In Pl. XLIV, figs. 4 and 5 are shown specimens from Kuwasima.

Occurrence:

Yamanoi (1, 3, 13), Yamaguti. Up. Triassic.
Tubuta (I), Yamaguti. Up. Triassic.

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1) M. YOKOYAMA (1905), p. 8, Pl. I, fig. 6; (1906), p. 18, Pl. II, figs. 5, 6; p. 21, Pl. IV, fig. 3; p. 22, Pl. IV, figs. 1, 2, 5, 6; p. 26, Pl. VI, figs. 1b, 2; p. 33, Pl. XI, fig. 3; p. 37, P. XII, fig. 3. H. YABE (1920), Pl. II, fig. 6; Pl. IV, fig. 2; (1905), p. 17, Pl. IV, figs. 1–5. H. YABE and S. ÔISHI (1928), p. 14, Pl. III, figs. 6–10; (1933), p. 38, Pl. IV, fig. 11; Pl. V, figs. 10–13; Pl. VI, figs. 3B, 4, 5, 6A. S. ÔISHI (1931f), p. 254, Pl. XVII, fig. 6; (1932), p. 13, Pl. III, fig. 13; Text-fig. 1; (1932a), p. 66; (1935a), p. 94; (1932b), p. 363, Pl. XIV, fig. 2; Pl. XXXIV, figs. 6–9. S. KAWASAKI (1925), p. 53, Pl. XXXI, fig. 87; Pl. XXXII, figs. 88, 89; Pl. XXXIII, figs. 90–92.

2) S. KAWASAKI (1925), p. 54, Pl. XXXIV, figs. 93–95; Pl. XXXV, figs. 96–99; Pl. XLVII, figs. 124–126.

3) S. KAWASAKI (1926), p. 22, Pl. V, fig. 16.

Kusaigawa Momonoki	Yamaguti.	Momonoki Bed.
Nariwa, Okayama.		Nariwa Series.
Kuruma, Nagano.		Kuruma Bed.
Sitaka, Kyôto.		Sitaka Bed.
Yanagidani Yunotani Kuwasima	Isikawa.	Tetori Series.
Tanimura (Tôkyô Coll.) Hakogase (Tôkyô Coll.)	Hukui.	Tetori Series.
Izuki Okamigô Usimaru	Gihu.	Tetori Series.
Mizutani Tanzaki	Wakayama.	Ryôseki Series.
Zusahara, Hukusima.		Ryôseki Series.
Nisinotani, Kôti.		Ryôseki Series.

Podozamites lanceolatus (L. and H.) subsp. *multinervis* TATEIWA

Pl. XLIV, Fig. 6 (type-specimen).

1929. *Podozamites lanceolatus* subsp. *multinervis* TATEIWA: Plate, figs. 13–14.
1935a. *Podozamites* sp. nov. ÔISHI: p. 94, Pl. VIII, figs. 8–9.

Remarks: The leaves shown in Pl. XLIV, fig. 6 were recognised by TATEIWA as a new subspecies of *P. lanceolatus* (L. and H.) and named *P. lanceolatus* subsp. *multinervis* and figured in his Geological Atlas of Tyôsen, No. 10 referred to above (TATEIWA, 1929). The material is represented by detached leaves lanceolate to linear lanceolate in outline with subacute apices and is characterised by the very densely crowded nerves. Each leaf carries more than 40 nerves, generally about 43. Some other specimens are at hand which also carry more than 40 nerves.

Although it may seem inconsistent with what has been said in regard to the variable character of *Podozamites* leaves to make the specimen shown in Pl. XLIV, fig. 6 the type of a new subspecies, the densely crowded nervation is, the writer also thinks, a feature deserving description. Specimens from Tun-ning in Manchoukuo which the writer (1935a) described because of the densely crowded nerves as *Podozamites* sp. nov. are identical with this subspecies.

Occurrence:

Kinkodô, Renkadô, Tomudô, Ryûsindô } Tyôsen. Rakutô Bed. (G. S. K. Coll.).

Podozamites Reinii GEYLER

Pl. XLIV, Figs. 1–3; Pl. XLV, Fig. 1.

1877. *Podozamites Reinii* GEYLER: p. 229, Pl. XXXIII, fig. 4a; Pl. XXXIV, fig. 1, 2, 3b, 4, 5a.
1889. *Podozamites Reinii* YOKOYAMA: p. 50, Pl. III, fig. 6a–c; Pl. IV, figs. 1b, 3b; Pl. VI, figs. 2, 3b–d, 4–7, 8a–d; Pl. IX, fig. 12a; Pl. XII, fig. 4.
1905. *Podozamites Reinii* YABE: p. 16, Pl. IV, fig. 6.
1929. *Podozamites Reinii* TATEIWA: Plate, fig. 11.

Diagnosis (GEYLER): "P. pinnulis late ovatis, apice obtusis, basi inaequali in petiolum brevem attenuatis, in rhachi leviter curvato alternantibus, nervis creberrimis (circiter 38–50) more *Podozamites* generis percursis."

Description of specimens: Many specimens are examined. The shoots of this plant seem to have attained considerable dimensions in their complete state. Pl. XLIV, figs. 1–2 and Pl. XLV, fig. 1 show portions of shoots consisting of an axis 2 mm. thick bearing ovate to oblong, short petiolate leaves with rounded apex. The nerves are numerous, forking near their origin, parallel to each other and to the lateral margins of the leaves and converging towards the apex. Their density is 20–25 per cm. Though YOKOYAMA recognised the presence of very fine interstitial nerves, the material now at hand does not show such an indication except minute wrinkles in the longitudinal direction which of course do not represent vascular courses.

Remarks: The ovate and oblong leaves distinctively characterise this species. As YOKOYAMA (1889, p. 51) also described, the shape of the leaves is somewhat variable, probably, the writer believes, in respect to the position (?) on the shoot or the difference of growth stage of the plant, sometimes the shape being much elongated thus coming near *P. lanceolatus* var. *latifolia* HR. or *P. lanceolatus* var. *Eichwaldi* SCHIMP. type. However, in many cases the oblong and ovate leaves are the most usual shape met with in the collection. Therefore the present species may represent a valid type in itself specifically identical with none of the known species of *Podozamites*. It is of course desirable in classifying *Podozamites* leaves to rely at least upon microscopical structures such as epidermal cells as recently done by HARRIS[1] on the Greenland material, but the unsatisfactory preservation of the present specimens made it impossible to obtain any cuticular preparation in spite of repeated treatment by the maceration method.

The mode of attachment of leaves to the axis is still uncertain, because the leaves occur in most cases in isolation. Even in case of direct connection to the axis the mode of attachment is obscure owing to the compression at the point of attachment, though the phyllotaxy seems in most probability to be spiral, the petiole being seen to have received torsion (Pl. XLIV, fig. 1). GEYLER (1877, Pl. XXXIV, fig. 1) figured the terminal leaf; a similar portion of shoot is figured in Pl. XLIV, fig. 3 in this work.

KRYSHTOFOVICH and PRYNADA[2] figured a small indistinct *Podozamites* leaf as *P. subreinii* which they described as characterised by being short lanceolate in shape, acuminated at the apex and with 1–2 interstitials between the parallel nerves.

P. Reinii is one of the commonest elements of the Tetori flora and occurs also in the Naktong Series, a Korean equivalent of the Tetori Series (YABE, 1905; TATEIWA, 1929).

Occurrence:

Kuwasima	Isikawa.	Tetori Series.
Yunotani		
Yanagidani		
Ozô		
Tanimura	Hukui.	
Kowasimizu		
Izuki		
Okamigô	Gihu.	
Iwaidani		

1) T. M. HARRIS (1935), pp. 82–97.
2) A. KRYSHTOFOVICH and V. PRYNADA (1932), p. 371, Pl. II, fig. 6.

Tomudô Ryûsindô Butudôken (Tôkyô Coll.) Ôtomen Coal-mine	Tyôsen. Rakutô Bed.

Podozamites Schenki HEER

1876. *Podozamites Schenki* HEER: p. 45.
1931. *Podozamites Schenki* SZE: pp. 28 and 29, Pl. IV, fig. 3.
1932a. *Podozamites Schenki* ÔISHI: p. 66.
1932b. *Podozamites Schenki* ÔISHI: p. 362, Pl. XXXIV, figs. 3–5.
For further references see ÔISHI, 1932b.

Remarks: HARRIS[1] in 1926 described some shoots from Greenland as *P. Schenki* but he[2] later divided narrow and linear acuminate leaves into four types calling them *P.* spp. indet. The reason is simple and clear from his statement: "Although I am convinced from my observations in the field that there are several different narrow-leaved species of *Podozamites* in Greenland, I was quite unable to divide them into satisfactory species, and I do not suggest that the four groups into which I have divided them are entirely natural. In any case *P. Schenki* sensu lato like *P. lanceolatus* sensu lato has little zonal significance since both types are found throughout the older Mesozoic." In Japan, shoots determined as *P. Schenki* are known from Nariwa,[3] Nagato[4] and Tyôsen,[5] and such identification is sometimes useful for reference when they occur commonly in any of the plant beds. As HARRIS wrote, shoots usually determined as *P. Schenki* have little stratigraphical value, as they occur also in Japan from Nagato, Nariwa and Tyôsen, each somewhat differing in age.

Occurrence:

Kusaigawa, Yamaguti. Momonoki Bed.
Nariwa (1, 10), Okayama. Nariwa Series.

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1) T. M. HARRIS (1926), p. 115, text-fig. 29.
2) T. M. HARRIS (1935), p. 92.
3) S. ÔISHI (1932b), p. 362.
4) S. ÔISHI (1932a), p. 66.
5) S. KAWASAKI (1926), p. 55, Pl. XLI, figs. 112–113; Pl. XLV, fig. 120.

Tongzin Hakuunzi Myongang	Tyôsen (G. S. K. Coll.). Daidô Series.

Genus *Sphenolepidium* HEER

Sphenolepidium Sternbergianum (DUNKER) HEER

1846. *Muscites Sternbergianus* DUNKER: p. 20, Pl. VII, fig. 10.
1871. *Sphenolepis Sternbergianus* SCHENK: p. 243, Pl. XXXVII, figs. 3–4; Pl. XXXVIII, figs. 3–13.
1895. *Sphenolepidium Sternbergianum* SEWARD: p. 205, Pl. XVI, figs. 4–6.
1911. *Sphenolepis Sternbergiana* BERRY: p. 435, Pl. LXXV, figs. 1–2.
1927. *Sphenolepidium Sternbergianum* CARPENTIER: p. 70, Pl. XX, figs. 4–5.
1936. *Sphenolepidium Kurrianum* forma *Sternbergianum* MICHAEL: p. 56, Pl. III, figs. 3–4.

SEWARD, 1895, gives additional references.

Remarks: The writer examined several imperfect branching sterile shoots with spreading leaves which are sometimes recurved, keeled dorsally and acutely pointed at spices. This species, first described by DUNKER as *Muscites Sternbergiana* from the Wealden of Germany, is probably represented by a sterile shoot in the Naktong Series. SCHENK figured several branches with terminal ovate cones with spreading cone-scales which he recognised as distinct from those of *Thuites Kurrianus* DUNKER in which the cones are spherical. Recently MICHAEL thought that the cones which SCHENK considered as those of *Sphenolepis Sternbergiana* are nothing but ripened cones of *S. Kurriana* and he called the latter type *S. Kurrianum* forma *Sternbergianum.* As SEWARD pointed out, *Sphenolepidium* are characterised by a considerable range in the habit of the foliage shoots, and it appears to be of little importance to separate *Kurrianum* and *Sternbergianum* based on the form of the leaves in detached branches. However, in the present case, the writer wishes provisionally to call the present specimens *Sphenolepidium Sternbergianum* (DUNKER) as they agree very closely with *S. Sternbergianum* from Germany figured by DUNKER and SCHENK.

Occurrence:

Kinkodô Sindô Tasseidô	Tyôsen. Rakutô Bed.

Genus *Storgaardia* HARRIS

Cfr. *Storgaardia spectabilis* HARRIS

1938. Cfr. *Storgaardia spectabilis* ÔISHI and HUZIOKA: p. 96, Pl. VI, fig. 3, Text-fig. 7.

Remarks: Specimens provisionally referred to *S. spectabilis* HARRIS are derived from the Nariwa district several examples having been acquired from Loc. No. 91. On a previous occasion, ÔISHI and HUZIOKA illustrated a portion of somewhat large shoot (ÔISHI and HUZIOKA, 1938, p. 97, text-fig. 7). It differs little from the type-specimen from Greenland described by HARRIS as *S. spectabilis*, but they distinguished it from the type-specimen in its having more crowded leaves which contracted basally less abruptly. Another apparent difference lies in the mode of insertion of leaves to the rachis: in the Greenland specimens the leaves are borne regularly in pairs, while in our specimen they appear to be not so, but likely to be subopposite as can be seen in the middle portion of the specimen in ÔISHI and HUZIOKA, 1938, p. 97, text-fig. 7, although ÔISHI and HUZIOKA wrote that the attachment may originally be decussate. Taking into consideration these differences they wish provisionally to call the Japanese specimens cfr. *S. spectabilis* HARRIS until further material available for more satisfactory comparison may be acquired.

Occurrence:

Nariwa (91), Okayama. Nariwa Series.

(Coniferales—Reproductive Organs)

Genus *Cycadocarpidium* NATHORST

Cycadocarpidium Swabii NATHORST

Pl. XLV, Figs. 6, 6a.

1911a. *Cycadocarpidium Swabii* NATHORST: p. 5, Pl. I, figs. 11–15.
1925. *Cycadocarpidium Swabii* ÔZAWA: p. 94, fig. 1.
1925a. *Cycadocarpidium Swabii* ÔZAWA: p. 6, Pl. I, fig. 10.
1932a. *Cycadocarpidium Swabii* ÔISHI: p. 66, Pl. II, figs. 10, 10a.
1935. *Cycadocarpidium Swabii* HARRIS: p. 101, Pl. XVII, figs. 3, 5, 6, 8; Text-fig. 40.
1937. *Cycadocarpidium Swabii* HARRIS: p. 64.

Remarks: The occurrence of this species in Japan was first reported by OZAWA from Ozigase near Ômine, Yamaguti pref. The specimen was a distal portion of a sporophyll with oval seeds laterally compressed so as to make two seeds overlap each other. Later, the present writer found a second specimen of this species from Kusaigawa and described it suggesting the Rhaetic age of the plant beds both of Ozigase and Kusaigawa. Recently, T. KOBAYASHI and M. KATAYAMA[1] who made a stratigraphical study of the district announced the Carno- Noric age of the plant-beds. If this view be accepted, then the geological range of this species should be lowered down from the Rhaetic to the Carno-Noric stage. Accordingly there is great need of a more careful comparison of additional Japanese specimens with foreign specimens the age of which is certainly Rhaetic, in connection with the closer examination of the stratigraphy and correlation of the district in question. According to HARRIS (1935, 1937), *C. Swabii* must be regarded as an aggregate of several similar sporophylls, but is a type characteristic to the *Lepidopteris* Zone only.

ÔISHI and TAKAHASI[2] figured a small, indistinct specimen from Yamanoi probably not identical with *C. Swabii* as *Cycadocarpidium* ? sp. Similar specimens have already been described by TURUTANOVA-KETOVA[3] from the Kirghis as *C. minor*.

Occurrence:

Ozigase, Yamaguti. Hirabara Bed.
Kusaigawa, Yamaguti. Momonoki Bed.

Genus *Leptostrobus* HEER

Cfr. *Leptostrobus laxiflora* HEER

1936. Cfr. *Leptostrobus laxiflora* ÔISHI and TAKAHASI: p. 131, Text-fig. 5.

Remarks: Some lax strobili with slender axis and bearing short stalked ovate to orbicular cone-scales, derived from Yamanoi,

1) T. KOBAYASHI and M. KATAYAMA (1938).
2) S. ÔISHI and E. TAKAHASI (1936), p. 131, Pl. I, figs. 12, 12a.
3) A. TURUTANOVA-KETOVA (1930a), p. 345, Pl. III, fig. 1; Pl. IV, fig. 2.

have provisionally been referred to *Leptostrobus laxiflora* HR.[1] from Siberia. Later, having received HARRIS' paper on Greenland fossil plants, pt. IV, 1935, the writer found that the Japanese specimens are more closely related to the Greenland ones described by him as *L. longus* HARRIS. But as the material is not satisfactory, the writer still wishes to refer them provisionally to HEER's species. A fragment from the Kirghis has provisionally been identified to HEER's species by TURUTANOVA-KETOVA[2].

Occurrence:

Yamanoi (16), Yamaguti. Upper Triassic.

Genus *Stenorachis* SAPORTA

Stenorachis bitchuensis ÔISHI

1932b. *Stenorachis bitchuensis* ÔISHI: p. 357, Pl. XXXII, fig. 9.

Remarks: A sporophyllous organ called by the name *Stenorachis bitchuensis* Ô. "consists of a straight and moderately stout central axis bearing at nearly a right angle a number of appendages characterised by an oval expansion at the distal end. The oval body suggests the former presence of reproductive organs, but there is no trace of actual seeds or microsporangia."[3] This species is distinguishable from *S. scanicus* (NATH.),[4] *S. Solmsi* (NATH.),[5] *S. dubius* ANTEVS[6] and *S.* sp. nov. KAWASAKI[7] by having unbranched distal end of the appendages:

Occurrence:

Nariwa (46), Okayama. Nariwa Series.

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1) O. HEER (1876), p. 72, Pl. XIII, figs. 10–13; Pl. XV, figs. 9b; (1880a), p. 23, Pl. VII, figs. 1–5.
2) A. TURUTANOVA-KETOVA (1930a), p. 347, Pl. IV, fig. 4.
3) S. ÔISHI (1932b), p. 357.
4) A. G. NATHORST (1902), p. 16, Pl. I, figs. 16–17.
5) A. G. NATHORST, Ibid., p. 17, Pl. I, figs. 18–21.
6) E. ANTEVS (1919) p. 38, Pl. V, figs. 8–15.
7) S. KAWASAKI (1925), p. 56, Pl. XLI, fig. 114.

Stenorachis elegans ÔISHI

Pl. XLV, Fig. 2.
(Type-specimen: OISHI, 1932b, Pl. XXXII, fig. 10).

1932a. *Stenorachis elegans* ÔISHI: p. 65, Pl. I, figs. 12, 12a.
1932b. *Stenorachis elegans* ÔISHI: p. 357, Pl. XXXII, fig. 10.

Remarks: This species is characterised by "a straight and moderately stout central axis, to which are attached at an oblique angle more or less crowded appendages. These are 5–6 mm. in length and characterised by an oval expansion at the distal end. On the surface of the oval body, there can be seen two faint striations in the longitudinal direction running from one end to another."[1]

The type-specimen is unfortunately poorly represented in the photograph. A better specimen from Nagato shows that the oval bodies are bilobed at their distal ends as is shown in ÔISHI, 1932a. This organ is allied to that of *S. bitchuensis* Ô. but is distinguished chiefly in the more crowded appendages and their more oblique insertion to the axis.

Occurrence:

Nariwa (63), Okayama. Nariwa Series.
Kusaigawa, Yamaguti. Momonoki Bed.

Stenorachis (*Ixostrobus*?) *Konianus* ÔISHI and HUZIOKA

1938. *Stenorachis* (*Ixostrobus*?) *Konianus* ÔISHI and HUZIOKA: p. 97, Pl. V, figs. 17, 17a.

Remarks: The specimen referred to above "consists of a stout, woody central axis more than 3.5 cm. long, 2 mm. thick with some longitudinal striations (vascular courses ?). To it appendages are attached at a right angle in the upper part and at a decreasing angle towards the proximal portion and spirally arranged, crowded, 7 mm. long, 0.6–0.9 mm. thick and bi-lobed at the apex towards which they increase in breadth gradually from the base somewhat decurrent to the central axis. Near the bottom of the lobes at the apex of each appendage is an indication of the presence of a small body

1) S. ÔISHI (1932b), p. 357.

which probably indicate the presence of a microsporangium, but there is no proof of it. There are one or two thin, longitudinal ridges in each appendage which probably indicate vascular courses."[1]

This species is similar to *Ixostrobus groenlandicus* HARRIS[2] from Greenland and *I. Siemiradzkii* RACIB.[3] from Poland. A comparison has already been made in the supplementary work on the Nariwa plants (ÔISHI and HUZIOKA, 1938, p. 98).

Occurrence:

Nariwa (50), Okayama. Nariwa Series.

Genus *Swedenborgia* NATHORST

Swedenborgia cryptomerioides NATHORST

1876. *Swedenborgia cryptomerioides* NATHORST: p. 66, Pl. XVI, figs. 6–12.
1884. *Swedenborgia cryptomerioides* SAPORTA: p. 528, Pl. LXX, figs. 1–4.
1919. *Swedenborgia cryptomerioides* ANTEVS: p. 48, Pl. V, figs. 31–37.
1935. *Swedenborgia cryptomerioides* HARRIS: p. 108, Pl. XVIII, figs. 8, 10–18, 21–22; Pl. XIX, figs. 5–8, 20–22.
1935. *Swedenborgia cryptomerioides* ÔISHI and YAMASITA: p. 439, figs. 1–3.

Remarks: The occurrence of this interesting fossil in Nariwa has already been reported by ÔISHI and YAMASITA in 1935. The specimens are represented by a strobilus and some detached cone-scales associated with seeds and it is beyond doubt that they are identical with *S. cryptomerioides* NATH.

Occurrence:

Nariwa (44), Okayama. Nariwa Series.

Swedenborgia major HARRIS

1935. *Swedenborgia major* HARRIS: p. 109, Pl. XVIII, figs. 19–20; Pl. XIX, figs. 10–12; Text-fig. 44A.
1935. *Swedenborgia major* ÔISHI and YAMASITA: p. 440, fig. 4.

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1) S. ÔISHI and K. HUZIOKA (1938), p. 97.
2) T. M. HARRIS (1935), p. 147, Pl. XXVII, figs. 12, 13; Pl. XXVIII, figs. 1–4, 7–10; Text-fig. 50c.
3) M. RACIBORSKI (1892), p. 15, Pl. II, figs. 5–8, 20b.

Remarks: This species differs from *S. cryptomerioides* only in size of cone-scales, those of the present species being larger. A single cone-scale agreeing in size with *S. major* was found in Nariwa in association with *S. cryptomerioides*. It has already been figured by ÔISHI and YAMASITA (1935).

Occurrence:

Nariwa (44), Okayama. Nariwa Series.

Dicotyledoneae

Genus *Trochodendroides* BERRY

Trochodendroides arctica (HEER) BERRY

Pl. XLVIII, Fig. 8.

1918. *Populus arctica* KRYSHTOFOVICH: p. 48, fig. 7.
1925. *Populus arctica* ENDÔ: p. 13, Pl. VII, fig. 21.
1935. *Trochodendroides arctica* SEWARD and CONWAY: p. 15, Pl. III, figs. 22, 23; Pl. IV, fig. 30; Pl. V, fig. 39; Text-fig. 3.

Remarks: ENDÔ (1925) described this species from the Hakobuti Sandstone of the Upper Ammonites Beds (Urakawa Series) in Hokkaidô under the name *Populus arctica* HEER. But as the writer thinks it more appropriate to use BERRY's generic designation *Trochodendroides* for such leaves usually called under the generic name "*Populus*", he also wishes to call the Japanese specimens *Trochodendroides arctica*. BERRY (1922) already suggested this generic name for *Populus arctica*. A careful comparison of fossil leaves with those of *Cercidiphyllym japonicum* living in Hokkaidô was made, but no important morphological distinctions were discernible between them. Thus there is a strong probability that the majority of the "*Populus*" leaves are nothing but ancient *Cercidiphyllum*.

In Pl. XLVIII, fig. 8 is shown an imperfect leaf hardly distinguishable from "*Populus*" *arctica*. It resembles also *Populus elliptica* HOLLICK[1] from the Upper Cretaceous of Alaska, but the specific value of the Alaskan specimen is exceedingly questionable.

1) A. HOLLICK (1930), p. 63, Pl. XXXI, fig. 5.

Occurrence:

Hakobuti, Asibetu, Hetonai	Hokkaidô.	Urakawa Series.
Kadonosawa, Iwate.		

Trochodendroides denticulata (HEER) n. comb.

1883. *Populus denticulata* HEER: p. 20, Pl. LV, fig. 5.
1925. *Populus denticulata* ENDÔ: p. 13, Pl. VII, fig. 21.

Remarks: The specimen from the Hakobuti Sandstone identified by ENDÔ with *Populus denticulata* from the Patoot Formation of Greenland is an ovate leaf characterised by possessing acute serration at the margin. The Hakobuti specimen certainly resembles the Greenland one figured by HEER in size and form of the leaf especially in respect to the acute marginal serration, but there exists a certain difference between them because the lowest pair of secondary nerves in HEER's specimen is given off close to the base of the midnerve while in ENDÔ's they are from within the lamina. The writer has no additional specimen referable to this type.

Occurrence:

Hakobuti, Hokkaidô. Urakawa Series.

Plantae Incertae Sedis

Genus *Aphlebia* PRESL

***Aphlebia nervosa* sp. nov.**

Pl. XLV, Figs. 3–5 (all the type-specimen).

Description of specimens: Pl. XLV, figs. 3–5 show leafy structures of leathery texture and very peculiar form. They are linear straight or curved, more than 4.5 cm. long and about 5 mm. broad, and the margin is more or less irregularly and pinnately dissected into narrow linear segments each directed forwards and provided with an acute tip. There are prominent nerves parallel to each other and to the longitudinal axis of the leafy structure and forking occasionally.

Remarks: The present specimens are, as can be seen in the figures, very peculiar in leaf from and it is somewhat difficult to describe them in a form of a diagnosis. It is also difficult to attribute such specimens to any existing genera of fossil plants. But if the writer is forced to adopt some generic designation for the specimens for the sake of convenience in description, he will choose the convenient generic designation *Aphlebis* founded by PRESL for "leaf-like impressions having a pinnate or pinnatifid form and characterised by a confused irregular type of venation, or by a fine superfical striation or wrinkling which simulates veins."[1]

Under this generic name several distinct types have been discriminated mostly from the Younger Palaeozoic rocks and a few from the Mesozoic. Most of the Plaeozoic Aphlebias were borne on *Sphenopteris* and certain genera of Pteridosperms or ferns as modified pinnules. Mesozoic Aphlebias are also found as modified pinnules at the base of the primary pinnae of certain ferns. One such case is represented by *Coniopteris hymenophylloides* (BRONGN.) described by SEWARD[2] from Yorkshire. In all the cases mentioned above, the common feature is that Aphlebias are always borne at the base of primary pinnae, and SEWARD extended this feature to the characteristic basal pinnules of primary pinnae of *Cladophlebis lobifolia* (PHILL.), which are different in shape from, and sometimes extraordinarily larger than, the others.

Unfortunately, the present specimens occur as isolated leaves, therefore, it is not clear to what kinds of fossil plants they might have belonged or whether they represent in themselves a distinct genus. At the same time it is impossible to write with confidence as to the nature of these specimens. Although most of the hitherto described Aphlebias were considered to be organs serving as stipules of ferns or fern-like plants, the leathery appearance of the leafy laminae and the well-marked nerves which stand out in distinct relief in the present specimens rather suggest their being scale-like protective organs belonging to Gymnospermae.

Occurrence:

Kowasimizu, Hukui. Tetori Series. Associations are

1) A. C. SEWARD (1910), p. 525.
2) A. C. SEWARD (1904), p. 109, Pl. XXI, fig. 1.

Sphenopteris Goepperti (DKR.), *Onychiopsis elongata* (GEYL.), *Coniopteris burejensis* (ZAL.), *Cladophlebis exiliformis* (GEYL.), *Ginkgoites digitata* (BRONGN.), *Ginkgoidium Nathorsti* YOK., *Pseudocycas ? acutifolia* sp. nov., *Podozamites Reinii* GEYL., and *P.* sp.

Genus *Campylophyllum* GOTHAN

Campylophyllum Hoermanni GOTHAN ?

1932b. *Campylophyllum Hoermanni* ÔISHI: p. 317, Pl. XXIV, fig. 5.

Remarks: A single imperfect specimen from Nariwa which the writer (1932b) formerly identified with *C. Hoermanni* GOTHAN[1] he now wishes to call provisionally as *C. Hoermanni* ? since he believes that the specimen was too imperfect to admit of precise specific identification. GOTHAN mentioned that the lower base of the pinnae is decurrent downwards to, and that the upper makes a sinus with, the axis, but such features are obscure in the present specimen. It is not impossible to consider that the present specimen may represent a lower portion of a frond which is described in this work (p. 342) as cfr. *Pterophyllum distans* MORRIS with which it was associated. But as the superficial resemblance is so close to the German species and as no forms which connect the present specimen and cfr. *P. distans* are found at Nariwa, the writer preferred to call the specimen *C. Hoermanni* ? provisionally.

Occurrence:

Nariwa (62), Okayama. Nariwa Series.

Genus *Geonoma* WILLDENOW

"*Geonoma*" *trinerve* sp. nov., ex IWAI (MS)

Pl. XLV, Fig. 7; Pl. XLVII, Figs. 9, 10 (all the type-specimen).

Description of specimen: In Pl. XLV, fig. 7 is shown a portion of a plant with pinnate leaflets; the leaf itself gives a somewhat rigid appearance. The petiole or axis is 4 mm. thick measured on the compressed surface. The leaflets or pinnae are subopposite,

1) W. GOTHAN (1914), p. 53, Pl. XXXI/XXXII, fig. 4; Pl. XXXIII, fig. 2; Pl. XXXIX, fig. 4.

about 1 cm. apart on each side of the axis, decurrent at the base which is about 3 mm. broad, thence widening gradually upwards and attached to the lateral sides of the axis at an angle of about 50°. They are at least 6 cm. in length, but their full length is unknown. There are three prominent parallel primary nerves in each leaflet. Finer interstitials are present; they are three in each of the two inner intervein areas, while four in the marginal ones (Pl. XLVII, figs. 9 and 10).

