Preface

This study deals with some Mesozoic plants collected by Mr. Shinji Sekido and the members of the Komatsu City Museum, Ishikawa Prefecture in 1956, 1957, and 1959, from the alternation of sandstone and black shale members at the most upper course of the Mekkodani, Ozo, Oguchi-mura, Ishikawa prefecture, which are presumed to be an equivalent in geological age to the Kuwashima formation, the Itoshiro sub-group (Kochian, the lowest of the Japanese triple Lower Cretaceous).

It is a pleasure to record here writer’s debt of gratitude to the following persons and organs for their help and support extended to him in conducting the present work. The present writer first expresses his sincere gratitude for the help of Dr. Seido Endo who kindly guided him in the prosecution of this study. The chief collector Shinji Sekido owed much to Prof. Z. Tsukano, Fukui University and Mr. H. Matsuo, Kanazawa University, both of whom kindly guided him in the study of fossil plants.

The present writer wishes, furthermore, to express his thanks to the members of the Conducting Commission of the Komatsu City Museum: Messrs. A. Hamasaka, M. Sekido, I. Kosaka, S. Nakayama, Y. Shirosaki and Y. Yamazaki for their great help in collecting the fossil plants described here and elsewhere, and Mr. I. Ishibuchi for his kind help in furnishing lodgings. Finally, particular thanks are due to the Komatsu Board of Education and the Komatsu City Museum (president: Mr. N. Ogawa) for the grant in aid which has rendered possible the collection of the Mesozoic plants described here and later on.

Description of Species

BENNETTITALES

Genus Dictyozaumites Oldham

This genus is one of the most important and characteristic genera in considering the Mesozoic floral provinces of the Japanese Islands (proposed by T. Kimura, 1959 MS) which are believed to have existed in geological age from the Donmerian to at least the Albian; especially in considering the Inner side (the Hida) Floral Province.
In the Japanese Islands and South Korea, five distinct species and three undetermined specimens have already been described or recorded. Their vertical as well as horizontal distribution is shown in Table 1.

Table 1. The Occurrence of *Dictyzamnites*

<table>
<thead>
<tr>
<th>Geologic Age</th>
<th>Outer Side Floral Province</th>
<th>Toyora Floral Province</th>
<th>Naktong Floral Province</th>
<th>Inner Side Floral Province</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albian</td>
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<tr>
<td>Aptian</td>
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<tr>
<td>Lower Cretaceous</td>
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<tr>
<td>Neocomian</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Berriasian</td>
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<tr>
<td>Malm (Upper Jurassic)</td>
<td></td>
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<tr>
<td>Dogger (Middle Jurassic)</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

(* seems to be peculiar to each Floral Province)

This genus has so far been considered to be an important element of the Middle Jurassic floras as stated by Seward (1917) and also by Arnold (1947). But in the Japanese Islands and Korea Peninsula, most of all the species belonging to this genus occur from the Upper Jurassic and the Lower Cretaceous strata, especially from the latter.

In 1936, Oishi stated "The geological age of both the Tetori and the Naktong Series corresponds approximately to the Upper Jurassic in the European standard. Therefore, all of the Japanese species of this genus are the youngest records in the world." But the Kochian (the lowest of the Japanese triple Lower Cretaceous) age in which the main part of both series (or groups) was formed is now accepted by most stratigraphers and also palaeontologists.

It is a striking fact that no species belonging to this genus has yet been recorded from the Outer side Floral Province. This fact shows the difference of climate between the Outer and the Inner side Floral Provinces bounded by the median ridge. The Toyora and the Naktong Floral Provinces were the intermingled area of both floral elements, and the mingling might be explained by the palaeogeographical circumstances in both areas in those days.

It is also noteworthy that the *Dictyzamnites* does not seem to have been yielded from the continental Mesozoic.
strata of Asia, i.e., Siberia, Manchuria, China and so on.

The imperfect specimen formerly described by the writer (1958) from the dark greenish shale exposed on the mountainsides (Kuzuryu sub-group?) near Lake Kizaki, Nagano prefecture, under the name of Dictyozamites sp., now can be identified as a well-known species called Dictyozamites falcatus (Morris) Oldham by its outward appearance.

