

四川江油中泥盆紀的一种輪藻化石*

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1955 年 9 月楊敬之先生及王水在川北江油縣馬角壩中泥盆紀石灰岩所夾的灰色薄層鈣質頁岩中采集了很多小化石,筆者等在其中發現一种輪藻类的藏卵器 (Oogonium) 化石,即本文所描述的 *Sycidium*。和此种化石共生的有介形虫化石。根据侯祐堂先生的鑑定,这些介形虫化石是屬於中、下泥盆紀的类型,而不像上泥盆紀的產物。

Sycidium 屬於 Sycidiaceae 科,外形作球狀,藏卵器为 16 行、18 行或 20 行縱分排列的許多細胞所組成,每一个細胞的外表,由于鈣化程度的不同而有所不同,如鈣化不完全則成小凹陷 (pits) (見插圖 1 之 b 和插圖 2 之 b),鈣化完全則成小突起 (tubercles) (見插圖 1 之 c 和插圖 2 之 a)。同时,各細胞之間的縫合綫在鈣化不完全时則往往突起作梁脊狀 (ridge) (見插圖 1 之 b 和插圖 2 之 b),鈣化完全时則凹陷成溝狀 (furrow) (見插圖 1 之 c 和插圖 2 之 a)。藏卵器之內为卵球 (Oosphere),卵球受精后

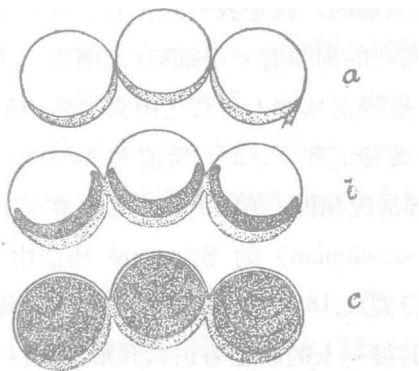


圖 1 表示輪藻植物藏卵器的包圍細胞鈣化之概況 a. 表示鈣化时,碳酸鈣首先沉積在包圍細胞的凹內壁上; b. 表示鈣化不完全时的情况; c. 表示鈣化完全时的情况。(根据 Peck)

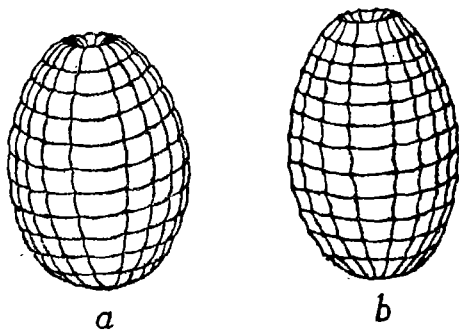


圖 2 *Sycidium* 的再造像
a. 表示鈣化完全时的 *Sycidium*; b. 表示鈣化不完全时的 *Sycidium*, (根据 A. Карпинский)

即为受精卵 (Oospore)。藏卵器頂底端各有一孔,頂孔較底孔为大,作漏斗狀,受精时作为精細胞進入的通道。底孔則附着在節細胞 (node-cell) 上。在我們的标本中,卵球

* 1956 年 5 月 10 日收到

及節細胞均未保存。

在江油發現的化石,藏卵器作橢圓形或長圓形,高 1.2—1.5 毫米,最大的橫直徑是在中部約 1.6 毫米。底部大致是圓形的,具有一个小底孔。頂部平切,向內陷入形成一個比底孔稍大的漏斗狀頂孔。底孔的周圍有 9 個凹陷的細胞(見圖版 I, 圖 5b, 5c, 5d),由此 9 個細胞再分出 18 行縱分排列的許多凹陷形的細胞,各凹陷的細胞的外形多作扁六角形,交互排列。各細胞之間的縫合綫則突起形成鋸齒狀的細胞間脊 (intercellular ridge) (見插圖 3; 圖版 I, 圖 5, 6, 7, 8)。除六角形的細胞外偶亦有長方形的細胞,這種細胞成直綫排列。

由通過藏卵器的最寬處所作的橫切面(見圖版 I, 圖 3, 4),可以看到 18 個縱行排列的細胞被縫合綫(suture line)所隔開。在通過頂底孔所切的縱切面中(見圖版 I, 圖 1, 2)也可以看到一些縫合綫把縱行排列的許多小細胞隔開。藏卵器之內全部被方解石結晶所填充,看不出生物構造的痕迹。

