

陝北石盒子系的兩塊 *Bowmanites* 式的子囊穗標本*

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(附 I 圖版)

赫勒教授在 1927 年所發表的“山西中部古生代植物化石”一書中曾描述幾塊楔葉屬的子囊穗化石，定為一新種，名 *Bowmanites lawus*，另外一種則定為 *Bowmanites* sp. 前者發現於太原附近的下石盒子系，後者則發現於上石盒子系。因為“孢子囊柄”的着生形態，赫勒教授相信他的標本很可能是屬於楔葉屬的。赫勒當時曾經指出：這些標本暫定其屬名為 *Bowmanites*，這個屬名是 Binney 1870 年所創立的，這個屬名後來仍被 Solms-Laubach 1895 年所應用，也曾經被 Scott 應用於“Studies in Fossil Botany”一書的最末版中。

山西中部所發現的兩種 *Bowmanites*，彼此並無多大重要的區別。*Bowmanites* sp. 的苞片 (Bracts 即孢子葉 Sporophylls) 較 *Bowmanites lawus* 的苞片的變曲處較為尖銳，其上端幾乎直向上指出。這兩種楔葉子囊穗的極相近似，赫勒教授自己也曾經明白地指出過的 (1927, 第 54 頁)。J. H. Hoskins 及 A. T. Cross 在其 1943 年所發表的一篇定名為“古生代的一屬 *Bowmanites* (楔葉目) 的專論”“Monograph of the Palaeozoic Genus *Bowmanites* (Sphenophyllales)”的文章中特別指出：山西中部的較高地層中所發現的 *Bowmanites* sp. 好像和較低地層中所發現的 *Bowmanites lawus* Halle 是同屬於一個種的。這兩位作者進一步指出：如果我們再詳細地研究一下 Halle 所描過的原來材料，似乎能夠建立這兩個種是同屬於一個種的關係。在同一篇論文的第 153 頁上，Hoskins 及 Cross 將 Halle 的三個原圖重新登出，定其名為 *Bowmanites lawus* Halle，同時在第 154 頁上，給這一個種一個新的、比較完全的“種的特徵”。很明顯的、這兩位作者最後是傾向將山西中部石盒子系的 *Bowmanites* 式

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的兩個種合成爲一個種的，因爲兩位作者所重新登出的兩個圖即 Fig. 38 及 Fig. 39 就是赫勒教授的 *Bowmanites* sp. 的原圖 (Hoskins 及 Cross 的圖 38 及 39 等於赫勒的圖版 11, 圖 5 及圖 8, 1927), 而他們的圖 37 就是赫勒的圖版 11, 圖 2。而根據赫勒的圖版 11 的說明, 他的圖 2 是定爲 *Bowmanites laxus* 的, 他的圖 5 及圖 8 是定爲 *Bowmanites* sp. 的。

經過詳細地研究赫勒教授 1927 年所送回中國的, 此後一直保存在古生物研究所的標本儲藏室中的幾塊副本以後, 本文作者完全相信山西中部的兩個種即 *Bowmanites laxus* 及 *Bowmanites* sp. 是很有理由合成而爲一個種的, 這一個種應當定爲 *Bowmanites laxus* Halle. Hoskins 及 Cross 所給的這一個種的“種的特徵”特重新登載譯述於下:

