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NEW FINDS OF *MARIOPTERIS*-REMAINS FROM CHINA

LEE HSING-HSÜEH

(*Institute of Geology and Palaeontology, Academia Sinica*)

Mariopteris is one of the most important Carboniferous pteridosperms in the Euramerican floras. It is represented by more than fifty species, most of which occur rather widely and abundantly in the Westphalian, and not uncommon in the Upper Namurian deposits. A thorough study of the family Mariopterides including the form genera *Mariopteris, Tetratmema, Dicksonites, Pseudomariopteris* and many species attributed to them commonly found in the Carboniferous of North France has been made by P. Danzé-Corsin in 1953.

The genus has hitherto not definitely been known in Eastern Asia; only a few fragmentary specimens have been described by Kawasaki (1931—34, p. 157, pl. 28, fig. 53) as ?*Mariopteris* sp. from the Jido Series of Korea, by Sze (1934, p. 604, pl. 5, fig. 8) as *Mariopteris*? sp. from the Hsuanmachuang Series of Tachingshan, Inner Mongolia and by Stockmans and Mathieu (1939, p. 8, pl. 8, fig. 3) as *Mariopteris*? *hallei* from the Chaokochuang Series of Kaiping Basin.

In this account, some specimens of *Mariopteris* from China are described. The specimens from Hsiaoyi, Shansi agree in all respects with the fragment referred by Stockmans and Mathieu to *Mariopteris*? *hallei*. The characteristic mariopteroid frond is well preserved on our specimens. Other specimens from Fungcheng, Kiangsi are probably identical with *Mariopteris acuta* Brongniart forma *obtusa* Gothan. A few specimens from Odors, Inner Mongolia are described as a new species: *Mariopteris lungwangkouensis* n. sp., which stands more closely to *Mariopteris disjuncta* Bell from the Cumberland group of Nova Scotia, N. America.

Mariopteris hallei Stockmans et Mathieu, emend.

(Pl. I, figs, 1—4; pl. II, figs. 7, 8)

The species is represented by about half a dozen specimens, most of which are rather fragmentary, especially the preservation of the venation leaves much to be desired. They are, however, sufficient to convey a good idea of the *Tetratmema*- or *Mariopteris*-"Aufbau" of the plant. The best specimen (pl. 1, fig. 2) agrees nearly in all essentials with the type-specimen of this species from Kaiping basin. This specimen, preserved more completely than the type-specimen, represents probably the left half of a young quadripinnate frond. Two other specimens showing more or less a complete *Tetratmema*-"Aufbau" of the frond is given in pl. 1, figs. 3, 4. The larger one shows some degree of damage and distortion, which ruptures along the basal part of the secondary rachis of the frond. The heavily damaged portions of the rachis are marked with an arrow. The specimen represents probably a negative imprint of a mature frond as the impression of the surface of the rachis is provided with a medium keel instead of a groove; it recalls the type-specimen of Kaiping as well as the specimen just mentioned above in the general outline of the pinnae, in the same type of rachis and in the shape of pinnules. The

smaller specimen (pl. 1, fig. 4), though fragmentary as it is, has shown more clearly the whole structure of a typical mariopteroid frond which probably belongs to the same species; it may represent a young frond derived from a higher position of the plant.

The diagnosis of the species are emended as follows:

Petiole, complete length unknown, bifurcating probably at a wide angle at its apex into two naked arms. These two arms, about 0.25 cm. in breadth and 1 cm. in length, longitudinally striated, without transverse wrinkles or bars, bifurcate again and the four resulting branches form the rachises of the four secondary pinnae of the frond. Secondary pinnae appear to be deltoid, rachis straight or slightly flexuous, finely longitudinally striated and often marked on the impression of the upper surface with a median groove. Tertiary pinnae, alternate, linear-lanceolate, distant or scarcely touching, are distinctly inequilateral, attaching on the one side of the rachis longer, well-developed than the other side. As traced upwards the ultimate pinnae are gradually reduced in size, and at the apex assume most probably the form of pinnules. Pinnules, triangular to obtusely subtriangular or rhomboid in outline, attached by the whole width of their base, more or less united to each other or very slightly contracted at the base, apex obtusely pointed, margin entire, except basal, catadromous ones being distinctly broader and usually divided into two lobes. Lamina rather thin. Veins not conspicuous; midrib moderate thick, distinct, more or less flexuous, persisting almost to the apex; lateral veins fine, arising at narrow angles, gently arching, divided once or rarely twice on the basal pinnules; veinlets very fine, when distinctly preserved, meeting the margin at wide angles.