Arnold (1947) stated that this genus probably belongs to the Williamsoniaceae, but no evidence for testifying the above statement has yet been found in spite of the writer's strenuous efforts.

In describing the Japanese and Korea species belonging to this genus the writer had so far been compelled to depend only on the ill-preserved materials. The specimens he had obtained, however, were fortunately so good in preservation that the writer was strongly tempted to describe and illustrate them as follows.

Dictyozamites imamurae Oishi emend.

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


Emended Diagnosis: Frond, pinnate, large, more than 20 cm. long and 10 cm. wide, probably oblanceolate to obovate in outline, contracting gradually towards the base and more or less abruptly towards the apex. The detail of the apical portion has not been made clear yet. Rachis slender 2-3 mm. thick measured on impression and alternately sending off the pinnae at a wide angle. Pinnae set closely together, touching or overlapping each other laterally: linear, slightly falcate, parallel-sided with the rounded apex and seem to be convex in their upper surface; the base asymmetrical, sessil and attached to the upper surface of rachis by a portion about 5-7 mm. wide at the central portion; upper half of base articulat-ed and lower base contracted; typical pinnae, 5.5 cm. long.
Tatsuaki KIMURA

and 2 cm. wide. Nerves very crowded, divergent, anastomosed, the reticulum consisting of meshes: meshes in the central median region about 1 cm. long, the density being about 25 per cm. and become abruptly shorter and narrower towards the margin.

Description of specimens: Many fine specimens in good preservation were obtained. One of them is shown in Pl. 5, fig. 1 on which the present emended diagnosis is mainly based. The rachis seems to be buried into the rock material. The lower pinnae are strongly rolled backwards as shown in the left-hand-side of the rachis. Text-fig. 1 shows the outline of the pinnae.

Remarks: This species is well characterized by the more or less linear pinnae provided with rounded apex and by having asymmetrical and auriculated base.

Dictyozamites cfr. imamurae described by the writer in the present paper, the writer can not identify thoroughly the former with the present species owing to both disagreeable characters of obtusely pointed apex and of the convex upper margin in the former.

Dictyozamites lateiuae originally described by Oishi from the Naktong group is an allied form to the present species. But as formerly stated by Oishi (1936), in the former species the pinnae are elongated triangular in form and the apex of them is obtusely pointed instead of being parallel-sided and rounded respectively, and the nervation is less crowded.

Occurrence: Abundant.
Reg. No.: KM-598111.

Dictyozamites cfr. imamurae Oishi

Pl. 4, fig. 1; Pl. 5, fig. 2;
Text-fig. 2

Many specimens were obtained. Pl. 4, fig. 1 shows a Dictyozamites frond, more than 14 cm. long and 10 cm. wide. The rachis slender, about 2 mm. across measured on impression and sending off alternately the pinnae at a wide angle, approximately 2.5 cm. distant on each side. The pinnae set closely together, touching or overlapping each other laterally; linear, lateral margin being nearly parallel-sided and apex obtusely pointed or rarely rounded. The basal part of pinnae is apparently sessil, auriculated and asymmetrical as seen in some of Otozamites pinnae, and attached to the upper surface of the rachis by the middle portion of the base. Nerves are very crowded, radiated and often reticularily anastomosed and end in the whole of the outer margin. The meshes in the central median region are approximately 1.0 cm. long, the density being about 25-28 per cm. and become shorter and narrower towards the margin.

Pl. 5, fig. 2 shows two pinnae belonging to Dictyozamites. They well represent the reason that the writer can not thoroughly identify such many fine specimens with Dictyozamites imamurae newly emended in this paper; pinnae set closely, nearly parallel-sided and end obtusely pointed apex; both margin, especially in the upper margin, are slightly convex. This specimen is a portion especially characterized, then it might be possible to distinguish so far as such a specimen from Dictyozamites imamurae or the other known species. Text-fig. 2 shows an outline of pinna illustrated here.

Occurrence: Abundant.

