NOTES ON SOME FOSSIL FERNS FROM THE NAKTONG SERIES OF KOREA

By

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With 1 Plate and 2 Text-figures

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In looking over the collection of fossil plants from the Naktong Series of southern Korea made by Professor YABE[1], a majority of which have already been described by him in 1905, the writer came across some interesting ferns not mentioned in YABE's paper and yet deserving special interest.

The fossils in question which may be mentioned in this note are all ferns in fructified condition quite new to science and were derived from Pul-tan-kokai[2], near Naktong, N. Keisyô-Dô, Korea. One of them is a fern with sori of *Asterotheca* type identical with none of the species of *Asterotheca* ever described, while the other is one which was believed by the writer to belong to a new schizaeaceous genus, *Naktongia*. There are several other specimens of ferns of special interest in Prof. YABE's collection, however, they may be mentioned in a separate later note.

The species of fossil plants described by Prof. YABE were 21 in number including species of the genera *Equisetites, Sagenopteris, Adiantites, Sphenopteris, Cladophlebis, Coniopteris, Onychiopsis, Pinus, Podozamites, Ctenophyllum*?, *Dioonites*?, *Nilssonia* and *Dictyozamites*. In 1936 the writer[3] described a new species of *Dictyozamites, D. Tateiwae,* in 1927 Dr. OGURA[4] described *Cibotiocaulis*

(1) H. YABE: Mesozoic Plants from Korea. Journ. Coll. Sci., Imp. Univ. Tôkyô, Vol. XX, Art. 8, 1905.

(2) 朝鮮慶尙北道洛東附近佛堂峴.

(3) S. ÔISHI: On the Japanese Species of *Dictyozamites*. Jap. Journ. Geol. Geogr., Vol. XII, Nos. 1–2, 1936, p. 25, Pl. IX, fig. 3; text-fig. 3.

(4) Y. OGURA: On the Structure and Affinities of Some Fossil Tree-Ferns from Japan. Journ Fac. Sci., Imp. Univ. Tôkyô, Sec. III. (Botany), Vol. I, Pt. 3, 1927, pp. 352 and 364.

Tateiwae OGURA and *Cyathocaulis naktongensis* OGURA, from the Naktong Series. In 1929, Dr. TATEIWA[1] enumerated, excepting the above one by the writer, more than thirty species of fossil plants from the same Series, some of which were accompanied by figures only.

The specimens dealt with by Dr. TATEIWA and enumerated in his list were later submitted to the writer for description. The full description with accompanying figures may, therefore, appear in a monograph of the Mesozoic floras in Japan which is now under preparation.

Thus the species of the Naktong flora attain a considerable number perhaps more than forty in total. The principal constituent of ferns of the flora are not only numerically but also biologically important as they suggest that tropical to subtropical conditions prevailed in southern Korea during at least the beginning of the Naktongian stage, which is equivalent to the Tetori Series and corresponds in age to the later phase of the Upper Jurassic.

MARATTIALES

GENUS *Asterotheca* PRESL

Asterotheca naktongensis sp. nov.

Pl. XXXV (I), Figs. 1, 1a, 1b, 2; Text-fig. 1 (all type-specimen).

Diagnosis: 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 pinnules, 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 opposition possibly attached to a central receptacle and free at least at their apices. Spores unknown.