Remarks: This plant had previously been named by Mr. Z. IWAI as *Pseudoctenis trinervis,* but the name was never published. Therefore, it is quoted here as a manuscript name. The writer is much at a loss in deciding the generic position of this peculiar plant. So far as he is aware there is no known Mesozoic plants to which the present specimen is comparable. Some Cycadophytan fronds such as *Zamiophyllum, Pterophyllum* and some allied genera are somewhat comparable, but in all these the nerves are always of the same strength.

There is only a single Tertiary species to which the Japanese specimen is closely allied. It is a large pinnate leaf described by KNOWLTON[1] from the Raton Formation of North America under the name "*Geonoma*" *gigantea* KNOWLT. As KNOWLTON described it the Raton species shows a fairly close resemblance to *Geonoma,* living in tropical America, the only difference being, he writes, in the shape of cross section of the petiole. Unfortunately, our specimen is imperfect and represents only a portion of a frond or leaf probably attaining to a considerable size in its complete state. But it is deniable at the same time that the habit of the leaf shows a striking resemblance to the American Tertiary species mentioned above.

Under such circumstances, the best way is, the writer believes, to place the present specimen under the genus "*Geonoma*" and wait a further supply of the material which may give light on the closer affinity of this peculiar plant. The writer wishes for the while to call the specimen "*Geonoma*" *trinerve* sp. nov., ex IWAI (MS).

If the present specimen does represent certainly a pinnate-leaved palm, it is highly interesting from the palaeophytogeographical point of view, because such a palm is exceedingly rare anywhere in the world in contrast to the widespread occurrence of palmate-leaved

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1) F. H. KNOWLTON (1917), p. 291, Pl. LXI.

palms especially in certain American Younger Mesozoic and Older Tertiary strata, and moreover it may perhaps be the oldest occurrence of Palmae known to date as it is derived from the Ryôseki Series of the Sôma district, Hukusima pref.

A German Wealden species described by SCHENK[1] as *Zamites pachyneura* SCHENK may be the only species to which the Japanese specimen is comparable, but in that there are no interstitials.

Occurrence:

Zusahara, Hukusima. Ryôseki Series. (Sendai Coll.).

Genus *Pachypteris* BRONGNIART

Pachypteris? sp. indet.

Pl. XLVIII, Fig. 7.

The very fragmentary specimen in Pl. XLVIII, fig. 7 has been illustrated here as it presents a somewhat peculiar type of pinnules rarely met with among the Mesozoic fossil plants.

Description: The specimen consists of an axis 1.5 mm. across to which are attached pinnules ? with a narrow base. The assumed pinnules are somewhat separate, more than 1 cm. long and 5 mm. broad, and the upper basal margin bends abruptly downward to the midnerve making a narrow sinus between the axis and the lamina, while the basal lower margin is decurrent downwards. Therefore, the supposed pinnules seem to attach to the axis by a very narrow basal portion like a stalk. The midnerve is distinct, acute at its origin, bends outward and then assumes a straight course making a wide angles with the axis. The secondary nerves are indistinct; however, by the aid of a magnifier one can see that they are simple, issue from the midnerve at an acute angle and reach straight to the margin of the pinnules.

Discussion: One of the striking features is the presence of a peculiar lobing at the upper basal portion of the lowest pinnules of the figured specimen; the lobe is small and oblong and bears forked secondary nerves; the writer thinks that the lobing is not an accidental, but a natural lobing.

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1) A. SCHENK (1869), p. 12, Pl. IV, fig. 1.

Another interesting feature is the presence of a narrow bulge along the upper basal secondary nerves as seen in the accompanying figure. Though there is no decisive evidence whatever indicating the nature of this bulgy object, it is highly interesting that it closely resembles linear sori as in *Asplenium.*

It is very difficult to settle the generic position of such an imperfect specimen; however, the basal character of the pinnules seems to suggest that it is a type closely allied to *Pachypteris* in the meaning delimited by HALLE.[1] Therefore the application of the generic name *Pachypteris* for the present specimen is only provisional. Though the writer thinks that the present specimen is a fern, that does not mean that all the specimens referred to this genus belong to the ferns.

Comparison: As the apical portion of the pinnules is broken, it is difficult to compare the present specimen with known species. It recalls *Cladophlebis distans* in respect to the basal contraction of the pinnules; however, in the present specimen the midnerve bends at its origin, while in *C. distans* it does not do so.

Occurrence:

Nisinotani, Kôti. Ryôseki Series.

Form-Genus *Taeniopteris* BRONGNIART

Taeniopteris emarginata sp. nov.

Pl. XLVI, Figs. 1–3 (all the type-specimen).

Diagnosis: Leaf petiolate, petiole being about 5 mm. long and 2 mm. thick, simple, elliptical to obovate, generally about 10 cm. long and 5 cm. broad, and abruptly contracting towards the notched distal end and also towards the cordate base; midrib broad and prominent, persisting to the apex; lateral nerves simple or forking at varying distances between their origin and midway, straight, and nearly at a right angle to the midrib, numbering 25–40 per cm.; margin entire.

Description of specimens: Pl. XLVI, figs. 1 and 2 show leaves on which the above diagnosis is chiefly based. The notched distal

1) T. G. HALLE (1913), p. 391.

end, cordate base and distinct petiole are clearly seen in the figures. The density of the lateral nerves per cm. varies in different leaves. In the lower leaf in fig. 3 it is about 30, in the upper one it is about 40, while in fig. 2 it is about 25. Another specimen in Pl. XLVI, fig. 1 is a little larger than the preceding specimen, the length being at least 10 cm. The notched apex is clearly seen, but the base is missing. The density of the secondary nerves is about 28 per cm. in this specimen.

Remarks: This species is well characterised by the shape of the leaf which is elliptical to obovate in outline with notched distal end, cordate base and bearing a distinct petiole. These characters are constant in the specimens examined, though the density of the lateral nerves varies to a considerable degree as mentioned above.

Comparison: So far as the writer is aware there is no species comparable with the present species. An imperfect specimen described by GOTHAN and SZE[1] from Chinese Turkestan as *Taeniopteris de Terrae* GOTHAN and SZE reminds one somewhat of the present species in regard to the notched distal end of the leaf, but those authors describe the lateral nerves as simple and densely crowded instead of being forked. As those authors say, the Chinese specimen seems to represent the back surface of a *Nilssonia;* especially the notched distal end of the leaf and the simple and densely crowded lateral nerves rather recall *Nilssonia orientalis* HEER, a species very common in the Mesozoic rocks of the Asiatic continent.

The present species also resembles *Nilssonia orientalis* HEER, but in this the lateral nerves are always simple. In all the specimens at hand the lamina shows the lateral attachment to the rachis in conformity with the diagnosis of the genus *Taeniopteris*.

Occurrence:

Kuwasima, Isikawa. Tetori Series.

Taeniopteris Inouyei TATEIWA

Pl. XLV, Fig. 8; Pl. XLVI, Fig. 4 (all the type-specimen).

1929. *Taeniopteris Inouyei* TATEIWA: Plate, fig. 12.

General description: Leaf petiolate, petiole being at least 1.5 cm. long; simple, lamina broadly linear in outline, widening gradually

1) W. GOTHAN and H. C. SZE (1931), p. 34, Pl. I, figs. 3, 3a.

upwards from a rounded base and ending in a rounded apex, with marginal corrugation or vasculum ?; rachis very thick and stout; nerves simple, straight, at a right angle to the rachis, about 17 per cm.

Description of specimen: Pl. XLV, fig. 8 shows a proximal portion of a frond. Basal contraction of the lamina, very thick rachis, distinct simple nerves and marginal corrugation are clearly seen in the figure. Only in a single case does branching of the nerves appear to occur close to its origin, but it is very indistinct. All other visible nerves are simple. In this specimen the greater part of the rachis is exposed between the laminae on both sides of it, while only a part is covered under the lamina, a feature which may possibly have been caused by the displacement of the lamina over the rachis. Pl. XLVI, fig. 4a shows the middle portion of a frond. It is nearly parallel-sided, and the marginal corrugation is also clearly seen. Irregular transverse wrinkles are seen on the surface of the rachis. Fig. 4b shows an apex of the frond.

Remarks: This species was recognised as a new species of *Taeniopteris* by TATEIWA who named it provisionally *T. Inouyei* and figured it in his Geological Atlas of Tyôsen, No. 10, 1929. The writer re-examined the type-specimen and also regards it as a new species. It is characterised by the very thick rachis, by the shape of the lamina with a marginal corrugation or vasculum (?) and by well-defined simple nerves.

The present species resembles *T. vittata* (BRONGN.) but the latter has frequently forking nerves. Another comparable species is *T. Uwatokoi* ÔISHI[1] from Tung-ning in Manchoukuo, which seems to belong to the same specific group with the present species. But as the cuticles, and minute pittings on the back surface of the lamina are not known in the present specimens, it is undesirable to identify them with *T. Uwatokoi*. There are also differences in the apex of leaf and the nerves, in the Manchurian species the lamina tapers to a subacute apex and the nerves are denser. An imperfect specimen from Nariwa described by the writer[2] as *Taeniopteris* ? sp. nov. is identical with the present specimens in the presence of marginal corrugation or vasculum (?) in the lamina, but it differs in that

1) S. ÔISHI (1935a), p. 90, Pl. VIII, figs. 5–7; Text-fig. 7.
2) S. ÔISHI (1932b), p. 333, Pl. XXVI, figs. 6A–B.

the lamina tapers gradually towards the base and does not contract as in the present specimens.

Occurrence:

Tomudô, Tyôsen. Rakutô Bed. (G. S. K. Coll.).

Taeniopteris Leclerei ZEILLER

1903. *Taeniopteris Leclerei* ZEILLER: p. 294, Pl. LV, figs. 1–4.
1927. *Taeniopteris Leclerei* HALLES p. 17, Pl. III, figs. 2–4.
1932b. *Taeniopteris* cfr. *Leclerei* ÔISHI: p. 331, Pl. XXVI, fig. 3.

Remarks: The writer figured two imperfect specimens from Nariwa as *T.* cfr. *Leclerei* ZEILL., but is now of the opinion that they may rather safely be referable to that species, because their resemblance is striking. In the presence of transverse foldings on the lamina, they somewhat resemble the example figured as *Taeniopteris* ? sp. nov. from Nariwa (ÔISHI, 1932, p. 333, pl. XXVI, fig. 6A–B), but in that specimen there is a distinct marginal thickening which can not be seen in the present species.

Occurrence:

Nariwa (64), Okayama. Nariwa Series.

Taeniopteris lanceolata ÔISHI

(Type-specimen: ÔISHI, 1932b, Pl. XXV, figs. 5–9).

1932b. *Taeniopteris lanceolata* ÔISHI: p. 325, Pl. XXV, figs. 5–9.

Diagnosis (ÔISHI, 1932b): "Frond simple, shortly-petiolate, linear-lanceolate, broadest at the portion slightly above the middle, thence tapering gradually to the acuminate or blunt apex and more gradually towards the base. Midnerve distinct, moderately strong, with a longitudinal median groove. Iateral nerves making an angle of 60°–80° with midnerve, not decurrent at the base, straight, once or twice forking at varying distances from the base, 25–30 in number per cm. at the margin."

Remarks: As already discussed in 1932, there are many species comparable to *T. lanceolata*, namely, *T. vittata*, *T. lenticuliforme*, *T. MacClellandi*, *T. Jourdyi*, *T. tenuinervis*, and some others, but ous differs from each of them in several points (ÔISHI, 1932b, pp. 326–328).

Occurrence:

Nariwa (40, 50), Okayama. Nariwa Series.

Taeniopteris minensis ÔISHI

(Type-specimen: ÔISHI, 1932a, Pl. II, figs. 1–5).

1932a. *Taeniopteris minensis* ÔISHI: p. 60, Pl. II, figs. 1–5.
1936. *Taeniopteris minensis* ÔISHI and TAKAHASI: p. 127.

Diagnosis (ÔISHI, 1932a); "Leaf simple, petiolate, long and narrow, reaching a length of more than 15 cm. and a breadth of 1–2 cm. The lamina increases gradually in breadth from the base and tapers towards a subacute apex. Margin entire or broadly wavy. Midnerve distinct, moderately strong, merging gradually into slender petiole not very much stronger than the midnerve. Lateral nerves distinct, at an angle of approximately 60° to the midnerve, simple or once forking at variable distances from their origin, and 20–25 in number per cm. at the margin."

Remarks: This species is very striking in respect to the gradual reduction of lamina towards the base, acuminate apex and in the wavy margin of the lamina. It may be comparable to *T. Thomasiana* ARBER[1] and *T. stenophylla* KRYSHT.,[2] but can be distinguished from either of them (ÔISHI, 1932a). A fragment probably referable to this species has been described from Yamaguti (ÔISHI and TAKAHASI, 1936).

Occurrence:

Nariwa (21), Okayama. Nariwa Series.
Kusaigawa, Momonoki } Yamaguti. Momonoki Bed.
Tubuta (I), Yamaguti. Upper Triassic.

1) E. A. N. ARBER (1917), p. 47, Pl. VI, fig. 4; Pl. VIII, figs. 4, 7.
2) A. KRYSHTOFOVICH (1910), p. 11, Pl. II, fig. 2. See also this work, p. 430.

Taeniopteris nabaensis Ôishi

(Type-specimen: Ôishi, 1932b, Pl. XXV, figs. 11–13).

1887. *Oleandridium* Schenk: Pl. IV, fig. 19.
1905. *Nilssonia* sp. Yokoyama: p. 12, Pl. III, figs. 1, 8.
1932b. *Taeniopteris nabaensis* Ôishi: p. 328, Pl. XXV, figs. 11–13; Text-fig. 3.

Description and Remarks: This species is unfortunately represented only by several imperfect leaves characterised by the nervation. They are rather linear, narrowing gradually towards the base, and the lateral nerves which spring off at a right angle from the midnerve or rachis fork twice in regular manner, first at their origin and secondly in their midcourse. As already noticed, imperfect leaves figured by Schenk (1887) from the Albour range merely as "Fragmente von *Oleandridium*" agree well with the present species, and may probably represent the same species; it has already pointed out that Schenk's *Oleandridium tenuinerve* in the same work is distinct from Braun's original specimen in having forking lateral nerves. The writer[1] described a somewhat indistinct specimen from Yamanoi as cfr. *T. nabaensis* Ô. Fragments described by Yokoyama (1905) from Nariwa as *Nilssonia* sp. belong to this species.

Occurrence:

Nariwa (21), Okayama. Nariwa Series.
Yamanoi (15), Yamaguti. Upper Triassic.

Taeniopteris Richthofeni (Schenk)

1883. *Macrotaeniopteris Richthofeni* Schenk: p. 257, Pl. L, figs. 4, 6.
1883. *Oleandridium eurychoron* Schenk: p. 258, Pl. LI, fig. 5.
1883. *Angiopteris Richthofeni* Schenk: p. 260, Pl. LIII, figs. 3, ?4.
1884. *Oleandridium eurychoron* Schenk: p. 6, Pl. I, figs. 3–5.
1889. *Macrotaeniopteris Richthofeni* Yokoyama: p. 37, Pl. III, figs. 4–5.
?1910. *Macrotaeniopteris* cfr. *Richthofeni* Kryshtofovich: p. 11, Pl. II, fig. 5.
1925. *Taeniopteris eurychoron* Kawasaki: p. 31, Pl. XX, fig. 61.
1932b. *Taeniopteris* cfr. *Carruthersi* Ôishi: p. 330, Pl. XXVI, figs. 1–2.
1933a. *Taeniopteris Richthofeni* Sze: p. 14, Pl. III, fig. 1; Pl. V, fig. 1.

Remarks: The writer provisionally described as *T. Carruthersi*

1) S. Ôishi (1932a), p. 62, Pl. II, figs. 7, 7a.

TENISON-WOODS fragments of leaves from Nariwa which are linear or somewhat narrowing gradually towards the base and with once forking lateral nerves nearly at a right angle to the rachis or midnerve. SZE (1933a) later regarded the Japanese specimens as specifically identical with SCHENK's *Macrotaeniopteris Richthofeni* SCHENK, a view to which the present writer subscribes for the present. A specimen described by KRYSHTOFOVICH (1910) from Ussuriland is a fragment specifically almost indeterminable. YOKOYAMA (1889) figured two imperfect specimens of this species representing apical portions of leaves from Kuwasima, where *T. emarginata* ÔISHI sp. nov. is abundant. However, no such leaves with distally attenuated apices as in YOKOYAMA's specimen are found in the collection at hand. SZE (1933a, p. 14) considers that some imperfect specimens described by KAWASAKI (1925, p. 34) from Tyôsen as *Taeniopteris MacClellandi* OLDH. and MORR. are specifically identical with *T. Richthofeni* SCHENK.

Occurrence:

Nariwa (1, 21), Okayama. Nariwa Series.
Kuwasima, Isikawa. Tetori Series.
Tongzin, Tyôsen. Daidô Series. (G. S. K. Coll.).

Taeniopteris shitakensis ÔISHI

1932. *Taeniopteris shitakensis* ÔISHI: p. 10, Pl. III, fig. 8.

Diagnosis (ÔISHI, 1932): "Leaf probably simple, elongate, linear-ovate in outline, broadest a short distance below an obtusely pointed apex, narrowing gradually towards the base. Midnerve distinct, 1.3 mm. broad at the proximal end, narrowing gradually towards the apex. Lateral nerves, making an angle of approximately 60° with the midnerve, straight, simple or once forking close to the origin, and numbering 25-30 per cm. at the margin."

Remarks: The oblique lateral nerves are somewhat like *T. stenophylla* with which it associates. However, as the leaves of the species are generally linear tapering towards both ends, the writer has provisionally separated the specimen from *T. stenophylla*.

Occurrence:

Sitaka, Kyôto. Sitaka Bed.

Taeniopteris stenophylla KRYSHTOFOVICH

1910. *Taeniopteris stenophylla* KRYSHTOFOVICH: p. 11, Pl. II, fig. 2.
1925. *Taeniopteris* cfr. *stenophylla* KAWASAKI: p. 31, Pl. XXI, fig. 65.
1932. *Taeniopteris stenophylla* KRYSHTOFOVICH and PRYNADA: p. 368.
1932. *Taeniopteris stenophylla* ÔISHI: p. 9, Pl. III, figs. 6–7.
1932b. *Taeniopteris* cfr. *stenophylla* ÔISHI: p. 329, Pl. XXV, fig. 10.

Remarks: KAWASAKI and the writer provisionally referred certain specimens from Tyôsen and Nariwa respectively to KRYSHTOFOVICH's species. Having compared these specimens more carefully with the description and figures of the type specimens from Ussuriland, and taking also into consideration the geological age of the strata from which the specimens are derived, the writer is now convinced of their specific identity. The exact agreement between the specimens from Tyôsen and Nariwa at least is beyond doubt. Recently SZE[1] figured a fragment of Taeniopteroid leaf with oblique lateral nerves from China as *T.* sp. cfr. *T. stenophylla.*

Occurrence:

Nariwa (58, 89), Okayama. Nariwa Series.
Sitaka, Kyôto. Sitaka Bed.
Hakuunzi, Tyôsen. Daidô Series. (G. S. K. Coll.).

Taeniopteris? sp. cfr. *T. auriculata* (FONTAINE) BERRY

Pl. XLVII, Figs. 1, 2, 2a.

1929. *Taeniopteris ?* sp. cfr. *T. auriculata* TAEIWA: Plate, fig. 25.

Description of specimens: In Pl. XLVII, fig. 1 is shown a pinnate leaf with long and narrow pinnules. The rachis or axis is comparatively thin, hardly exceeding 1 mm. in thickness. The pinnules are linear, straight, 7–8 cm. long and about 1 cm. broad at the base thence attenuating towards acute (?) apices, spaced laterally, and attached alternately to the axis at a wide angle. As the basal region of the pinnules is imperfect, it is not obvious whether they are attached by their whole or contracted bases. In certain pinnules the base appears to be contracted, while in another ones not so. The midnerve is prominent, persisting to the tip. The

1) H. C. SZE (1933a), p. 20, Pl. V, fig. 5.

lateral nerves are entirely obliterated but a faint indication of them are elsewhere visible. In another fragment found in association with the preceding specimen is seen a faint indication of lateral nerves which branch actually, at least at their origin (Pl. XLVII, figs. 2 and 2a).

Remarks: The present specimens were determined by TATEIWA as *Taeniopteris* ? sp. cfr. *T. auriculata* (FONTAINE) and figured in his Geological Atlas of Tyôsen, No. 10 (1929). Upon examining TATEIWA's specimens the writer found that their resemblance to *T. auriculata* (FONT.) described first by FONTAINE[1] as *Angiopteridium auriculatum* is certainly close. However, the reason why the writer and probably also TATEIWA do not venture to identify the present specimens directly to FONTAINE's species is the imperfection of the former, the base of pinnules in the American species being distinctly cordate and attached to the axis by the midnerve features not satisfactorily represented in the present specimens. The application of the generic name *Taeniopteris* to the specimens now under consideration is also provisional because the bipinnate leaf of *Taeniopteris* is very little known to us except some Palaeozoic species such *T. jejunata* GRAND' EURY and *T. Carnoti* REN. and ZEILLER from the European Upper Palaeozoic rocks.

Occurrence:

Tôtôri, Tyôsen. Kasandô Bed. (G. S. K. Coll.).

Taeniopteris ? sp. nov.

1932b. *Taeniopteris*? sp. nov.: p. 333, Pl. XXVI, figs. 6A–B.

Remarks: As already described, the transverse folding of the lamina and the presence of marginal corrugation and coarse simple lateral nerves are the characteristic features of this plant. The first and the last mentioned features suggest a *Nilssonia*, but the second feature is often met with in *Taeniopteris* (*Taeniopteris Uwatokoi* ÔISHI, in ÔISHI, 1935a, p. 90; *T. angustedunensis* SAPORTA, in SAPORTA, 1873, p. 435).

1) W. FONTAINE (1889), p. 113, Pl. VII, figs. 8–11; Pl. XXVIII, fig. 1. E. W. BERRY (1911), p. 293.

KAWASAKI[1] figured from Tyôsen a similar plant with coarse lateral nerves as *T.* cf. *superba* SAPORTA.

Occurrence:

Nariwa (65), Okayama. Nariwa Series.

Genus *Yabeiella* ÔISHI

(Type-species: *Taeniopteris mareyesiaca* GEINITZ, 1876).

Diagnosis (ÔISHI, 1931d): "Leaf Taeniopteroid; midnerve strong, generally with minute pittings: lateral nerves simple or forked and occasionally two adjacent ones joining or connected with cross bars; at their outer extremities lateral nerves joining to form distinct marginal nerves. Fructification unknown."

Remarks: It is unfortunate that the taxonomic position of this genus is as yet undetermined, but the supposition is, if permissible, that it may be gymnospermous or fern-like resembling *Stangeria* or *Taenites* respectively, though WIELAND[2] considered it dicotyledonous.

It is considered that *Yabeiella* comprises six distinct species, namely, *Y. mareyesiaca* (GEINITZ), *Y. brackebuschiana* (KURTZ), *Y. Wielandi* ÔISHI, *Y. spatulata* ÔISHI, *Y.* ? *DuToiti* ÔISHI and *Y.* ? *crassinerve* (FEIST.). It is noteworthy that the occurrence of *Yabeiella* is almost confined to the Older Mesozoic strata of the Gondwana region, except an unsatisfactory record of the genus in Nariwa, Japan (see below). The occurrence of this genus in the Liassic and Triassic strata in Australia was reported by WHITEHOUSE.[3] Specimens described by NATHORST[4] from the Upper Jurassic of Advent Bay as *Taeniopteris Lundgreni* NATH. have distinct cross connection of the lateral nerves and indistinct marginal nerves or thickening. It somewhat resembles *Yabeiella,* but is indistinct in the nature of marginal nerves. If this is a true *Yabeiella,* it is the youngest representative of the genus.

1) S. KAWASAKI (1925), p. 35, Pl. XX, fig. 64.
2) W. WIELAND (1929), p. 446.
3) F. W. WHITEHOUSE (1931).
4) A. G. NATHORST (1897), p. 50, Pl. III, figs. 1–5.

Yabeiella sp.

1931e. *Yabeiella* sp. ÔISHI: figs. 1–2.

Remarks: The specimen described as *Yabeiella* sp. is represented by some very imperfect leaves hardly specifically determinable, but showing the characteristic nervation in conformity with the generic diagnosis of *Yabeiella*.

Occurrence:

Nariwa (46), Okayama. Nariwa Series.

Form-Genus *Phyllites*

Phyllites sp.

Pl. XLVIII, Figs. 4, 4a.

Pl. XLVIII, fig. 4 shows an obovate leaf which can hardly be determined generically. As the figure shows the leaf is short petiolate and obovate in shape but the apex is missing. The axis or midnerve is distinct and sends off secondary nerves more or less at an acute angle. The secondary nerves are straight and as far as can be seen they are simple. The margin appears to be entire.

The generic position of the specimen is uncertain. It resembles *Nilssonia*, but there is no basis for referring it to that genus. A similar specimen was described by WALKOM[1] from the Burrum Series of Queensland as *Taeniopteris howardensis* WALK.

Occurrence:

Ôtani, Koti. Ryôseki Series.

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1) A. B. WALKOM (1919), p. 36, Pl. I, fig. 1.

X. LIST OF GEOGRAPHICAL NAMES

A

Aburaisi	高知縣香美郡大楠植村字油石
Aritahama	宮城縣牡鹿郡荻濱村有田濱
Asibetu	北海道石狩國空知郡蘆別村
Ayukawa	宮城縣牡鹿郡鮎川村

B

Bankeidô	朝鮮慶尙北道漆谷郡石積面幡溪洞
Bansyô	朝鮮江原道上東蓮花里盤松
Butudôken	朝鮮慶尙北道尙州郡佛堂峴

C

Changpa = Tyôha
Choja = Tyozya

D

Daiseizan	朝鮮平安南道大同郡林原面大聖山

E

Eidô	朝鮮慶尙北道漆谷郡石積面榮洞

F

Fujikawa = Huzikawa

G

Gabisan	朝鮮平安南道大同郡林原面峨嵋山
Gyoindô	朝鮮魚隱洞 (詳細不明)

H

Haginotani	高知縣長岡郡上倉村萩ノ谷
Hakobuti	北海道石狩國夕張郡夕張町南大夕張函淵
Hakogase	福井縣大野郡上穴馬村箱ケ瀬
Hakuunzi	朝鮮忠淸南道保寧郡嵋山面聖住里白雲寺
Hasyû	朝鮮京畿道坡州郡坡州里
Hatimanzawa	群馬縣多野郡中里村八幡澤
Heijo = Heizyô	
Heizyô	朝鮮平安南道大同郡平壤
Hetonai	北海道膽振國勇拂郡邊富內
Hidesima	岩手縣下閉伊郡崎山村日出島
Higasi-Nagano	山口縣豐浦郡豐田下村東長野
Hiromura	和歌山縣有田郡廣村
Hongsan = Kôsan	
Horisakabasi	福島縣相馬郡山上村堀坂橋

Hukodô	朝鮮慶尙北道阿陽面釜湖洞
Huruke	德島縣勝浦郡高鉾村古請
Hutaba	福島縣雙葉郡
Huzinami-mura	和歌山縣有田郡藤並村
Huzikawa	德島縣勝浦郡高鉾村藤川

I

Ikusagawa	樺太豐原郡豐原町軍川
Ikusyumbetu	北海道空知郡三笠山村幾春別
Inken	朝鮮平安南道大同郡斧山面鶴山里院峴
Irino	高知縣長岡郡新改村入野 (弘法谷)
Isigami-mura	福島縣相馬郡石神村
Isimati	山口縣豐浦郡豐田下村石町
Isiseki	高知縣長岡郡上倉村八京附近石關
Iwakura	三重縣渡會郡加茂村岩倉
Iwaidani	岐阜縣吉城郡山之村岩井谷
Izuki	福井縣大野郡下穴馬村伊月

K

Kadonosawa	岩手縣九戸郡夏井村門ノ澤
Kagahara = Hatimanzawa	
Kaisekiyama	高知縣高岡郡佐川町介石山
Kami Mano-mura	福島縣相馬郡上眞野村
Kami Usaka-mura	福井縣足羽郡上宇坂村藏作
Katazi	高知縣香美郡片地村
Kawakami Coal-mine	樺太豐原郡川上炭坑
Kayanokibasi	福島縣相馬郡上眞野村栢ノ木橋
Kenziho	朝鮮黃海道黃州郡兼二浦
Kikumenzawa	北海道空知郡三笠山村幾春別川菊面澤
Kinebasi	福井縣大野郡北谷村木根橋
Kinkodô	朝鮮慶尙北道漆谷郡枝川面錦湖洞
Kinpuzan	朝鮮慶尙北道漆谷郡倭館面錦舞山
Kinzandô	朝鮮慶尙北道漆谷郡倭館面錦山洞
Kiyosue	山口縣豐浦郡淸末村
Kôbôdani	高知縣長岡郡新改村入野弘法谷
Komô	德島縣那賀郡古毛
Kôsan	朝鮮忠淸南道扶余郡鴻山面上川里
Kôsei Coal-mine	朝鮮平安南道江西郡東津面江西炭坑
Kosyurihama	宮城縣本吉郡大島村コシュリハマ
Kowasimizu	福井縣足羽郡下宇坂村小和淸水
Koyatori	宮城縣牡鹿郡大原村小屋取
Kuruma	長野縣北安曇(アヅミ)郡北小谷(オタリ)村來馬
Kusaigawa	山口縣豐浦郡田合村草井川
Kuwasima	石川縣能美郡白峯村桑島
Kuzi	岩手縣九戸郡久慈
Kwankadô	朝鮮慶尙北道星州郡船南面官花洞