Dictyozamites kawasakii Tateiwa

Pl. 4, fig. 2; Text-figs. 7-8
398.  Mesozoic Plants from the Itoshiro Sub-group. the Tetori Group

1929. Dictryozamites kawasaki TATEIWA: Plate. figs. 6a-b.
1936. Dictryozamites kawasaki OISHI: p. 27. Pl. IX, fig. 4: Text-fig. 2.
1940. Dictryozamites kawasaki OISHI: p. 325. Pl. XXIX, figs. 4-5.
1950. Dictryozamites kawasaki TAKAHASHI et NAITO. p. 188, Text-fig. 1.

A striking good specimens which agree all with TATEIWA’S original specimens were obtained. Frond pinnate, large more than 15 cm. long and 8.5 cm. wide. Rachis probably slender. Pinnae alternate, reniform in outline, about 4.5 cm. long and 2.5-3 cm. wide, with rounded apex, and attached by a narrow portion about 1 mm. wide in the middle of the base to the upper surface of the rachis. Nerves numerous, divergent, anastomosed, the reticulum consisting of polygonal meshes. Pl. 1. fig 2 shows a good preserved specimen on which the above description was mainly based. The rachis seems to be buried in the rock material. Text-fig. 8 shows the outline of pinnae of this species which is to be distinguishable from Dictryozamites reniformis described in the present paper. Text-fig. 7 might show an anterior portion of the frond. The only outline of each pinna impression reminds us of that of Podozamites or Otosamites leaves. but its nervation is apparently divergent and reticulately anastomosed as well as the specimens described above.

In 1950, TAKAHASHI and NAITO reported the occurrence of this species from the Uppermost of Jurassic. Kiyosue formation. According to them, their specimens were not distinguishable from Dictryozamites kawasaki and D. reniformis, and these two forms were quite continuous and they could be safely united into one species. D. kawasaki.

The present writer thinks that the above statement is possibly natural. In the writer’s collection of a large quantity, however, there have yet been found no evidence showing that the two forms belong to the same species. So now the writer deals with them as distinct species respectively.

Occurrence: Common.

Dictryozamites reniformis OISHI

Text-fig. 3-4

1936. Dictryozamites reniformis OISHI: p. 29, Pl. IX, figs. 1, 1a.
1950. Dictryozamites kawasaki TAKAHASHI et NAITO: p. 188, Text-fig. 2.

The writer’s specimens, though they are not so good in preservation, agree all with OISHI’S characteristic species derived from Yambara (the upper course of R. Kuzuryu, Fukui prefecture) of the Itoshiro sub-group.

Pinnae reniform in outline, distinctly short stalked, set closely together and filled with reticulum consisting of fine meshes radiating from the top of the stalk and distributed in almost equal density over the lamina.

Occurrence: Not rare.

Genus Otosamites F. W. BRAUN

In the Japanese Islands, this genus seems to be an Older Mesozoic element, flourishing in Jurassic and becoming to decline in the early stage of Cretaceous. Eight distinct species and several undetermined specimens have already been described: O. huzisawae, O. lancifolius and O. molinianus from the Saragaian (mainly Norian in European standard) strata. O. fujimotoi and O. molinianus from the Liassic (Lower-Middle) strata,
O. beani from the Middle to Upper Jurassic strata in the North-East and the Hida Floral Provinces respectively. As to the Cretaceous species, only O. klipsteinii has been known commonly from both Outer and Inner side Floral
Provinces.

The specimens described by Oishi (1932) from the Shitaka Coal Field, Kyoto prefecture, under the name Otozamites klipsteinii are so imperfect that his identification has need of reexamination about them.

Except some exceptional cases, it might be admitted to consider that each species belong to this genus is respectively peculiar to a certain floral province.

Otozamites sp. described by the present writer (1958) from the Kuzuryu subgroup in Hida massif is a characteristic form, but its specific identification has not been done yet owing to its ill-preservation.

Otozamites cf. beani (Lindley et Hutton) Brongniart

Text-fig. 5

Comparable specimens:
1944 Otozamites beani Harris: p. 419. figs. IA-C, 1k.

