Norio SAHASHI* & Masa IKUSE*: **Pollen morphology of *Aldrovanda vesiculosa* L.**

佐橋紀男*・幾瀬マサ*: ムジナモの花粉粒の形態

(Plate XX)

Aldrovanda vesiculosa L. (Nom. Jap., Mujinamo) is known from Central and Southern Europe, North and East Asia, India (Bengal) and Australia (Queensland). In Japan, it was reported first by Dr. T. Makino in 1893, from a small pond at Koiwa-mura on the river side of Edo-gawa, about 7 miles east of central Tokyo. Since then it has been found on the basin of the Tone-gawa, in the bog Tatara in Gumma Pref., Oguraga-ike near Kyoto and so on. Recently the growing habitat of this swimming water-plant becomes scarce in Japan.

In 1952, Erdtman published pollen morphology of *A. vesiculosa* L., but his explanation is brief and lacks figures. On the other hand, Chanda (1965) reported more detailed one, but it was based on the herbarium materials. On August 2, 1972, the authors were able to obtain some fresh pollen grains of *A. vesiculosa* by the kindness of Dr. S. Miki who collected the plant at Oguraga-ike near Kyoto and cultivated it at his garden in Takarazuka, Hyogo Prefecture. The authors used this material and observed its pollen grains by the method of Ikuse (1956). In the present paper some pollen morphological data are dealt with, especially of tetrad and its apertures.

Observations Tetrads Pollen grains usually tetrahedral (Fig. 1a, Plate XX. A, B) or cross tetrad (Fig. 1b, Plate XX. C, D) and rarely tetragonal (Plate XX. H) or rhomboidal tetrad (Plate XX. I), but frequently transitional forms from typical cross to typical tetragonal tetrad (Plate XX. E, F, G). It is very difficult to separate the tetrad for each grain.

Diameter Tetrahedral tetrad diameter about 66 μ, range 60–75 μ; cross one about 68 μ, range 61–76 μ; tetragonal one about 65×53 μ and rhomboidal one about 84×70 μ. The individual grain in a tetrad has an average

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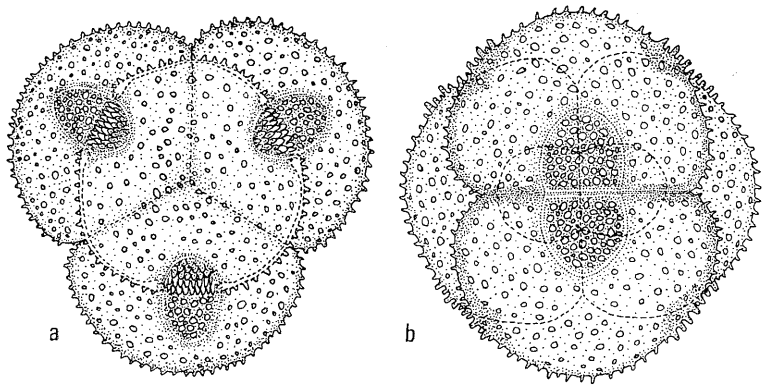

Fig. 1. Pollen grains of *A. vesiculosa* L. a. Tetrahedral tetrad. b. Cross tetrad. ×660

diameter of about 35×45 μ, range 30–39×42–48 μ.

Germinal apertures Each grain of tetrad has three colpoid apertures located in accordance with 'Fischer's law', i.e. they meet two and two at six points in grains in tetrad arrangement, and have not any sharply delimited margin. Sometimes two or four grains of tetrad have four colpoid apertures (Fig. 4). Apertures in the transitional forms are not always situated in accordance with the law (Fig. 3. c, d). At rhomboidal tetrad apertures situated a little irregular (Fig. 3. f). Each aperture is covered with an operculum (Fig. 2).

Operculum Generally more or less hemispherical or elliptical and showing the same staining properties as in the exine. When moistened, the operculum appears to be floating on the germinal aperture or it opens like a lid (Plate XX. K, L); but when dry, it is drawn to the throat of the aperture (Plate XX. J), which is rather effectually closed. The operculum 15–18×11–15 μ in size and 2 μ thick, and its pattern is similar to exine but rather dense with blunt

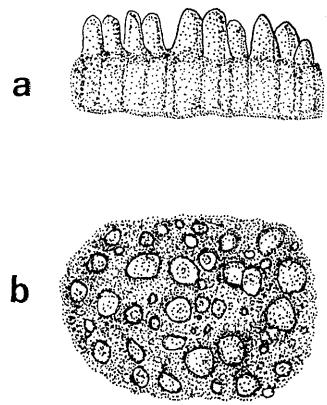

Fig. 2. The operculum of *A. vesiculosa* L. a. Side view. b. Surface view. ×2000

spinules (Fig. 2).