M

Maesaka	福井縣大野郡下穴馬村前坂
Massaki	宮城縣氣仙郡末崎村
Meigan	朝鮮忠淸南道保寧郡大川面鳴岩
Michiichi = Mitiiti	
Mitiiti	山口縣美禰郡豐東村道市
Mizutani	和歌山縣有田郡湯淺町水谷
Myongham = Meigan	
Mominoki	山口縣美禰郡豐東村樅ノ木
Momonoki	山口縣美禰郡大嶺村桃ノ木
Mosi	岩手縣下閉伊郡小本村茂師
Motiana	福井縣大野郡上穴馬村持穴

N

Naedong = Nairi	
Nagano	福井縣大野郡上穴馬村長野
Naibuti-gawa	樺太內淵川
Nairi	朝鮮平安南道大同郡西川面內里
Namikawa	樺太豐原郡豐原町並川
Nampo = Rampo	
Nanami	山口縣豐浦郡岡枝村七見
Nariwa	岡山縣川上郡成羽町
Neietu	朝鮮江原道寧越郡
Neiridani	富山縣下新川郡市振村寢入谷
Nisi-Nakayama	山口縣豐浦郡豐田下村西中山
Nisinotani	高知縣長岡郡新改村西ノ谷
Notino	福井縣大野郡下穴馬村後野

O

Okamigô	岐阜縣大野郡莊川村尾上鄉
Okukawakami	樺太豐原郡奧川上
Omoto	岩手縣下閉伊郡小本
Oriki	福島縣雙葉郡廣野村折木
Ôsima	宮城縣本吉郡大島村
Ôtani	高知縣長岡郡岡豐(オコー)村大谷
Ôtomen Coal-mine	朝鮮慶尙南道河東郡王東面炭坑
Outi	山口縣豐浦郡淸末村阿內
Ôyagawa	宮城縣牡鹿郡大原村大谷川

Ozigase	山口縣美禰郡大嶺村祖父ヶ瀬
Ozô	石川縣能美郡尾口村尾添

P

Paju = Hasyû	
Pommosiri	北海道石狩國空知郡奔茂尻
Pul-tan-kokai = Butudôken	

R

Rakusandô	朝鮮慶尙北道漆谷郡枝川面樂山洞
Rakutô	朝鮮慶尙北道尙州郡洛東
Rampo	朝鮮忠淸南道保寧郡藍浦
Renkadô	朝鮮慶尙北道漆谷郡枝川面蓮花洞
Renkari	朝鮮江原道寧越郡上東面蓮下里
Rensen	朝鮮京畿道漣川郡
Rokumambô	山口縣豐浦郡豐東村六萬坊
Roseiri	朝鮮平安南道大同郡
Ryûsindô	朝鮮慶尙北道星州郡船南面龍新洞
Ryûzyôdô	朝鮮慶尙北道永川郡北安面柳上洞

S

Sakamoto	德島縣勝浦郡棚野村坂本
Saradô	朝鮮慶尙北道漆谷郡倭館面紗羅洞
Shimamnra = Kuwasima	
Shitaka = Sitaka	
Simoyama	福井縣大野郡下穴馬村下山
Sindasawa	福島縣相馬郡石神村信田澤
Sindô	朝鮮慶尙北道漆谷郡枝川面新洞
Sinkô	朝鮮咸鏡南道新興郡東古川面仁興里
Sinsyû	朝鮮慶尙南道晋州郡晋州
Sitaka	京都府加佐郡丸八江村志高
Sizugawa	宮城縣本吉郡志津川
Syurihama	宮城縣本吉郡大島村シュリハマ

T

Taihô Coal-mine	朝鮮平安南道大同郡大寶炭坑
Takazi	山口縣豐浦郡淸末村高知峠
Takata	和歌山縣有田郡湯淺町高田
Takinosiri	宮城縣本吉郡大島村タキノシリ
Tanimura	福井縣大野郡北谷村谷
Tanno	德島縣勝浦郡棚野村棚野
Tanohata-mura	岩手縣下閉伊郡田野畑村
Tanzaki	和歌山縣有田郡湯淺町丹崎

Tarai	山口縣豐浦郡豐田下村手洗
Tasseidô	朝鮮慶尙北道漆谷郡枝川面達西洞
Tennôhama	和歌山縣有田郡湯淺町天皇濱
Toba	三重縣度會郡鳥羽町
Togadani	石川縣能美郡尾口村鴇ケ谷
Tôgôdani	高知縣長岡郡上倉村東郷谷
Tomudô	朝鮮慶尙北道漆谷郡倭館面杜霧洞
Tongzin = Tûsin	
Toriken	朝鮮慶尙北道星州郡聖巖面杜里峴
Torikubi	高知縣長岡郡上倉村八京附近鳥首
Tôtôri	朝鮮慶尙北道漆谷郡枝川面陶唐里
Tubuta	山口縣厚狹郡生田村津布田
Tûsin	朝鮮京畿道金浦郡月串面高陽里通津
Tyôha	朝鮮咸鏡南道豐山郡天南面長坡里
Tyôzairi	朝鮮慶尙南道晋州郡道洞面長在里
Tyôzya	高知縣高岡郡長者村長者

U

Ueno	高知縣長岡郡久禮田村植野
Usimaru	岐阜縣大野郡莊川村牛丸
Utasinai-gawa	北海道石狩國空知郡歌志內川
Utinami	福井縣大野郡五箇村打波

W

Wenhorokabetu	北海道石狩國夕張郡夕張町ウエンホロカベツ
Wonhyon = Inken	

Y

Yakyô	高知縣長岡郡上倉村八京
Yamanoi	山口縣厚狹郡出合村山野井
Yambara	福井縣大野郡下穴馬村山原
Yanagidani	石川縣能美郡白峯村柳谷
Yatuzi	高知縣高岡郡北原村谷地
Yoroizaki	宮城縣本吉郡大島村ヨロヒザキ
Yosidayasiki	高知縣高岡郡佐川町吉田屋敷
Yuasa	和歌山縣有田郡湯淺町
Yûbari	北海道石狩國夕張
Yunotani	石川縣能美郡白峯村湯ノ谷

Z

Zindô	朝鮮慶尙北道漆谷郡仁洞面仁洞
Zizindô	朝鮮慈仁洞 (詳細不明)
Zusahara	福島縣相馬郡上眞野村椿原

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Figs. 1, 1a. *Otozamites Sewardi* sp. nov. Simoyama. Tetori Series. (T. S. M. Coll.).

Fig. 2. *Otozamites Klipsteinii* (DKR.). Takazi. Kiyosue Group. (Tôkyô Coll.).

Figs. 3, 3a, 4. *Otozamites Molinianus* ZIGNO. Neiridani. Kuruma Bed. (Fig. 3, Reg. No. 8561; Fig. 4, Reg. No. 8563).

Plate XXXII

Figs. 1, 1a, 2. *Ptilophyllum pecten* (PHILL.). Photographs of YOKOYAMA's original specimens of *Nilssonia pterophylloides* YOK. (YOKOYAMA, 1894, Pl. XXII, figs, 10 and 8 respectively).

Fig. 3. *Ptilophyllum pecten* (PHILL.). Kaisekiyama. Ryôseki Series. (Reg. No. 8490).

Fig. 4. *Ptilophyllum pecten* (PHILL.). Takazi. Kiyosue Group. (Reg. No. 8498).

Fig. 5. *Ptilophyllum pecten* (PHILL.). Ôyagawa. Ogihama Series. (Reg. No. 8891).

Fig. 6. *Ptilophyllum pecten* (PHILL). Nisinotani. Ryôseki Series. (Reg. No. 8505).

Plate XXXIII

Fig. 1. *Ptilophyllum pachyrachis* sp. nov. Motiana. Tetori Series. (Reg. No. 8485).

Fig. 2. *Pseudocycas ? acutifolia* sp. nov. Kuwasima. Tetori Series. (Reg. No. 8578).

Figs. 3, 3a. *Pseudocycas ? acutifolia* sp. nov. Kowasimizu. Tetori Series. (Reg. No. 89).

Fig. 4, 4a. *Pterophyllum Lyellianum* DKR.? Kuwasima. Tetori Series. (Reg. No. 8481).

Plate XXXIV

Figs. 1, 2, 3. *Ptilophyllum pachyrachis* sp. nov. Motiana. Tetori Series. (Reg. No. 8485).

Fig. 4. Cfr. *Nilssonia tenuicaulis* (PHILL.). Kuruma. Kuruma Bed. (Sendai Coll. Reg. No. 8163).

Fig. 5. Cfr. *Zamites megaphyllus* (PHILL.). Ôsima. Ôsima Plant Beds. (Sendai Coll. Reg. No. 22055).

Plate XXXV

Fig. 1. *Ptilophyllum pecten* (PHILL.). Hiromura. Ryôseki Series. (Reg. No. 8892).

Fig. 2. *Ptilophyllum* sp. Outi. Kiyosue Group. (Reg. No. 8558).

Fig. 3. *Ptilophyllum pecten* (PHILL.). Kami Mano-mura. Ryôseki Series. (Sendai Coll. Reg. No. 59622).

Figs. 4, 4a. *Zamites tosanus* sp. nov. Kôbôdani. Ryôseki Series. (Reg. No. 8596).

Plate XXXVI

Fig. 1. Cfr. *Zamites Feneonis* BRONGN. Ôsima. Ôsima Plant Beds. (Sendai Coll. Reg. No. 22117).

Figs. 2, 2a. *Williamsonia* sp. cfr. *W. Whitbiensis* NATH. Ôsima. Ôsima Plant Beds. (Sendai Coll. Reg. No. 22118).

Plate XXXVII

Figs. 1, 2. *Sagenopteris petiolata* sp. nov. Rokumambô. Kiyosue Group. (Reg. No. 8511).

Fig. 3. *Sagenopteris Nilssoniana* (BRONGN.). Neiridani. Kuruma Bed. (Reg. No. 8559).

Fig. 4. *Cycadolepis kiiensis* sp. nov. Tanzaki. Ryôseki Series. (Reg. No. 8592).

Fig. 5. *Cycadolepis kiiensis* sp. nov. Tennôhama. Ryôseki Series. (Reg. No. 8503).

Fig. 6. *Zamites Yabei* sp. nov. Maruyama near Nisi-Nakayama. Nisi-Nakayama Bed. (Sendai Coll. Reg. No. 6825).

Plate XXXVIII

Fig. 1. Cfr. *Zamites Feneonis* BRONGN. Kayanokibasi. Ryôseki Series. (Reg. No. 8607).

Fig. 2. *Cycadolepis oblongiformis* sp. nov. Tôgôdani. Ryôseki Series. (Reg. No. 8627).

Fig. 3. *Ginkgoidium gracile* TATEIWA. Toriken. Rakutô Bed. (G. S. K. Coll.).

Fig. 4. *Baiera Brauniana* (DKR.). Kôbôdani. Ryôseki Series. (Reg. No. 8462).

Fig. 5. *Baiera paucipartita* NATH. Momonoki. Momonoki Bed. (Sendai Coll.).

Fig. 6. *Ginkgoites adiantoides* (UNG.). Kawakami coal-mine. Urakawa Series. (Reg. No. 8893).

Fig. 7. *Ginkgoites digitata* (BRONGN.). Yanagidani. Tetori Series. (Reg. No. 8629).

Fig. 8. *Ginkgoites digitata* (BRONGN.). Kuwasima. Tetori Series. (Reg. No. 8507).

Fig. 9. *Ginkgoites digitata* (BRONGN.). Kowasimizu. Tetori Series. (Reg. No. 8482).

Fig. 10. *Ginkgoites digitata* (BRONGN.) var. *Huttoni* SEW. Kuwasima. (Reg. No. 8587).

Fig. 11. *Ginkgaites sibirica* (HR.). Takazi. Kiyosue Group. (Tôkyô Coll.).

Plate XXXIX

Fig. 1. *Ginkgoites sibirica* (HR.). Kuwasima. Tetori Series. (Reg. No. 8504).

Figs. 2, 4, 5. *Ginkgoidium Nathorsti* YOK. Kuwasima. Tetori Series. (Fig. 2, Reg. No. 8524; Fig. 4, Reg. No. 6475; Fig. 5, Reg. No. 8536).

Fig. 3. *Ginkgoidum Nathorsti* YOK. Kowasimizu. Tetori Series. (Reg. No. 92).

Figs. 6, 7. *Czekanowskia rigida* HR. Takazi. Kiyosue Group. (Reg. No. 8614).

Figs. 8, 9. *Araucarites cutchensis* FEIST. Takazi. Kiyosue Group. (Reg. No. 8894).

Figs. 10, 11. *Brachyphyllum expansum* (STERNB.). Takazi. Kiyosue Group. (Reg. No. 8615).

Fig. 12. *Elatocladus constricta* (FEIST.). Takazi. Kiyosue Group. (Tôkyô Coll.).

Plate XL

Fig. 2. *Frenelopsis Hoheneggeri* (ETT.). Reproduced from YABE (1922). Ôsima. Ôsima Plant Beds. (Sendai Coll.).

Figs. 3, 3a. *Frenelopsis Hoheneggeri* (ETT.). Ayukawa. Ayukawa Bed. (Reg. No. 8605).

Fig. 4. *Frenelopsis Hoheneggeri* (ETT.). A part of the specimen in Pl. XXX, fig. 2b. Ôsima. Ôsima Plant Beds. (Sendai Coll.).

Fig. 5. *Frenelopsis parceramosa* FONT. Hukodô. Taikyû Bed. (G. S. K. Coll.).

Figs. 1, 6, 6a, 8. *Frenelopsis parceramosa* FONT. Ryûzyôdô. 1, 6, 8, reproduced from TATEIWA (1929). Taikyû Bed. (G. S. K. Coll.).

Fig. 7. *Frenelopsis parceramosa* FONT. Gyoindô. Taikyû Bed. (G. S. K. Coll.).

Fig. 9. *Brachyphyllum expansum* (STERNB.). Takazi. Kiyosue Group. (Reg. No. 8496).

Plate XLI

Figs. 1, 1a. *Elatocladus obtusifolia* sp. nov. Kami Mano-mura. Ryôseki Series. (Sendai Coll.; Reg. No. 59620).

Figs. 2, 3. *Elatocladus constricta* (FEIST.). Takazi. Kiyosue Group. (Reg. No. 6820).

Fig. 4. *Elatocladus constricta* (FEIST.). Outi. Kiyosue Group. (Reg. No. 8610).

Fig. 5. *Elatocladus constricta* (FEIST.). A part of the specimen in Pl. XXXIX, fig. 12. Takazi. Kiyosue Group.

Figs. 6, 7. *Sagenopteris paucifolia* (PHILL.). Motiana. Tetori Series. (Reg. No. 8488).

Plate XLII

Figs. 1, 1a. *Cupressinocladus koyatoriensis* sp. nov. Koyatori. Ogihama Sedies. (Reg. No. 8606).

Fig. 2. *Brachyphyllum japonicum* (YOK.). Sindô. Rakutô Bed. (G. S. K. Coll.).

Figs. 3, 3a. *Brachyphyllum japonicum* (YOK.). Nisinotani. Ryôseki Series. (Reg. No. 8590).

Plate XLIII

Fig. 1. *Nageiopsis longifolia* FONT. Outi. Kiyosue Group. (Reg. No. 8611).

Fig. 2. *Nageiopsis longifolia* FONT.? Ôsima. Ôsima Plant Beds. (Sendai Coll. Reg. No. 22169).

Figs. 3, 3a. *Nageiopsis zamioides* FONT. Tanzaki. Ryôseki Series. (Reg. No. 8608).

Fig. 4. *Podozamites distantinervis* FONT. Outi. Kiyosue Group. (Tôkyô Coll.).

Plate XLIV

Figs. 1, 2, 3A. *Podozamites Reinii* GEYL. Kuwasima. Tetori Series. (Fig. 1, Reg. No. 85; Fig. 2, Reg. No. 8519; Fig. 3A, Reg. No. 8531).

Fig. 3B. *Nilssonia Kotoi* (YOK.). Kuwasima. Tetori Series. (Reg. No. 8531).

Figs. 4, 5. *Podozamites lanceloatus* (L. and H.). Kuwasima. Tetori Series. (Reg. No. 8520).

Fig. 6. *Podozamites lanceolatus* (L. and H.) subsp. *multinervis* TATEIWA. Renkadô. Rakutô Bed. (G. S. K. Coll.).

Plate XLV

Fig. 1. *Podozamites Reinii* GEYL. Kuwasima. Tetori Series. (Reg. No. 8627).

Fig. 2. *Stenorachis elegans* ÔISHI. Kusaigawa. Momonoki Bed. (Reg. No. 8499).

Figs. 3, 4, 4a, 5. *Aphlebia nervosa* sp. nov. Kowasimizu. Tetori Series. (Figs. 3, 4, Reg. No. 8483; Fig. 5, Reg. No. 8486).

Figs. 6, 6a. *Cycadocarpidium Swabii* NATH. Photographs of specimen in OZAWA, 1925, fig. 1; 1925a, Pl. I, fig. 10. Ozigase. Hirabara Bed.

Fig. 7. "*Geonoma*" *trinerve* sp. nov, ex IWAI (MS). Zusahara. Ryôseki Series. (Sendai Coll.).

Fig. 8. *Taeniopteris Inouyei* TATEIWA. Tomudô. Rakutô Bed.

Plate XLVI

Figs. 1, 2, 3, 3a. *Taeniopteris emarginata* sp. nov. Kuwasima. Tetori Series. (Fig. 1, Reg. No. 8512; Figs. 2, 3, Reg. No. 1813).

Fig. 4. *Taeniopteris Inouyei* TATEIWA. Tomudô. Rakutô Bed. (G. S. K. Coll.).

Plate XLVII

Figs. 1, 2, 2a. *Taeniopteris?* sp. cfr. *T. auriculata* (FONT.). Tôtôri. Kasandô Bed. (G. S. K. Coll.).

Figs. 3, 4, 5. *Sagenopteris inequilateralis* sp. nov. Tanzaki. Ryôseki Series. (Reg. No. 8886).

Figs. 6, 7, 8. *Adiantites yuasensis* YOK. Tanzaki. Ryôseki Series. (Reg. No. 8886).

Figs. 9, 10. "*Geonoma*" *trinerve* sp. nov., ex IWAI (MS). Parts of the specimen in Pl. XLV, fig. 7. Zusahara. Ryôseki Series.

Plate XLVIII

Fig. 1. *Cladophlebis denticulata* (BRONGN.). Kuwasima. Tetori Series. (Reg. No. 78).

Figs. 2, 2a. Cfr. *Aneimia fremonti* KNOWLTON. Asibetu. Urakawa Series. (Reg. No. 8895).

Figs. 3, 3a. *Tapeinidium ? undulatum* KNOWLTON. Asibetu. Urakawa Series. (Reg. No. 8896).

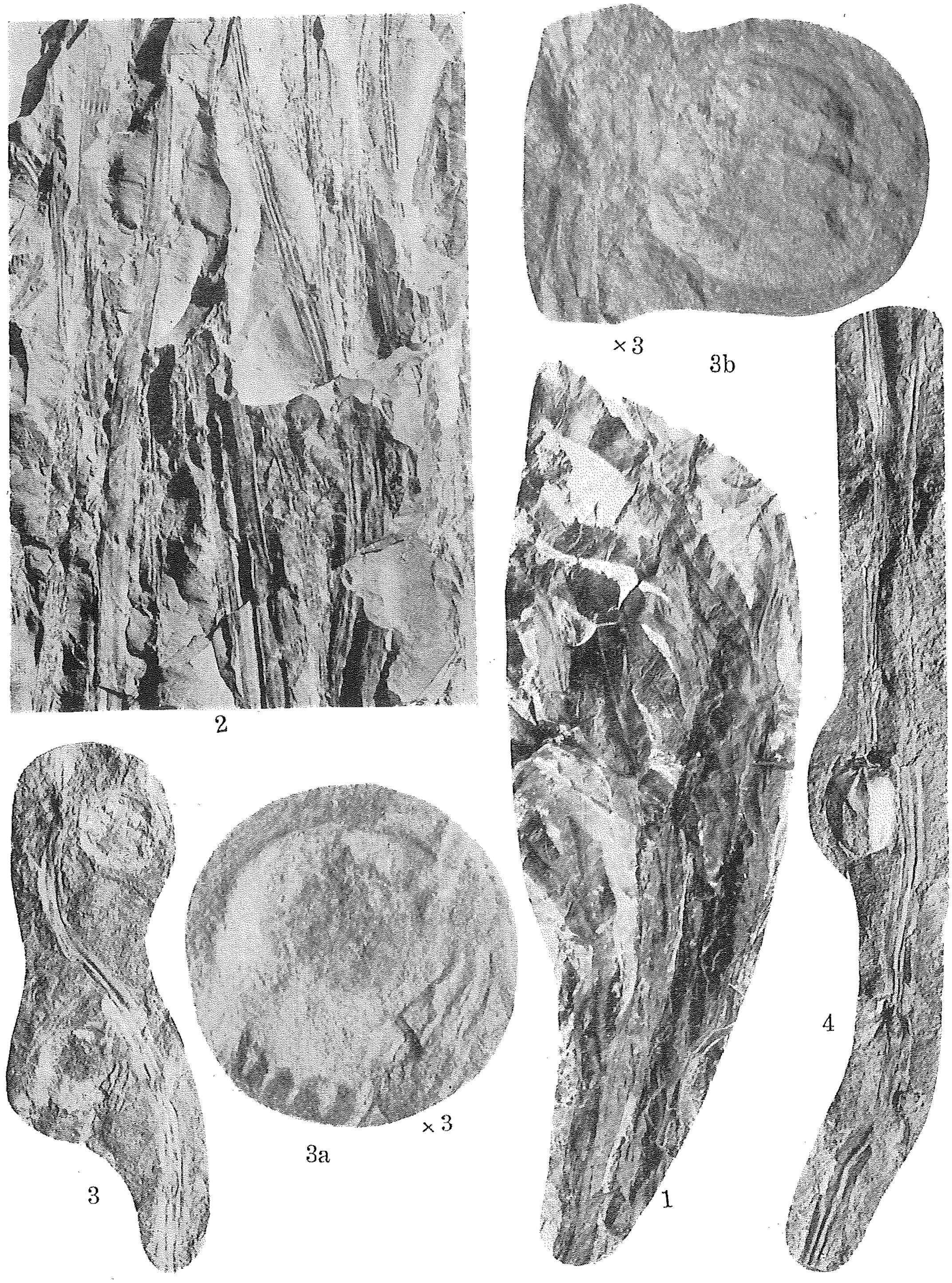
Figs. 4, 4a. *Phyllites* sp. Otani. Ryôseki Series. (Reg. No. 8897).

Fig. 5. *Adiantites yuasensis* YOK. Tanzaki. Ryôseki Series. (Reg. No. 8885).

Fig. 6. *Pseudocycas* ? sp. indet. Tomudô. Rakutô Bed. (G. S. K. Coll.).

Fig. 7. *Pachypteris* ? sp. indet. Nisinotani. Ryôseki Series. (Reg. No. 8583).

Fig. 8. *Trochodendroides arctica* (HR.). Asibetu. Urakawa Series. (Reg. No. 8898).



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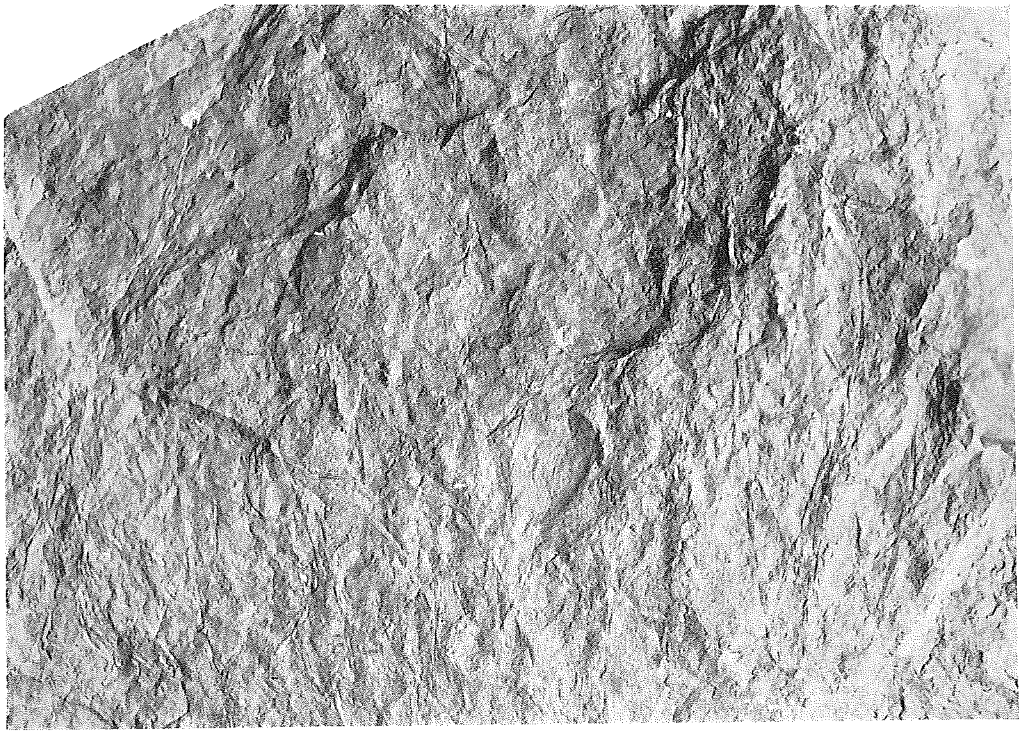

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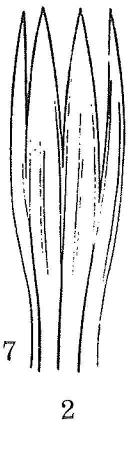

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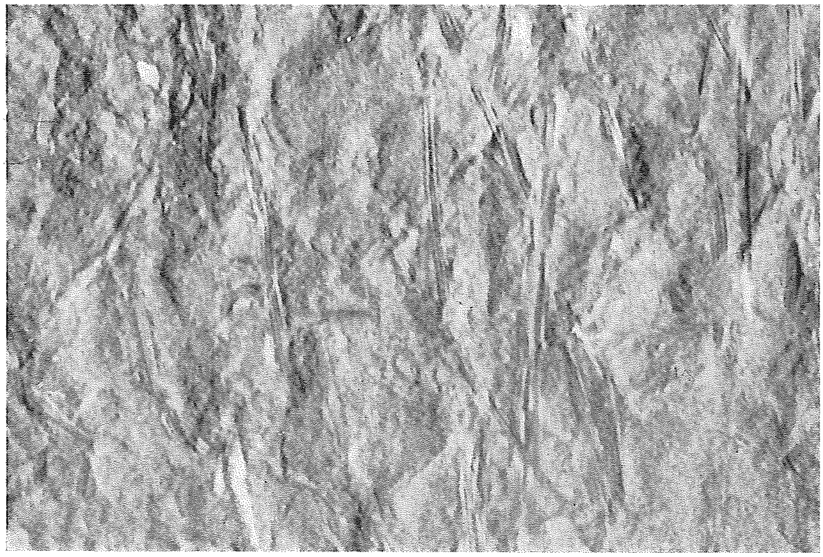

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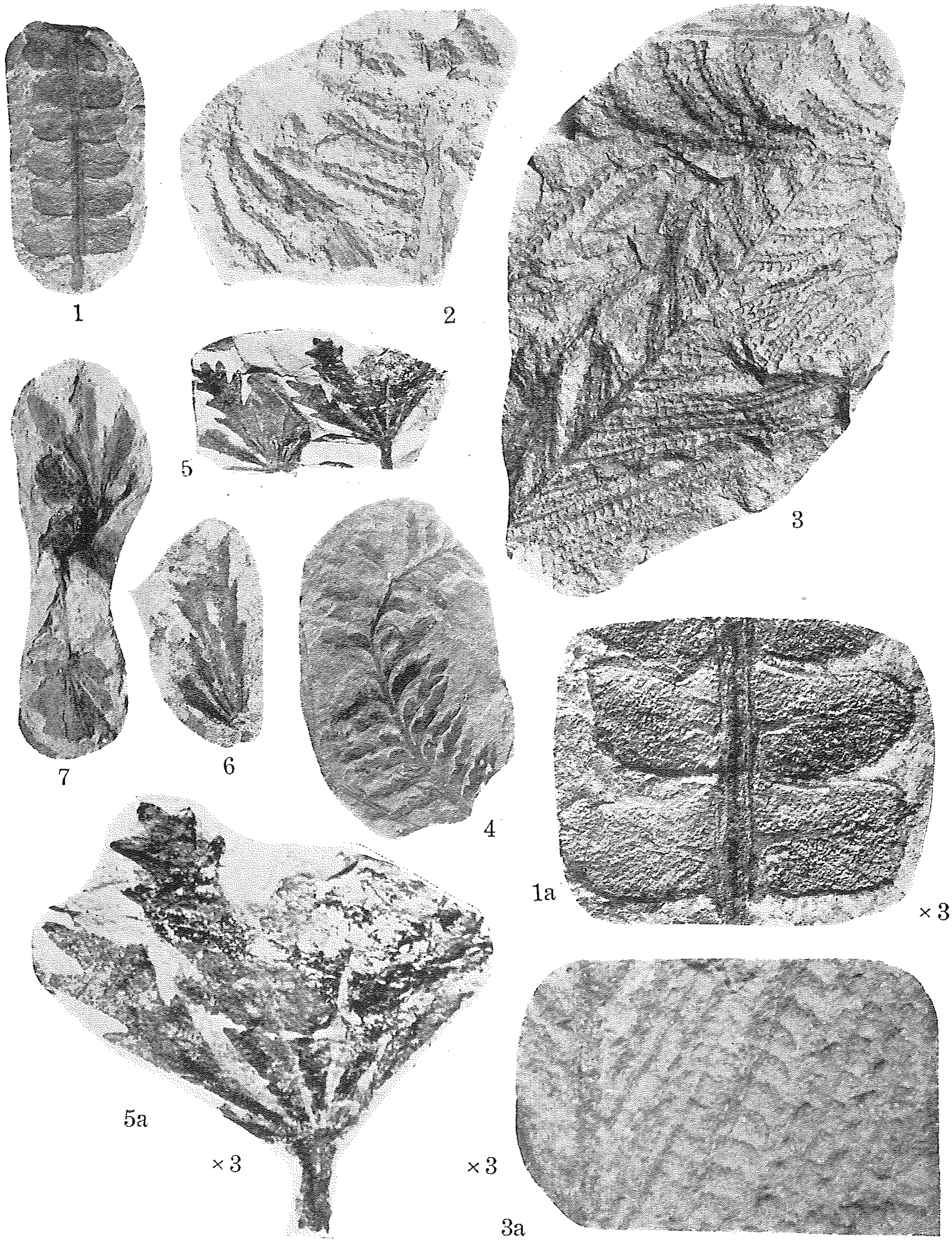

