NOTES ON SOME FOSSIL PLANTS FROM THE MOULIN AND THE MISHAN COAL-FIELDS, PROV. PINCHIANG, MANCHOUKUO

By

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With 1 Plate

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The collection of the fossil plants described in this paper was made by Mr. T. TAKEYAMA, a geologist to the Geological Survey of the South Manchuria Railway Co., and sent to us for description by Mr. R. SAITÔ, also a geologist of the Survey, on behalf of the collector.

The region from which the specimens were obtained lies on the eastern border of Manchoukuo. The fossils were found at two localities, viz., Li-shun-chen (梨樹鎮) in the Moulin (穆稜) coal-field and a place 6 km. east of Ti-tao-ho-tzu (滴道河子) in the Mishan (密山) coal-field, both belonging to the Moulin Series.

The Moulin Series, according to WANG[1] and AHNERT, consists mostly of sandstone. The lower part contains tuff; workable coal seams occur in the middle part; and the upper part is composed of sandstone and shale. The total thickness is about 700 m. The Series appears to be considerably rich in fossil plants. WANG and AHNERT enumerated more than a dozen of species without figures and description and are of the opinion that the Series is of an Upper Jurassic. The list given by the authors above cited contains Upper Jurassic and Lower Cretaceous elements such as *Cladophlebis Browniana* (DKR.) and *Sphenopteris Goepperti* (DKR.), Middle Jurassic elements, such as *Cladophlebis* (*Eboracia*) *lobifolia* (PHILLIPS) and *Elatocladus manchurica* (YOKOYAMA), while there is a certain species indicating

(1) H. S. WANG: The Geology and Mineral Resources of Mishan and Muling District, Kirin. Bull. Geol. Surv. China, No. 13, 1929, p. 25.

a still lower horizon, namely, *Neocalamites Carrerei* (ZEILLER). Therefore, there needs to be a re-examination of their material.

The fossil plants described in this paper are as follows:

Li-shun-chen:

Coniopteris hymenophylloides (BRONGN.)
Cladophlebis (*Gleichenites*?) *Takeyamae* sp. nov.
C. lobifolia (PHILLIPS)
C. sp.
Elatides manchurensis sp. nov.

Ti-tao-ho-tzu:

Coniopteris burejensis (ZALESSKY)

The material is by no means satisfactory for determining the geological age of the Series, but the existence of *Coniopteris hymenophylloides, C. burejensis, Cladophlebis lobifolia* indicates that the Series, at least its plant-bearing horizons, is not older than the Middle Jurassic. The opinion of the present writers is that it belongs probably to the Middle Jurassic or to the Upper Jurassic at the youngest.

Looking over the list of fossil plants by WANG and AHNERT, and by the present writers as well, it is noteworthy that the Cycadophyta are not represented, while the ferns form the dominant group; Conifers are few in number as compared with the ferns.

DESCRIPTION

Coniopteris hymenophylloides (BRONGN.)

Pl. V (I), Figs. 1, 1a, 2.

A slab of rock is covered with many fragments of sterile pinnae which belong undoubtedly to the well-known Jurassic species, *Coniopteris hymenophylloides* (BRONGN.). The preservation is satisfactory. One of the pinnae is shown in Pl. V (I), fig. 1. It is a back surface of a small fragment of pinnae more than 2.5 cm. long; the pinna-axis is prominent, being elevated as a ridge, and its surface is smooth. The pinnules are opposite or subopposite, closely set, more or less rhomboidal, lobed into 5–7 lobes with rounded apex. The nervation is of characteristic *C. hymenophylloides* type.

Another, unillustrated, specimen shows the upper surface of a pinna, in which the pinna-axis is longitudinally grooved. Therefore, the ideal cross section of the pinna-axis is as shown in fig. 2 on the same plate.

C. hymenophylloides is very common in the Jurassic rocks of Manchuria[1], and in China also the occurrence was recently reported by SZE[2] from several localities.

Locality: Li-shun-chen.

Coniopteris burejensis (ZALESSKY)

Pl. V (I), Figs. 3, 3a, 3b, 4.

Sterile pinna: axis more slender than that of *C. hymenophylloides*, with longitudinal ridge on its back surface and a groove on the upper; pinnules linear in outline, with a few shallow serrations along the margin. Nervation of *Sphenopteris* type.

Fertile pinna: each pinnule is much reduced to a round sorus.

Both sterile and fertile pinnae are not in the organic connection; however, the slabs of the rocks are covered with many fragments of sterile pinnae of *C. burejensis* almost exclusive of other fossil plants, and the fertile pinnae are associated with them. Therefore, it is highly probable that they belong to the same fern.