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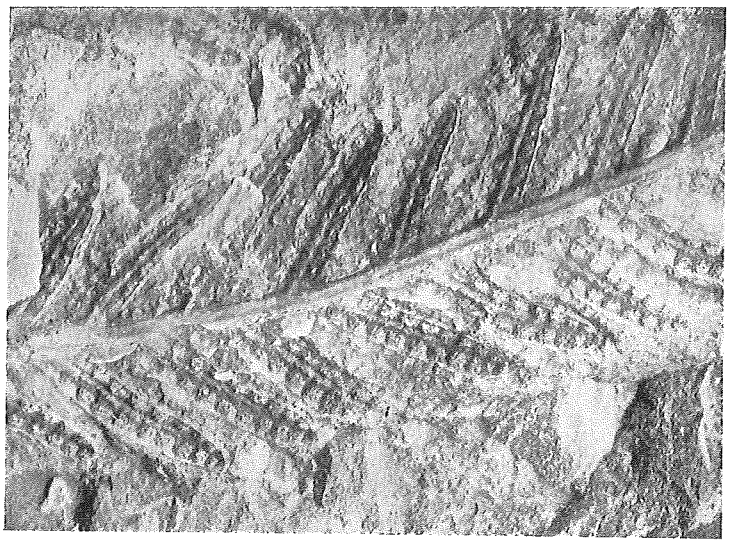
(1) I. TATEIWA: Geological Atlas of Chôsen, No. 10, Keisyû-Eisen-Taikyû and Wakwan Sheets, 1929.

Description of specimens: The specimen in Pl. XXXV (I), fig. 1 was found on the back surface of the same slab of rock as that on which a fertile specimen of *Cladophlebis naktongensis* YABE (YABE, 1905, Pl. III, fig. 12) is impressed. It shows a portion of a penultimate pinna which bears ultimate pinnae attached oppositely to the axis of the penultimate pinna. This specimen shows that the penultimate pinnae are very slender and flexuous. Each pinnule in this specimen bears distinct sori on each side of the midnerve. However,



Text-fig. 1. *Asterotheca naktongensis* sp. nov. A part of the specimen in Pl. XXXV, fig 2, ×4.

they are mostly appressed, and in a small number of them only can be made out the number of sporangia comprising each sorus. Most sori seem to be made up of 5–7 sporangia in close apposition forming a circular group instead of being fused to compose a synangia. Neither annulus nor indusium can be made out in any of the sori examined. Therefore, it is highly probable that the sporangia are entirely exannulate.

The specimen in Pl. XXXV (I), fig. 2 is an impression of a back surface of another fertile frond. It indicates well the habit of the frond: it shows that the penultimate pinnae are opposite, slender and overlapping each other laterally. The outline of sori is very distinctly impressed on each pinnule of this specimen, though their inner structures are obscure.

As the secondary nerves in the two specimens above described are obscure, the exact position of sori in regard to the nervation cannot be ascertained.

Remarks: The soral character, especially the exannulate sporangia of the Korean specimens show that this fern belongs to an *Asterotheca*. The sori resemble those of Gleicheniaceae, but in the latter the sporangia have an annulus.

More than a dozen species of fossil ferns with *Asterotheca* type of sori or synangia have been described from Carboniferous and Permian rocks of the world, while they are very meagrely known from the Mesozoic. With none of the Palaeozoic species of *Asterotheca* is the present specimen comparable. From the Mesozoic rocks only two valid species of *Asterotheca* are known to paleobotaniste, viz. *A. Meriani* BRONGN.(1) from the Middle Keuper of Europe and North America and *A. Cottoni* ZEILLER from the Rhaetic of Tonkin(2): these two exotic species show a stronger habit of the frond and have larger pinnules. Accordingly there is certainly a distinction between these exotic species and the ones now in hand.

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 period.

SCHIZAEACEAE

Naktongia gen. nov.

Type-species: *N. Yabei*.

Diagnosis: Sporangia arranged in a single row on each side of pinna-axis, each sporangium corresponding to a single pinnule, apical annulus uniserial, with broad distal face.

Naktongia Yabei sp. nov.

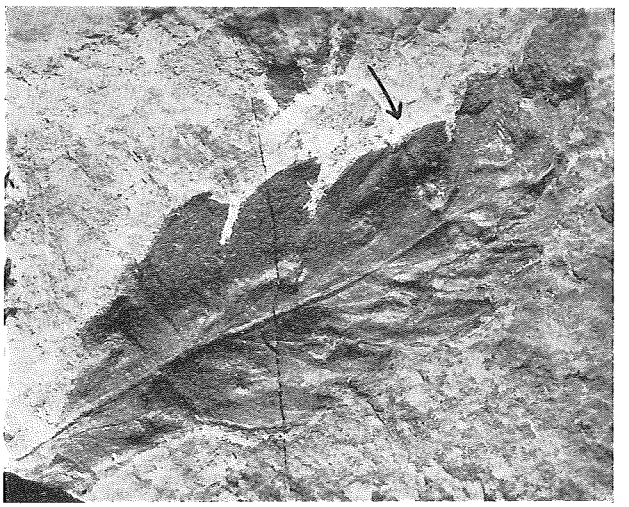
Pl. XXXV (I), Fig. 3 (type-specimen); Text-fig. 2.