当前的标本几乎在各方面和著名的苏联种 *Sycidium melo* F. Sandberger^[8] 是相同的,尤其是和 A. Карпинский 教授^[3,4]所描述的產于 Isborsk 的 *S. melo* var. *pskowensis* 完全一致(見插圖 3)。*S. melo* var. *pskowensis* 一般是以六角形的、交互排列的細胞為其主要特征,因此筆者等就把当前的标本定為這一個變種。

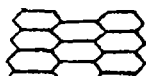


圖 3 表示 *Sycidium melo* var. *pskowensis* Karpinsky 的外形及縱列細胞上的小細胞的形狀(根據 A. Карпинский)

特別令人感興趣的,就是我們的化石中有一個保存較好的標本,在底孔的周圍有 9 個細胞(見圖版 I, 圖 5b, 5c, 5d)。這 9 個細胞是從伸入到底孔中去的節細胞上生出來的。此一重要特征和 Peck^[7]所描述的美國種 *S. foveatum* 的底部情況相似,美國的標本是產在下石炭紀底部 (Basal Mississippian) 的 Sylamore 建造中,我們的

標本也和美國的標本一樣,由此 9 個細胞縱分裂成 18 個縱分排列的細胞來包圍着卵球,然而這個美國種和当前的標本不同之處是其縱列上的細胞為正六角形,並且排列不很緊密。

盧衍豪^[5]在 1948 年發表了一篇重要的論文 “On the Occurrence of *Sycidium*, a Palaeozoic charophyta in the Lunghuashan Formation of Poshi, eastern Yunnan”, 其中曾描述了雲南東部婆兮中泥盆紀龍華山系底部所產的化石 *Sycidium melo* F. Sandberger。這一篇論文是中國唯一的關於 *Sycidium* 的著作。盧氏所描述的化石和我們的化石不同之處是在縱列上的小細胞是長方形的,成直綫排列的。雲南婆兮所發現的化石,顯然

是屬於標準的 *Sycidium melo* (見插圖 4)。

Sycidium 屬名首先為 G. Sandberger^[9] 於 1849 年所創立, 標本是在德國 Eifel 的泥盆紀中發現的, 以 *S. reticulatum* 為其屬型 (genotype)。Sandberger 認為它是一個水螅的屬 (Polyp genus) 與 Goldfuss 所定的屬 *Conodictyum* 的關係至為接近。從那時起這一類化石曾被誤歸到動物或植物的各種不同的門類中去, 有人把它當作水螅體 (Polyps), 有人認為是魚卵 (fish egg) 或葉足類卵 (Phyllopod egg), 也有人定為有孔蟲 (Foraminifera) 或棘皮動物 (Echinoidea), 也有人認為是管藻^[1] (Siphonales) 化石等, 眾說紛紜, 莫衷一是, 但一般曾把它當作有問題的 (Problematic) 化石來看的。直至 1906 年 A. Карпинский^[3,4] 教授發表了一篇著名的論文 “О трохилискахъ” (即 “Die Trochilisken”) 後, 這一類化石的分類學上的地位, 才完全確定。根據外殼細胞的詳細構造和其他證明, A. Карпинский 教授認為 *Sycidium* 是屬於輪藻植物的。另外還有一個重要的事實, 足以證明此類化石是屬於輪藻類的藏卵器的是 Peck (1934, p. 95)^[7] 在美國密蘇里州 (Missouri) 的下石炭紀底部 (Basal Mississippian) Sylamore 建造中所發現的一個標本。Peck 的標本經切成薄片後, 在少數的薄片中發現在頂孔的下面懸掛着一個隱晶的矽質薄壁內囊 (inner sac) (見 Peck, 1934, pl. 13, fig. 16)^[7], 此種情況和輪藻類的另一科即 Trochilisceae 完全相同。但其內囊強烈收縮, 并可起褶皺, 根據 Peck 意見此種構造應代表受精卵硬化了的外殼, 即卵球膜 (Oospore membrane)。這一構造的發現更證明它屬於輪藻類的植物。Gothan 在其最近出版的教科書^[2] (1954, p. 52) 中也承認這些曾被前人定為 “有疑問的植物化石” 的 *Trochiliscus* 和 *Sycidium* 是屬於輪藻類植物。

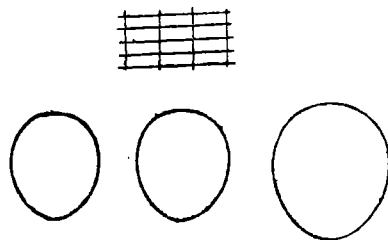


圖 4 表示 *Sycidium melo* F. Sandberger 的外形及縱列細胞上的小細胞的形狀 (根據 A. Карпинский)