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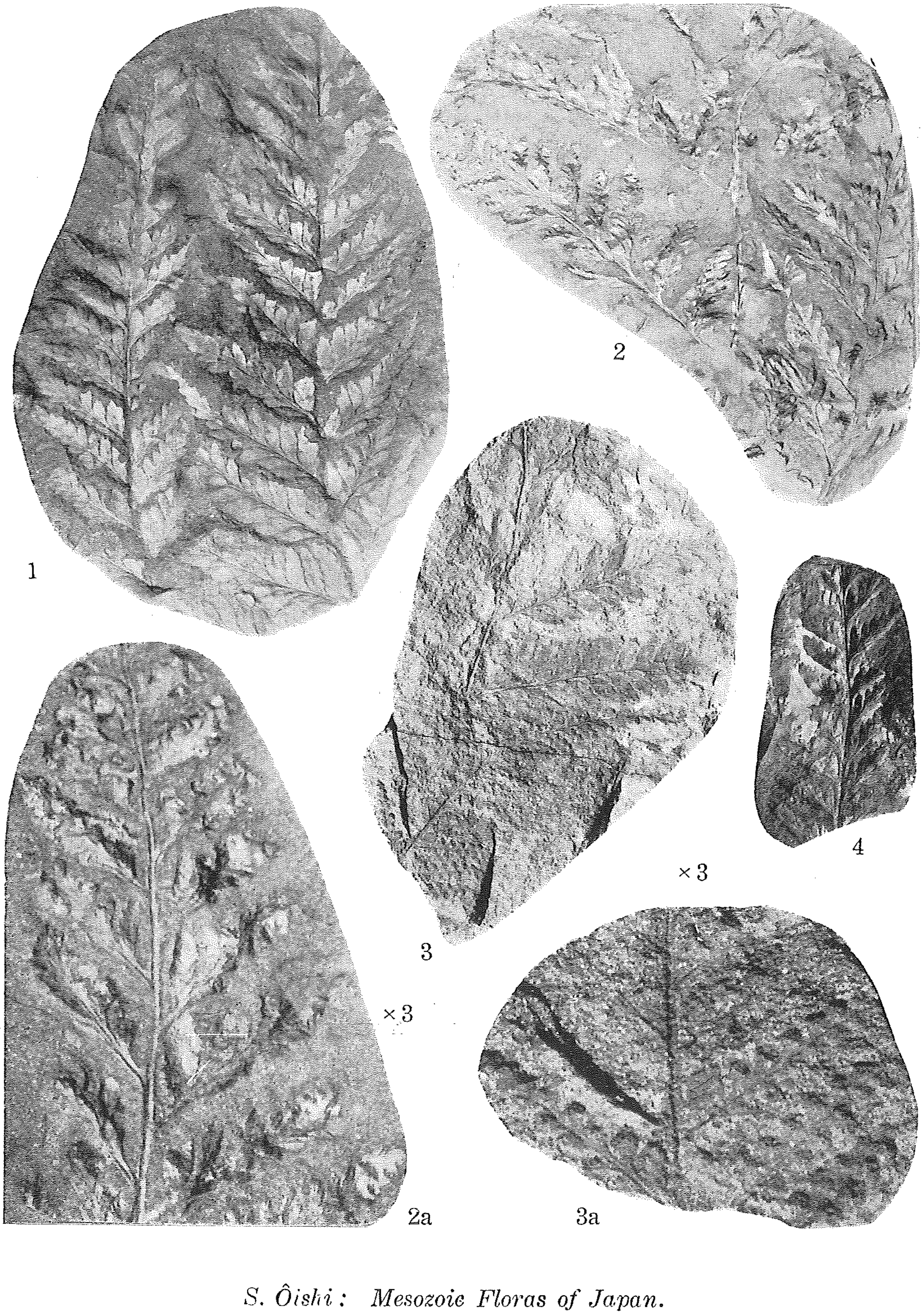

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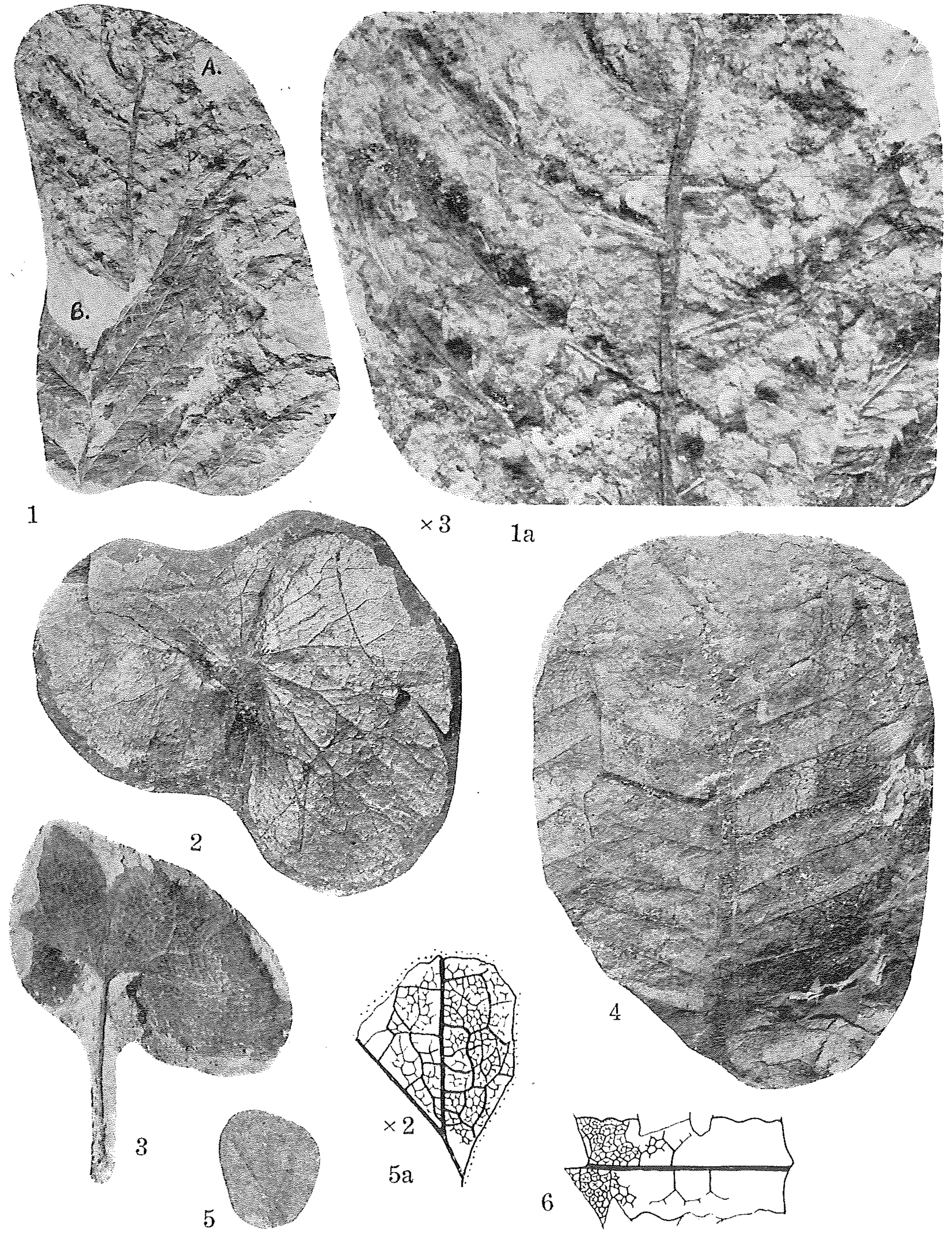

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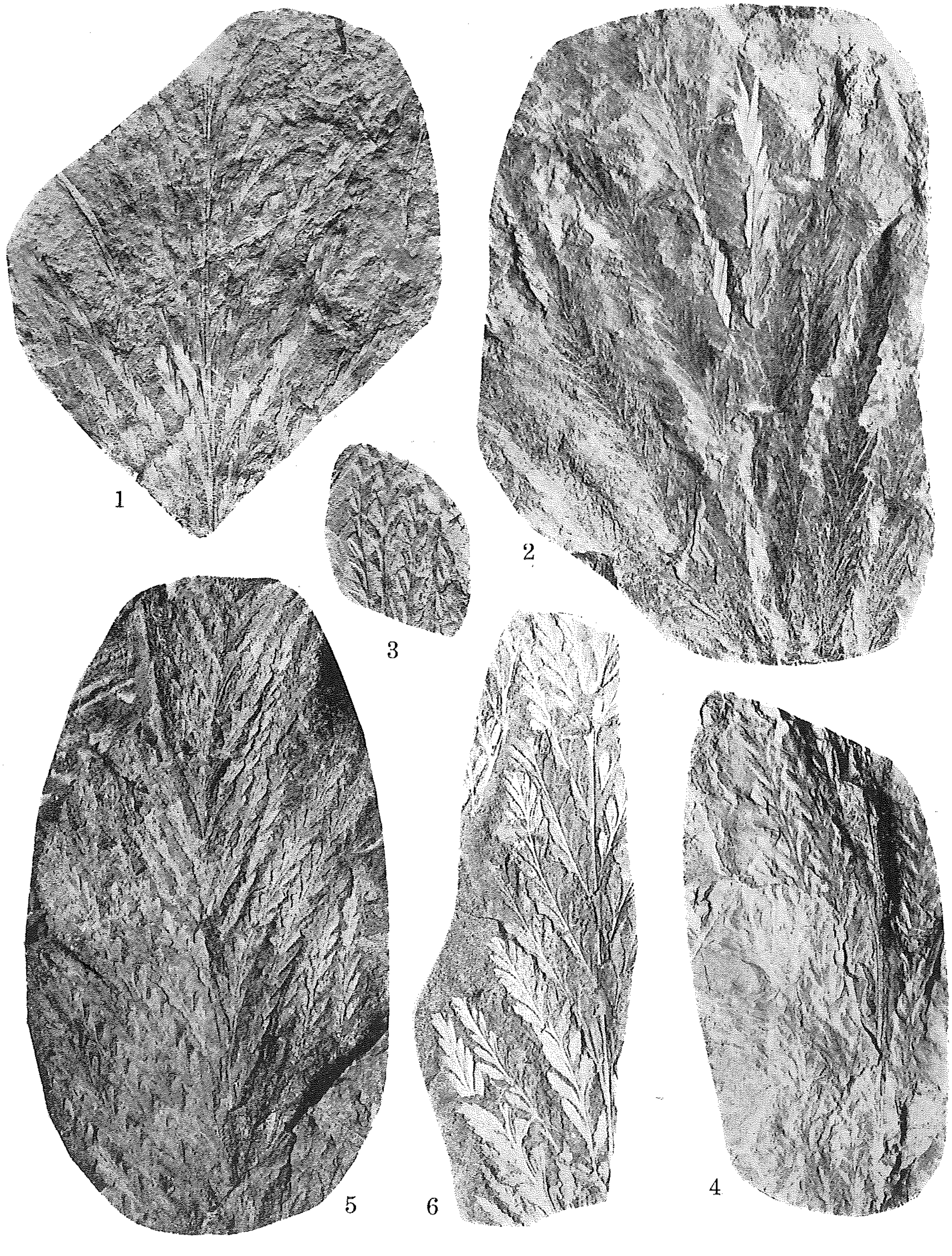

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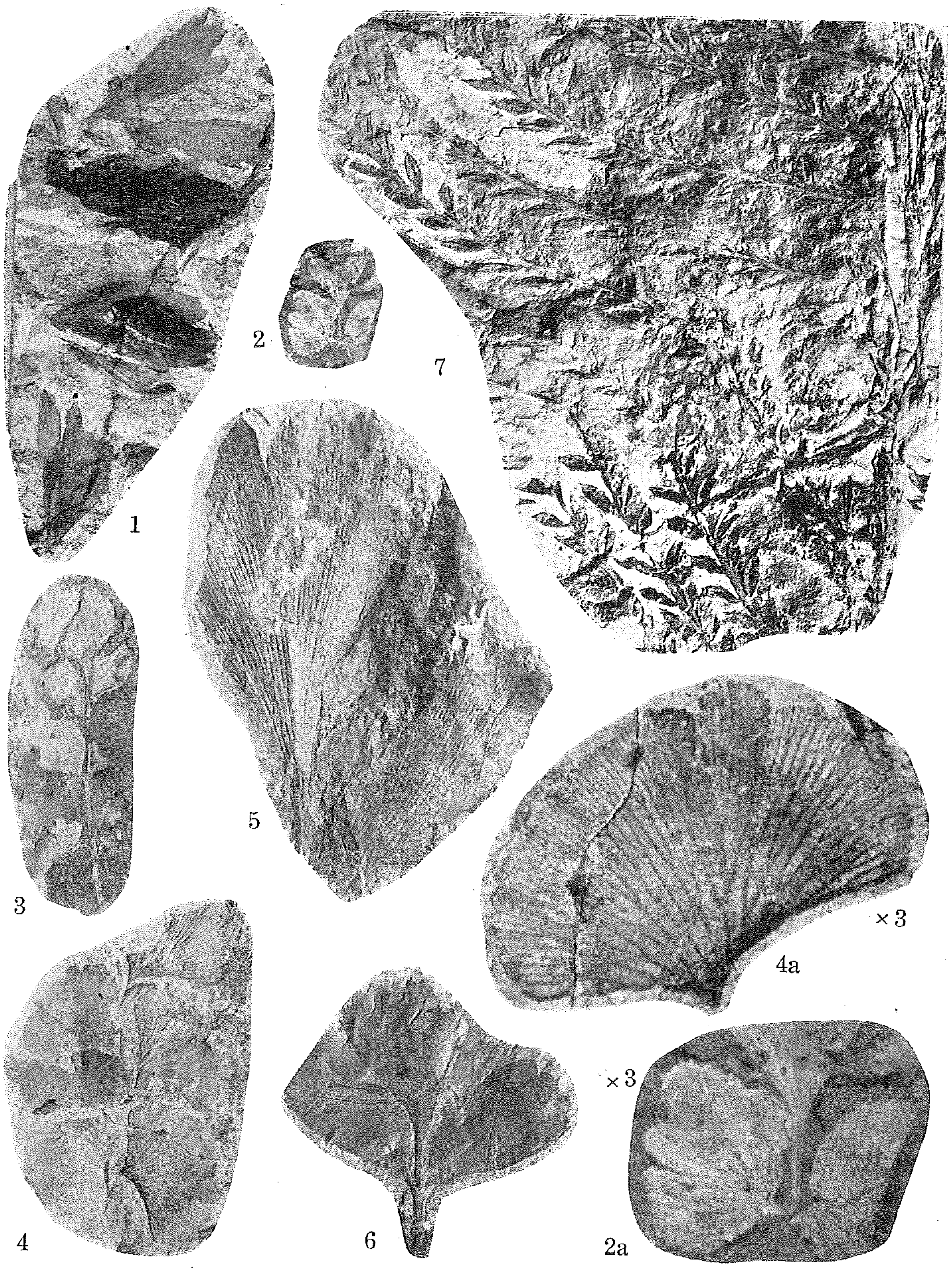

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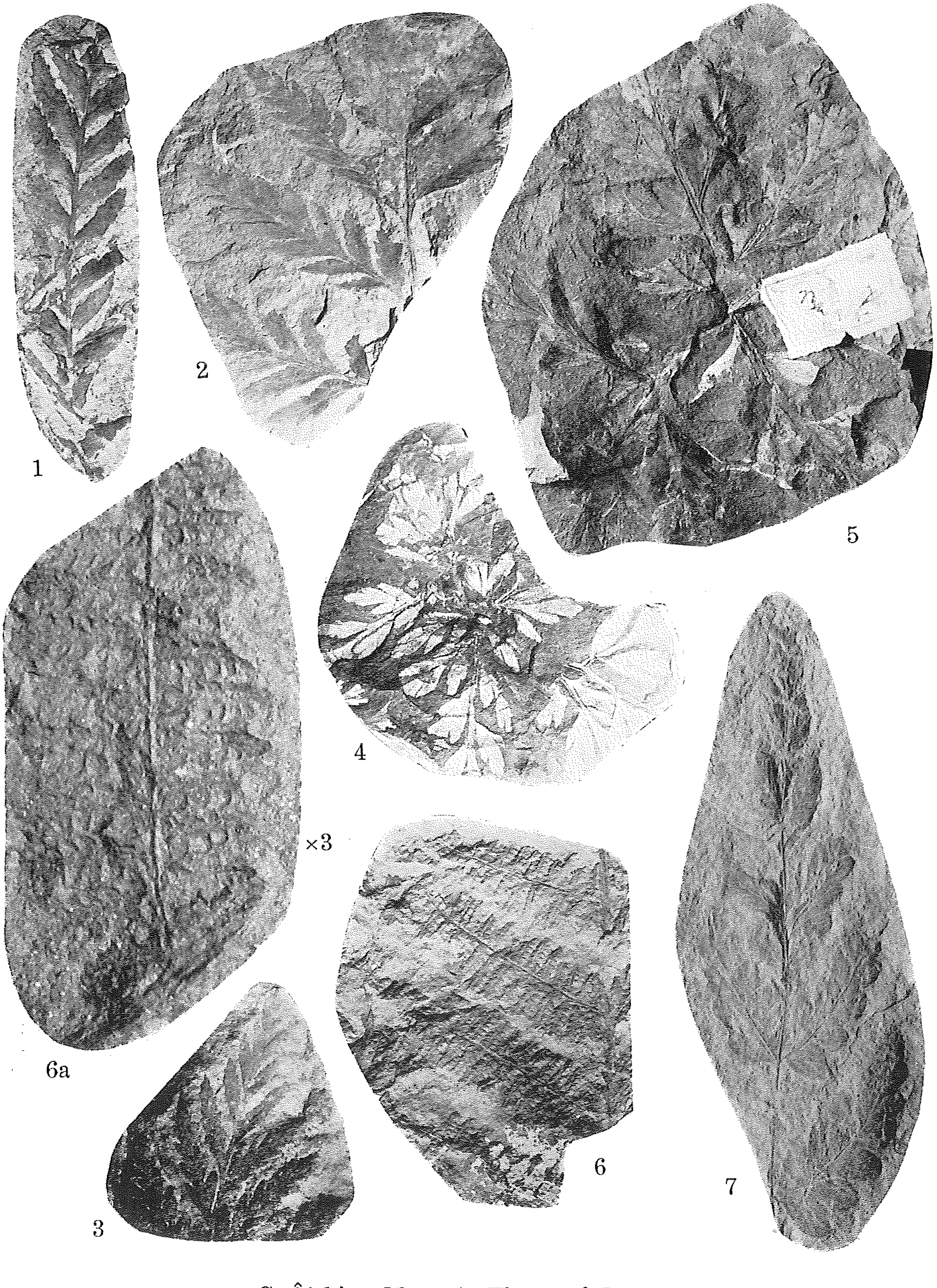

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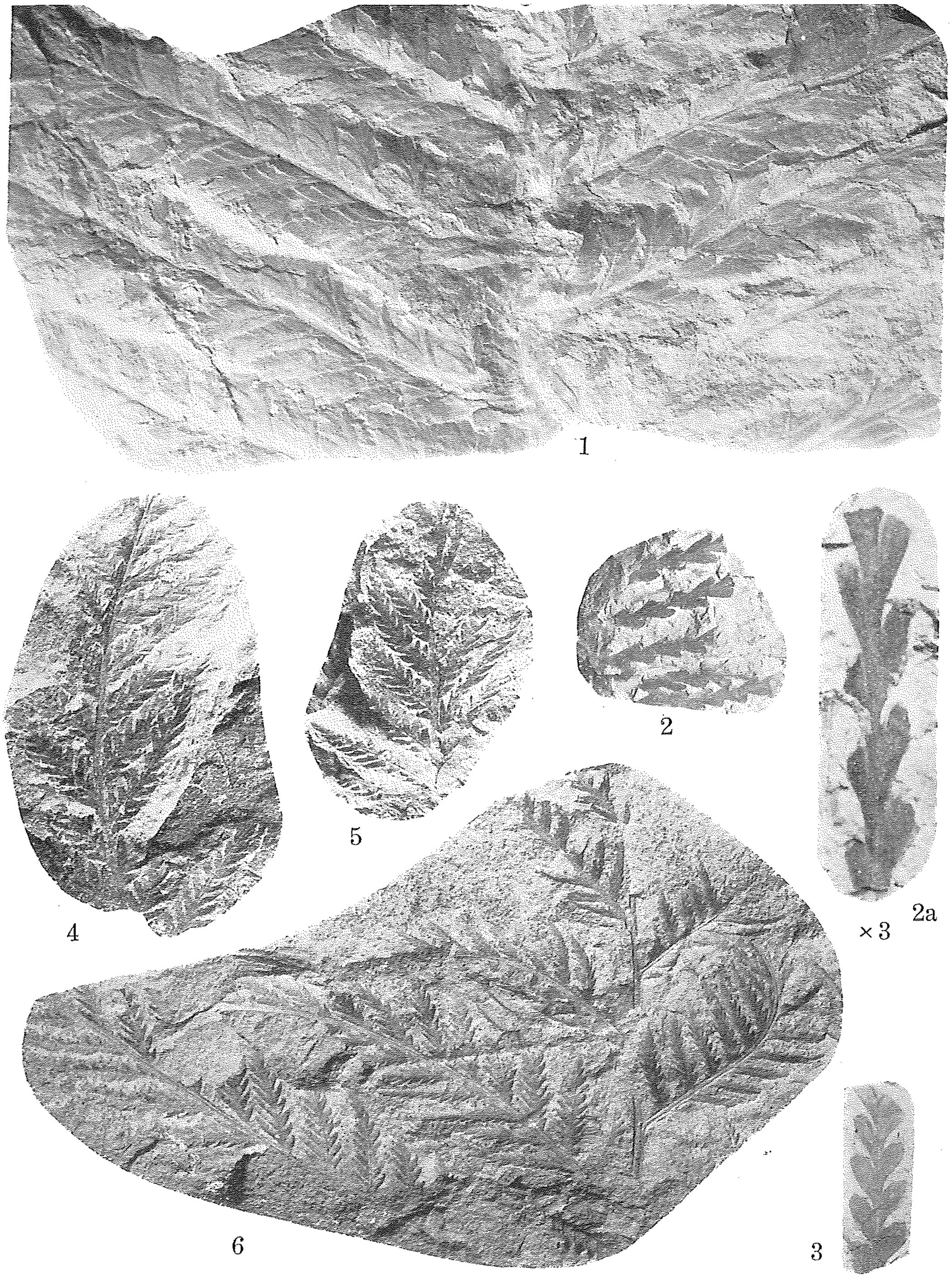

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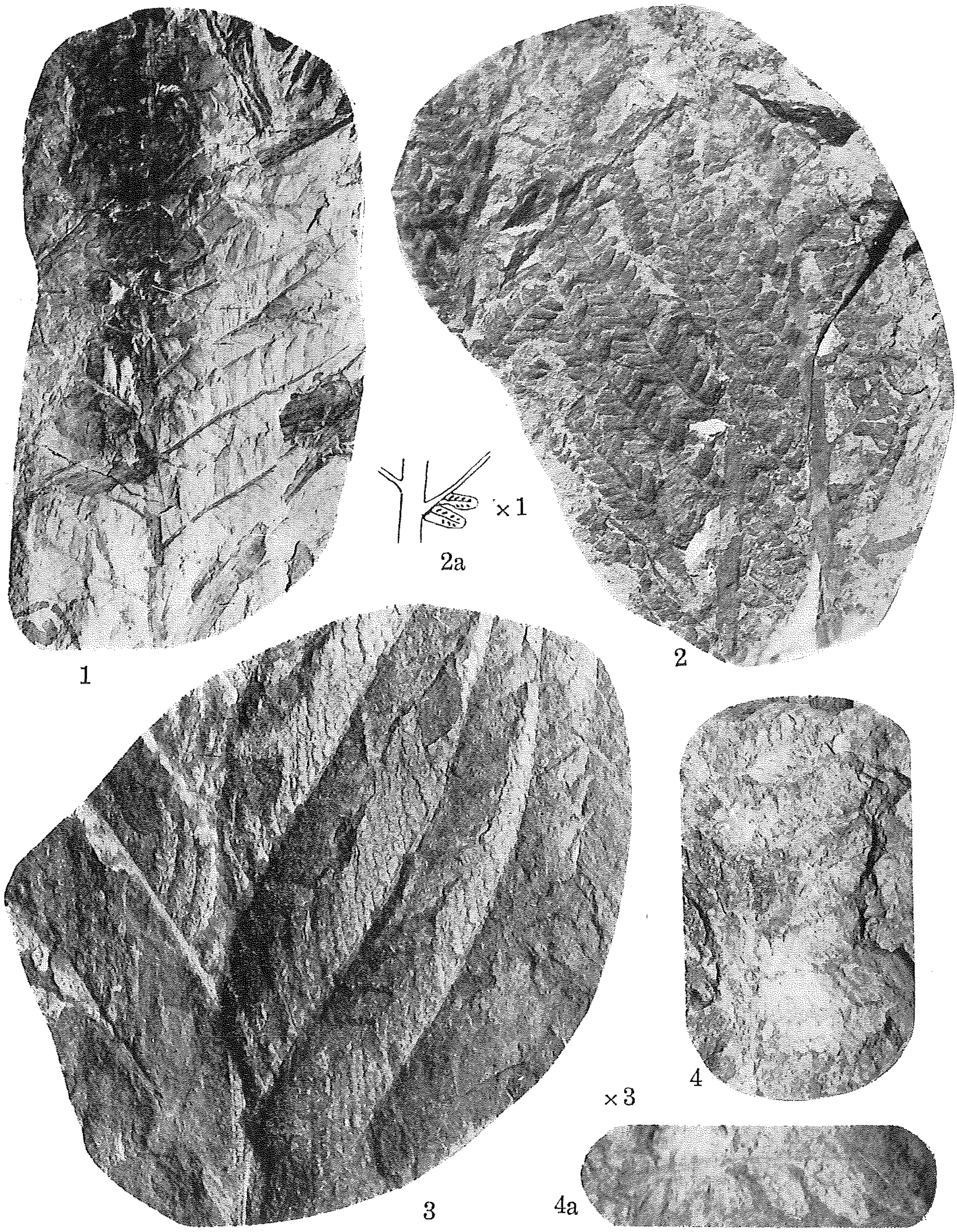

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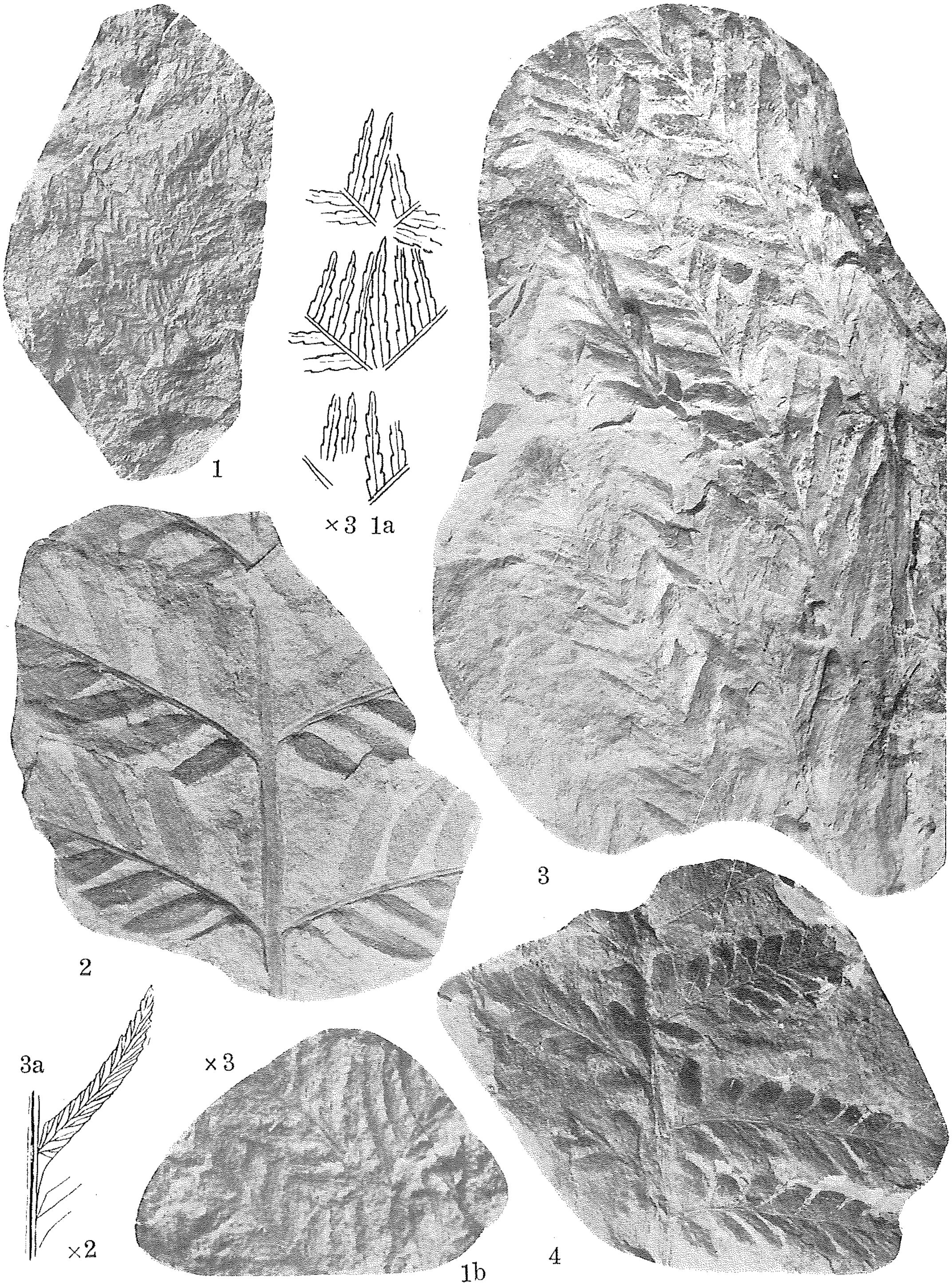

