微瘤孟氏藻(新种)靜孢子的形成*

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在孟氏藻属(*Mougeotia*)中的一些种类,它們是完全以靜孢子营生殖的。以往的藻类学家对于此种孢子的形成过程有不同的意見:如 Hassall (1845)、Wittrock (1878)、W. 及 G. S. West (1902)和 Czurda (1931)等氏訊为此种孢子在形成过程中,孢子母細胞的內含物要发生分裂,接着又进行接合。由于这些孟氏藻被訊为有这样的特点,Wittrock 氏曾将营此种生殖的孟氏藻从孟氏藻属中分出来,另建一属,称为"曲絲藻属"(*Gonatonema*)。这个属, G. S. West 氏(1904)也曾采用; Czurda 氏則将此属作为孟氏藻属的一个組。其他的一些藻类学家,如 Transeau 氏及其共同工作者(1951)則訊为此类孟氏藻的靜孢子在发生过程中,这样的內部分裂現象,无論是在原生質或者是在核,都是不存在的。这样完全相反的意見,至今还沒有确定誰是誰非,尙有待于細胞学方面的研究結果去加以判断。

在 1947 年 8 月,作者发現一种純粹由靜孢子生殖的孟氏藻,大量繁殖在上海中国科学院上海分院的一个洋灰魚池中。当时,除作种类鑑定,訊为它是一种新种外,并对它的靜孢子的形成过程,从不同时間采得的生活材料以及将它制成的染色标本作了詳細的观察。現将这些观察的結果提要記述如下。

此种藻类的营养細胞很狹长,直径为 5.5—6.5μ,长度为112—275μ。色素体仅占細胞的中部,具有排列成一行的蛋白核 4—6 个(图 1:1)。

在形成靜孢子的初期,生殖細胞自核的所在部分逐漸弯曲。弯曲部的外側逐漸膨大。細胞內絕大部分的原生質連同整个色素体向核存在的部分集中。同时,色素体卽逐漸分散,蛋白核成为不規則的排列,蛋白核的淀粉鞘显著地逐漸膨大(图 1:2)。在此时期中,原生質和核都沒有分裂的迹象。核的构造始終保持靜止状态,为扁球形,具有大形的核仁。

在色素体全部轉移到細胞膨大部分之后,在膨大部分两端的細胞壁逐漸发生横隔壁以形成靜孢子囊。横隔壁在发生之初,仅仅是母細胞壁內側的一个环状突起(图 1:3),逐漸向中央扩张,終于在細胞中心癒合起来成为一完整的"原始横隔壁"(图 1:4)。它的組成成分含果胶質为多,在用鉄矾苏木精染色后,着色远較一般細胞壁为深。在原始横隔壁未形成之前,原細胞两端殘存的細胞質与向中部集中的原形質是相連的,在原始横隔壁形成时始完全切断。在原始横隔形成后,它的內側卽由幼孢子分泌纖維質逐漸增厚起来,略呈分层的构造(图 1:5—7)。