最近 Karl Mädlar (1955, p. 103)^[6] 曾把輪藻類分成三個目, 即:

1. Sycidiales: 包圍細胞不是螺旋狀卷曲的, 而是直的。
2. Trochiliscales: 包圍細胞是從左向右螺旋的。
3. Charales: 包圍細胞是從右向左螺旋的。

Sycidiales 這一個目僅包括一個科即 Sycidiaceae 和一個屬即 *Sycidium*。 *Sycidium* 的種為數不多, 僅五、六個種, 就目前所知, 它在世界上的產地為蘇聯 (列寧格勒附近)^[3,4,8], 德國 (Gerolstein 附近的 Eifel)^[9] 和中國 (雲南^[5], 四川) 的泥盆紀和北美下石炭紀底部^[7] (密蘇里州的 Sylamore 建造), 中國除雲南及四川外, 在廣西的中泥盆紀

中最近亦有所發現。這一屬化石在地層上說垂直分布是很短的，迄至今日為止僅限于泥盆紀及下石炭紀的底部；其地理上的分布却很廣，曾發現于歐洲、北美及中國。無疑地它是很重要的標準化石，對地層的對比和時代的決定是有很重大意義的。

本文在研究過程中承斯行健教授和盧衍豪教授不斷的鼓勵和指導，並抽暇修改文稿，筆者等特致衷心的感謝。又承王鈺，楊敬之、李星學、侯祐堂諸先生閱讀文稿，並提供寶貴意見筆者等亦深表謝忱。

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ON THE OCCURRENCE OF *SYCIDIUM MELO* VAR. *PSKOWENSIS* KARPINSKY FROM THE DEVONIAN OF NORTHERN SZECHUAN

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Among the specimens collected by Messrs. Yang King-chih and Wang Shui in a recent trip to the Kiangyou district of Northern Szechuan, the writers noticed several pitted and straight meridional ridged oogonia of the *Sycidium* type of the

Charophytes that merit description. The specimens were found from the strata probably belonging to the Middle Devonian. The evidence of the ostracods found from the same horizon tends also to support this conclusion.

The specimens are all ellipsoidal to elongated spherical in shape, ranging from 1.2 mm to 1.5 mm in height. The greatest transverse diameter is at mid-height. The base is more or less rounded, with a small basal opening. The summit is truncate, depressed into a summit opening slightly larger than the basal one. Grouped around the small opening are nine shallow pits that branch into eighteen meridional rows of numerous pits extending from the point of origin to the comparatively large, funnel-shaped summit opening. The pits are transversely elongated, hexagonal in shape and are arranged alternately with the zigzag intercellular ridges. Occasionally, the pits are rectangular and are arranged in lateral alignment.

In the equatorial section, there are eighteen meridional units of cells divided by sutures. Each cell is concave inside. The longitudinal section through both the summit and basal openings shows that the meridional unit is apparently separated by numerous transverse sutures into cells. Inside the shell there is a hollow spherical space filled with calcite crystals. No trace of organic structures can be observed.

The present specimens agree almost in all respects with the well-known Soviet species, *Sycidium melo* F. Sandberger, especially with the specimens described by Prof. Karpinsky as *S. melo* var. *pskowensis* from Isborsk (see Karpinsky 1906, p. 103, text-fig. 26, Pl. I, fig. 6). The variety, *S. melo* var. *pskowensis*, is distinguished generally by the hexagonal and alternately ornamental pits.

It is of special interest to point out that a well preserved specimen in our collection (Pl. I, figs. 5b, 5c, 5d) shows an original number of nine cells budded from the outer surface of the node cell, which occupied the perforation described as the basal opening. This important feature of our specimen recalls strongly an American species described and figured by Peck as *S. foveatum* Peck (1934, p. 117, pl. 13, fig. 24) from the Sylamore formation of the Basal Mississippian age. Like the American specimen, these nine cells are divided vertically to form a total of eighteen meridional units around the oospore. This American species differs however in the pits which are less tightly arranged in each meridional row and are more hexagonal in shape.

In his important paper published in 1948, Mr. Lu described many specimens of oogonium under the name of *Sycidium melo* F. Sandberger from the early Middle Devonian Lunghuashan Formation of Poshi district, Eastern Yunnan.

These specimens, as described by Lu, are distinguished by the pits which are more rectangular in shape and are in the outstanding lateral alignment. These specimens belong evidently to the type-species *Sycidium melo* F. Sandberger.