Chinese specimens described by SZE[3] from Mentoukuo agree in both fertile and sterile pinnae with the Manchurian ones. SZE claims the Liassic age for the Mentoukuo plant-bed, but the present writers' view is that it may be still younger, viz., Middle Jurassic at the oldest. YABE and ÔISHI[4] described it from the Fang-tzu coal-field, Shantung, China.

Locality: 6 km. east of Ti-tao-ho-tzu.

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(1) H. YABE and S. ÔISHI: Mesozoic Plants from Manchuria. Sci. Rep., Tôhoku Imp. Univ., Ser. II, Vol. XII, No. 2B, 1933, p. 16.

(2) H. C. SZE: Beiträge zur liasischen Flora von China. Mem. Nat. Research Inst. Geol., Acad. Sinica, No. XII, 1931, pp. 35, 45; Beiträge zur mesozoischen Flora von China. Pal. Sinica, Ser. A, Vol. IV, Fasc. 1, 1933, pp. 11, 27; Mesozoic Plants from Kansu. Mem. Nat. Research Inst. Geol., Acad. Sinica, No. XIII, 1933, p. 69; Jurassic Plants from Shensi. Ibid., p. 78.

(3) H. C. SZE: Beiträge zur liasischen Flora von China. Loc. cit., p. 43, Pl. VII, figs. 5–8.

(4) H. YABE and S. ÔISHI: Jurassic Plants from the Fang-tzu Coal-Field, Shantung. Jap. Journ. Geol. and Geogr., Vol. VI, Nos. 1–2, 1928, p. 8, Pl. II, fig. 11.

Cladophlebis lobifolia (PHILLIPS)

Pl. V (I), Figs. 5, 5a.

The figured specimen is a part of a frond at least bipinnate, at least 6 cm. long, traversed by a slender rachis 1 mm. thick; the pinnae are subopposite, about 4.5 cm. long and 9 mm. broad at the middle portion where the pinnae are broadest, thence narrowing gradually towards both ends, and attached to the rachis at a wide angle or nearly perpendicularly at an interval of about 1 cm. on each side of the rachis; the pinnules are deltoid, with a blunted apex, set closely, attached to the rachis by the slightly contracted base; the lower basal one is larger than the others; the midnerve enters the pinnules at a small angle near the adaxial side of the lamina, and soon bends outwards in an angle of approximately 45° with the rachis, sending off a number of secondary nerves once or twice dichotomously forking.

C. lobifolia is characterised by possessing a lower basal pinnule greater in size than the other ones; in this point, the present specimen agrees with the type-specimen.

In Manchuria, this species was described by YABE and ÔISHI[1] from Sha-ho-tzu, while in China it was recently described by SZE[2] from Kansu and Shensi.

Locality: Li-shu-chen.

Cladophlebis (*Gleichenites*?) *Takeyamae* sp. nov.

Pl. V (I), Figs. 6, 6a (type-specimen).

Frond at least bipinnate, more than 12 cm. long and 8 cm. broad at the lower broken end, attenuating gradually towards the broken apex. Rachis 3 mm. thick almost throughout its whole length. Pinnae long and narrow, linear, about 7 mm. broad, narrowing very gradually towards the blunt apex, and attached to the rachis at an angle of 60°–65°. Pinnules small, finger-shape or elongate-ovate, about 4 mm. long and 2 mm. broad, set closely, alternate, straight or sometimes slightly falcate, and attached somewhat on the upper side of the pinna-axis by the whole or slightly contracted base so as to overlap the pinna-axis. Nervation is of usual *Cladophlebis* type;

(1) H. YABE and S. ÔISHI: Mesozoic Plants from Manchuria. Loc. cit., p. 14.

(2) H. C. SZE: Mesozoic Plants from Kansu. Op. cit., p. 68; Jurassic Plants from Shensi. Loc. cit., p. 78.

midnerve straight, persisting to the tip of the pinnule, and sends off 4–5 number of secondary nerves arising at a fairly wide angle (50°–60°) to the midnerve and forking once midway to the margin; lower basal one sometimes forking twice. Fructification unknown.