In the habit of the "Aufbau" and non-wrinkled rachis of the frond and in the general shape of the pinnules, the present species belongs most probably to the group of *Mariopteris lobatifolia* in Danzé-Corsin's sense (1953), but is not identical with any species of this group. Among other mariopteroid forms to which our species is comparable is only the one originally described by Zeiller as *Diplotmema Busquesti* from the Commentry of North France. The French species, as pointed out by Stockmans and Mathieu (1939, p. 60), resembles ours in the shape of basal bilobed pinnules and in the general habit of the frond. But it is distinguished by the dense venation without a distinct midrib and by the relatively much pronounced contraction at the base of the pinnules. Zeiller's species is referred by Danzé-Corsin in 1953 to her new genus *Pseudomariopteris,* namely *P. Busquesti.* The genus *Pseudomariopteris* differs from *Mariopteris* mainly in the more sphenopteroid, fan-shaped venation and in the more acute bifurcating angle of the rachis. This genus is not yet fully acceptable. The present writer is therefore inclined to use the name *Mariopteris hallei* for the Chinese material. If this is a true *Mariopteris,* it might be the youngest representative of the genus.

Finally it should be pointed out that the type-specimen of the present species, bound up with an additional similar specimen from Kaiping basin, has subsequently been placed by Stockmans and Mathieu (1957, p. 34, pl. 7, figs. 2, 2a) in the genus *Emplectopteris,* namely *E. hallei* (Stockmans et Mathieu). In the memoir recently published (Lee, 1963, p. 41, 152), the writer has expressed the opinion that the Kaiping species, or any other forms which show no anastomosing venation should not be referred to the genus *Emplectopteris,* even though they resemble this genus in many other respects. The present discovery of more satisfactory specimens which show fairly the characteristic mariopteroid frond affords further evidence in favour of supporting such a view.

Distribution: Lower Shihhotze Series (P_1); Hsiaoyi, Shansi.

Mariopteris acuta Brongniart forma *obtusa* Gothan

(Pl. II, figs. 1—6)

This species is represented by several fragments of secondary(?) bipinnate pinnae; all of the specimens are coming from the Tzushan Series of Kiangsi province.

Penultimate rachis, straight or slightly flexuous, marked by a faintly longitudinal groove on the upper surface, and in favorable state of preservation by a few short wrinkles and scattered punctae. Ultimate pinnae, alternate, probably lanceolate to deltoid-lanceolate, with up to five or more pairs of pinnules. Pinnules, subtriangular to sub-oblong, the largest are sphenopteroid, contracted at base to a short foot-stalk and are pinnatifidly divided into one or two pairs of ovate obtusely, pointed lobes in addition to terminal lobe; smaller pinnules, occupying a higher position, more or less pecopteroid, have less prominent lobes or are entire, and become more and more pecopteroid and decurrent. The basal pinnules are differentiated from the others by being relatively broader and by having a spreading posterior lobe; the lobe of the inferior, basal pinnule being larger than the corresponding superior one; the lobes in general are strongly ascendant and directed forwards, and are obtusely pointed. Veins not conspicuous; midrib, somewhat flexuous, breaking up before reaching the apex and giving off lateral veins at narrow angles; each lobe of the dissected pinnules receiving one vein, which divides near point of origin and again by several dichotomies. Upper and perhaps also lower surface of the pinnule with a very fine striation almost parallel to the veins, probably caused by minuted adpressed hairs or epidermal cells as described by Kidston (1925, p. 632; pl. 150, fig. 22).