Dr. Karl Mädlar (1955, p. 103) has recently classified the Charophytes into three distinguished orders, namely:

1. Sycidiales: Enveloping cells not twisted.
2. Trochiliscals: Enveloping cells twisted from the left to the right.
3. Charles: Enveloping cells twisted from the right to the left.

The Sycidiales consists of only one family Sycidiaceae with one genus *Sycidium*. Of special importance is the fact that a few sections of the silicified American specimens, as pointed out by Peck (1934, p. 95), ordinarily show a comparatively thin-walled inner sac of cryptocrystalline silica suspended from the summit opening (see Peck 1934, pl. 13, fig. 16), as in the Trochiliscaceae. In a few forms this sac is represented by a thin layer of cryptocrystalline silica adjoining the inner side of the oogonium wall, but it is usually greatly contracted and may be folded. This structure, according to Peck, represents the hardened outer covering of the fertilized oospore, the oospore membrane. That the hitherto assigning to the "vermeintliche oder zweifelhafte pflanzliche Fossilien" of the *Trochiliscus*- and *Sycidium*-forms certainly belong to the Charophytes, was also ratified by Prof. Gothan in his recently published Lehrbuch (1954, p. 52). There are only a few species (ca. five to six species) of *Sycidium* hitherto described, i. e. from the Devonian of the U. S. S. R. (in the vicinity of Leningrad), from the Devonian of Germany (in Eifel near Gerolstein), from the Devonian of China (Yunnan), and from the basal Mississippian of North America (Sylamore Formation of Missouri). Beside the localities of Yunnan and Szechuan in China, a few specimens of the *Sycidium*-type have recently been found from the Middle Devonian of the Kwangsi province. The specimens remain undescribed.

The writers are greatly indebted to Dr. H. C. Sze for his cordial encouragement, constant guidance during the course of carrying on the study and critical reading of this manuscript. They also wish to express their thanks to Mr. Y. H. Lu for his helpful suggestions.

