The Science Reports of the Kanazawa University, Vol. II, No. 1, pp. 139—144, March, 1953.

Three Neogene species of *Osmunda* from Ishikawa and Fukui Prefectures, Central Japan

(with 7 Text-figures)

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(Received Decemb. 10, 1952)

Introductory

Filicales is rather rare in the Tertiary. In Japan, it has been known in the *Woodwardia* Sandstone[5] (Ishikari-flora), the Harutori formation of the Urahoro Series (Kushiro Coal-field), and the Uryû formation (Uryû Coal-field), all being the Palaeogene formations of Hokkaido. They are *Woodwardia Endoana* OISHI & HUZIOKA, *W. decurrens* OISHI & HUZIOKA, *Onoclea sensibilis* L. *fossilis* NEWBERRY, *Dennstaedtia nipponica* OISHI & HUZIOKA, *Athyrium delicatulum* OISHI & HUZIOKA and *Osmunda japonica* THUNBERG *fossilis* OISHI & HUZIOKA.[8]

In the Neogene, it is rarer than in the Palaeogene. The only species hitherto known is *Aspidium* sp. found in the Oguni flora[2] (Yamagata Pref. -Miocene); *Woodwardia cf. japonica* Sw., *W.* sp. and *Osmunda* sp. in the Taihata formation[10] (Hyôgo Pref. -Upper part of the Middle Miocene, *Comptoniphyllum-Liquidambar* Zone) and *Aspidium* sp. and *Dryopteris manchuriensis* HOOK in the Shiobara flora[2] (Tochigi Pref.-Pliocene).

The Hokuriku region (Northern side of the Central Japan) is not exceptional in yielding only a few fossil species of Filicales in the Neogene formation.

In the following localities comparatively good samples of pinnae have been collected.

Localities :

1) Tsunenomori, Kunimi-Mura, Nyu-Gun, Fukui Pref.
(福井県丹生郡国見村常ノ森)

2) Godaishi, Nishiago-Mura, ditto, ditto.
(福井県丹生郡西安居村五太子)

3) Gohyakutoge, Shinmaru-Mura, Nomi-Gun, Ishikawa Pref.
(石川県能美郡新丸村五百峠)

4) Kammachi, Kumaki-Mura, Kashima-Gun, ditto.
(石川県鹿島郡熊木村上町)

5) Kuragatake-Machi, a detached piece of Kanazawa City, ditto.
(石川県金沢市倉ヶ岳町)

Of these localities, the genus *Osmunda* has been found at Tsunenomori, Kammachi and Kuragatake.

Geological Notes

These occurrences of the *Osmunda*-florules are geologically briefly accounted for in the following lines ;

1) Tsunenomori

This locality is assumed to be of the Tôbu (燈豊) formation, because of the dominant occurrence of the tuffaceous sandstone with *Vicarya yokoyamai* and *Comptoniphyllum naumanni* zones at the neighbouring village of Aikawa (国見村鮎川).

Tôbu formation contains three lignite seams, and the uppermost one yields abundant plant fossils. Tsunenomori florule is characterized by the content of *Liquidambar formosana* HANCE and *Osmunda tsunenomoriensis* nov. sp. which occurs in the uppermost of these seams.

2) Kammachi

This locality was discovered, August, 1951, by Prof. W. ICHIKAWA and Assist. K. KOJIMA of the Geological Institute of the University of Kanazawa.

Our collection contains a fruit of *Liquidambar* sp., leaves of *Comptoniphyllum naumanni* NATHORST, needles, cones and seeds of *Pinus* sp., needles and cones of *Abies* sp., leaves of Cupressaceae, capsules of Leguminosae, and many leaves of latifoliates (mainly *Salix* sp.), besides *Osmunda bromeliaefolioides* nov. sp.

This Kammachi florule is found in the diatomaceous mudstone of the Tajiri (田尻) mudstone bed of the Nanao (七尾) formation ; it is useful for the recognition of the similar formations in the other regions of Noto Peninsula.