The present specimens, although rather fragmentary, agree in all essential characters with Brongniart's species. The pinnules of ours, however, are less dissected and provided with more obtusely pointed lobes. This type of frond has been separated from the typical form of the species and named *Mariopteris acuta* forma *obtusa* by Gothan (1935, p. 20, pl. 31, fig. 2). The same type of frond has also been recognized by P. Danzé-Corsin (1953, p. 83, pl. 5, figs. 1a—1c & text-fig. 13b) from North France.

Mariopteris acuta (incl. forma *obtusa*) is one of the oldest representatives of the genus *Mariopteris*, generally considered to be restricted to the young Namurian and early Westphalian. The occurrence of this form in the Tzushan Series of South China suggests that the age of the Tzushan Series may be somewhat earlier than the late Westphalian as generally supposed (see Sze et Chan 1942, p. 198; Sze 1958, p. 386, etc.).

Distribution: Tzushan Series ($?C_1^3$—C_2); Fungcheng, Kiangsi.

Mariopteris lungwangkouensis Lee, n. sp.

(Pl. I, figs. 5—7)

The specimens of mariopteroid frond given in pl. 1, figs. 5—7, are not well preserved, but seem to represent a distinct form which differs from any described species.

Frond of unknown shape, probably large. Rachis of penultimate pinna with fine longitudinal striations and with a central groove. Ultimate pinnae, lanceolate, touching or slightly distant, with a straight rachis probably also furrowed on the upper surface and terminated in a blunt-pointed pinnule. Pinnules, alternate, mainly rhomboid- to lanceolate-ovate, entire, or basal ones with one or two marginal lobes; the largest, strongly

contracted at base to a short foot-stalk, distant, forming an angle of 45°—60° with the pinna rachis; smaller pinnules, occupying a higher position, with a relatively short and broad, stalk-like, decurrent base and a gradually narrowing acutely obtusely pointed apex. Terminal pinnules, slightly larger than those i immediately preceding. Basal pinnules differentiated by possession of larger, more spreading, posterior lobe; the lobe of the inferior, basal pinnules being larger than the corresponding superior one. Veins generally not shown due to bad preservation, where visible, seemingly marked with a thick midrib, which is persisting about to three-fourths the length of a pinnule, abruptly decurrent in the base, and giving off lateral veins at very narrow angles.

The species is characterized by the rhomboid-ovate to lanceolate-ovate shape with a more or less foot-stalk base in almost all the pinnules. The only known species of mariopteroid frond, which can be compared with ours, is *Mariopteris disjuncta* Bell (1944, p. 77, pl. 29, fig. 1) from the Cumberland group of Nova Scotia, Canada, which was first described by Kidston (1925, p. 669, pl. 150, fig. 1) as *Mariopteris* sp. from the Westphalian Series of the British Isles. The Euramerican species differs from our form in that the rachis is not medium grooved, but with short transverse wrinkles, and in that the pinnules on the upper portion of the pinnae gradually become more united to the rachis and finally assume the form of blunt-pointed subtriangular pinnules attached to the rachis by the whole of the base.

Distribution: Penchi Series (C_2); Lungwangkou, Ordos, Inner Mongolia.