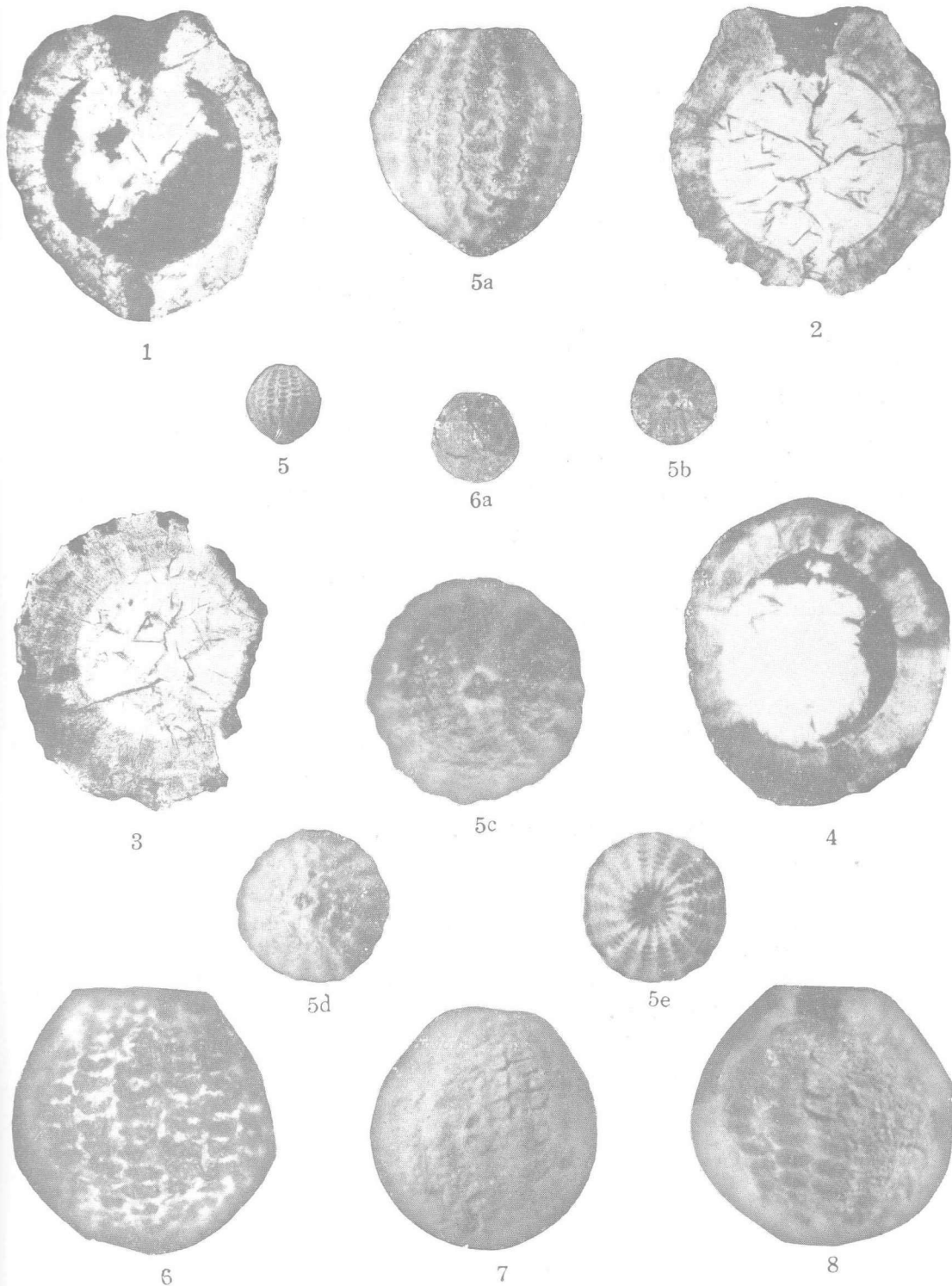


圖 版 說 明

这些标本是楊敬之和王水二同志在四川江油馬角渠中泥盆紀石灰岩所夾之灰色薄層鈣質頁岩中所采集的。所有的标本和薄片都保存在中國科學院古生物研究所。所有的照片未加任何潤飾,攝影者劉雲筠同志。

Sycidium melo var. *pskowensis* Karpinsky

圖 1, 2. 兩個标本的縱切面, 表示由包圍細胞所形成的外壳的厚度, 頂孔和底孔以及細胞之間的分裂狀況。放大 $\times 30$ 。登記號碼: PB 2559—2560。

圖 3, 4. 另外兩個标本的橫切面。放大 $\times 30$ 。登記號碼: PB 2561—2562。

圖 5, 5a. 保存較好的一個标本的側面, 表示六角形的小凹陷細胞排列的狀況。圖 5 放大 $\times 10$, 圖 5a 放大 $\times 30$ 。登記號碼: PB 2563。

圖 5b, 5c, 5d. 同一個标本的底面, 表示環繞着底孔的小凹陷細胞的排列狀況。圖 5b 放大 $\times 10$, 圖 5c 放大 $\times 30$, 圖 5d 放大 $\times 20$ 。

圖 5e. 同一标本的頂面, 表示寬漏斗狀的頂孔, 放大 $\times 20$ 。

圖 6, 6a. 另外一個标本, 表示小凹陷細胞的排列和細胞間脊的狀況。圖 6 放大 $\times 30$, 圖 6a 放大 $\times 10$ 。登記號碼: PB 2564。

圖 7, 8. 兩個不同标本的側面, 表示小凹陷細胞的排列和細胞間脊的狀況。放大 $\times 30$ 。登記號碼: PB 2565—2566。

Explanation of Plate I

All the figured specimens were collected from the locality Machiaopa of the Kiangyou District, Northern Szechuan. They are kept in the Institute of Palaeontology, Academia Sinica.

Sycidium melo var. *pskowensis* Karpinsky

Figs. 1, 2. Longitudinal sections of two specimens, showing thickness of wall, summit and basal openings, and the divisions between cells. $\times 30$. Cat. No. PB. 2559-2560.

Figs. 3, 4. Cross-sections of another two specimens, $\times 30$. Cat. No. PB. 2561-2562.

Figs. 5, 5a. Lateral views of a well-preserved specimen showing the lateral arrangement of the hexagonal pits. Fig. 5 $\times 10$, fig. 5a $\times 30$. Cat. No. PB. 2563.

Figs. 5b, 5c, 5d. Basal views of the same specimen shown in fig. 5. Note the arrangement of pits around the basal opening. Fig. 5b $\times 10$; 5c $\times 30$; 5d $\times 20$.

Figs. 5e. Summit view of the specimen shown in fig. 5, showing wide funnel-shaped summit opening. $\times 20$.

Figs. 6, 6a. Lateral views of another specimen showing the arrangement of pits and intercellular ridges. fig. 6 $\times 30$; 6a $\times 10$. Cat. No. PB. 2564.

Figs. 7, 8. Lateral views of two different specimens showing the arrangement of pits and intercellular ridges. $\times 30$. Cat. No. PB. 2565-2566.