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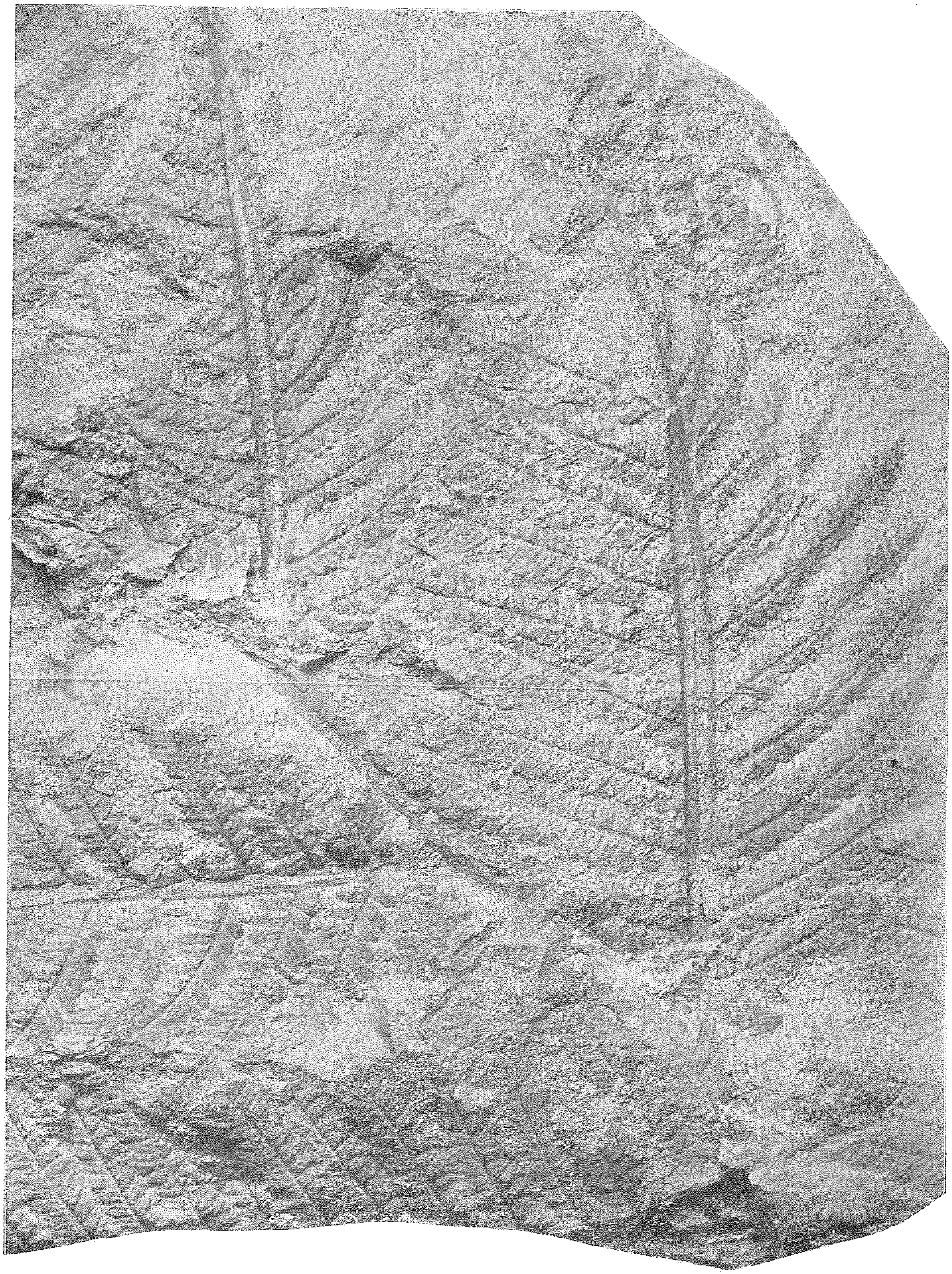

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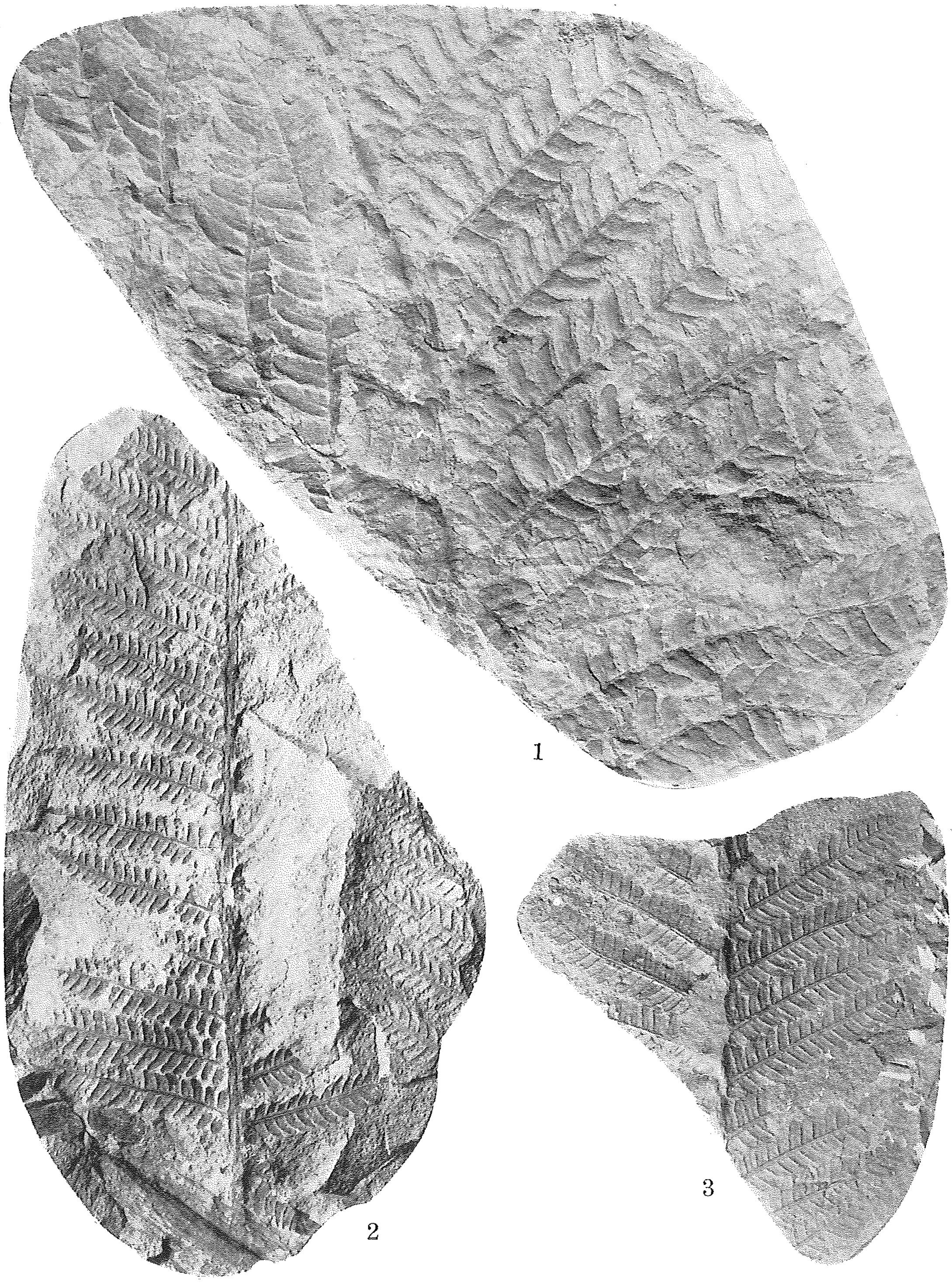

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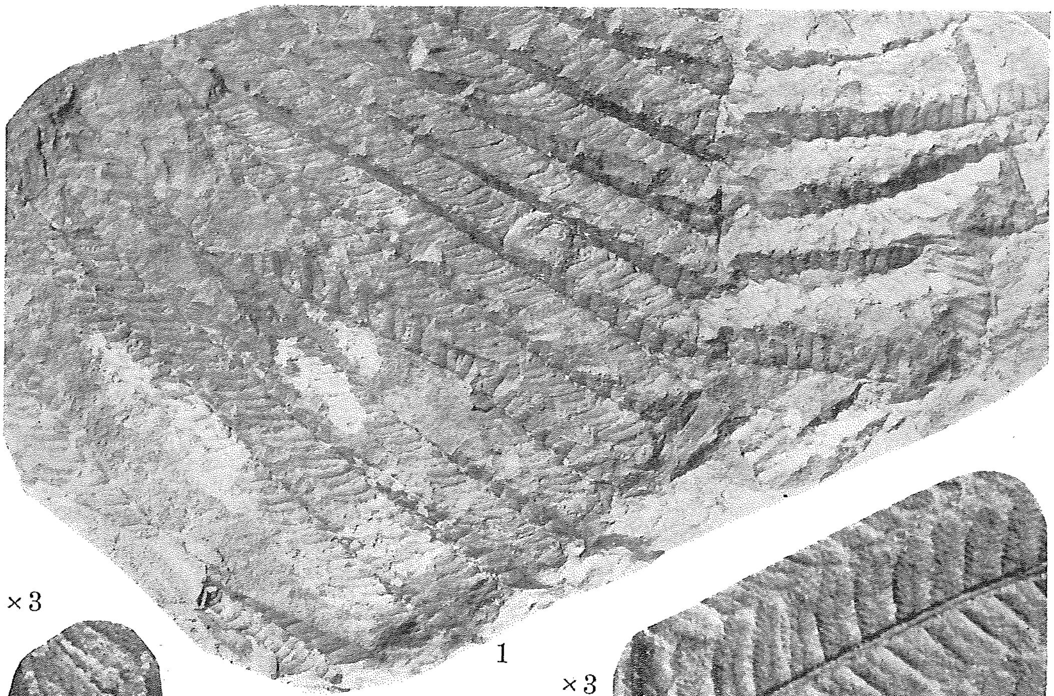
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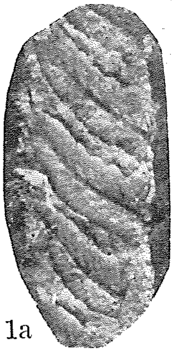
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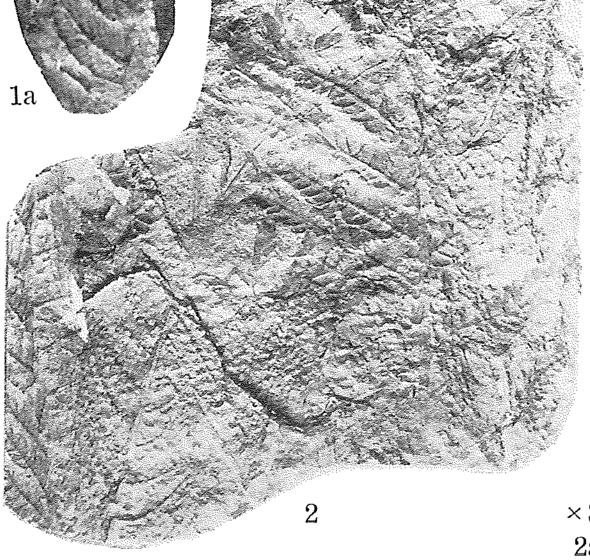
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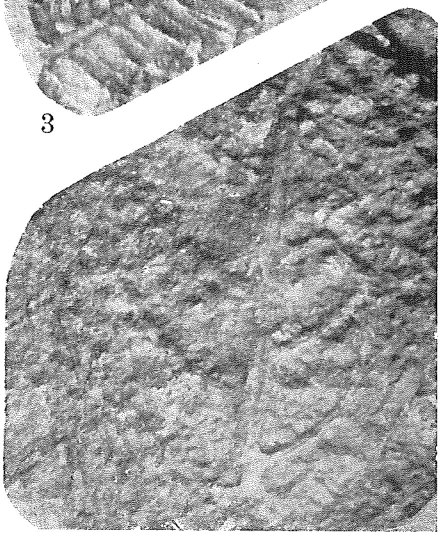
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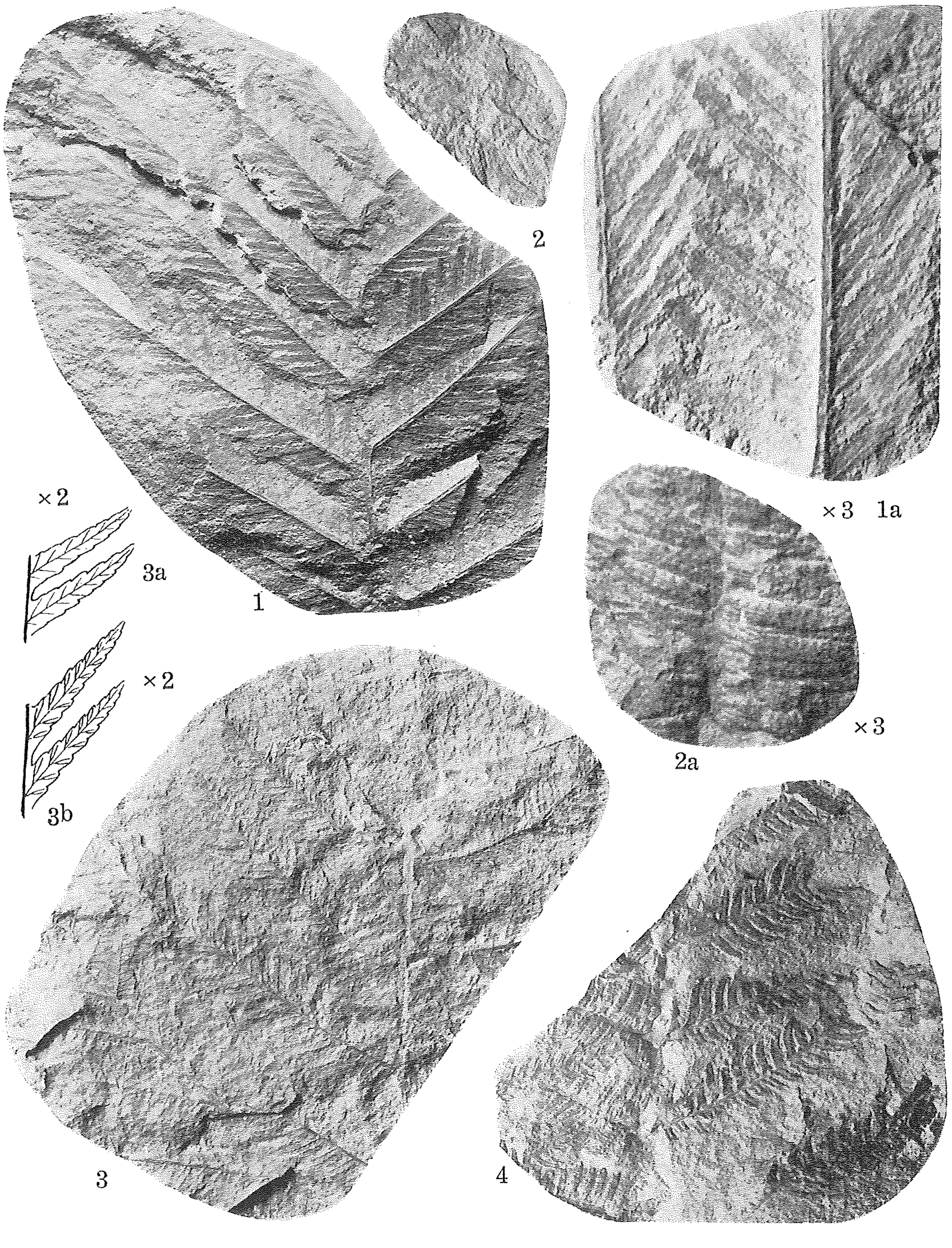

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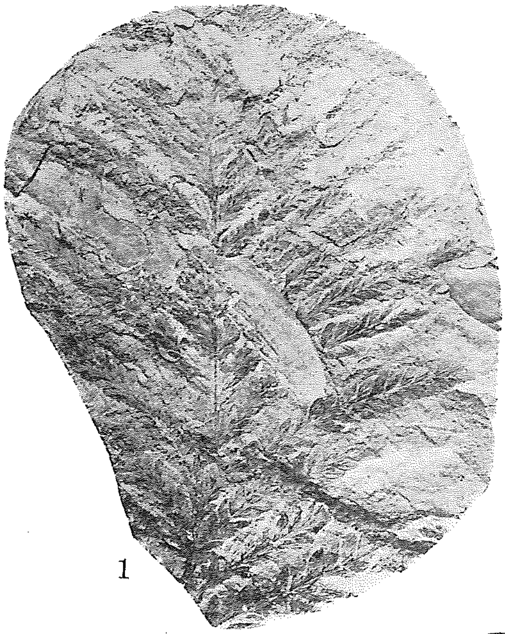

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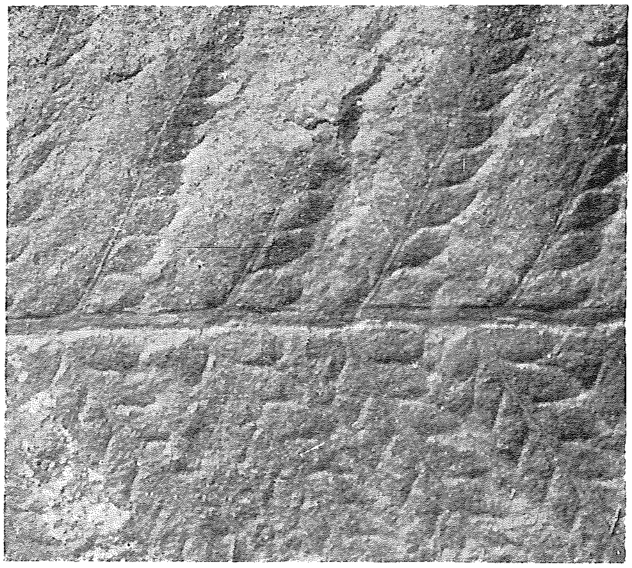

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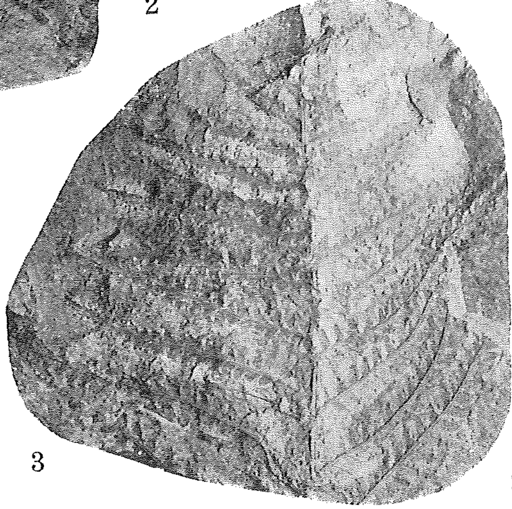

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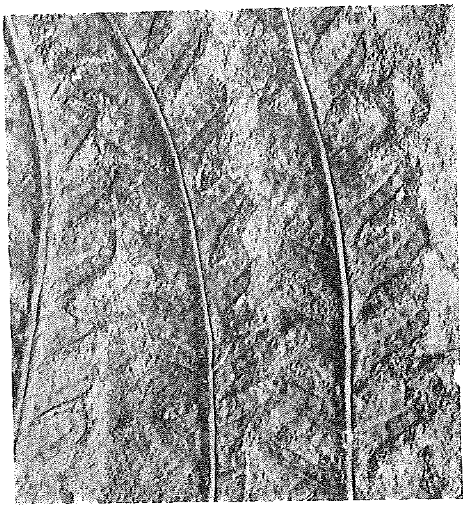

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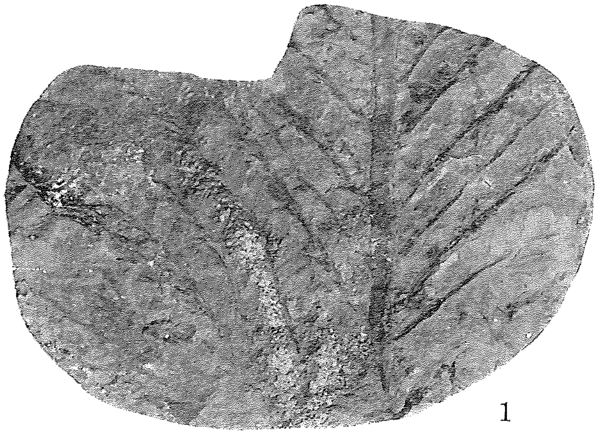

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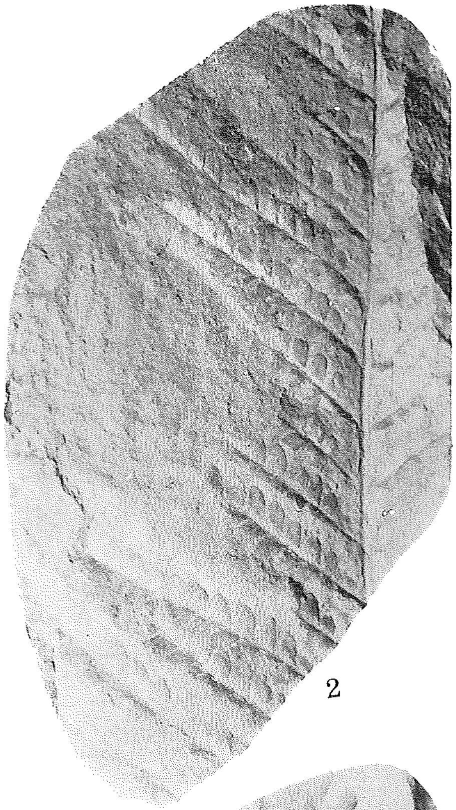

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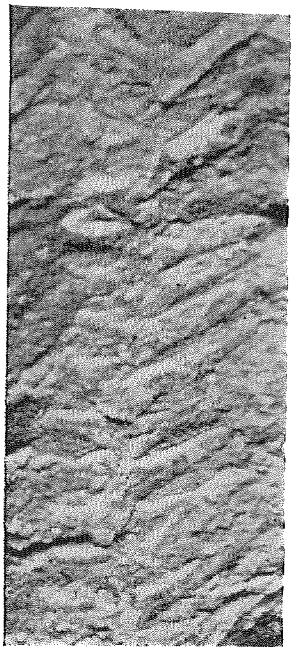

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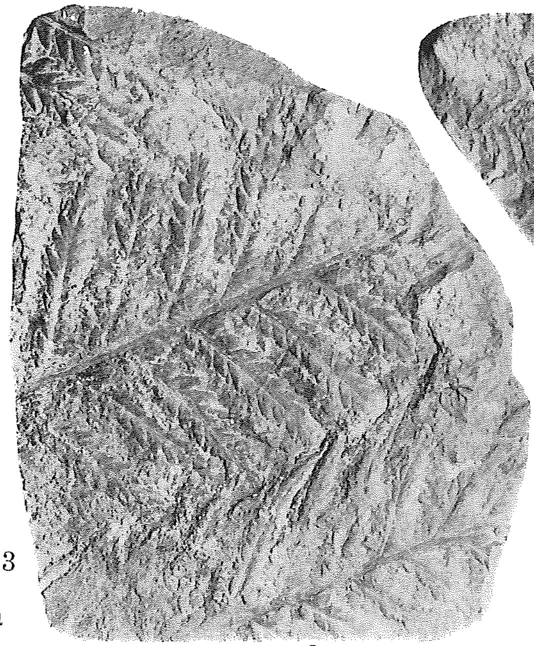

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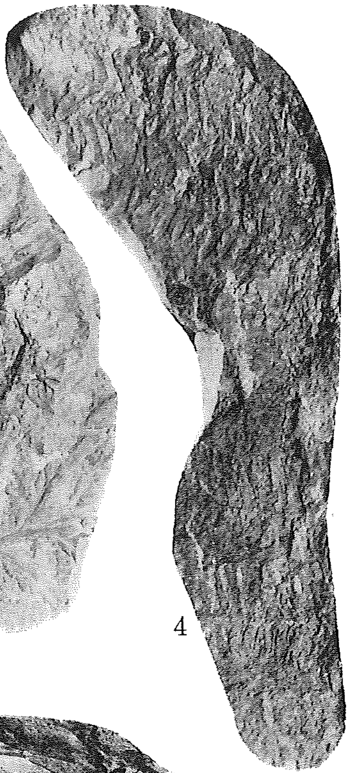

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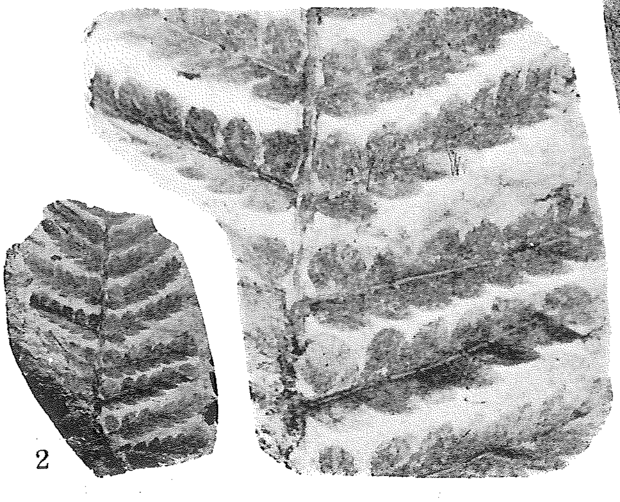

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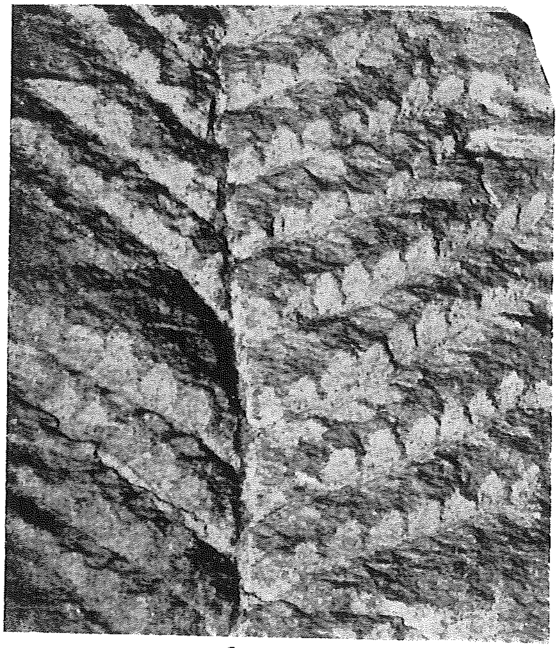

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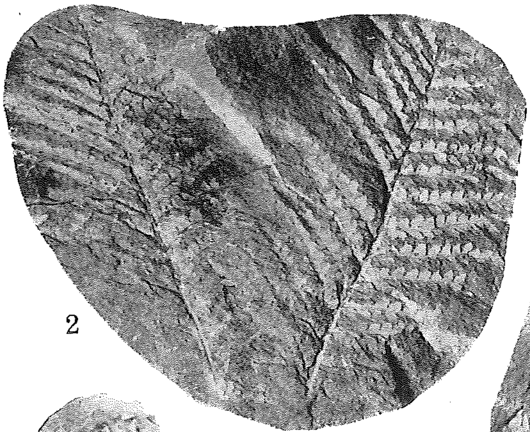

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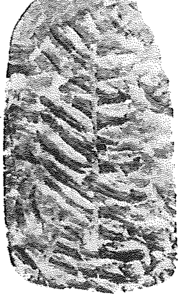

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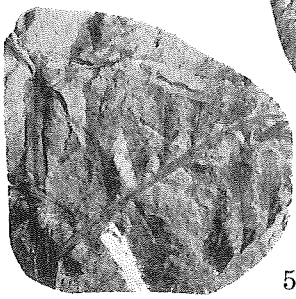