“發育完全的子囊穗, 其直徑超過 1 厘米, 其長度在 5 厘米以上; 中軸頗厚 (其直徑爲 4 毫米); 中軸上有顯明的縱肋, 這些縱肋在關節上是對生, 也就是不互生的; 節的長度少於 3 毫米。孢子囊作半圓球形, 其直徑爲 1.0—1.5 毫米, 成對地以其遠軸的一面 (Abaxial side) 着生於狹細的、伸長的 (2.5 毫米) ‘孢子囊柄’ 上, ‘孢子囊柄’ 的頂端作帽狀。在每一枚苞葉 (即孢子葉) 的每一個 (或兩個) 不分叉的 ‘孢子囊柄’ 上, 着生兩個 (很少爲四個) 孢子囊 (在子囊穗的徑切面上, 普通顯出爲每一輪苞葉上, 有一輪孢子囊) 。“孢子囊柄” 從每一枚苞葉的表面伸出, 頗似近於一種腋生的狀況 (axillary position)。這個狀況極似 *Cingularia*。孢子尚未找到。孢子葉即苞葉在其基部互相連合, 連合之處幾達孢子葉的長度的一半, 成爲一特殊的盤形。每一枚苞葉的頂端不互相連合, 作錐針狀 (subulate), 常和中軸作垂直的方向; 僅有時作彎曲狀而和中軸相並行, 很少地上伸而到達於位在其上的一輪苞葉。”

本文作者在 1951 年之秋曾有陝北之行, 在那一次的野外工作中曾採得大批標本。在一批材料中, 最令人注意的是兩塊 *Bowmanites* 的碎片。這些化石是在銅川縣的郊外不遠的石盒子系地層中所採集的。和山西中部所發現的一樣, 陝北所採集的標本其保存狀況也很不能令人滿意。根據子囊穗的形狀及其體積, 本文圖版 I, 圖 1, 1a 所表示的標本和 Halle 所描述的 *Bowmanites* sp. 是完全相一致的。根據現在研究的結果, 這一塊標本應該定爲 *Bowmanites laxus* Halle。這一塊標本是保存在一種灰黑色的頁岩上, 化石上面有一層厚的炭質薄膜, 這一現象頗足以表示其孢子葉 (Sporophylls) 是具相當的厚度的。作者曾利用“浸解方法”作一試驗以便獲得孢子, 但未曾成功。這一塊標本其地層層位較高, 是在上部石盒子系中所找到的, 其地點爲

銅川縣南門外東南砂坡。上面已經提及 Halle 原定為 *B. laxus* 的標本是在山西中部的下石盒子系中所發現的，那末這一個種的“直的分佈”似可略為增長，它可發現於下部石盒子系至上部石盒子系。

另外一塊標本（即本文的圖版 I，圖 2，2a）和 *B. laxus* 區別甚鉅，因為其孢子葉的頂部比較長得多，其孢子葉的頂部向上彎曲的程度亦較甚，孢子葉頂端向上彎伸，蓋住了位在其上幾輪孢子葉。這一塊標本，我們現在暫時定為 *Bowmanites* sp. (?n. sp.) 這一塊標本是在較低的地層層位中所找到的，其地層似為下部石盒子系，其地點為銅川縣城外的十里舖老虎溝。這一塊標本頗值得注意，因為它可能是代表着一個新種。子囊穗的保存狀況不甚完善，茲暫簡單地描述於下：

Bowmanites sp. (? n. sp.)

（圖版 I，圖 2，2a）

子囊穗作圓筒狀，至少為 4 厘米長，其長度可能更長於此。中軸很厚，在標本上其寬度為 2 毫米。“節”的長度，有時大於軸的寬度，有時小於軸的寬度。中軸上顯出數條縱肋，縱肋在“關節”上不作互生狀態而是對生着的。“孢子葉”幾乎是垂直地着生於中軸上的，和中軸大致成 90° ，孢子葉的前端向上彎曲，甚為尖銳，完全蓋住着位在其上的數輪孢子葉。“孢子囊柄”，孢子囊及孢子的形態俱尚未明白。孢子葉的基部是否是互相連合着的或是互相分離的，亦尚未明白。假使它們在基部是互相分離的，那末，每一輪上其孢子葉的數目因化石保存狀況也尚未明白。子囊穗以一徑切面的形態保存於一種母岩，係一種灰黃色微帶綠色的砂岩。化石上未曾保存炭質薄膜。