Exine ornamentation Exine usually about 2 μ thick but incrassate near colpi with dimorphic spinules; macro-spinules blunt or sometimes verruca-like, about 1-2 μ tall and almost equally broad (Plate XX. J, L); micro-spinules minute, perceptible only in LO-analysis.

Discussion The description presented above is essentially in agreement with that of Erdtman (1952) and of Chanda (1965). They did not describe, however, the operculum and several types of grain arrangement of tetrad in Droseraceae. Wodehouse (1935), Erdtman (1952), Ikuse (1956) and Huang (1972) described not only tetrahedral or cross tetrad but also tetragonal, rhomboidal and some irregular forms in Droseraceae, Apocynaceae, Asclepiadaceae, Typhaceae or Orchidaceae.

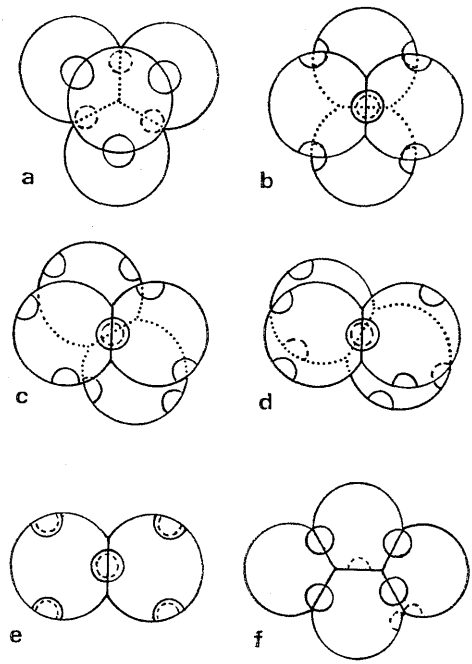

Fig. 3. Position of germinal apertures of some tetrad types of *A. vesiculosa* L. a. Tetrahedral tetrad. b. Cross tetrad. c-d. Transitional form. e. Tetragonal tetrad. f. Rhomboidal tetrad

The present study revealed that the above-mentioned irregular forms can be regarded as the transitional forms from tetrahedral to tetragonal tetrad. Geometrically, a tetrahedral tetrad can be changed to a tetragonal one if two grains are rotated together by a right angle, and vice versa (Fig. 3. a or b, e). Two pairs of grains in a tetrad were often observed in transitional position between tetrahedral and tetragonal arrangement, two longitudinal axes of two pairs of grains being oriented at an angle between zero and a right angle (Fig. 3. c, d). This was confirmed by a detailed observation of apertures.

Erdtman (1952) pointed

out that three apertures of each grain of a tetrahedral tetrad are situated in accordance with Fischer's law, namely each aperture of a grain faces another one of the other grain so that a pair of apertures faces closely to each other (Fig. 3. a, b). In tetragonal tetrad, two apertures, of different grain are facing each other in an analogous manner to that in tetrahedral tetrad (Fig. 3. a or b, e), while in transitional forms the apertures are in transitional orientations (Fig. 3. c, d).

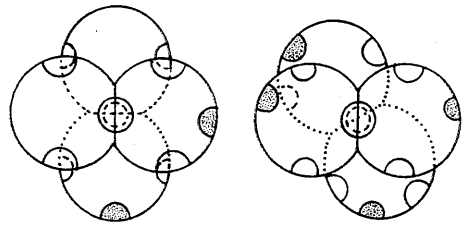

Fig. 4. Individnal grains in the tetrad have 4 germinal apertures. Dotted one may be irregular position.

Momose (1941) presented an idea on the gametophyte of ferns that the simultaneous division of a mother cell may be attributable to a biologically labile condition changeable to a stable condition under which the successive division takes place. Similar interpretation has been presented by Sahashi (1971) on the young spores of some *Pteris* ferns and is applicable to the present results. It is likely that the labile condition is caused by the simultaneous division forming tetrahedral or cross tetrad, while the stable condition by the successive division forming tetragonal tetrad. The transitional condition, from labile to stable, results in a production of transitional forms of tetrad.

It is noteworthy that the operculum was observed to cover each germinal aperture. The operculum has not been found so far in Droseraceae. According to Faegri and Iversen (1950), operculum is an isolated part of ektexine which is separated from the rest by a narrow zone where the ektexine is missing or greatly reduced. The operculum reported has the same staining properties as the exine, and the fact is almost agreeable with the observation of Faegri and Iversen (1950).

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Explanation of Plate XX.

Pollen grains of *Aldrovanda vesiculosa* L.