On examining the diatoms in this formation, W. ICHIKAWA identified forms that are mostly fresh-water in habitat, together with a few brackish-water forms. This suggests that this diatomaceous mudstone was deposited in a lagoon-like area.

3) Kuragatake-Machi

Here, the members of the Geological Institute of the University of Kanazawa collected *Osmunda kuragatakensis* nov. sp., *Plagiogyria* sp. and a fertile pinne of *Pteridium* sp. in association with many large latifoliate leaves (*Magnolia* sp., *Quercus* sp. etc.).

This florule occurred in a white liparitic tuff of the socalled "Green-tuff beds", and this tuff stratigraphically corresponds to the Iwaine (岩稲) formation of the Lowest part of the Yatsuo (八尾) group. Thus, it is suggested that this florule is older than the *Comptoniphyllum-Liquidambar* zone.

Acknowlegement

I take this occasions to acknowlege my indebtedness to the members of the Geological Institute of the University of Kanazawa, whose collections of many good samples have been made accessible to me, and whose valuable informations and opinions on the stratigraphical and bio-ecological status have encouraged me carry out this study. To Prof. G. MASAMUNE, who is a member of the Biological Institute of the University of Kanazawa, I am great's

indebted for his kindness on the botanical status have suggested to me carry out this study. Especially, to Prof. I. HAYASAKA, I have no words to my gratitude for his kind criticism of this study as well as for reading the manuscripts.

The expense for the present study is being met by a grant from the Department of Education to me I wish to express my sincere thanks.

Description of Species

Osmundaceae

1. *Osmunda bromeliaefolioides* nov. sp.

Textfig. 1 (Reg. No. GKZ 10001 a)

1933. Cfr. *Osmunda bromeliaefolia* OGATA (Recent species) Vol. 5, Fig. 237 (Text-fig. 2)

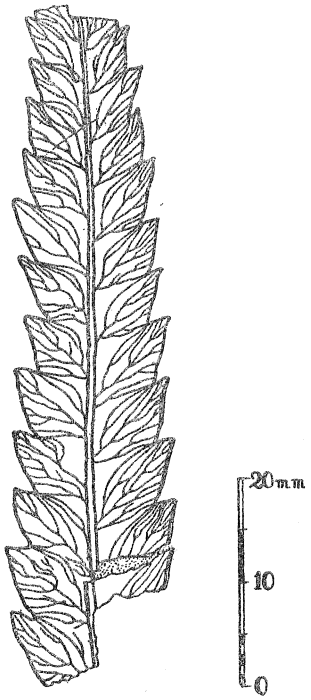
Pinnule simple and large ; borders deltoid-undulate, lacking parts of top and base ; about 80 mm long, and 16 mm broadth. Medial nerve broad ; lateral nerves palmate-furcate, reaching the borders at some broader angle of divergence. These palminerves are assumed to be 12 in a leaf 80 mm long, and 11 in that 62 mm long.

The beautiful fragment at hand is not distinguishable from the recent specimens of *Osmunda bromeliaefolia* (COPELAND) OGATA (Text-fig. 2), which grows in abundance in the Islands of Ogasawara, southern side of Shikoku and Kyusyu, Islands of Ryukyu, Taiwan, Borneo, Java, Sumatra, Celebes etc., being distributed from the temperate regions to the tropical regions.

This florule seems to has been in the temperate regions, because of which is characterized by *Liquidambar* sp., *Comptoniphyllum* sp., *Pinus* sp. etc.

Locality : Kammachi, Kumaki-Mura, Kashima-Gun, Ishikawa Pref. (Topographical Map of "Nanao" 1/50,000) Lat. 37°7′5″ N. Long. 136°50′24″E.

Geological horizon : Tajiri mudstone bed of Nanao formation. *Comptoniphyllum-Liquidambar* zone.



Text-fig. 1. (GKZ 10001a) *Osmunda bromeliaefolioides* n. sp.