根據比較長的孢子葉以及其完全蓋住着位在其上的數輪孢子葉的形態，我們的種較接近於一個歐洲的中部石炭紀（Mittleres Oberkarbon 即等於 Westphalian 期）的一個種即 *Bowmanites roemeri* Solm-Laubach 這一個歐洲種是發現於波蘭 Cracow 附近的 Niedzielisko 地方的。

Bowmanites 的一個屬名是 Binney 在 1870 年所創立的（Binney, 1870, 第 59—60 頁，圖版 XII，圖 1a—c，圖 2，3）。這一個屬名的“合法性”在 Hoskins 及 Cross 1943 年的專著中是討論很詳的。Arnold 1947 年在其所著的一本“古植物學的導引”的書上的第 136 頁也頗支持 Hoskins 及 Cross 的說法。屬名 *Sphenophyllostachys* 是 Seward 1898 年所創立的（Foss. Pl. IV，第 402 頁）。這一個屬名的創立，據 Seward 自己說是應用於“一種楔葉類似的子囊穗，它不能完全決定其屬於任何的一個楔葉的種

的。” Seward 自己承認屬名 *Bowmanites* 是有優先權的；但是相信 *Sphenophyllostachys* 一個名詞要比較好得多，因為這一個名詞的含義是屬於楔葉即 *Sphenophyllum* 的子囊穗。Seward 曾這樣說：“後者（本文作者按：即 *Sphenophyllostachys*）的應用在這裏，是因為根據現在一般所採用的並且比較便當的定名方法，而且這個名詞立刻表示出這一個事實，那就是說這一個化石不但是子囊穗，並且是屬於 *Sphenophyllum* 的”。自此以後，*Sphenophyllostachys* 一個名詞為若干學者所應用，而在最近二、三十年來更為少數古植物學大師所重視如 Hirmer (1927)；Zimmerman (1930)；Walton (1940) 等。根據分類學上的“優先條例”，本文作者的意見，殊和 Hoskins 及 Cross 相同，即我們現在實有重新建立 Binney 所創的名詞即 *Bowmanites* 的必要。*Bowmanites* 一屬化石的特殊形態以及它和其他各屬子囊穗化石的不同之點，如 *Calamostachys*, *Cheirostrobos*, *Cingularia*, *Palaeostachys*……等等，根據 Hoskins 和 Cross 是它的“同形孢子”的現象 (homospory)；它的孢子葉的可分上下兩部分，即位在上的孢子囊部分，及位在下面的苞葉部分；它的有“孢子囊柄”的現象；它的孢子的形態；以及它的中軸的內部的木質部構造是三原型及六原型的形態。

除出赫勒教授所描述的山西中部的石盒子系中所發現的標本以外，在東亞的二疊石炭紀地層中，還有川崎所鑑定的 *Bowmanites* sp. 這僅有的一塊標本是發現於朝鮮南部江原道三涉羣所達面道溪里市基的寺洞統地層中。(Kawasaki 1931, 圖版 XIX, 圖 20; 1934, 第 90 頁)。根據這一事實，我們知道有如 Hoskins 及 Cross 所說 *Bowmanites* 一個名詞是被很多著名學者如 Solm-Laubach 1895; Halle 1927; Kawasaki 1931 所承認的。這一事實又足以證明這些學者是贊成以 *Bowmanites* 一個名詞應用於楔葉即 *Sphenophyllum* 的子囊穗化石的，而這個名詞比後來創立的名詞即 *Sphenophyllostachys* 是有優先權的。

應該指出的是：本文所描述的 *Bowmanites* sp. (? n.sp.) 根據子囊穗化石的體積和形態頗接近於川崎所描述的朝鮮寺洞統的化石。兩者地層上的發現也大致相等，因為朝鮮的寺洞統，其時代大致和中國北方的下石盒子系及上月門溝系是相等的。