1905. *Sphenopteris* sp. YABE: Mesozoic Plants from Korea, p. 38, Pl. I, fig. 15.

(1) F. KRASSER: Die Diagnosen der von Dionysium Stur in der obertriadischen Flora Lunzerschichten als Marattiaceenarten unterschiedenen Farne. Sitzungsb. k. Akad. Wiss. Wien, Bd. CXVIII, Abt. 1, 1909, p. 32.

(2) R. ZEILLER: Flore Fossile des gîtes de charbon du Tonkin, 1903, p. 26, Pl. I, figs. 4–9.

In describing *Sphenopteris* sp. from the Naktong Series of Korea, Prof. YABE[1] gave the following description: "Frond bipinnate, rachis slender; pinnae linear, springing almost at right angles from the rachis, pinnately lobed; lobes obtuse, acuminate with entire margin; somewhat falcate; venation of a *Sphenopteris* type, that is to say, with a distinct vein sending off an obsolete secondary vein into each lobe. Sori in two rows, one on each side of the median vein, placed near the base of each lobe and one at the summit of the uppermost branch of the vein."



Text-fig. 2. *Naktongia Yabei* gen. et sp. nov. The lowest pinnae of the specimen shown marked with an arrow in Pl. XXXV, fig. 3, ×3. A sporangium indicated with an arrow in the enlarged pinna shows structure: it consists of a central circular area, the distal face, and surrounding apical annulus consising of approximately 20 elongated cells.

Discussion: Having examined the type specimen of *Sphenopteris* sp., the author found that YABE's sketch of the specimen (his Pl. I, fig. 15) was drawn pretty right, and also found that one of the soral impressions shows its structure. A photograph of the type-specimen is shown in Pl. XXXV (I), fig. 3. An enlarged figure of a soral impression marked with an arrow from the specimen is shown in text-

(1) H. YABE: Mesozoic Plants from Korea, p. 38.

fig. 1; the specimen is by no means satisfactorily preserved, but a careful examination by the aid of a magnifier or binocular microscope at low magnitude shows that each soral impression in fig. 3 represents a single sporangium 1 mm. in diameter consisting of a central circular area and surrounding annulus consisting of approximately 20 elongated cells. In the figure the sporangium is seen from above, the cells of the annulus radiating from the circular central area, that is distal face, but there is no evidence that the annulus was apical. Unfortunately, neither the general shape nor the further internal structure of the sporangium can be made out; however, the solitary sporangium suggests that the fern is schizaeaceous.

Among fossil schizaeaceous ferns the present specimen resembles *Ruffordia* in respect to the Sphenopteroid habit of the frond, but in the latter the sporangia is scattered all over the surface of the fertile pinnules(1).

Diagnosis: 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.

EXPLANATION OF THE PLATE XXXV (I)