Text-fig. 2. *Osmunda bromeliaefolia* COPELAND (after OGATA 1933)

Upper part of the Middle Miocene.

Collectors : The members of the Geological Institute of the University of Kanazawa (1951).

Repository : The Geological Institute of the University of Kanazawa. Reg. No. GKZ 10001 a (Typespecimen), GKZ 10001 b, GKZ 10002.

2. *Osmunda tsunenomoriensis* nov. sp.

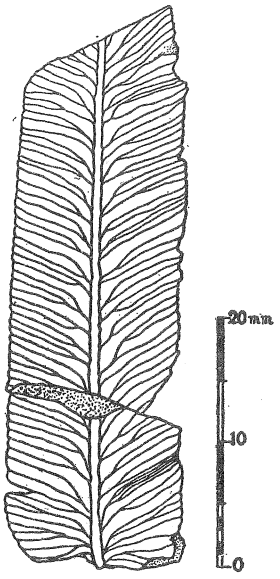
Text-fig. 3 (Reg. No. GKZ 10003)

1833. Cfr. *Osmunda major* LESQ. Pl. XVIII, Fig. 5 (Text-fig. 5)

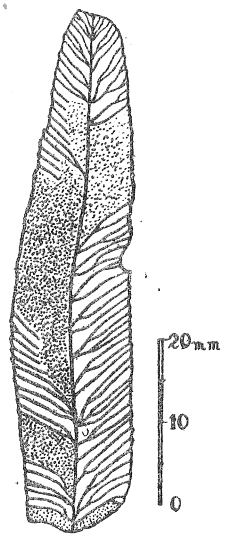
Pinnule simple and somewhat larger ; top part lacking ; 46 mm long and 13.5 mm broad ; rectangular-lanceolate ; unequilateral at base ; borders undulate ; medial nerve broad ; lateral nerves reaching the borders at a broad angle of divergence, generally forking once at near the base, one of the branches forking again at the middle, but some are non-furcate, and two furcate veins forming a group.

These characters suggest a close affinity of this species to the remains of *Osmunda macrophylla* PENHALLOW (Text-fig. 4) from Kanayama, Nishishirakawa-Gun, Fukushima Pref. (福島県西白河郡金山). But borders of *O. macrophylla* is entire rather than undulate like in this new species.

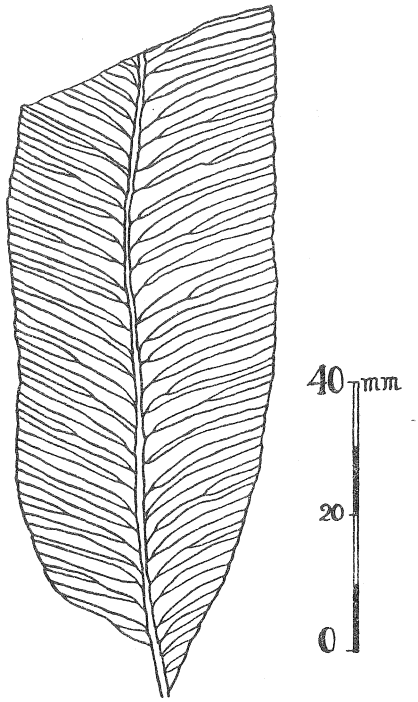
This new species is characterized by a group of furcateveins, 17 groups of which being counted in a leaf 46 mm long (average interval, 46/17=2.71 mm), but *O. macrophylla* counted 30 groups in 64 mm long (lacking a top part, average interval, 64/30=2.13 mm),



Text-fig. 3. (GKZ 10003)
Osmunda tsunenomoriensis
n. sp.



Text-fig. 4.
O. macrophylla
PENHALLOW



Text-fig. 5.
O.major LESQ.
(after LESQUEREUX 1833)

33 groups in still other 68 mm long (average interval, 68/33=2.06 mm). Thus the average interval of veins in the new species is somewhat larger than that of *O. macrophylla*, the ratio being 2.7 : 2.1.