根據 Hoskins 及 Cross 的地層對比表 (1947, 第 156 頁)，中國北部的下石盒子系是以用一間號和歐洲的上石炭紀即 Stephanian 期 (等於 Westfal E 期亦即等於 Ottoweilian 期) 及北美的賓雪法尼亞期頂部 (即 Uppermost Pennsylvanian 等於 Monongahela 期) 相對比的。這一種結論顯然是沒有建築在可靠的證據上面的。中國北方的下石盒子系，沒有問題是屬於二疊紀的。

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ON TWO SPECIMENS OF *BOWMANITES* FROM THE SHIHHOTZE SERIES OF NORTHERN SHENSI

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Remains of Sphenophyllum-cones of the *Bowmanites* type from the Shihhotze Series of Central Shansi have been described by Prof Halle in his great memoir "Palaeozoic Plants from Central Shansi" published in 1927. In this memoir, a new species *Bowmanites laxus* Halle and a *Bowmanites* sp. were described, the former was found from the Lower Shihhotze Series and the latter from the Upper Shihhotze Series. On account of the character of the attachment of the sporangiophores, Halle believed that his specimens belong probably to *Sphenophyllum*. The specimens may be described, as pointed out by Halle, under the provisional generic name *Bowmanites* Binney, as employed, for instance, by Solms Laubach (1895) and still used in the latest edition of Scott's "Studies in Fossil Botany." The two forms of *Bowmanites* found from Central Shansi differ from each other in no essential respects. The bracts of *Bowmanites* sp. are often more sharply bent than in *Bowmanites laxus*, their upper parts pointing almost straight upwards. The close resemblance of these two forms has also been emphasized by Prof. Halle (1927, p.54). In their excellent paper entitled "Monograph of the Palaeozoic Genus *Bowmanites* (Sphenophyllales)" published in 1943, J. H. Hoskins and A. T. Cross claimed that the specimens collected from a slightly younger stratum in Central Shansi and figured by Halle as *Bowmanites* sp. appear to belong to the species *B. laxus* Halle. The two authors further pointed out that a careful study of the original material would be necessary to establish this relationship. On page 153 of the same paper, Hoskins and Cross reproduced three original figures of Prof. Halle and named them *B. laxus* Halle and on page 154 a new complete diagnosis was given for this species. It appears clear that Hoskins and Cross were finally inclined to unite the two forms into one species, because the two figures figs. 38 and 39 of the two authors are the original figures of Prof. Halle's *Bowmanites* sp. (Figs. 38 and 39 of Hoskins et Cross = Figs 5 and 8 of Halle's Pl. 11, 1927), and the figure 37 is the original figure of *B. laxus* figured by Halle

on his Pl.11, fig. 2.

A careful study of the original duplicate specimens sent back by Prof. Halle in 1927 and kept in our museum since then enables the writer to assert that the two forms found from Central Shansi and described by Halle as *Bowmanites* sp. and *B. laxus* may more appropriately be united into one species. The new diagnosis of this species i.e. *B. laxus* Halle given by Hoskins and Cross is reprinted here:

“Well developed cones, over one cm. in diam., more than 5 cm. long; axis thick (4 mm. in diam.); prominent longitudinal ridges, opposed at the nodes, i.e., not alternating; internodes less than 3 mm. in length. Sporangia sub-globose, 1.0—1.5 mm. in diam., attached in pairs by their abaxial side to the peltate tip of the slender, elongated (2.5 mm.) sporangiophore; 2 (rarely 4) per bract on 1 (2) unbranched sporangiophores (usually appearing as one vertical of sporangia per whorl of bracts in a radial section of the cone). Sporangiphore appears to arise from the surface of each bract in an almost axillary position. This condition plus the peltate, bisporangiate tip, recall *Cingularia*. Spores unknown. Sporophylls or bracts confluent for about half their length (forming the Characteristic disc) which is about twice the diameter of the length of the internodes. Tips of individual bracts free, subulate, and often perpendicular to the axis; only occasionally recurved and nearly parallel with it, and rarely ascending to the base of the superior whorl of bracts.”