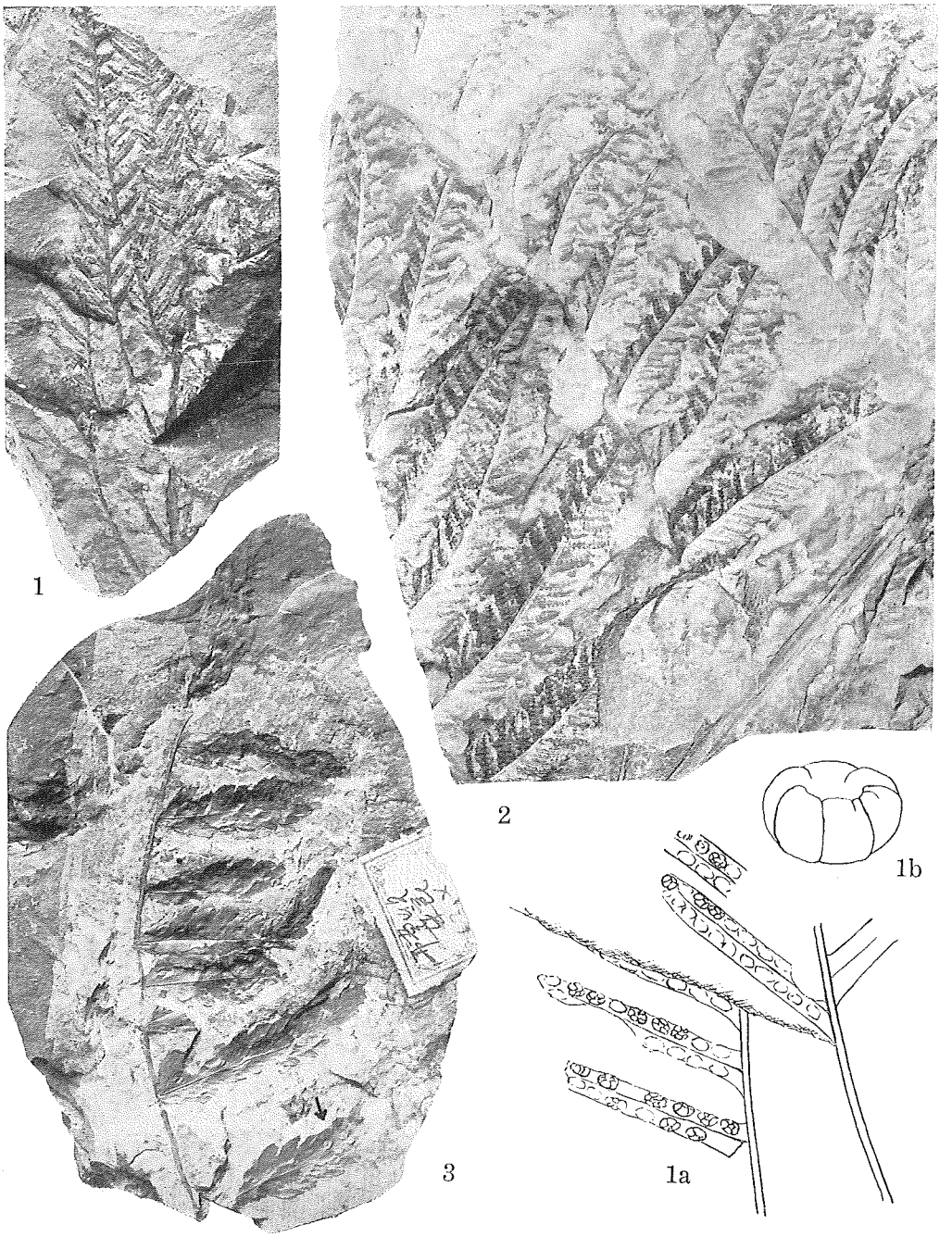
(The figures are natural size unless otherwise stated).

Figs. 1, 1a, 1b. *Asterotheca naktogensis* sp. nov. 1, the type-specimen, × 1; 1a, a part of the specimen in fig. 1 thrice magnified in order to show the arrangement of sori; 1b, a sorus considerably enlarged.

Fig. 2. *Asterotheca naktongensis* sp. nov., a larger specimen which shows the tripinnate habit of the frond.

Fig. 3. *Naktongia Yabei* gen. et sp. nov., × 1. The pinna marked with an arrow is shown in the text-figure 2.

(1) T. G. HALLE: On the Sporangia of Some Mesozoic Ferns. Ark. f. Bot., vol. XVII, No. 1, 1921 p. 11, Pl. II, figs. 1–8; text-fig. 1.



Takeda photo. and Ôishidel.

S. Ôishi : Fossil Ferns from the Naktong Series.