图 版 說 明

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图 版 I

图 1—4. *Mariopteris hallei* Stockmans et Mathieu (赫勒瑪利羊齿)

1，2 可能代表其四回羽状的蕨叶的一个对半部分 (Showing probably one-half of a quadri-pinnate frond)。

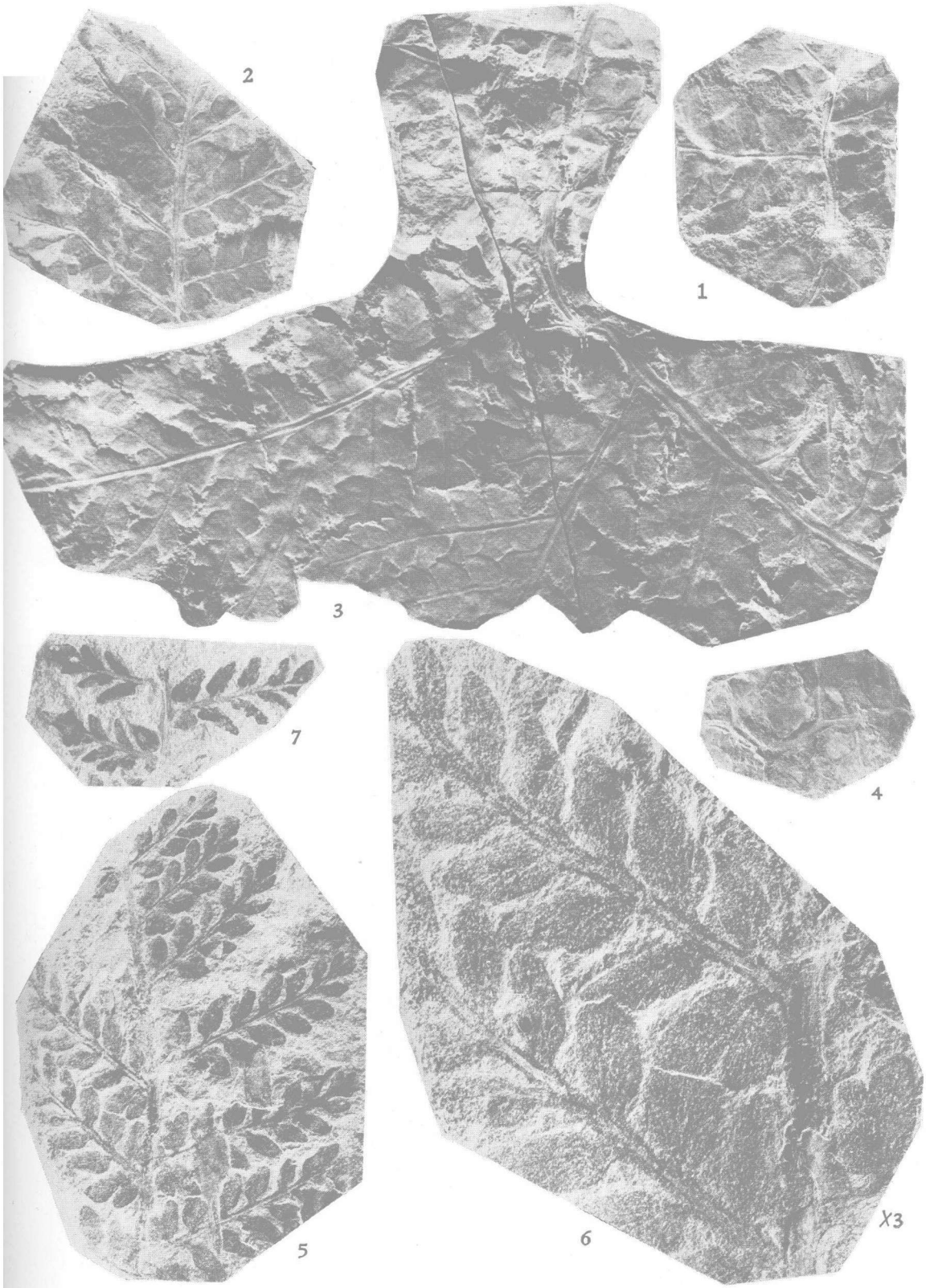
3，4 显示其比較标准的瑪利羊齿型的叶架；图 3 的箭头示其第二次羽軸遭受撕裂的情况 (Showing the characteristic mariopteroid frond; the heavily damaged portion of the secondary rachis is marked with an arrow)。