Text-fig. 5 shows an imperfect portion of the frond. Rachis obscure owing to being covered with closely set pinnae. Pinnae broad deltoid in outline with rounded or obtusely pointed apex. The bases, though the detail is obvious because of ill-preservation of material, are somewhat asymmetrical, but not so strongly auriculated. Nerves probably originating from the point of attachment, fine, often forking, straight and diverging to the margin of the lamina.

The writer’s specimen closely resembles in general habit those described by Oishi from the Kiyosue formation and also by Harris from the Gristhorp Bed (Middle Estuarine, Bajocian) under the name of Otozamites beani.

The writer, however, hesitates to identify the present specimen with the European species because he concerns anxiously himself about the following reasons, i.e., the present specimen is imperfect in preservation and furthermore, in Otozamites, it is common that the outline of pinnae widely varies according to the position of a frond, then only a part of the frond makes it identification impossible or very difficult.

Occurrence: Rare.
Reg. No.: KM-59005.

Otozamites endoi Kimura sp. nov.

Pl. 5. fig. 4: Text-fig. 6

Description of species: Frond pinnate, unknown size, more than 12 cm. long.

Explanation of Text-figures

Text-fig. 1: Dictyozamites imamurae Oishi emend.: (Reg. No. KM-598111) x4
Text-fig. 2: Dictyozamites cf. imamurae Oishi: (Reg. No. KM-598112) x4
Text-fig. 3: Dictyozamites reniformis Oishi: (Reg. No. KM-57003) x4
Text-fig. 4: Dictyozamites reniformis Oishi: (Reg. No. KM-59910) x4
Text-fig. 5: Otozamites cf. beani (Lindley et Hutton) Brongniart: (Reg. No. KM-59005) x4
Text-fig. 6: Otozamites endoi Kimura sp. nov.: (Reg. No. KM-59001) x4
Text-fig. 7: Dictyozamites kawasakii Tateiwa: (Reg. No. KM-57002) x4
Text-fig. 8: Dictyozamites kawasakii Tateiwa: (Reg. No. KM-57001) x4
Text-fig. 9: Otozamites sp.: (Reg. No. KM-59002) x4
Text-fig. 10: Otozamites sp.: (Reg. No. KM-59001) x4
and 5 cm. wide. Rachis slender about 2 cm. across measured on impression. Pinnae elongated oval in shape, approximately 5 mm. long and 1-1.3 cm. wide at the widest portion, apex rounded and base contracted but the upper base slightly auriculated: attached to the upper surface of the rachis with the lower half of base and strongly directed forward; set closely together, overlapping each other laterally. Nerves fine and delicate, originating from the point of attachment, parallel each other near the base and radiating to the whole of margin, not anastomosed.

Pl. 5. fig. 4 shows a specimen on which above diagnosis was based and Text-fig. 6 shows the outline of pinnae of this characteristic species.

Remarks and Comparison: A single figured specimen has been examined. The writer's species is well characterized by having elongated pinnae strongly directed forward, and there is no comparable species of this genus, though the specimen is not a satisfactory one.

An anterior portion of Otozamites graphicus (Lecknby) figured by Harris (1919, p. 561. Fig. 2A) somewhat resembles the present specimen in outline of pinnae, but smaller and more strongly auriculated than the latter.

Otozamites lancifolius originally described by Iishi from the Saragoton Nariwa group is allied form to the present specimen, but the former is different in having acutely pointed apex and representing coarse nervation from the latter.

It might be possible to obtain further good specimens than the present one from the same locality sometime in future.

Occurrence: Probably rare.
Reg. No.: KM-59011.

Otozamites sp.

Text-figs. 9-10

Large specimens, though they are imperfect, were obtained as shown in Text-fig. 10. Frond long and narrow, nearly parallel-sided, more than 30 cm. long and probably 7 cm. wide, both of apical and basal portion missing. Rachis considerably thick, 3 mm. across measured on impression. Pinnae alternate, oblong or oval in shape, apex bluntly rounded, about 3 cm. long and 1.5 cm. wide at the widest portion; bases almost symmetrical and not auriculated and attached to the upper surface of the rachis by their middle portion. Text-fig. 9 shows probably an anterior portion of the frond: pinnae seem to be short petioled. Nerves indistinct because of ill-preservation of material, but seem to be forking near the broad point of attachment, nearly parallel, ending in the outer margin and considerably coarse in density.