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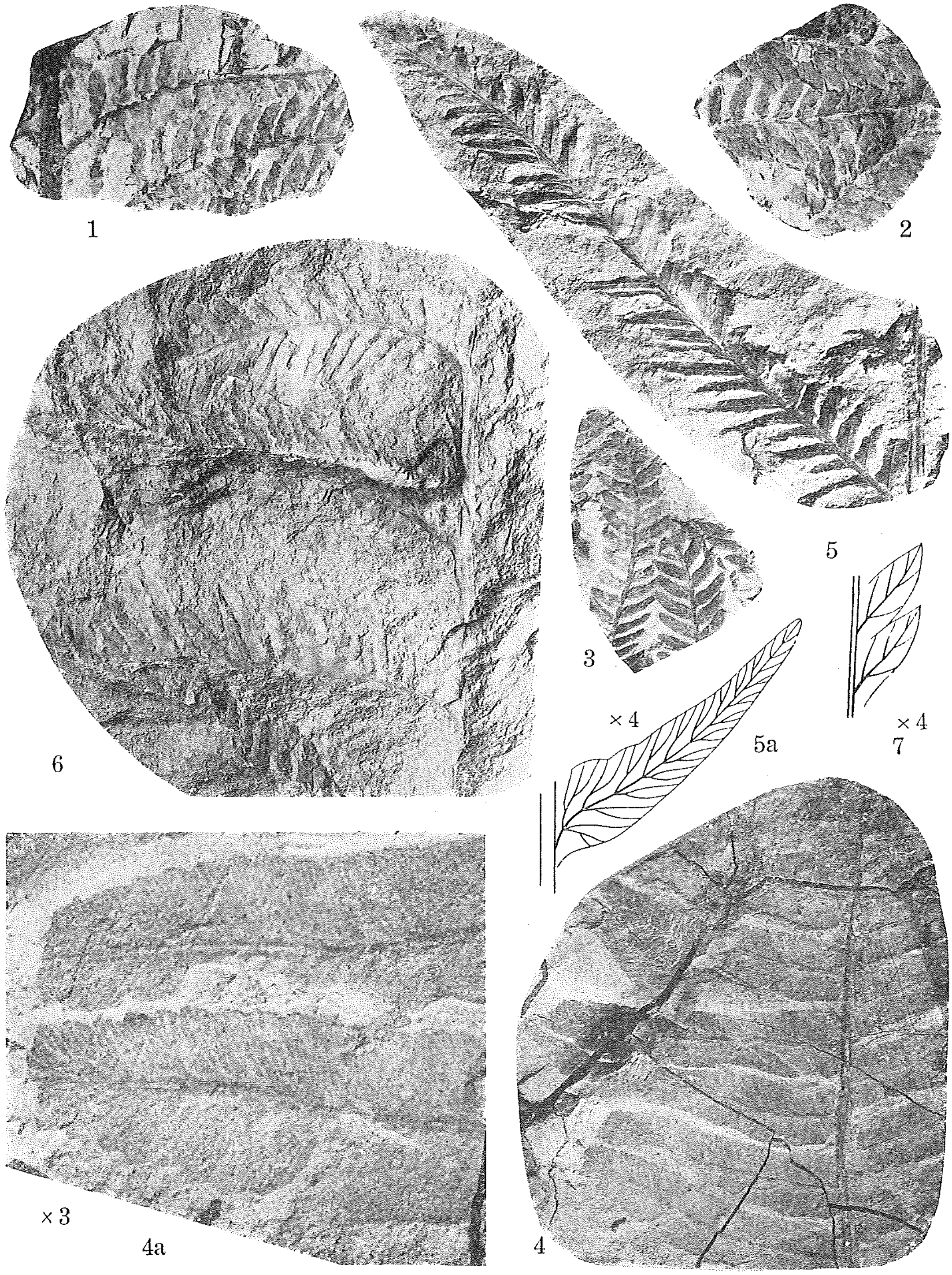

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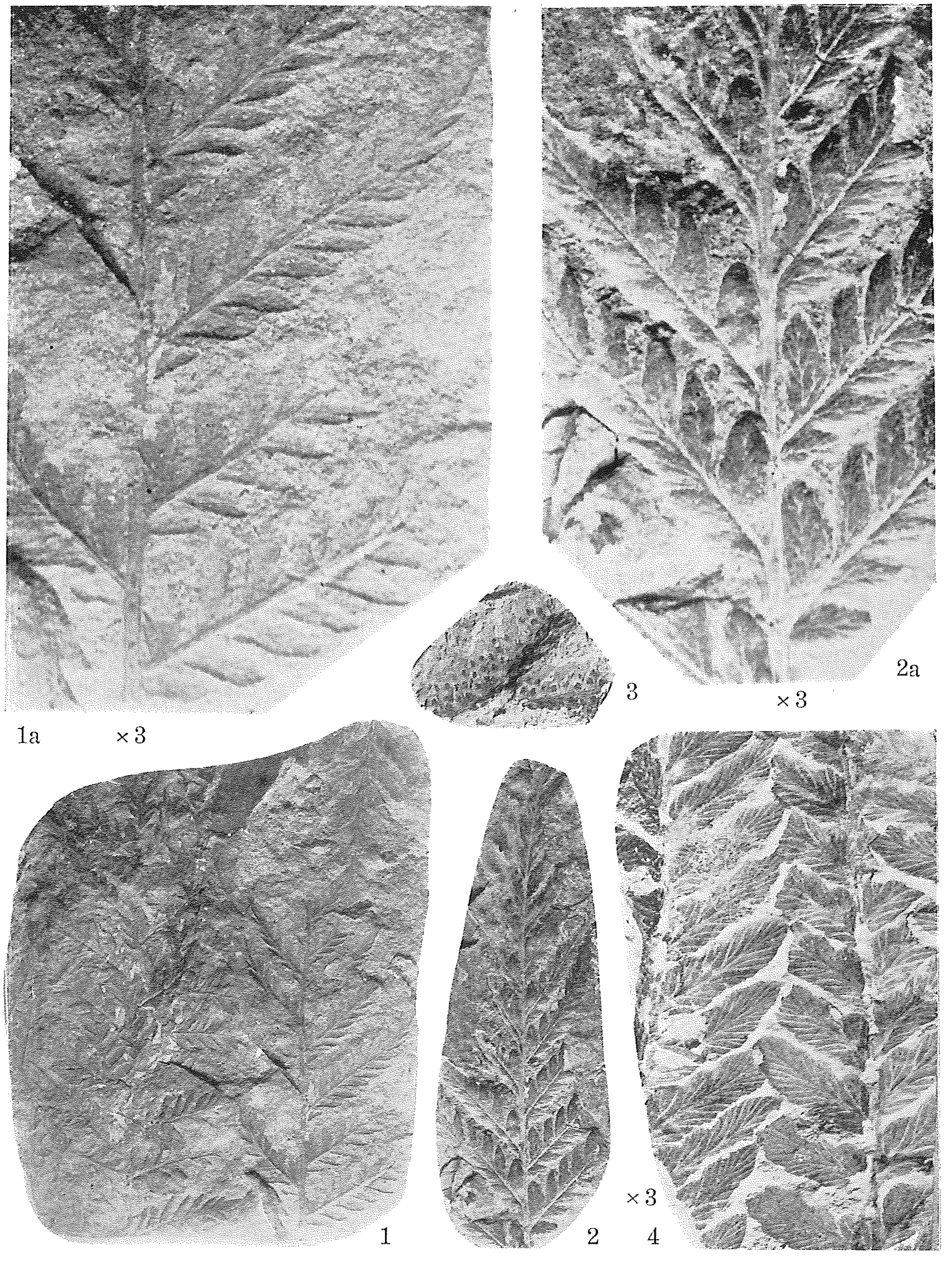

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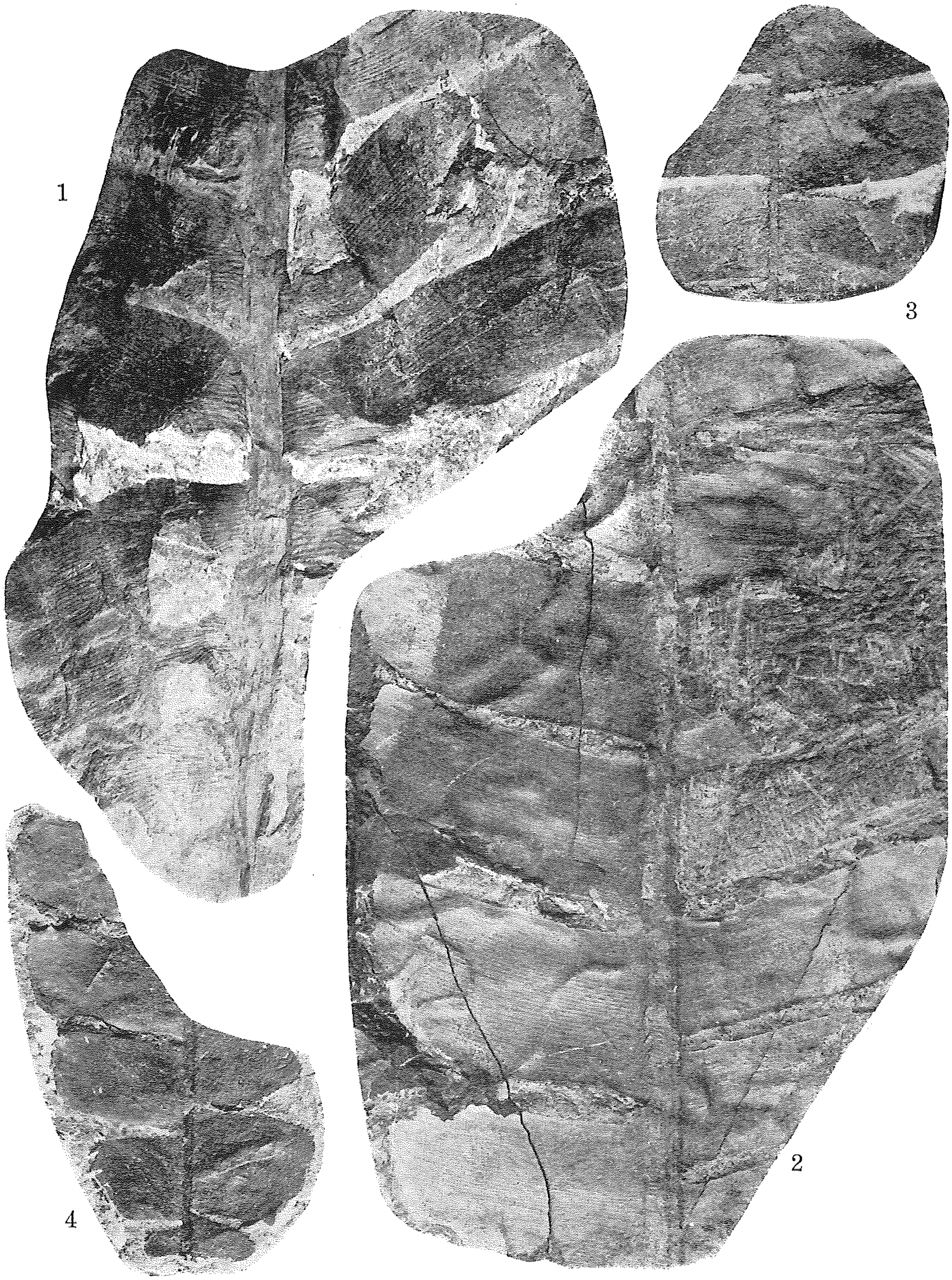

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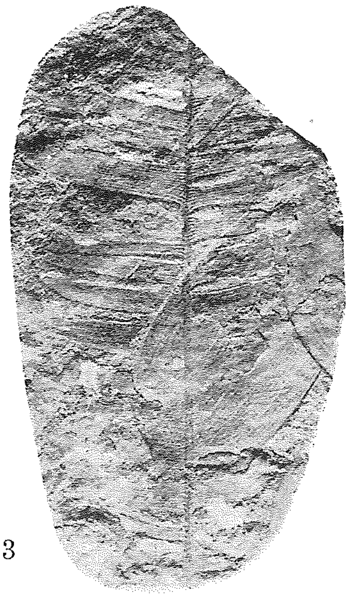

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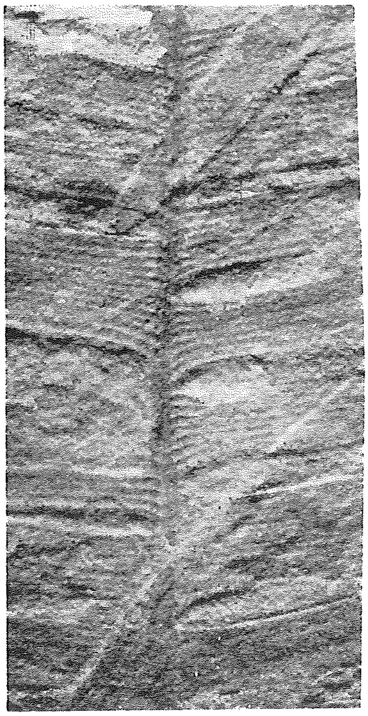
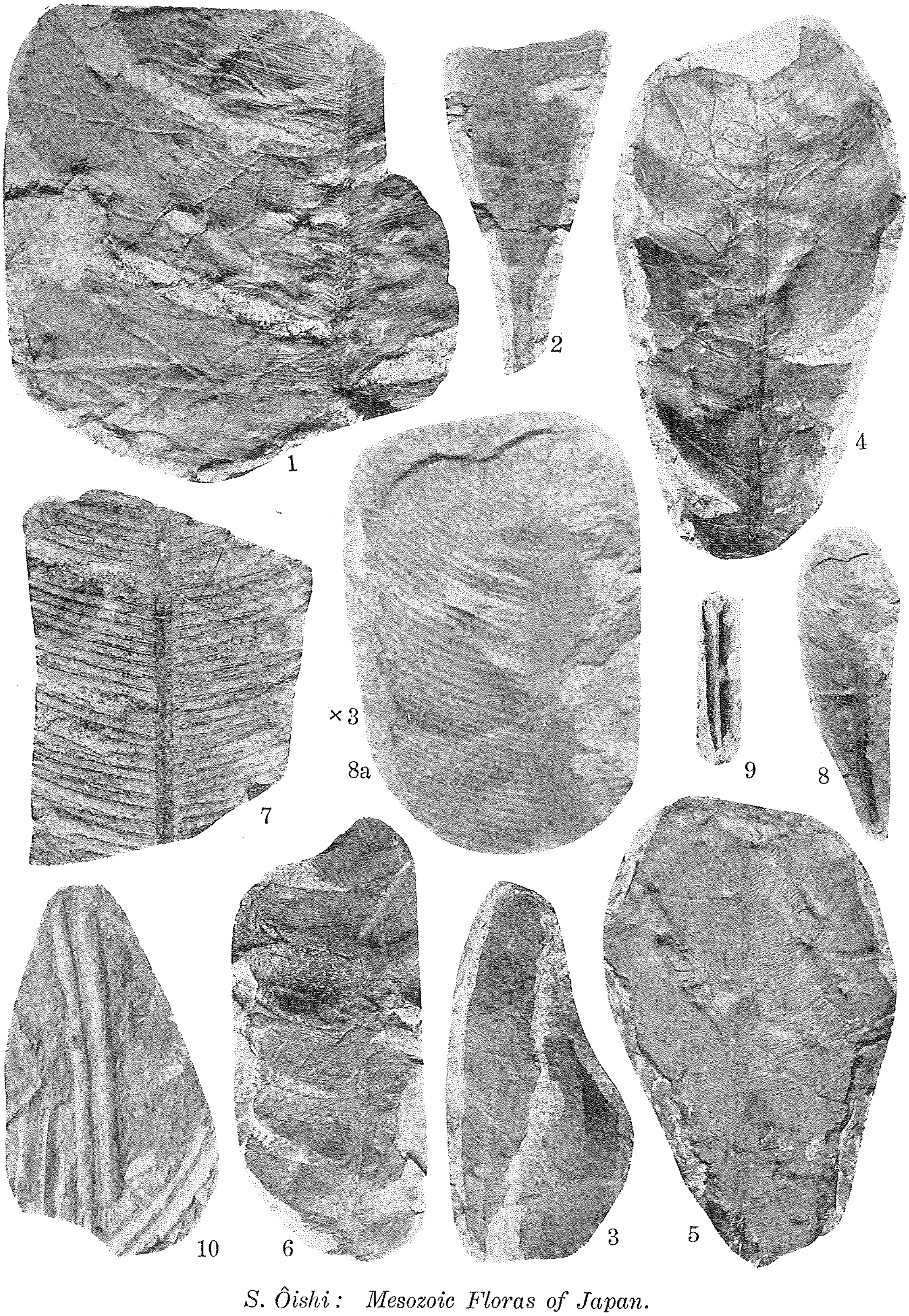


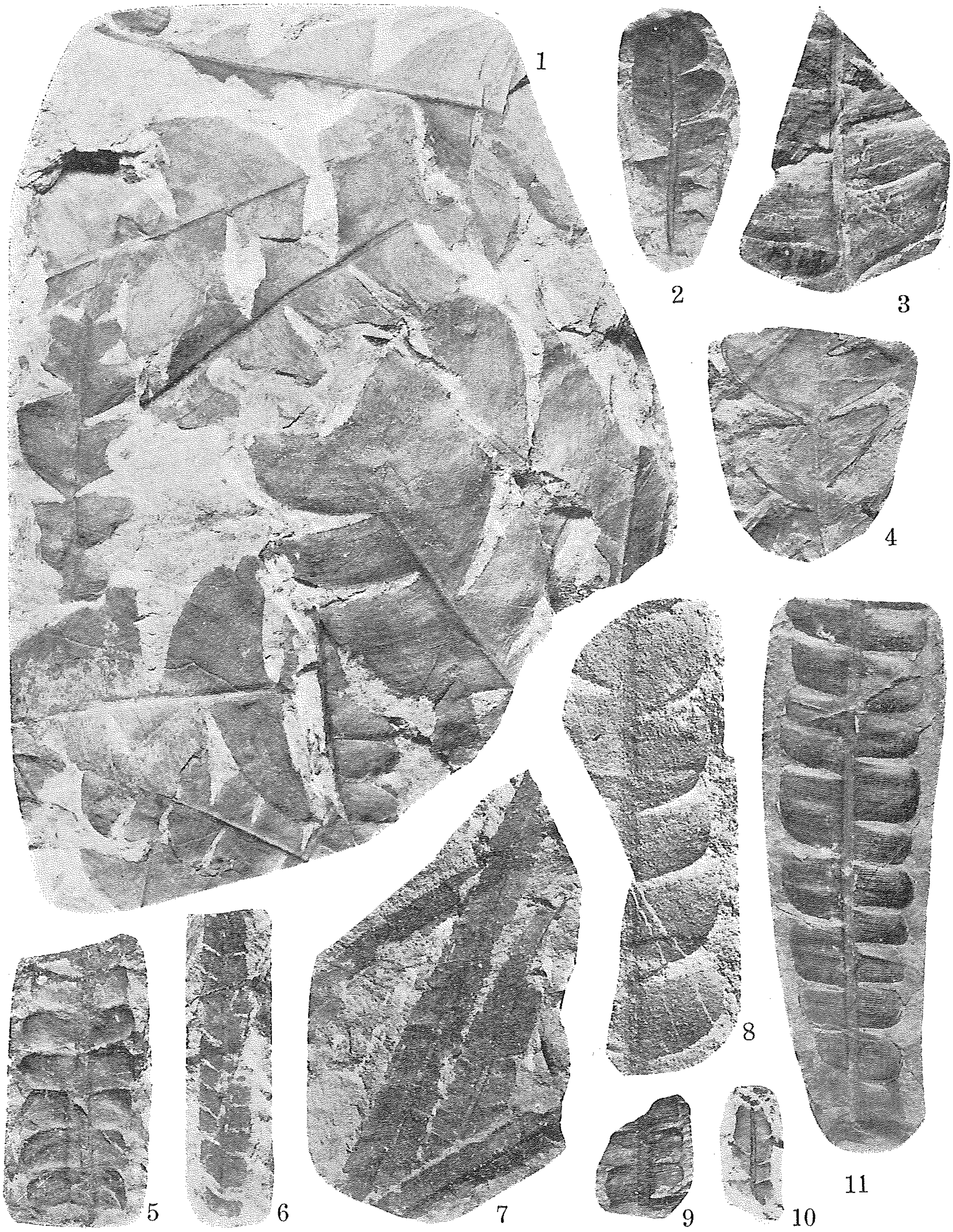
×3

3a

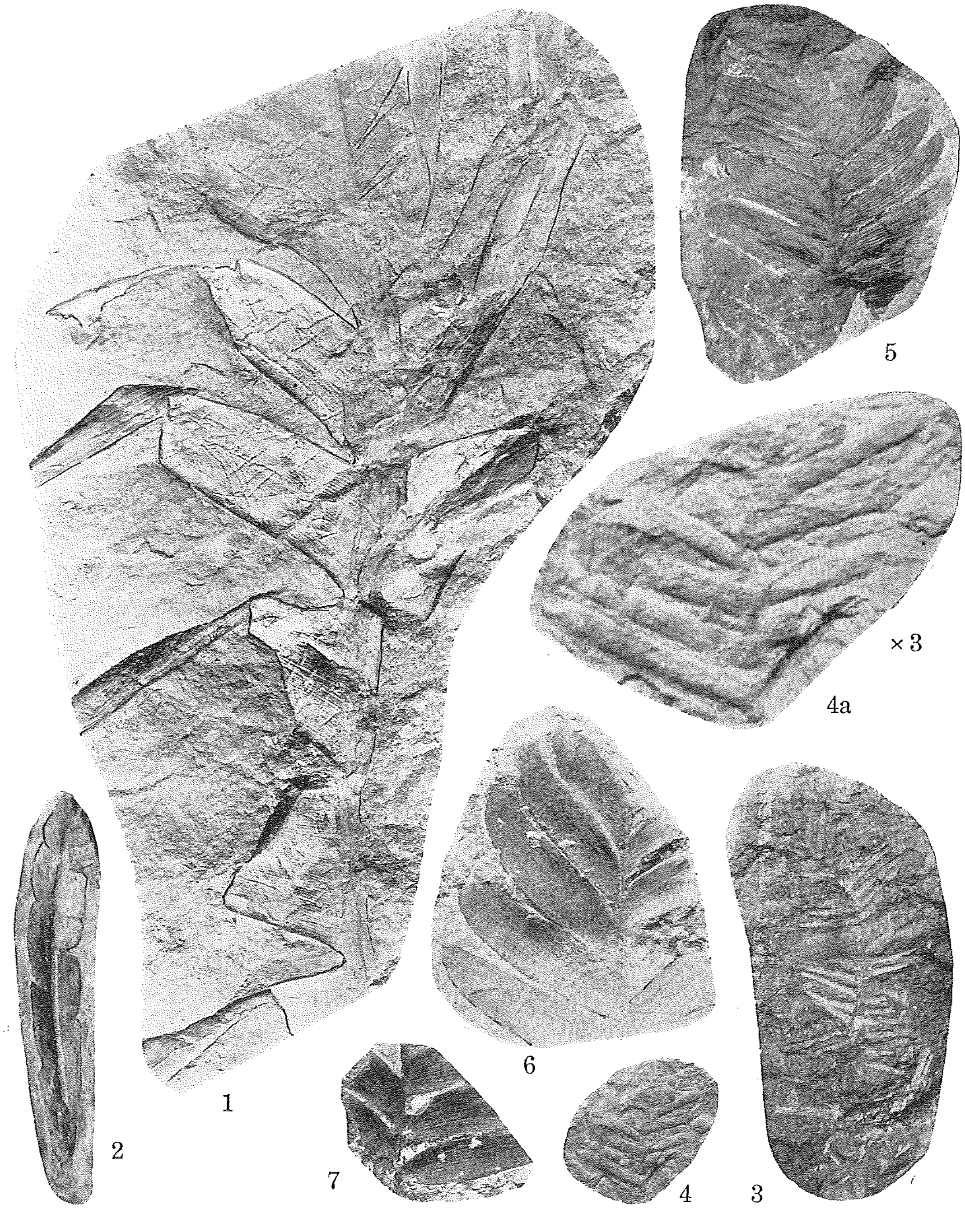
S. Ôishi: Mesozoic Floras of Japan.



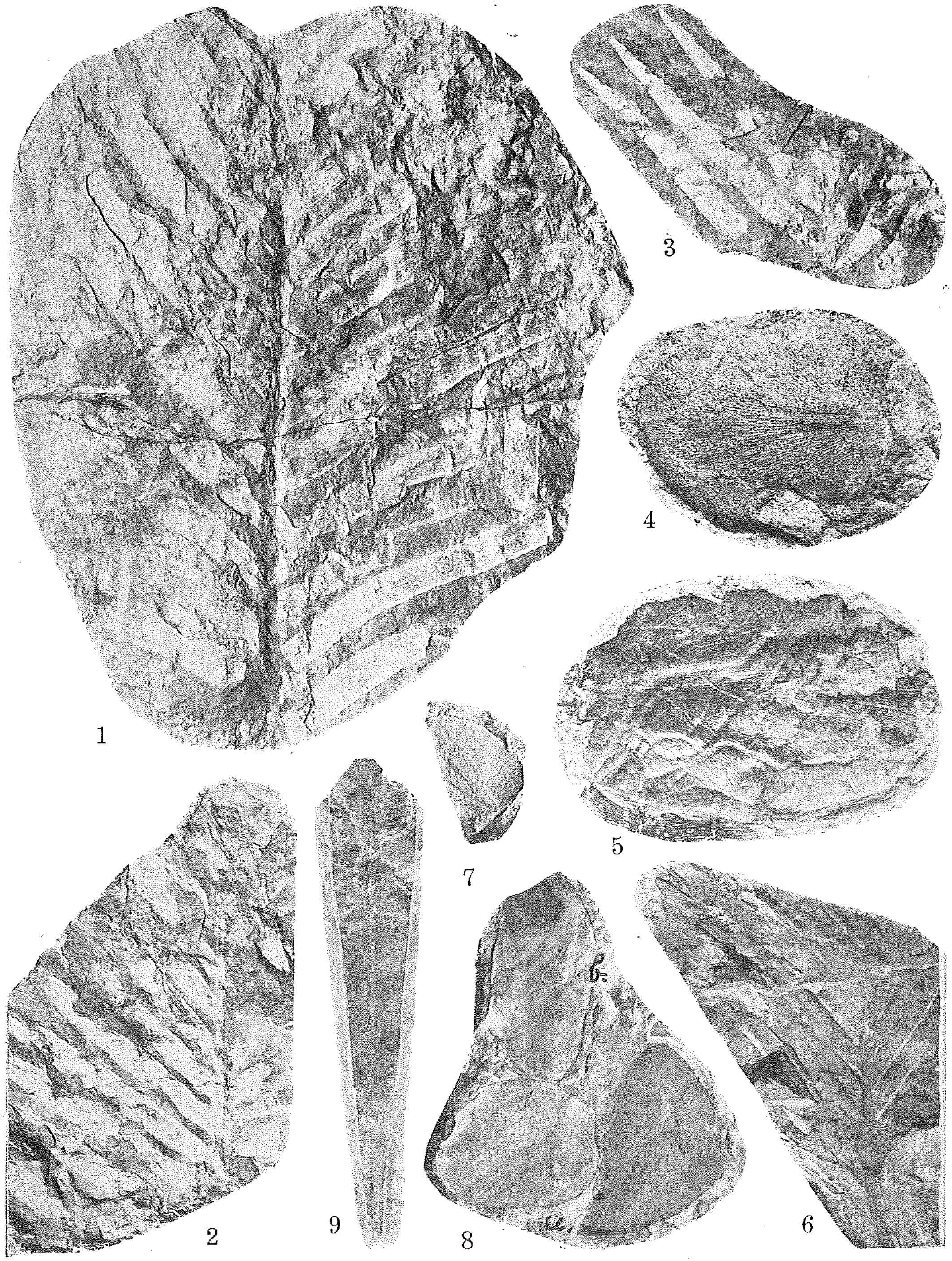
S. Ôishi: Mesozoic Floras of Japan.