在形成横隔壁时期中,核和原生質也沒有分裂的迹象,一直到靜孢子完全形成也是如此。最明显的变化,仅仅是蛋白核的淀粉鞘更为膨大,貯藏淀粉增多,几乎充滿了整个孢

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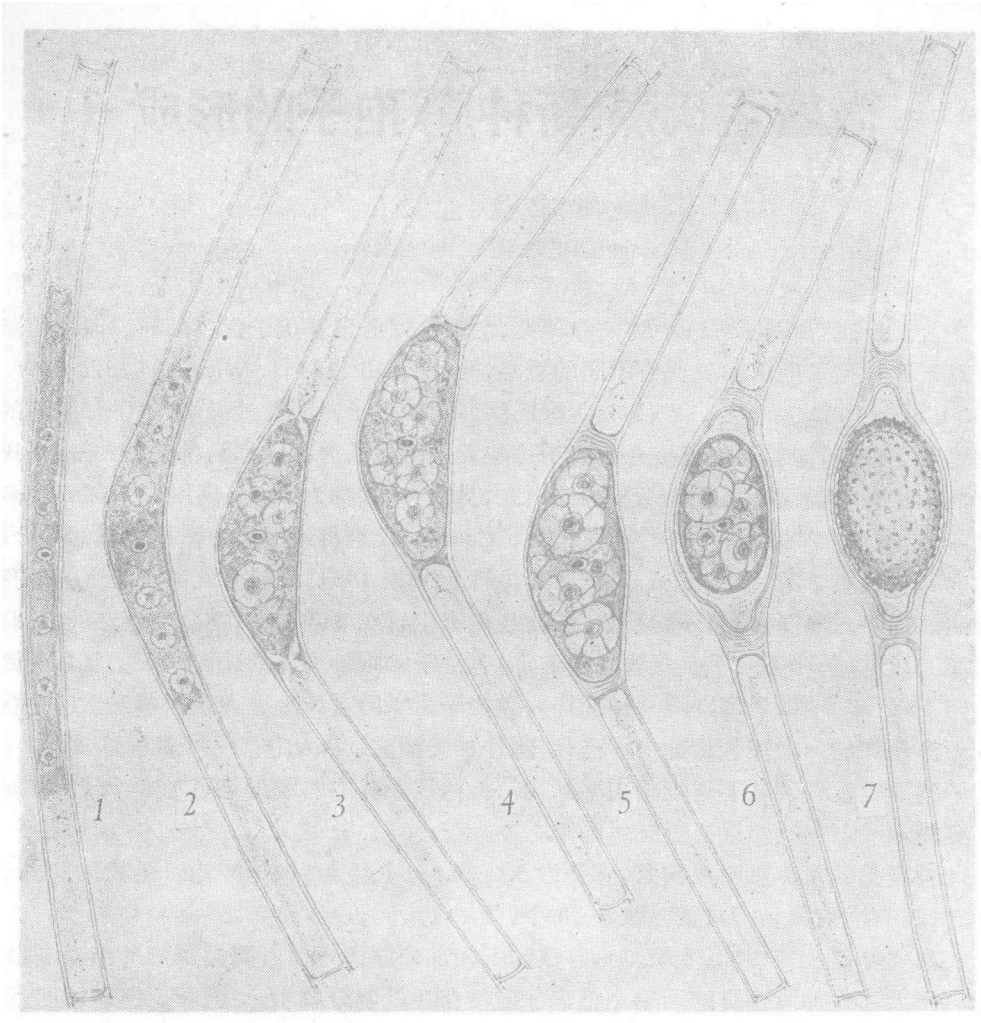

图 1 微瘤孟氏藻(新种)靜孢子的发生过程，×720:1,营养細胞;2,生殖細胞从中部弯曲并膨大; 3—5, 生殖細胞的三个发生时期,表示孢子囊横隔壁的形成及蛋白核的膨大;6—7,靜孢子发生后期,表示孢子囊横隔壁的构造和孢壁的形成;7,成熟的靜孢子。

Figs. 1. Developmental stages of the aplanospore of *Mougeotia verruculosa* Jao, sp. nov., ×720: 1, vegetative cell; 2, geniculation and inflation of the middle of a young reproductive cell; 3—5, three stages the reproductive cell, showing the formation of cross walls of the sporangium and enlargement of pyrenoids; later developmental stages of the aplanospore, showing the structure of cross walls of the sporangium and the formation of spore walls; 7, mature aplanospore.

子囊。

此后,靜孢子的三层孢壁——外孢壁、中孢壁及內孢壁——即依次发生。外孢壁附着在孢子囊壁上,較孢子囊壁薄,无色,但可明显地看出。在外孢壁发生时,幼孢子的內含物,尤其是在幼孢子的两端,更向中央收縮,在原生質与外孢壁之間,产生具果胶質反应的物質,初为无色,后变为淡黃色,有时还可看出略具分层的构造。在这个时期,中孢壁才围繞着收縮了的原生質逐漸发生(图 1:6)。

中孢壁最初也是很薄的。并且是无色而平滑的。它逐漸增厚,并略呈分层构造。顏色

由无色而轉为淡色，再变为黃褐色，同时，在表面产生不規則排列的小形瘤状突起（图 1：7）。

內孢壁在中孢壁形成后才能明显地看出。它始終是很薄的。到此靜孢子即达到完全成熟。

成熟的靜孢子为橢圓形，两端常具或較长或很短的突出頂端，直径为 16—22μ，长度为 22—45μ。

从上所述，这种藻类的靜孢子在形成过程中，完全沒有內部分裂的迹象，在夜間各时期观察的标本也是如此。这与前述 Transeau 氏的观察相同。作者对于純粹以靜孢子营生殖的孟氏藻仅詳細地观察过这一种，其他营同样生殖的种类很可能也是这样。以往的藻类学工作者有的訊为此属植物的靜孢子在形成过程中有內分裂的現象，很可能是由于此属植物的有些种类具有两个軸生的叶状色素体，它們是由細胞質連絡起来的。这样的种类在原生質向中部收縮时，看来好象是分裂的現象，其实是两个色素体的分离部分看来很象是分裂面罢了。

作者观察的植物，它的中孢壁具有不規則排列的小形瘤状突起，并在外孢壁与中孢壁間充滿了果胶質。这样的特征是与过去已知的、純粹以靜孢子营生殖的所有种类都不相同，因此，訊为它是一新种，命名为**微瘤孟氏藻 Mougeotia verruculosa**。其特征为：