Among the fossils collected by the writer in a field trip to Northern Shensi in 1951 are two fragmentary specimens of the *Bowmanites* type that require special notice. The fossils were found from the Shihhotze Series in the vicinity of the Tungchuan district. Like the specimens found from Central Shansi, the preservation of the material leaves much to be desired. In regard to the shape and size of the cone, the specimen shown on pl. 1, figs. 1, 1a in the present paper agrees in all respects with the specimens figured by Halle as *Bowmanites* sp. This specimen may thus be named *Bowmanites laxus* Halle. The impression is covered with a thick coating of carbonaceous matter, which seems to indicate that the sporophylls were rather thick. Attempts to obtain spores by maceration were, however, not successful. The other specimen (Pl. 1, figs. 2, 2a in the present paper) differs markedly from *B. laxus* in the much longer sporophyll-tips overlapping several superior whorls. This specimen may be named *Bowmanites* sp. (? n. sp.) for the present. The specimen here described as *B. sp.* (? n. sp.) was found from the

Lower Shihhotze Series and the specimen here described as *B. laxus* Halle was found from the Upper Shihhotze Series. As mentioned above, the specimens described by Halle as *B. laxus* were found from the Lower Shihhotze Series of Central Shansi. It appears, therefore, that the vertical range of this species may be slightly extended; it can be found from the Lower to the Upper Shihhotze Series.

The specimen here described as *Bowmanites* sp. (? n. sp.) claims special attention, for it differs markedly from the other type of cone on account of its narrow and much longer sporophyll-tips overlapping several whorls above. Since the preservation of the cone is far from satisfactory, it may be briefly described below:

Bowmanites sp. (? n. sp.)

Pl. 1, figs. 2, 2a.

The cone is cylindrical, at least 4 cm. long, probably much more. The axis of the cone is thick measuring about 2 mm. in breadth on the impression, with internodes either a little shorter or a little longer than the breadth of the axis. The impression of the axis shows several longitudinal fine ribs. These ribs are not alternating but opposed at the node. The sporophylls are almost perpendicular to the axis, inserted at an angle of about 90°; laminae sharply bent upwards and overlapping several superior whorls. The details of sporangiophores, sporangia and spores are unknown. It is also not clear whether the bracts are confluent at the base or separate to the base. If they are separate, the number of sporophylls per whorl is difficult to determine, owing to the state of preservation. The cone is preserved as a radial section on a matrix of yellow-gray or greenish sandy shale, without any carbonaceous matter.

In regard to the shape of the much longer sporophylls overlapping several superior whorls, our species may be more closely related to the European Middle Upper Carboniferous (Mittleres Oberkarbon = Westphalian) species *Bowmanites roemeri* Solm-Laubach found from Niedzielisko, near Cracow of Poland.

For the status of the genus *Bowmanites* (Binney, 1870, p.59-60, pl. XII, figs. 1a-c, 2,3) and the legitimacy and validity of its name, the present writer refers to the discussions in the important paper of Hoskins and Cross and in Arnold's "An Introduction to Palaeobotany" (1947, p.136). The name *Sphenophyllostachys* was first created by Seward (1898, p.402) applicable to "Sphenophylloid cones which cannot be connected with certainty to particular species of

Sphenophyllum." Seward admits that the name *Bowmanites* has priority but justifies *Sphenophyllostachys* as being more tenable since it signifies cones belonging to *Sphenophyllum*. He said for instance: "The latter is used here as being in accordance with a generally accepted and convenient system of nomenclature, and as a name which at once denotes the fact that the fossil is not only a cone but that it belongs to a *Sphenophyllum*." The name *Sphenophyllostachys* has been used by several authors in subsequent works and has recently been gained favor among leading palaeobotanists. (Hirmer, 1927; Zimmerman 1930; Walton 1940). On the basis of taxonomic priority and in the recognition of the basic nature of fossil plant remains, the present writer is in complete accord with the view of Hoskins and Cross that it is necessary to reestablish the name *Bowmanites* as proposed by Binney. The outstanding characters of *Bowmanites* which delimit this genus from many other genera such as *Calamostachys*, *Cheirostrobos*, *Cingularia*, *Palaeostachys* etc. are, as remarked by Hoskins and Cross, its homospority, the division of sporophylls into a sterile lower portion and a fertile upper portion, the sporangiophores, the pedicellate or stalked nature of the sporangia, the configuration of the spores and the triarch or hexarch nature of the xylem of the axis.