The new species was found in the upper part of the Middle Miocene formation while the latter occurred in the Upper Oligocene.

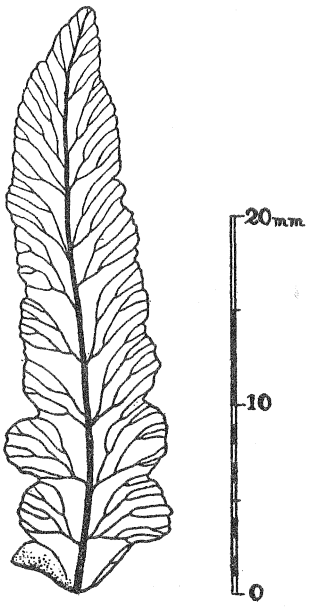
Moreover, fragments with similar characters are found in the flora of the Laramie group. It is *O. major* LESQ. (Text-fig. 5) ; it differs in the following points from this new species, however. Namely, *O. major* is larger and broader than the new species (40 mm : 16 mm of breadth) : the former is linearly lanceolate, while the latter is rectangular ; and the former is Palaeogene in age (Laramie Group).

Locality : Tsunenomori, Kunimi-Mura, Nyu-Gun, Fukui Pref. (Topographical Map of "Fukui" 1/50, 000).

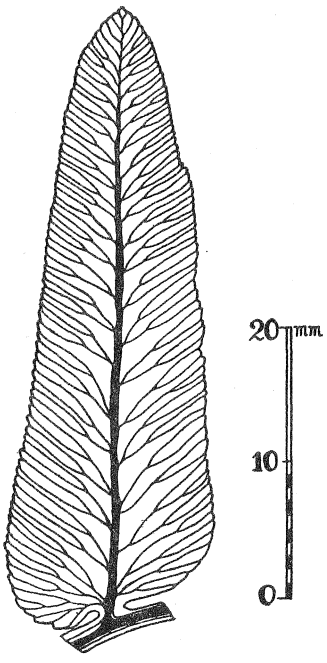
Geological horizon : Tôbu formation. *Liquidambar* zone. Upper part of the Middle Miocene.

Collectors : The members of the Fukui Municipal Museum of Fukui City (1952).

Repository : The Geological Institute of the University of Kanazawa. Reg. No. GKZ 10003 (Type-specimen).



Text-fig. 6. (GKZ 10004) *Osmunda kuragatakensis* n. sp.



Text-fig. 7. *O. japonica* TUNB. (after OGATA 1933)

3. *Osmunda kuragatakensis* nov. sp.

Text-fig. 6 (Reg. No. GKZ 10004)

Pinnule simple, and smaller than the above mentioned species ; base is lost ; 32 mm in length and 8 mm breadth ; border is assumed to have 3-4 undulations in the basal part, while the top is obtuse ; medial nerve broad ; lateral nerves reaching the border, once forking at the base ; in the middle part, one of the branches fork again at the middle ; and the basal part shows a palmifurcate as the result of twice branching.

Characters of forking resembles that of *O. japonica* TUNB. (Recent species, Text-fig. 7),

and *O. japonica fossilis* OISHI & HUZIOKA (Pl. XXXIX, Figs. 5, 6), but the average interval of nerves of the new species is assumed to be larger ; border of the leaflet is not entire ; and narrower than in the former.

Locality : Kuragatake-Machi, a detached piece of Kanazawa City, Ishikawa Pref. (Topographical Map of "Tsurugi" 1/50,000). Lat. 36°28′19″N. Long. 136° 38′47″ E.

Geological horizon : Upper part of the Lower Miocene? Basal part of the so-called "Green tuff beds".

Collectors : The members of the Geological Institute of the University of Kanazawa (1952).

Repository : The Geological Institute of the University of Kanazawa. Reg. No. GKZ 10004 (Typespecimen).

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