The general habit of the specimen, especially its strong rachis, crowded pinnae, and small pinnules shows striking resemblance to *Gleichenia longipennis* HEER[1] from the Kome bed of Greenland. So great was the resemblance that the present writers first inclined even to believe the existence of this species in the plant-bed of Li-shu-chen. However, after a careful examination of the specimen it was decided to give it a new specific name, *Takeyamae*. This has been done for the reasons that, firstly, the specimen does not show the characteristic forking of the rachis, secondly, the frond or penultimate pinna contracts more abruptly towards the apex than the corresponding vegetative part in HEER's specimen (Pl. VIII, fig. 1), thirdly, the pinnules are much more crowded and overlap at their bases on the pinna-axis, forthly, HEER's largest specimen (Pl. VIII, fig. 1), which may be the type-specimen, does not show the nervation and a small specimen which does show the nervation (Pl. VIII, fig. 3a) is from another locality, fifthly, *G. longipennis* is from the Kome bed, while the present specimen is from a bed possibly not younger than the Upper Jurassic; thus there is a considerable difference in geological age between the two beds.

Locality: Li-shun-chen.

Cladophlebis sp.

Pl. V (1), Fig. 7.

The specimen in Pl. V (I), fig. 7 is a fragment of fern-frond at least bipinnate, and is characterised by a very thin and delicate axis less than 0.5 mm. thick to which pinnae are attached alternately; the pinnae also are very delicate, set closely, measuring about 2 cm. long and 7–8 mm. broad; the pinnules are long and narrow, the length being three times the breadth, somewhat remote, and attached by their whole bases. The nervation is indistinct; hardly anything can be seen except the well-marked midnerve.

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(1) O. HEER: Die Kreide-Flora der arctischen Zone. Kgl. Svensk. Vet.-Akad. Handl., Bd. XII, No. 6, 1874, p. 46, Pl. VIII, fig. 1 (other specimens are doubtful).

This specimen being very fragmentary, it is difficult to get an idea as to the general habit of the fern. The shape of the pinnules somewhat resembles *C. Browniana* (DKR.), a well-known Wealden species, but the present specimen may be different from it. There is another possibility of its being an upper portion of a pinna of *Cladophlebis Takeyamae* sp. nov. described above in this paper.

Locality: Li-shun-chen.

Elatides manchurensis sp. nov.

Pl. V (I), Figs. 8, 8a, 9, 9a (all are type-specimens).

Cone ovate, 13 mm. high and 10 mm. wide; cone-scales about 25 in number, leathery, rigid, rhomboidal in their distal ends, 4–5 mm. high, acuminated at the apices.

Vegetative shoots of *Pagiophyllum* type; shoots branched frequently bearing leaves elongated triangular in shape, sometimes falcate, acuminated at apices, about 5 mm. long, 2 mm. broad, appressed to the stem in the lower portion of the lamina, with distinct dorsal keel.

E. manchurensis is characterised by a small, ovate cone with leathery rather rigid cone-scales. The cone and the vegetative shoots are of Araucarian type, but there is not sufficient data to serve as a criterion of affinity.

The cone is comparable with those of *E. ovalis* HR., *Brandtiana* HR., *falcata* HR., *Williamsoni* (BRONGN.)[1] but it is smaller and possesses cone-scales more rigid and less acuminated. The cone resembles also one described by CARRUTHERS[2] from the British Gault under the name *Sequoites Gardneri*, but ours is smaller and narrower, and the cone-scales are much fewer in number.

The present specimens represent a type which is not identical with any other Coniferous shoots with similar cones.

Locality: Li-shun-chen.

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(1) O. HEER: Beiträge zur Jura-Flora Ostsibiriens und des Amurlandes. Mém. l'Acad. Imp. d. Sci. d. St. Pétersbourg, Ser. VII, Tom. XXII, No. 12, 1876, pp. 77–79.

(2) W. CARRUTHERS: On Some Undescribed Coniferous Fruits from the Secondary Rocks of Britain. Geol. Mag. London, Vol. VI, 1869, p. 7, Pl. I, fig. 7.

Plate V (I)

PLATE V (I)

(The figures are of natural size unless otherwise stated).

Figs. 1, 1a, 2. *Coniopteris hymenophylloides* (BRONGN.). 1, back surface of a pinna; 1a, a pinnule of fig. 1, × 3; 2, an ideal cross-section of pinna-axis. Li-shun-chen. (Reg. No. 7888).