細胞直径为 5.5—6.5μ，长度为 112—275μ。蛋白核一列，4—6 个。以靜孢子营生殖。靜孢子橢圓形，两端鈍圓，頂部常突出，直径为 16—22μ，长度为 22—45μ。孢壁分为三层：外孢壁薄，无色，紧附于孢子囊壁內；中孢壁厚，略分层，成熟时黃褐色，表面具不規則排列的小形瘤状突起；內孢壁很薄，但明显；外孢壁与中孢壁分离，其間，充滿略呈分层的、淡黃色的果胶質性的物質。

产上海一洋灰魚池中。模式标本存中国科学院水生生物研究所藻类标本室。标本号数为：KSU*51*。

ON THE APLANOSPORE-FORMATION OF *MOUGEOTIA VERRUCULOSA*, SP. NOV.

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Abstract

In some species of *Mougeotia* the reproduction is solely by aplanospores. There is, however, a divergence of opinion as to the precise developmental stage represented by these aplanospores. Some algologists, such as Hassall (1845), Wittrock (1878), W. & G. S. West (1902), and Czurda (1931), suggested that these spores may result from the internal division of a vegetative cell, followed by lateral conjugation, just before rounding off of the protoplast. Then other workers, including Transeau and his colleagues (1951), maintained that there is no such preliminary division either of the protoplast or of the nucleus in developing aplanospores. The solution, however, still awaits cytological evidence.

In 1947, the writer found a large quantity of an aplanosporic species of *Mougeotia* in a concrete fish-pond in Shanghai. While identifying it as a new species, the opportunity was taken of making a special study of the developmental stages of the aplanospores, from both the living and stained specimens, and the results can now be summarized.

In none of the developmental stages of the aplanospore is there any trace of an internal division, either of the protoplast or of the nucleus, and the latter is always in the resting condition. These findings are in agreement with Transeau's observations.

Spore-formation begins with both the geniculation and inflation of the middle of the reproductive cell, at the same time the major portion of the protoplast contracts and migrates towards the inflated middle; the chloroplast becomes diffuse, while the pyrenoids are now irregularly yet compact in arrangement. The starch sheath of all the pyrenoids is greatly thickened. The cytoplasmic remnants in the original part of the reproductive cell are still connected with the contracted portion of the protoplast (Fig. 1:2).

After the major portion of the protoplast has migrated to the middle, the formation of cross-walls of the sporangium is initiated. The walls originate as a continuous ring-shaped ingrowth opposed to the longitudinal walls of the cell (Fig. 1:3). The initial ring expands gradually towards the centre, finally closing on itself to form a complete primary cross-wall, and completely cuts off the connection between the cytoplasmic remnants and the contents of the young spore (Fig. 1:4). These primary cross-walls give a pronounced reaction of pectic compounds. In ordinary cases, secondary layers of cellulose secreted by the young spore are deposited on the inner side of the primary cross-wall. This fact is reflected in its lamellate structure.

At maturity the spore-wall is composed of three layers. The epispore is the first to form: it is a thin, colorless, smooth layer, adjoined to the sporangial wall, and follows the same outline (Fig. 6). During the development of the epispore, the spore contents, especially those at each end of the sporangium, are continuously contracting towards the middle. A pectic substance, which later becomes yellowish and indistinctly lamellate, appear in the space between the epispore and the spore-contents. Then the mesospore begins to form: at maturity, this layer is much thicker than the others, becoming yellowish-brown and irregularly verrucose (Fig. 1:7). The endospore is a very thin layer which appears next to the mesospore.

So far, only seven species of *Mougeotia* have been found to reproduce by aplanospores alone. The new Chinese alga differs from them chiefly in having a verrucose mesospore, and in the presence of a pectic substance filling the space between epispore and mesospore. **Mougeotia verruculosa**, sp. nov. has the following diagnosis.

Cellulis vegetativis 5.5—6.5 μ latis, 112—275 μ longis; pyrenoidiis 4—6, monostichis; generatio aplanosporis; aplanosporis forma eadem ac sporangiis, haec complentibus, ellipsoideis, apicibus obtusis, plerumque productis, 16—22 μ latis, 22—45 μ longis, membrana triplici: episporio tenui et hylino, semper a mesosporio valde disjuncto; mesosporio crasso, maturitate verriculoso et fuscescente; endosporio tenui; inter episporio et mesosporio materia flavescenti impleta, interdum plus minusve distincte lamellosa.

Hab. In picina in Shanghai, Sina. Aug. 1947. KSU: 51 (typus).