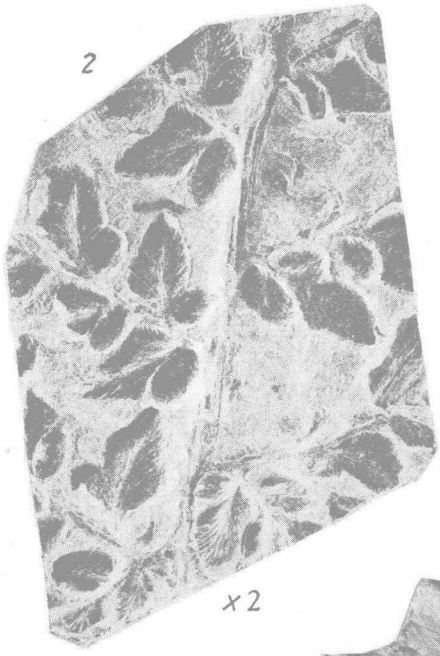
产地及层位：山西孝义；下石盒子組 (Lower Shihhotse Series; Hsiaoyi, Shansi). 登記号碼：PB 2868—2871。

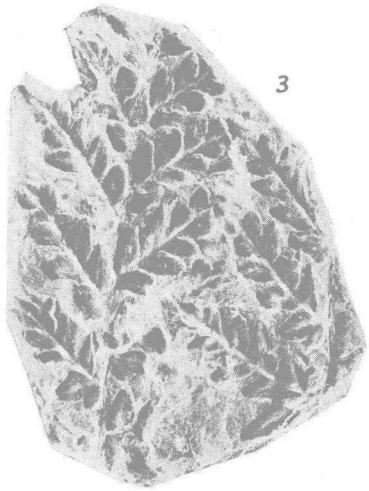
图 5—7. *Mariopteris lungwangkouensis* Lee, n. sp. (龙王沟瑪利羊齿，新种)

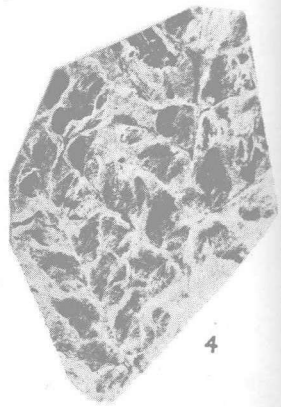
具不对称的最后一次羽片的倒数第二次羽片；图 6，放大，×3，示其叶脉及最后一次羽片基部的二裂状小羽片 (Penultimate pinnae with asymmetrical ultimate pinnae; venation and basal bilobed pinnules of the ultimate pinnae shown thrice magnified in fig. 6)。

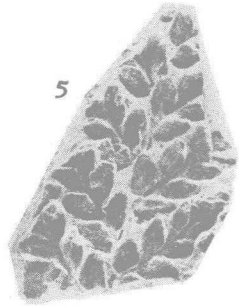
产地及层位：内蒙鄂尔多斯龙王沟；本溪羣 (Penchi Series; Lungwangkou, Ordos, Inner Mongolia). 登記号碼：PB 2874—2875。