S. Ôishi: Mesozoic Floras of Japan.



S. Ôishi: Mesozoic Floras of Japan.



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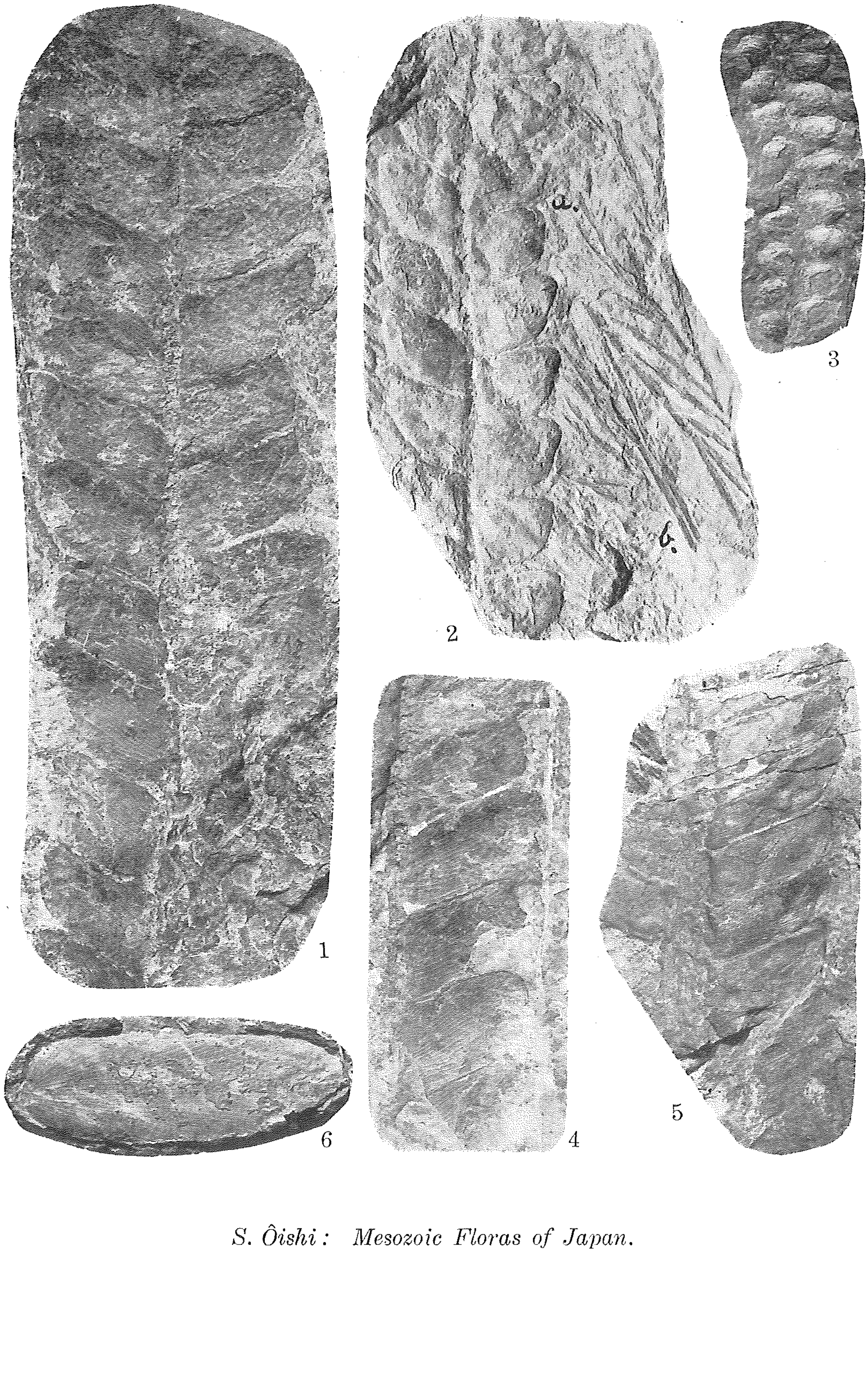
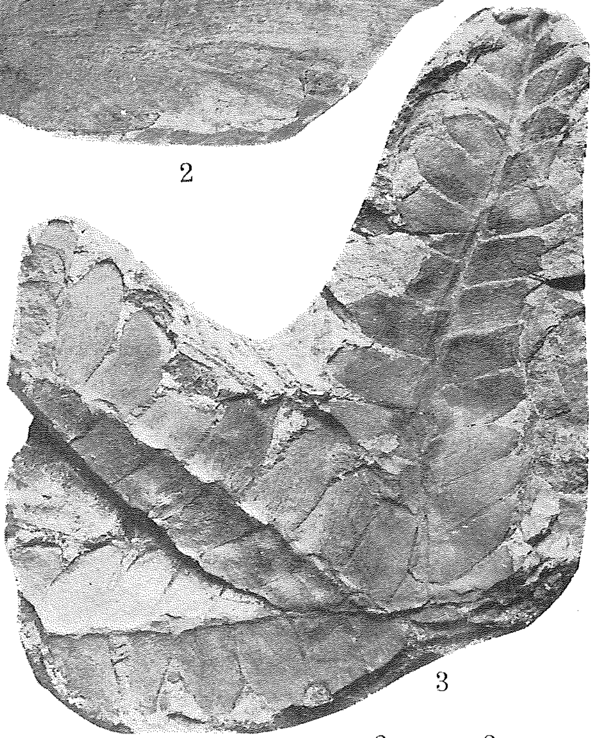


S. Ôishi: Mesozoic Floras of Japan.

1

2



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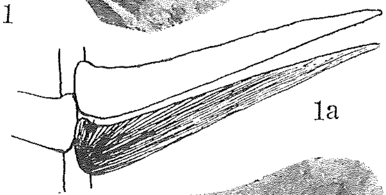
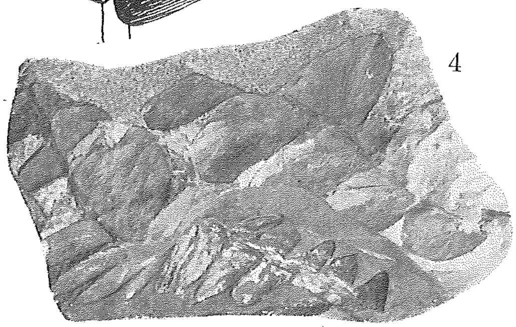


×2

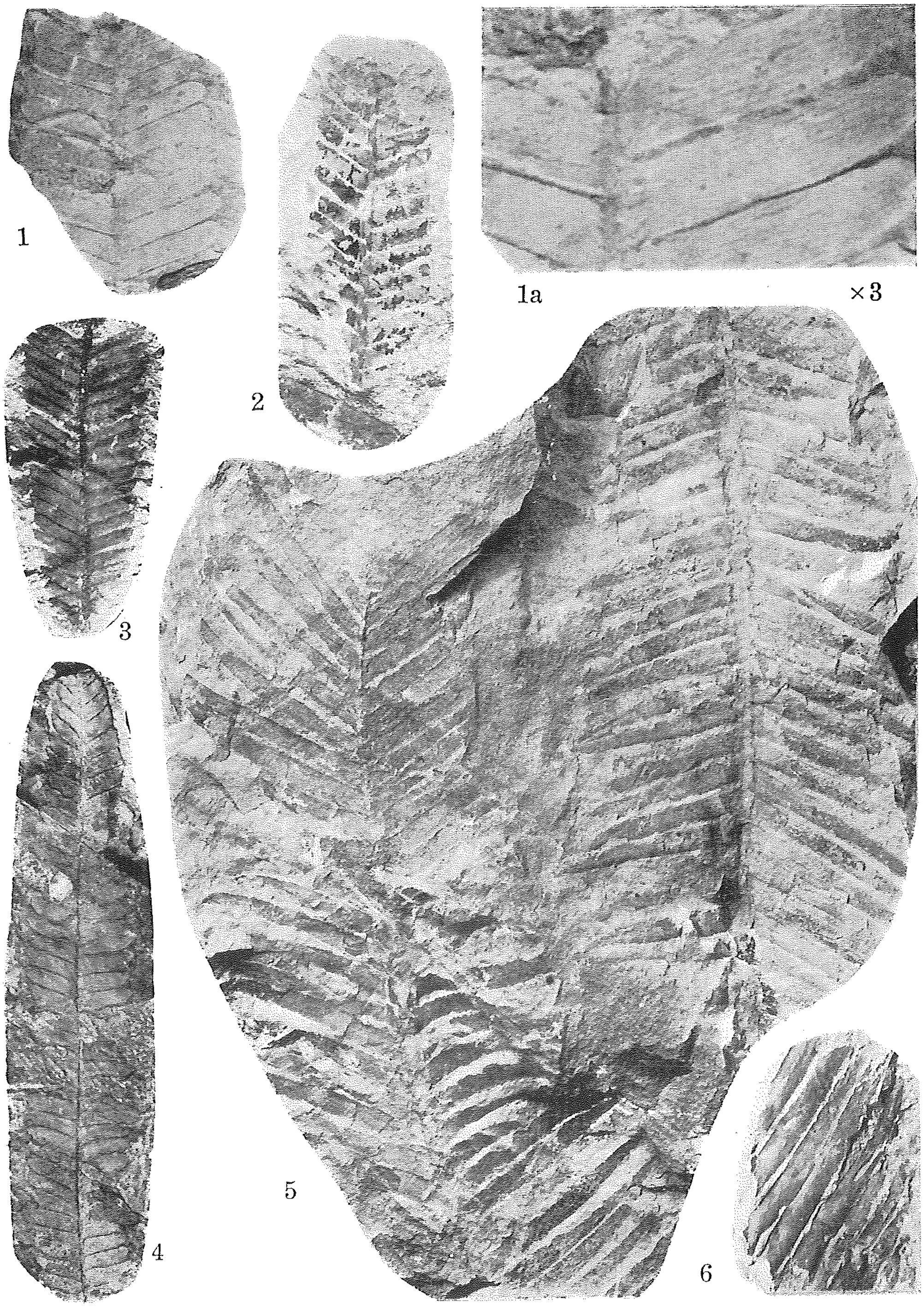
1a



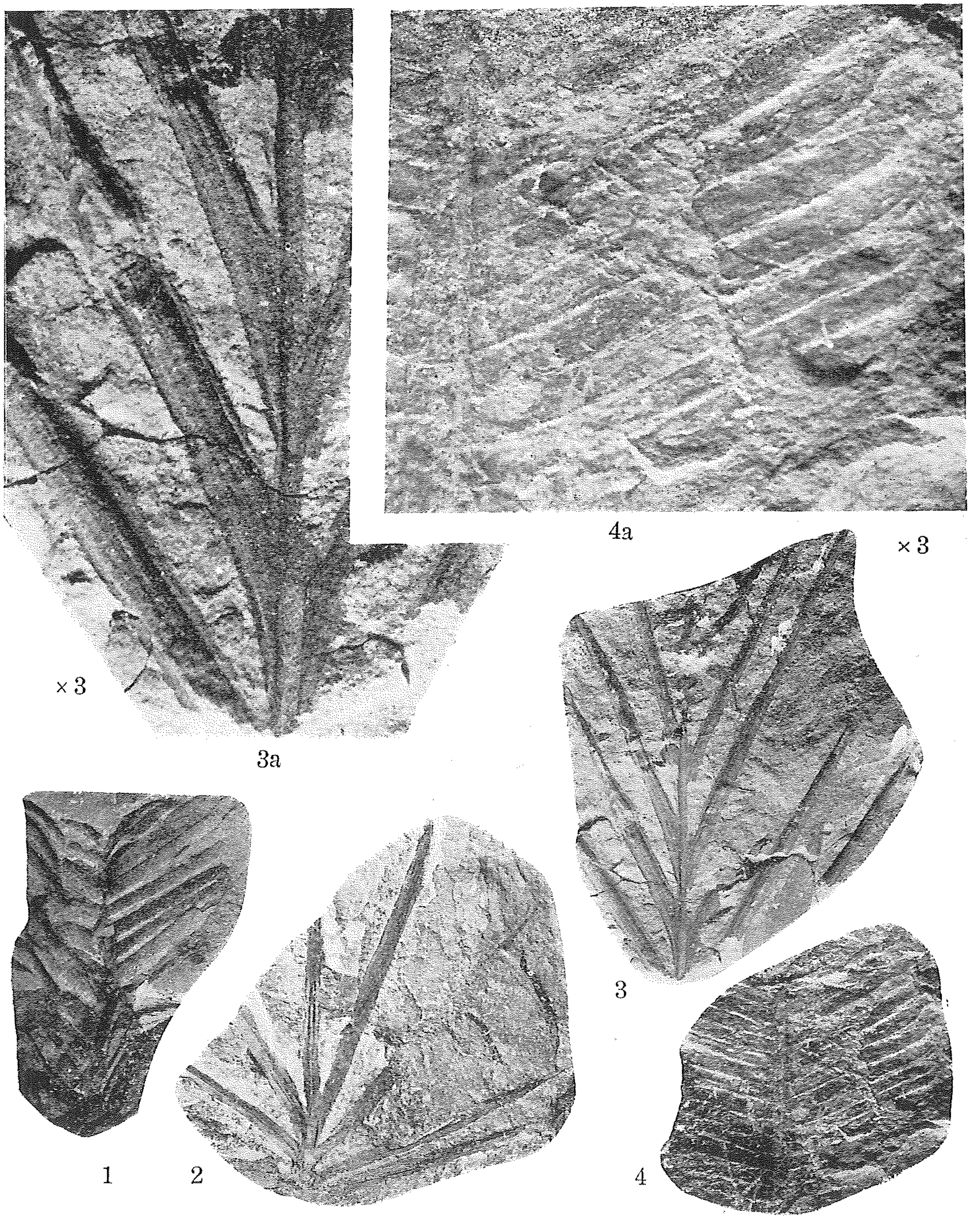
4

3a ×3

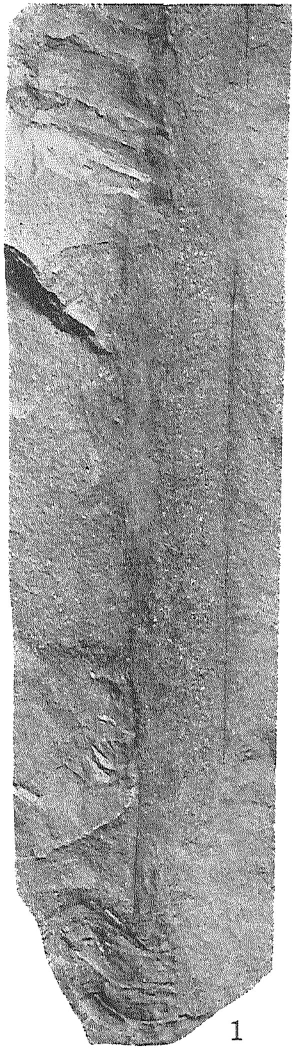
S. Ôishi: Mesozoic Floras of Japan.



S. Ôishi: Mesozoic Floras of Japan.



S. Ôishi: Mesozoic Floras of Japan.



1

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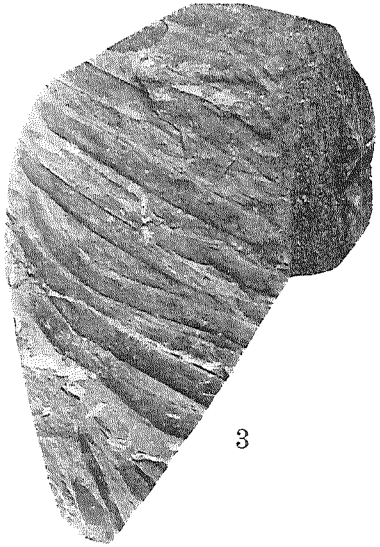

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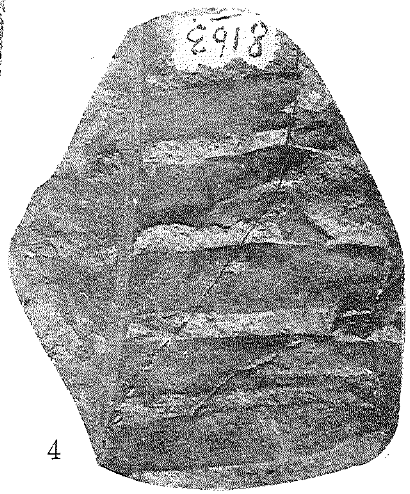
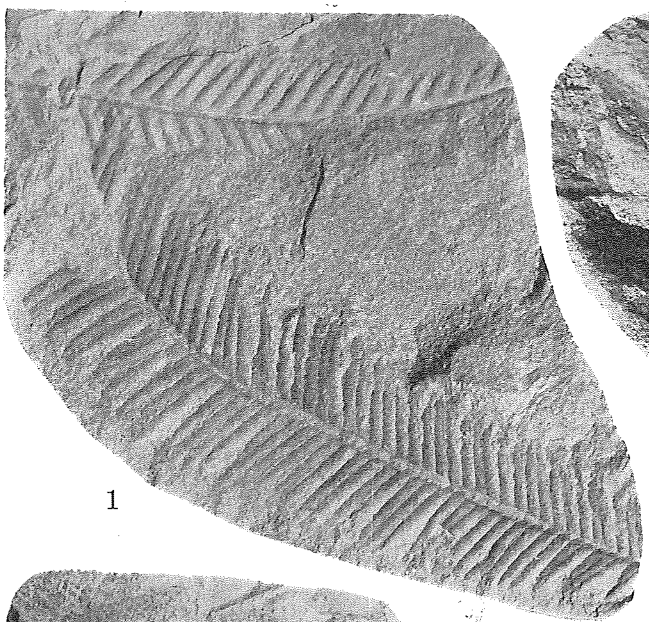


4

S. Ôishi: Mesozoic Floras of Japan.



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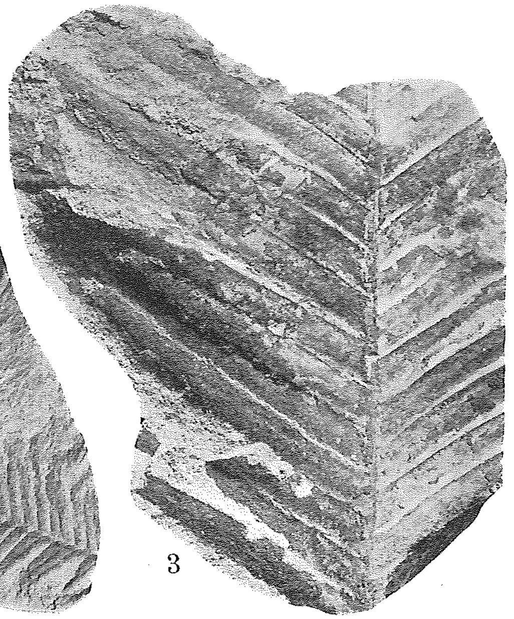

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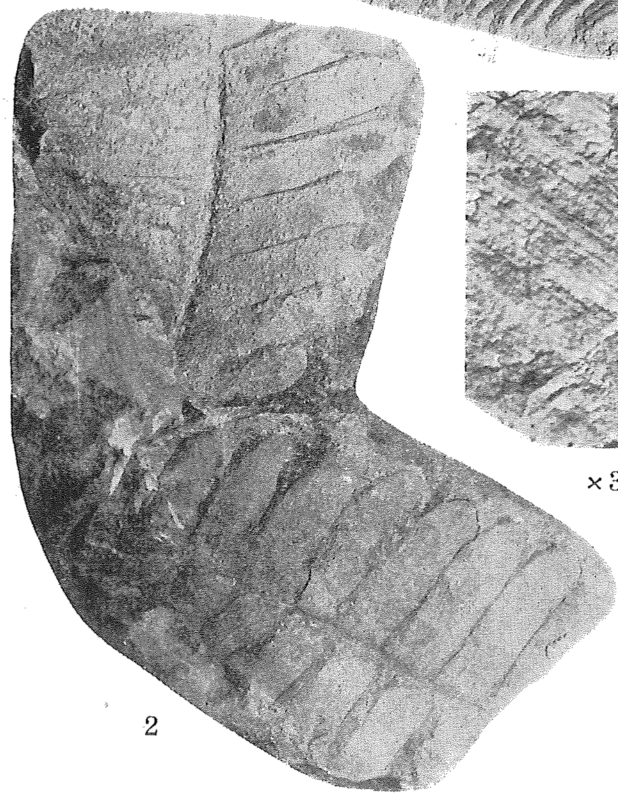
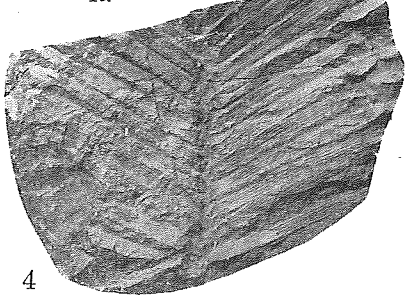


2

×3 4a



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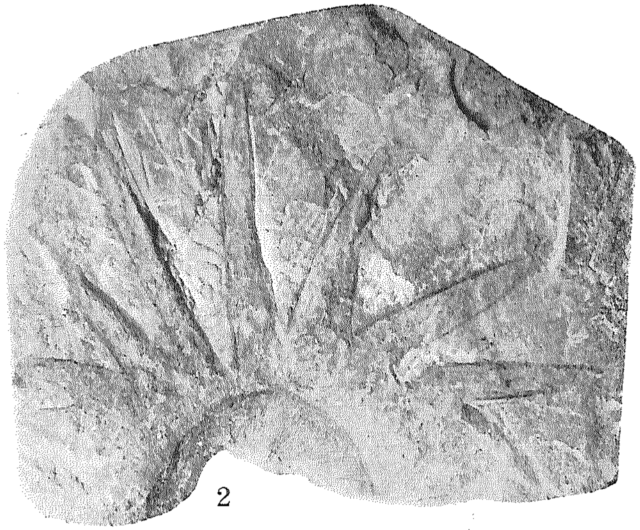
S. Ôishi: Mesozoic Floras of Japan.