The present specimens closely resemble Otozamites kondoi described by Iishi from the Mon formation (Upper Jurassic) at the northern Pacific coast of the Japanese Islands, in the shape of frond and also of pinnae, mode of attachment to the rachis and the nervation. But the former species is approximately twice as large as the latter.

Explanation of Plate 4

Fig. 1. Dictyozamites cfr. inamurae Iishi; (Reg. No. KM-588112)
Fig. 2. Dictyozamites kawasaki TATSIWA; (Reg. No. KM-57001)
Olozonmites molinianus ZIGNO is an another allied form to the present specimens. But in the former species, the base of pinna is slightly auriculated instead of symmetrical and the size of pinna is smaller than the latter. It also can be expected to obtain more good specimens than the present ones from the same locality.

**Occurrence**: Not rare.

### CYCADOPHYTA

**Cycadales**

**Genus Nilsonnia (BRONGNART)**

*Nilsonnia kotoi (YOKOYAMA) OISHI*


The writer’s specimens are closely referable in general feature to those originally described by YOKOYAMA from Kuwashima (Shimamura) and Tanimura of the Itoshiro sub-group. Frond simple and delicate. Rachis slender, being 1 mm. wide measured on impression and narrowly grooved longitudinally on the upper surface. Lateral lamina deeply cut up to the rachis into long and narrow segments; segments opposite or alternate, lightly curved and directed forward. Nerves considerably fine, mostly simple or rarely once forking near the base, parallel to each other and to the upper margin of the segment running obliquely downwards in the grooved surface of the rachis to its median line.

This species closely resembles the specimens described by YOKOYAMA and YABE and OISHI under the name of *Nilsonnia sinensis* from the Jurassic strata of Manchuria (Shu-ho-tsu and Wei-chia-pu-tzu, Liaoning), and Jurassic strata of Ussuriland and Vladivostok (KRYSHTOFONOVICH: 1916, 1923).

It is the writer’s preliminary opinion that these Japanese and the continental specimens might possibly belong to a same species. This species has not yet been recorded from the Outer side Floral Province of the Japanese Islands in those days.

**Occurrence**: Not rare.
**Reg. No.**: KM-57111.

**Genus Ctenis LINDELEY et HUTTON**

*Ctenis kaneharai* YOKOYAMA

1933. *Ctenis kaneharai* YABE et OISHI: p. 32.

**Description of specimens**: Frond large, unknown size, pinnate. Rachis attaining a width of 0.6 cm. across measured on impression. the ornamentation of its surface not clear. Pinnate apparently subopposite, attached to the lateral sides of the rachis, either in contact or slightly separated in the lower part of the frond, becoming more widely spaced in the middle and upper part of the frond. Pinnate arising nearly at right angle to the rachis. Pl. 6, fig. 1 shows the middle or upper part of the frond which is closely referable to the specimens des-
cribed originally by YOKOYAMA from Nien-tzu-kou Coal-field (Middle Jurassic), Liao-tung, Manchuria, by OISHI from the Kukashima formation and by Harris from the Lower Estuarine pinnae elongated, somewhat inclined forward, mostly parallel-sided, contracted at the base, never expanded: the length of pinnae is not known, as they are not wholly preserved, but the width in one of them is 30 mm. which diminishes to 17 mm. at base.

Owing to its intimate occurrence with the specimen described above, Pl. 6, fig. 2 seems to show the lower part of the frond of the same species, though such a type of pinnae has not been recorded so far: pinnae set closely together, 9.5-10.5 cm. long and 3 cm. wide at the middle portion, tapering to an acute apices and more or less contracted at base. Nerves strong near the base, becoming comparatively fine towards the apex, often dichotomizing and also unifying so as to form elongated meshes. Density 9-10 per cm. at the base, rather more crowded, 13-15 per cm. near the apex.

Remarks: In this species, the apical nature of pinnae was more cleared up by the present specimens, and still more, it might be possible to obtain the complete specimens from the same locality in future.