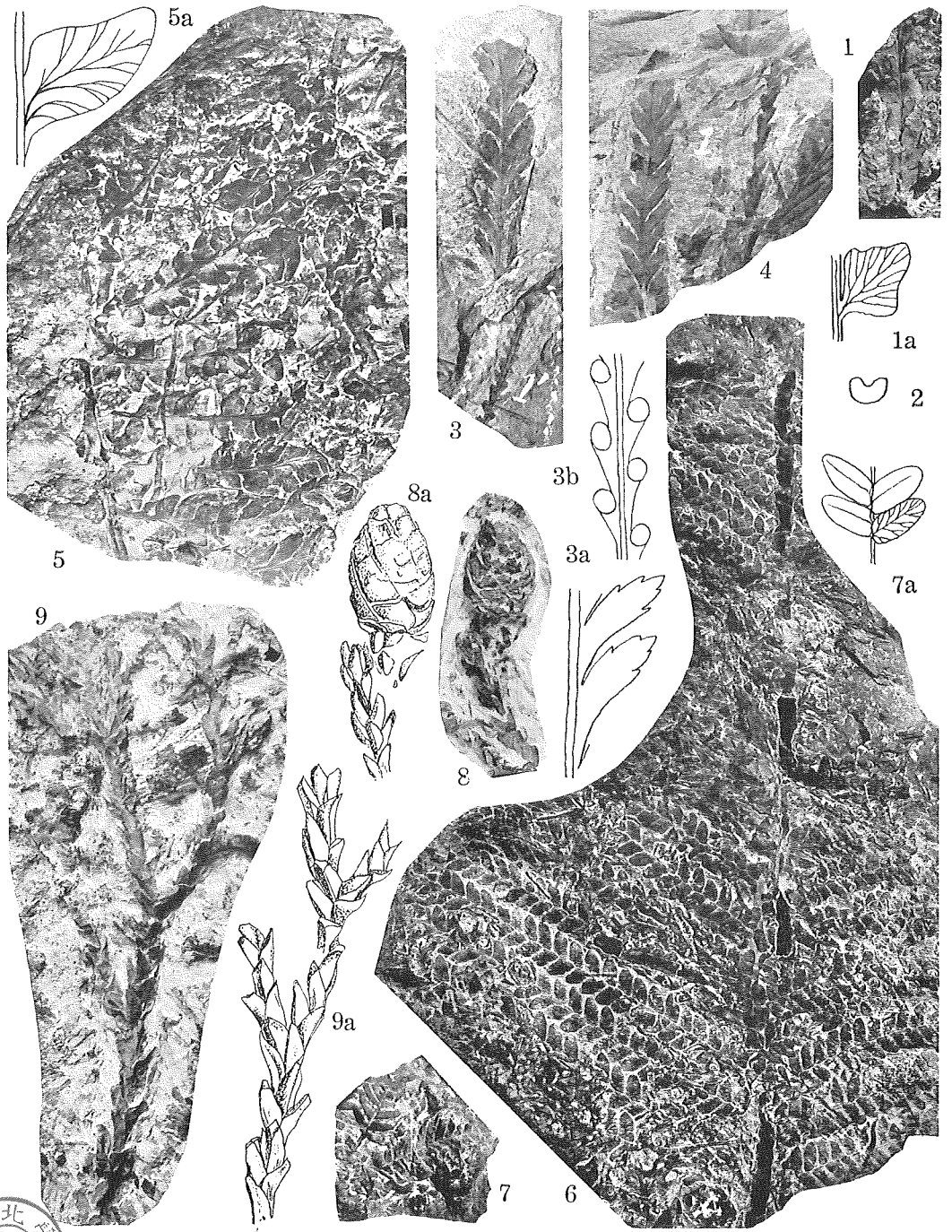
Figs. 3, 3a, 3b, 4. *Coniopteris burejensis* (ZALESSKY). Sterile and fertile pinnae. 3a, sterile pinna, × 2; 3b, fertile pinna, × 4. Ti-tao-ho-tzu. (Reg. No. 7886).

Figs. 5, 5a. *Cladophlebis lobifolia* (PHILLIPS). 5a, an ordinary pinnule, × 4. Li- shun-chen. (Reg. No. 7887).

Figs. 6, 6a. *Cladophlebis* (*Gleichenites*?) *Takeyamae* sp. nov. 6a, × 2. Li-shun-chen. (Reg. No. 7885).

Fig. 7. *Cladophlebis* sp. Li-shun-chen. (Reg. No. 7889).

Figs. 8, 8a, 9, 9a. *Elatides manchurensis* sp. nov. 8, a shoot with a cone; 8a, the same slightly magnified; 9, a vegetative shoot; 9a, a part of the same slightly magnified. Li-shun-chen. (Reg. No. 7890).



Takeda photo. and Takahasi del.

S. Ôishi and E. Takahasi: Fossil Plants from Moulin and Mishan.