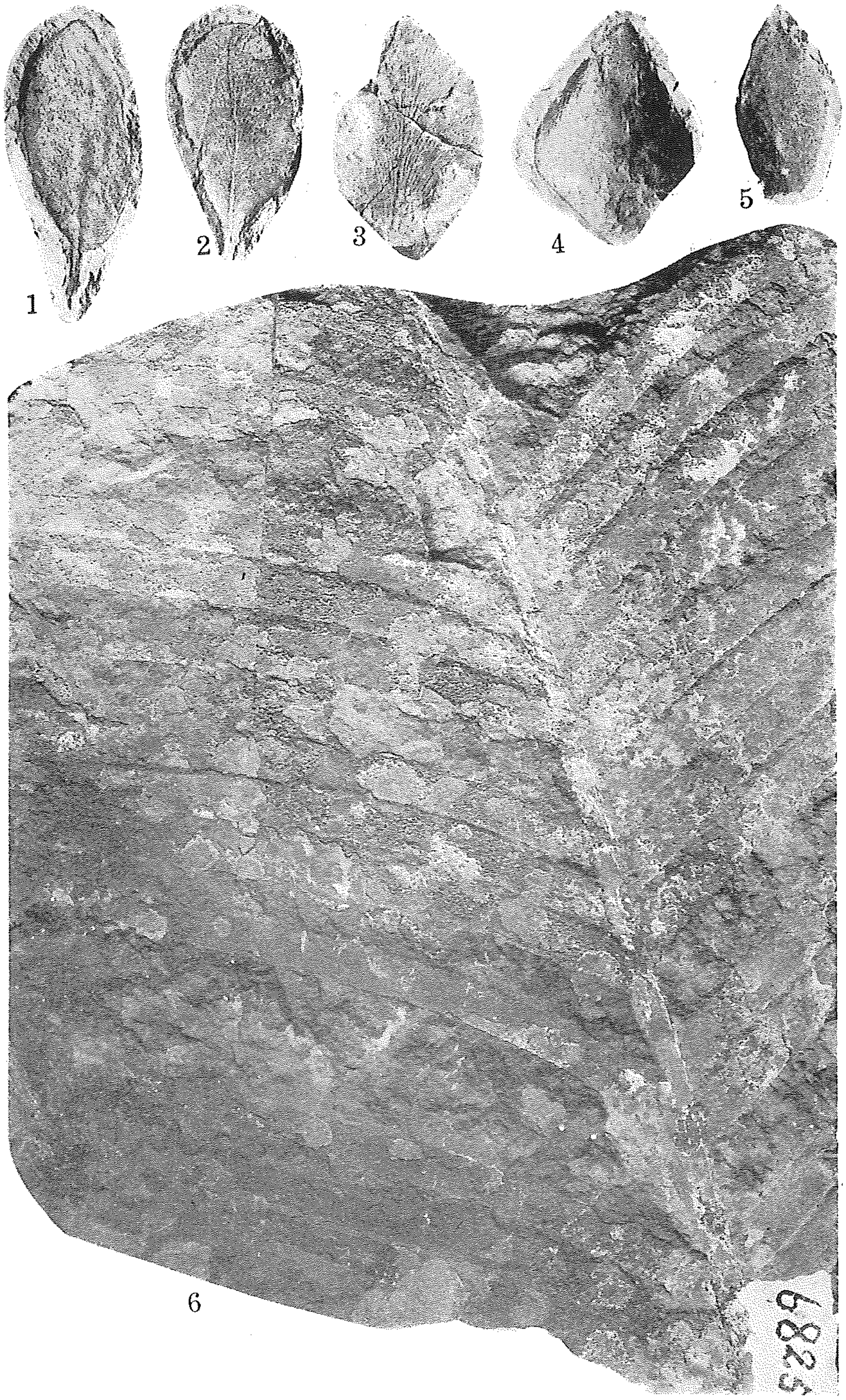
1



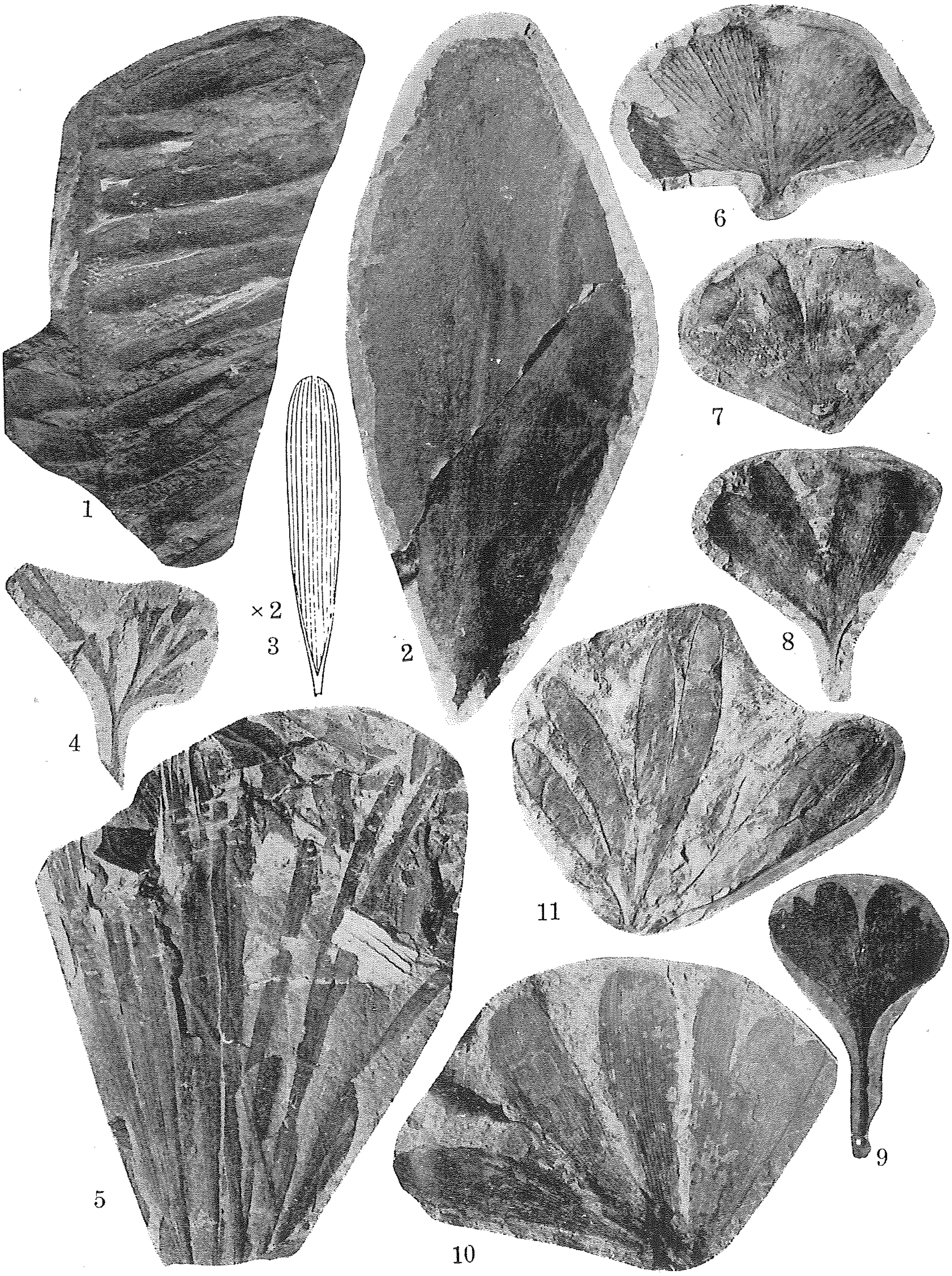
2

2a ×3

S. Ôishi: Mesozoic Floras of Japan.



S. Ôishi: Mesozoic Floras of Japan.



S. Ôishi: *Mesozoic Floras of Japan.*

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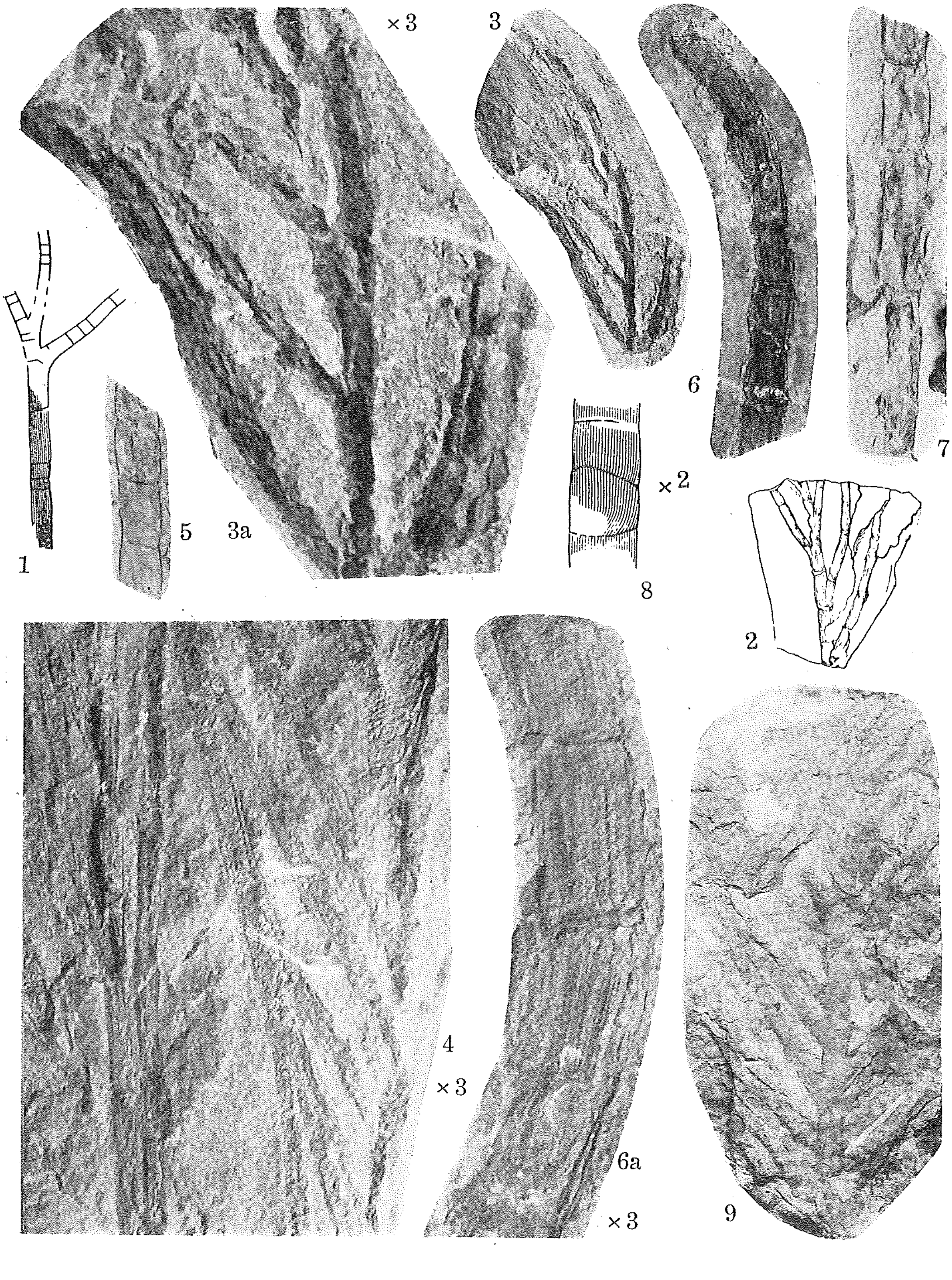
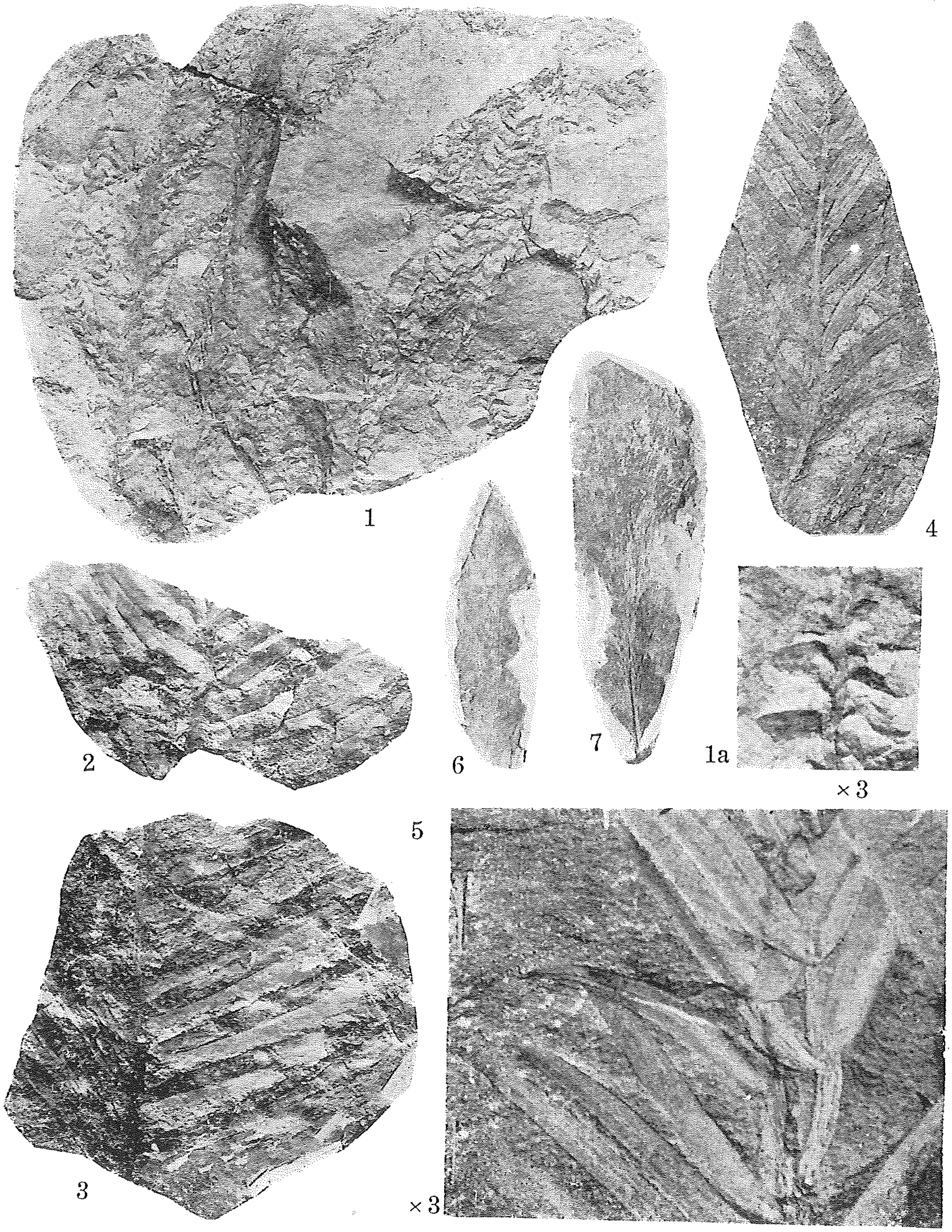
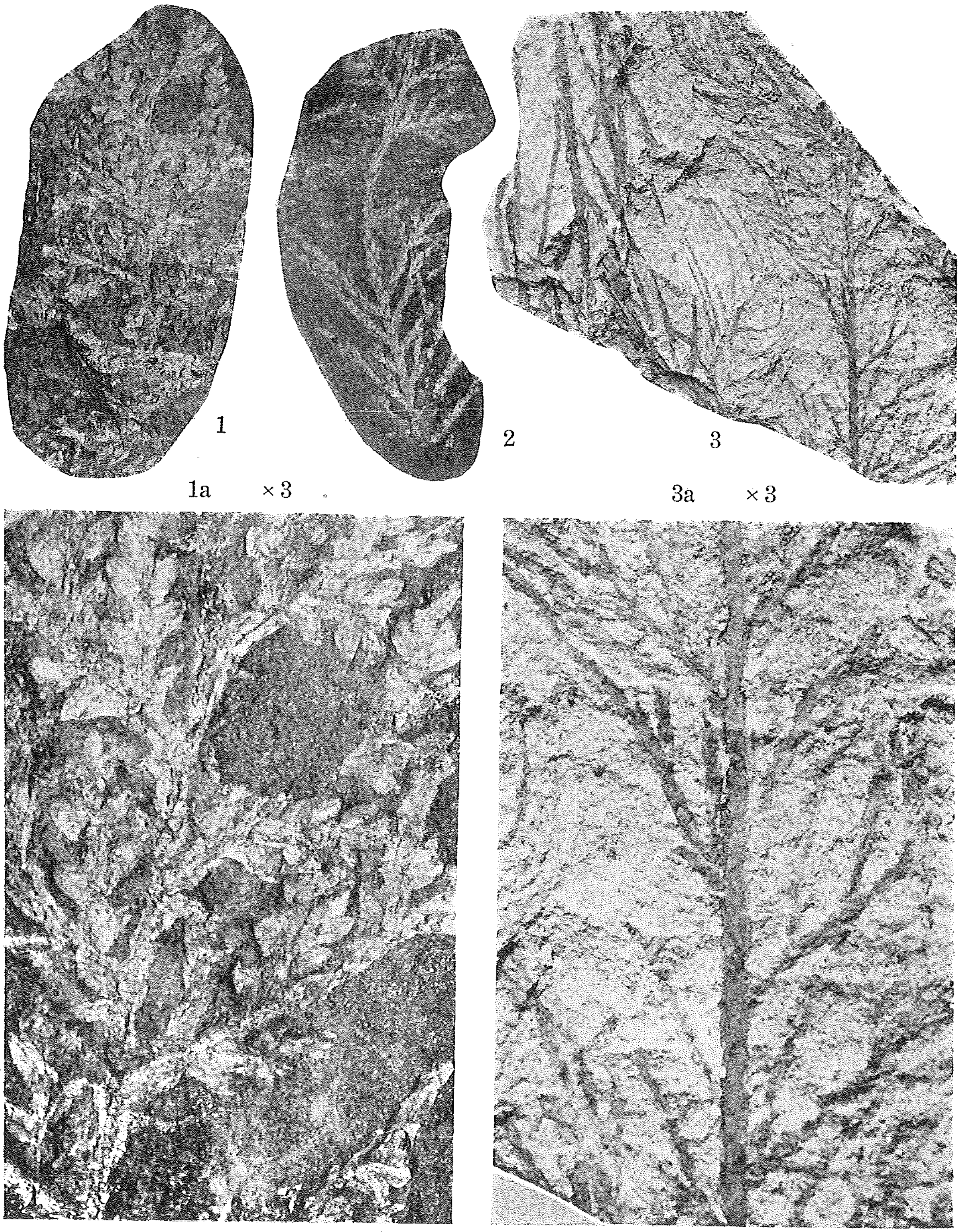


S. Ôishi: Mesozoic Floras of Japan.

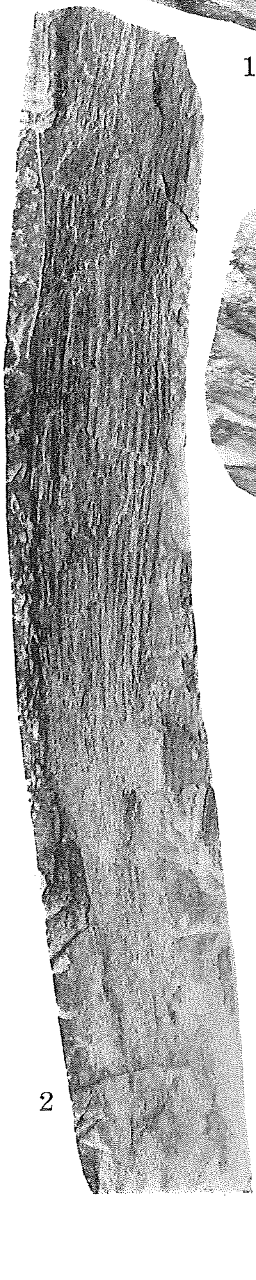


S. Ôishi: Mesozoic Floras of Japan.



S. Ôishi : Mesozoic Floras of Japan.

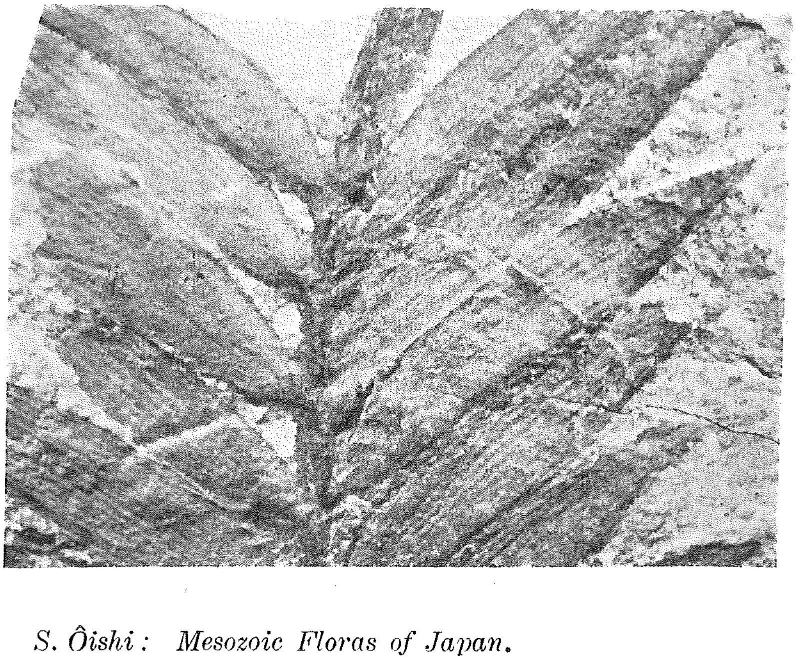

1


2

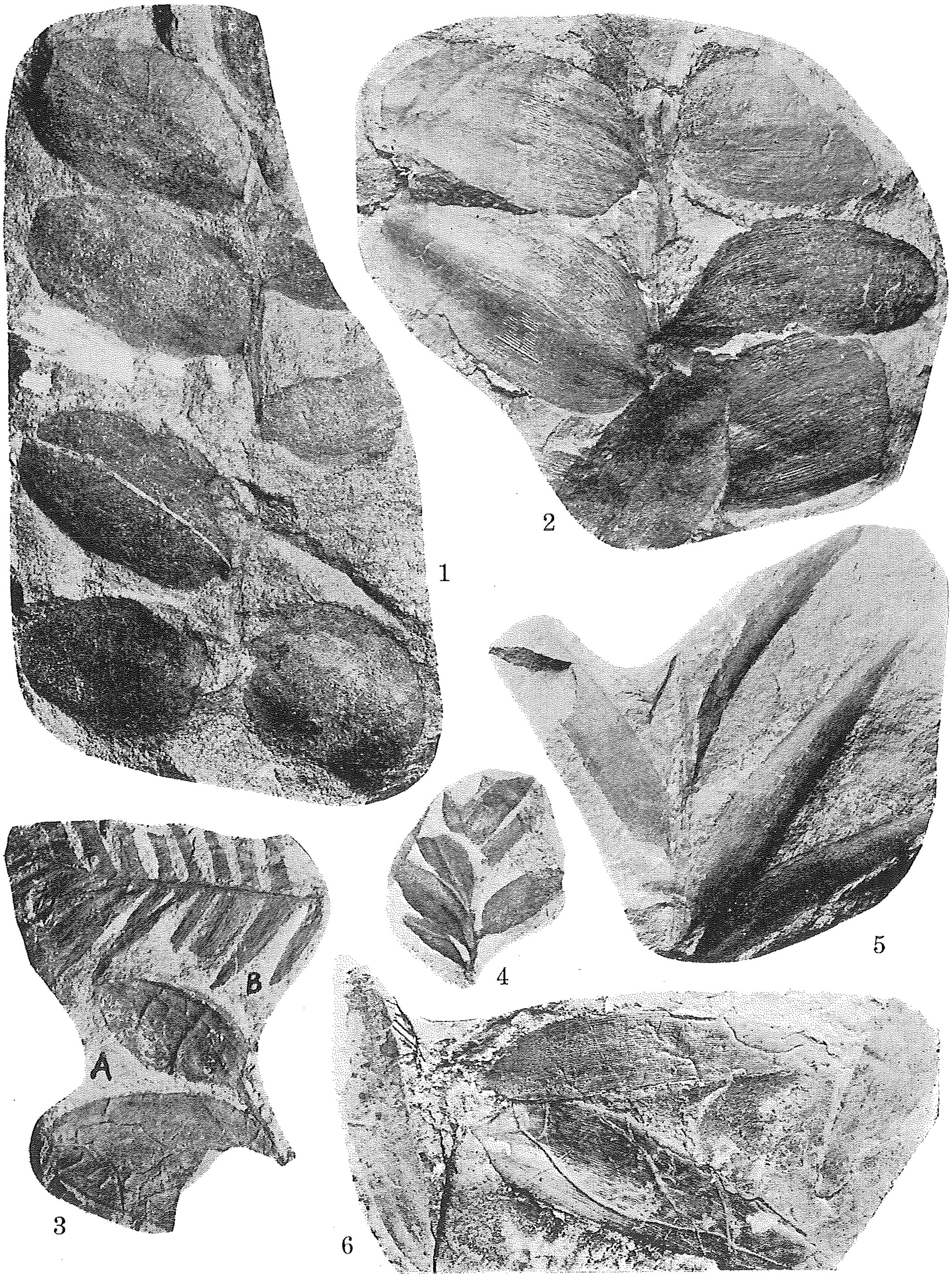

3


4

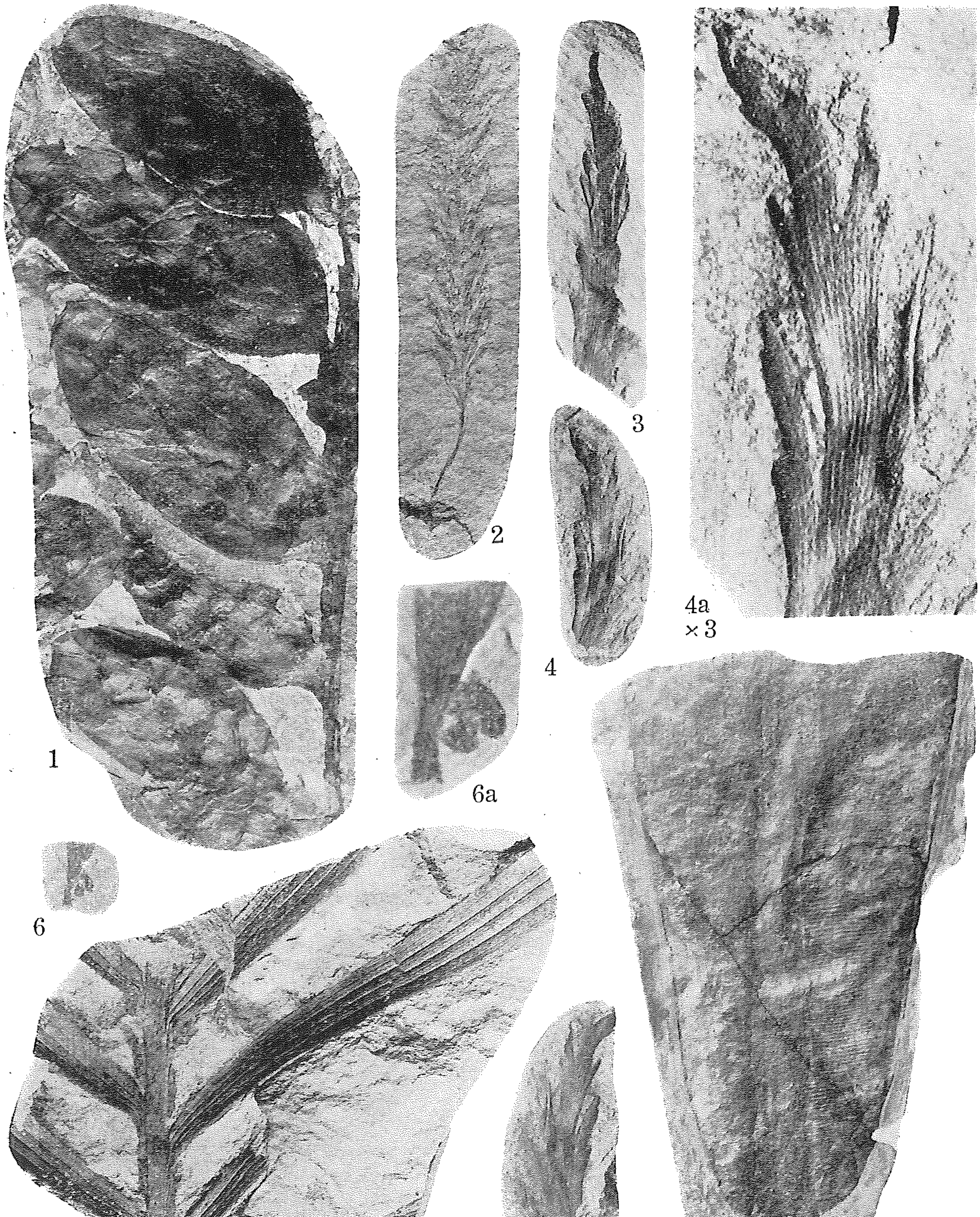
3a ×3



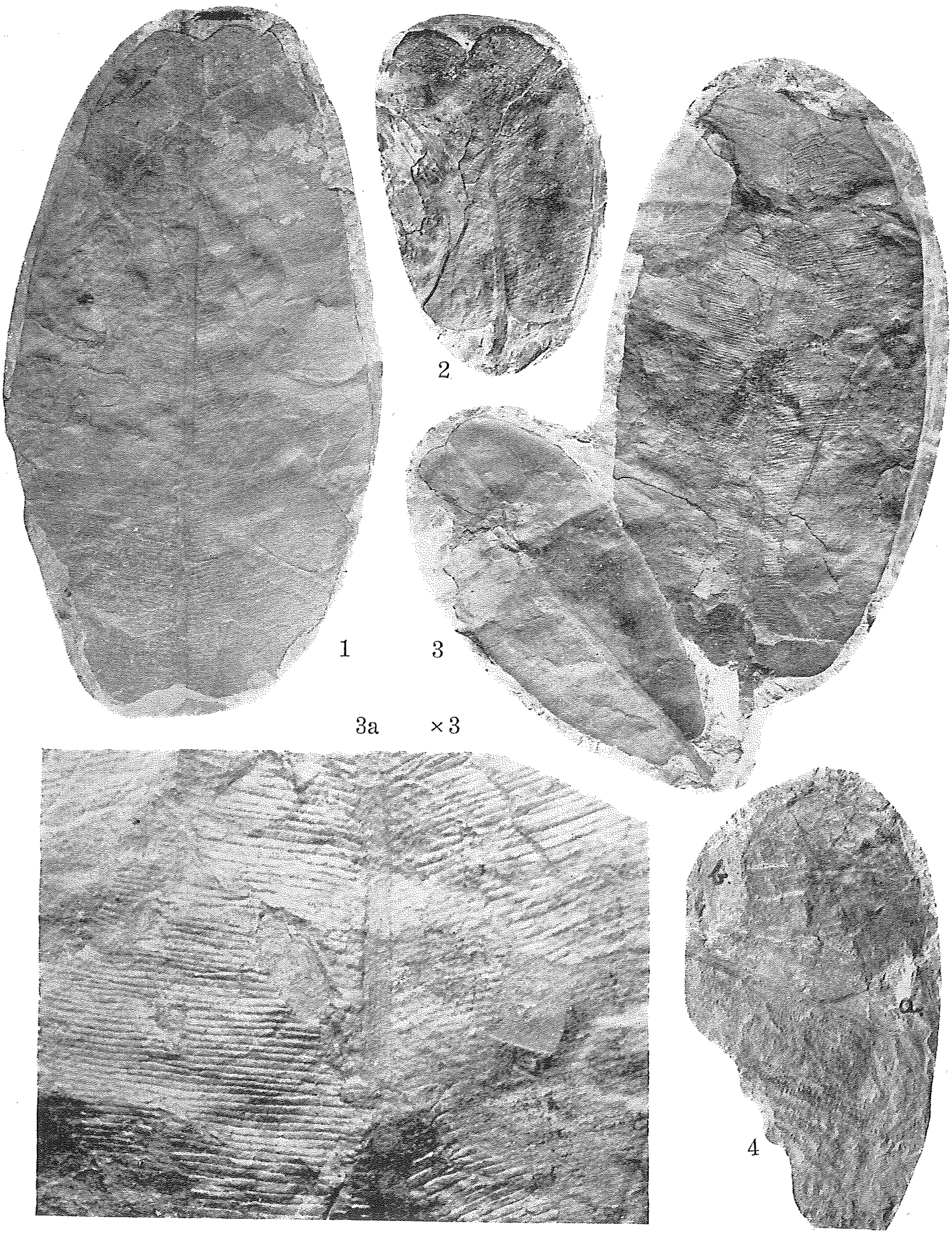
S. Ôishi: Mesozoic Floras of Japan.



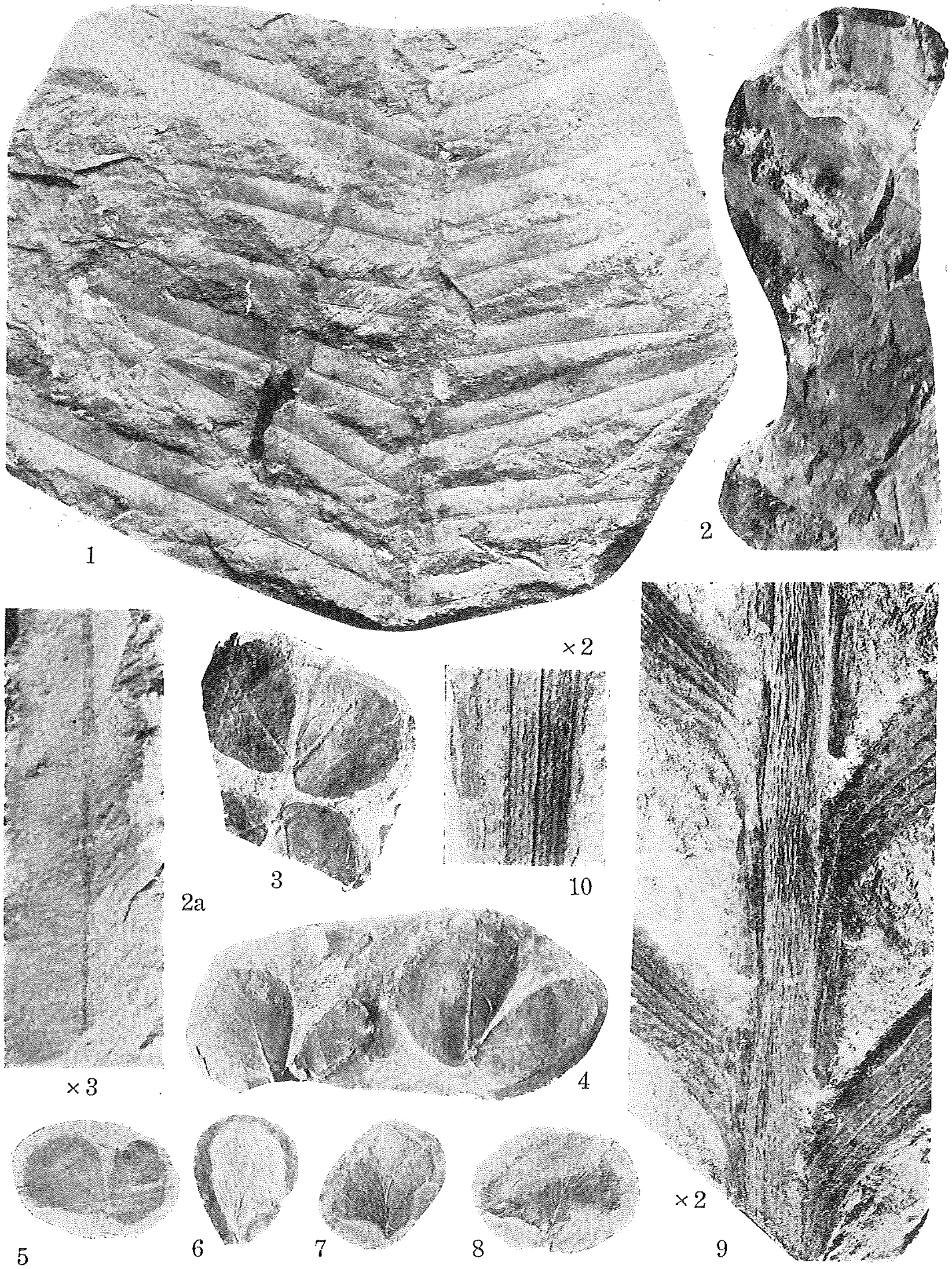
S. Ôishi: Mesozoic Floras of Japan.



S. Ôishi: Mesozoic Floras of Japan.



S. Ôishi: Mesozoic Floras of Japan.



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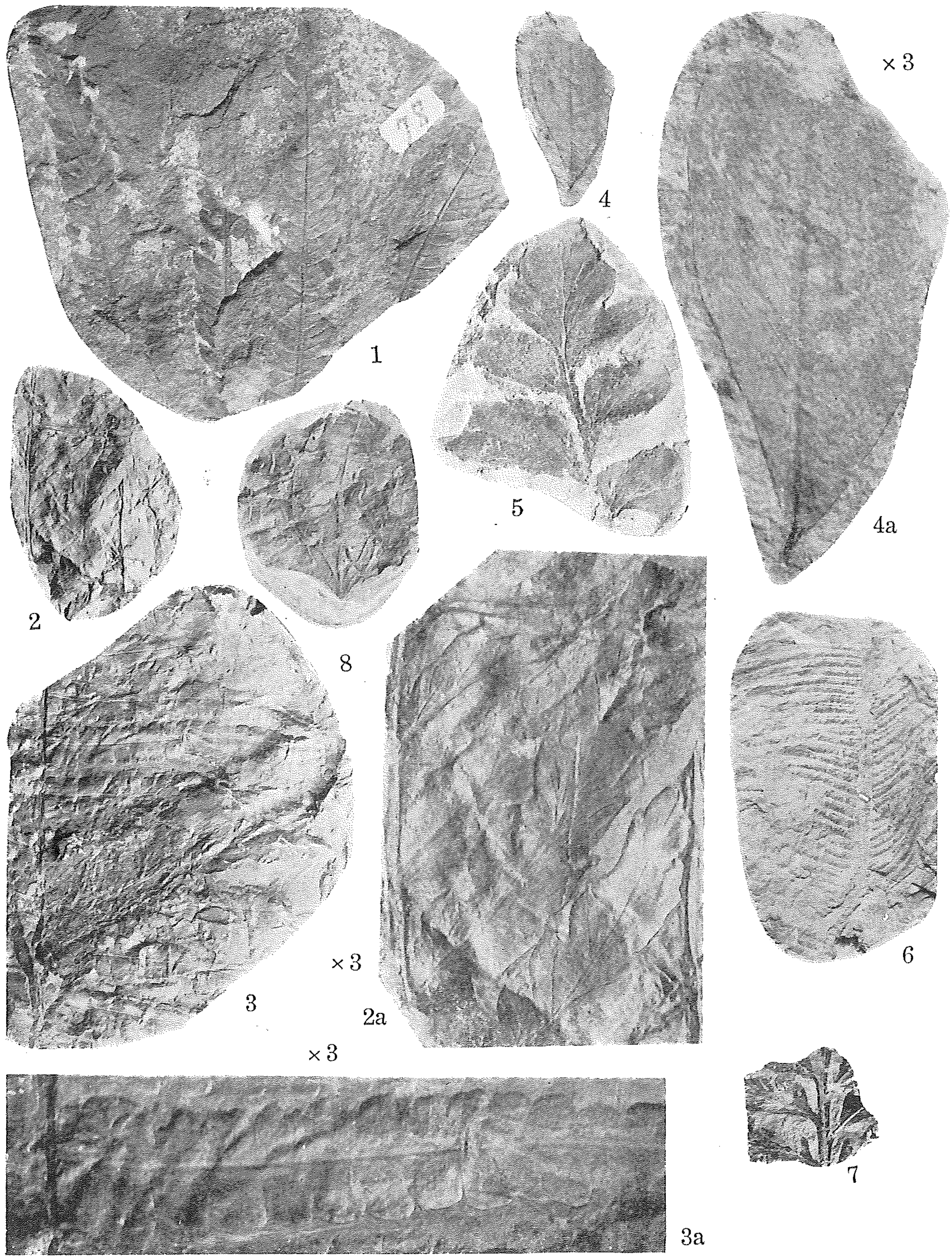

S. Ôishi : Mesozoic Floras of Japan.