In 1950, Harris emended the diagnosis of this species adding the detail of its cuticle. In the Japanese specimens, it is regretted that an anatomical study has not yet succeeded on account of the state of preservation, in spite of the writer's exertion.

In the Japanese Islands, this species has only been known from the Kotschian of theInner side Floral Province.

Occurrence: Not rare.


**GINKGOPHYTA**

*Genus Phoenicopsis* HEER

This Ginkgoalean genus is considered to be a continental one which has been widely known from the Mesozoic strata of Siberia, Manchuria, the Northern and Western part of China, Korea and the Arctic region, while it has been rare in the Japanese Mesozoic.

In the Japanese Islands, *Phoenicopsis* spp. have been described by Oishi (1932) from the Norian Nariwa group and also by OISHI (1931) and KIMURA (1959) respectively from the Lower-Middle Liasic Kuruma group. These were all impressions of incomplete and detached leaves. The following genera, i.e., Carptkameskia, Hartzia, Windwardia, Torrellia and *Phoenicopsis*, possess long, slender, ribbon-like leaves growing in clusters upon scaly dwarf shoots. Without reseating into the epidermal and stomal characters, it is very difficult to distinguish one from another in connection with the above genera, while dealing only with incomplete or detached leaves. The generic name of *Phoenicopsis* being
given to the Japanese specimens already described, they are probably referable either to the well-known species in the Jurassic of Eastern Asia, *Phoenicopsis angustifolia* Heer or to *P. manchurica* originally described by Yabe and Oishi.

*Phoenicopsis?* sp. cfr. *P. speciosa* Heer

Pl. 6. fig. 3

Only a specimen shown in Pl. 6. fig. 3 was obtained. This is represented by cluster of detached leaves attaining 13 cm. long and 0.6-1.0 cm. wide, narrowing very gradually into slender basal portion. apex is missing. Nerves are distinct, parallel, about 15 in number and faintly marked interstitials between each pair of them being able to seen.

In the present specimen, it is regreted that both the apical and the basal portions are broken away but the general habit of the leaves reminds us of *Phoenicopsis*, especially *Phoenicopsis speciosa* originally described by Heer from the Jurassic of Siberia.

The specimens described by Kawasaki (1925) from the Daido Series of Korea under the name of *Phoenicopsis speciosa* is an allied form to the present specimen. The designation titled above being precisely given to it, the present specimen is the youngest record of this genus in Eastern Asia. At any rate, this genus is a continental element and rare in the Japanese Islands and it has not yielded yet in the Outer side Floral Province.

**Occurrence:** Very rare.

**Reg. No.:** KM-57008.

**Addendum**

The writer has been conducting researches on the occurrence of fossil plants, especially on the relation between the stratigraphical horizon and its bearing species.

As to the occurrence of fossil plants, we have more or less known that for instance, tree or shrub species was dominant in a certain horizon, while grass species was dominant in another horizon. According to the writer’s experience, good example showing the above fact can be seen in the Iwamuro formation (Lower-Middle Liassic) and also in the Itoshiro sub-group studied in detail.

So far as at least the sphere of geological unit of a member or a formation is concerned, the distinction of the yielded species among various horizons should be explained so much by the vertical range of plant evolution as by the rise and fall of the sedimentary basin having much to do with the vegetation and its variation growing around the basin.

It is interesting to note that tree and shrub species are dominant in the present locality, though such is not the case in its lower horizons. The detail will be stated by the writer sometime in future.

**References**


— (1958). *On the Tetori Flora (Pt. 1)*. *Mesozoic Plants from the Kuzuryu Sub-
Tatsuki KIMURA


Explanation of Plate 6

Fig. 1. Cenrus kaneharai YOKOYAMA: (Reg. No. KM-59101)
Fig. 2. Cenrus kaneharai YOKOYAMA: (Reg. No. KM-57101)
Fig. 3. Phoenicopsis ? sp. cfr. P. speciosa HEER: (Reg. No. KM-59112)

(All specimens illustrated here are in natural size)
Photogr. by S. AOKI

All specimens described here are deposited in Department of Geology of the Komatsu City Museum, Ishikawa Prefecture.