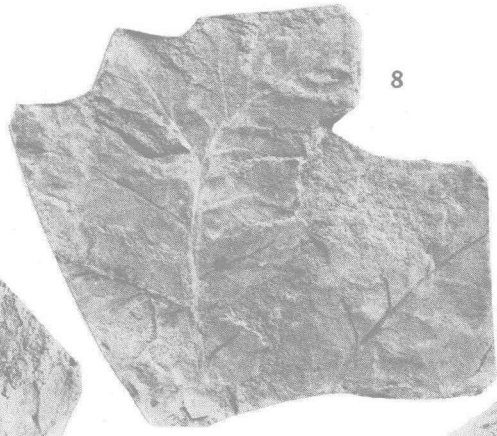


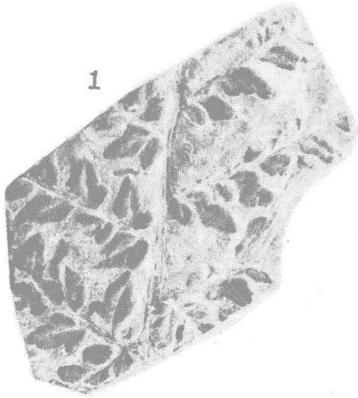












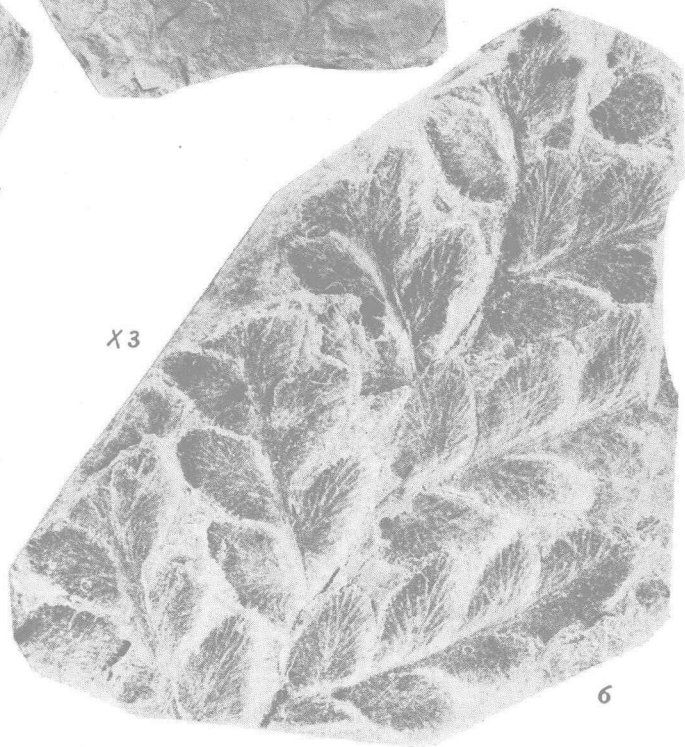


图 版 II

图 1—4. *Mariopteris acuta* Brongn. forma *obtusa* Gothan (短尖瘤利羊齿、鈍尖异型)
比較发育的倒数第二次羽片;图 2 为图 1 的一部分,放大,×2,示最后一次羽片的小羽片作較強的分裂 (Rather well-developed penultimate pinnae; fig. 2, part of the specimen in fig. 1, × 2, showing the ultimate pinnae with strongly lobed pinnules)。
产地及层位: 江西丰城;梓山羣 (Tzushan Series, Fungcheng, Kiangsi). 登記号碼: PB 2876—2878。

图 5, 6. *Mariopteris acuta* Brongn. forma *obtusa* Gothan (短尖瘤利羊齿、鈍圓异型)
較高部位的倒数第二次羽片; 下部最后一次羽片的小羽片略略分裂,上部的近于全緣,甚至下延。图 6,为图 5 的一部分,放大, × 3, 显示其非常細致的、几乎和叶脉平行的綫紋 (Upper part of Penultimate pinna; pinnules of lower ultimate pinnae slightly lobed, upper almost entire, decurrent. Fig. 6, part of the same pinna in fig. 5, × 3, showing very fine striations almost parallel to the veins)。
产地及层位: 江西丰城;梓山羣 (Tzushan Series; Fungcheng, Kiangsi). 登記号碼: PB 2879。

图 7, 8. *Mariopteris hallei* Stockmans et Mathieu (赫勒瘤利羊齿)
可能代表比較发育的倒数第二次羽片,具有明显不对称的最后一次羽片 (Probably rather well- developed penultimate pinnae with distinctly asymmetrical ultimate pinnae)。
产地及层位: 山西孝义;下石盒子組(Lower Shihhotse; Hsiaoyi, Shansi). 登記号碼: PB 2872—2873。