In Eastern Asia, in addition to the specimens described by Halle from the Shihhotze Series of Central Shansi, there is a small fragment determined by Kawasaki as *Bowmanites* sp. from the Jido Series of the Sanchoku district, South Chosen (1931, Pl. XIX, fig.20; 1934 p.90). The recognition of the *Bowmanites* by the competent workers (Solm-Laubach 1895; Halle 1927 and Kawasaki 1931), as pointed out by Hoskins and Cross, indicates their approval of that generic name at least for isolated fragments in preference to *Sphenophyllostachys* which was established later. It should be pointed out that the specimen described in the present paper as *B. sp.* (? n. sp.) may be more closely related in size and shape to the cone figured by Kawasaki found in the Jido Series of South Chosen, an assumption consistent with the relatively lower geological horizon of both these forms, since the Jido Series of Chosen is more or less equivalent to the Lower Shihhotze Series and Upper Yuemenkou Series of Northern China.

According to the stratigraphic correlation table given by Hoskins and Cross (1947, p.156), the Lower Shihhotze Series of Northern China has been correlated with a query mark with the Stephanian (=Westfal E) of Europe and the uppermost Pennsylvanian (Monongahela) of North America, a conclusion not fully justified by the evidence.

圖 版 說 明

所有標本俱保存在中國科學院古生物研究所，假使沒有特別符號標出，所有的圖影未加任何的潤飾都是用標本的原大攝取的。攝影者是劉雪筠同志。

圖 1. *Bowmanites laxus* Halle

圖 1a 放大 $\times 2$ 。

地點：陝西銅川縣南門外東南砂坡。

地層：上石盒子系。

登記號碼：PB 2209。

圖 2, 2a. *Bowmanites* sp. (? n. sp.)

圖 2a 放大 $\times 2$ 。

地點：陝西銅川縣十里舖老虎溝。

地層：下石盒子系。

登記號碼：PB 2210。

圖 3. *Bowmanites laxus* Halle

地點：山西太原東山石盒子溝。

地層：上石盒子系。

此標本是赫勒教授 (Halle) 1927 年所寄回的副本，在標籤上經赫勒自己定為 “*Bowmanites* sp., Shansi, Taiyuanfu, Upper Shihhotze Ser. Bed 31. Det. T. G. Halle. Coll. F. Norin.”

登記號碼：PB2211。

圖 4, 5, 6. *Bowmanites laxus* Halle

圖 4, 6. 放大 $\times 5$ 。圖 5 放大 $\times 3$ 。

圖 4. 地點：山西太原東山石盒子溝；地層：下石盒子系，(Bed 14)此圖是從 Halle 1927, Pl. 11, fig. 2 的圖所重攝的，表示一個子囊德的苞葉 (Bracts) 形態以及着生在其上的“孢子囊柄”及孢子囊。

圖 6. 地點：山西太原東山石盒子溝。地層：上石盒子系，(Bed 31)此圖是從 Halle 1927, Pl. 11, fig. 8 的圖所重攝的，表示一個子囊德的苞葉，“孢子囊柄”，及孢子囊。

圖 5. 地點及地層：和圖 6. 相同。此圖是從 Halle 1927, Pl. 11, fig. 6 所重攝的，表示一個子囊德的苞葉及“孢子囊柄”。在此圖的左邊的一輪苞葉上，可見兩個孢子囊 (S)，着生於同一“孢子囊柄” (Sporangio-phore) 上。