A-B. Tetrahedral tetrad; A, high focus; B, low focus. C-D. Cross tetrad; C, high focus; D, low focus. E-G. Transitional forms from cross tetrad to tetragonal one; E, prophase; F, metaphase; G, anaphase. H. Tetragonal tetrad. I. Rhomboidal tetrad. J-L. Three kinds of forms of the operculum; J, closed operculum; K, opened operculum which looks like as floating unsupported above the aperture; L, opened operculum which looks like a lid. A-I ×400, J-L ×500.

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ムジナモの花粉粒を光学顕微鏡で観察した結果を報告した。

1) 花粉粒はすべて4集粒をなし，おもに正4面形4集粒 (Fig. 1-a) と十字形4集粒 (Fig. 1-b) からなっている。注目に値するのは，十字形4集粒から正方形4集粒への，一連の移行形が観察できたことである (Plate XX)。

2) 4集粒の大きさは正4面形4集粒で平均 66 μ あり，個々の花粉粒の大きさは平均 35×45 μ である。

3) 花粉管口は3類溝粒でその位置はほぼ 'Fischer' の法則に従っているが，しばしば4類溝粒を持つ花粉粒もあり，その位置はかならずしも一定していない。また移

行形4集粒では‘Fischer’の法則はあてはまらないように思われる (Figs. 3, 4)。

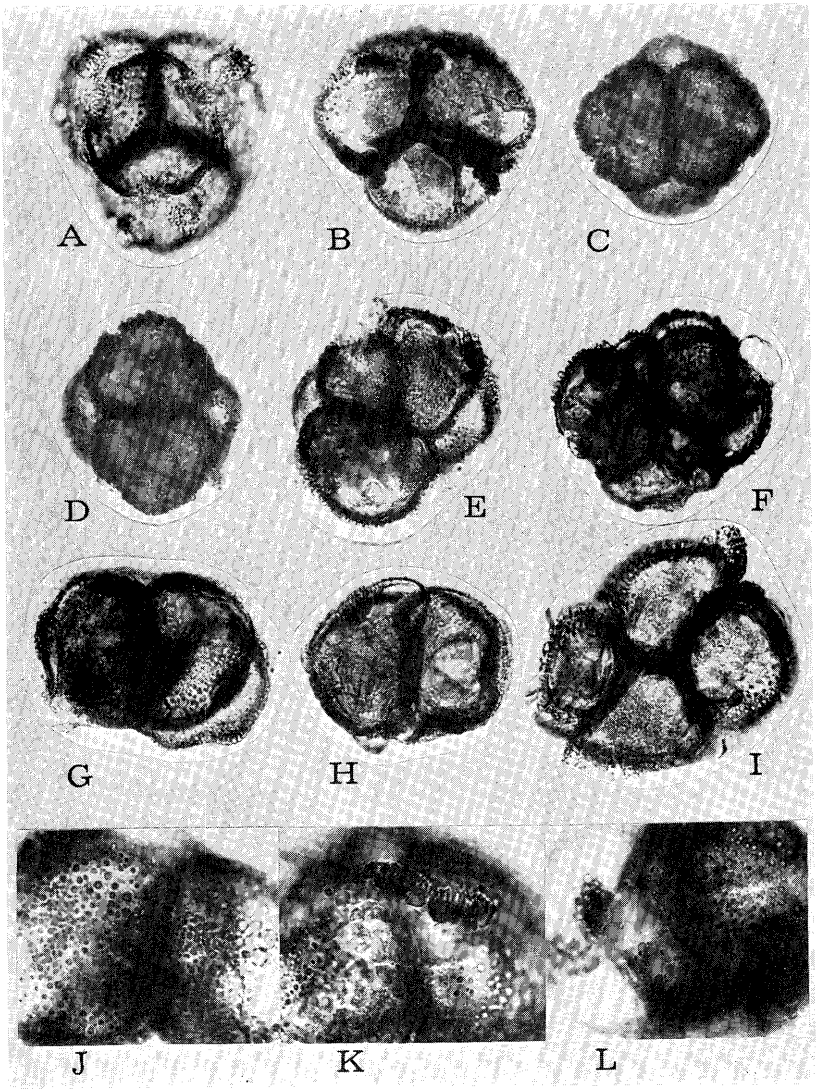
4) 個々の花粉管口には口蓋があり (Fig. 2)，花粉粒が乾燥状態の時は閉じているが，吸湿状態では開いている (Plate XX. I-L)。口蓋は外壁の一部からできているものと思われる。

5) 外壁は比較的厚く半透明である。表面の彫紋は小刺状で，長さは 1-2 μ あるが先端は鈍いものが多い。また非常に小さな刺状突起が表面全体に見られる。

以上の観察結果からムジナモの花粉粒はモウセンゴケ科の他の属のものと，大きさや表面の彫紋など類似した点もあるが，花粉管口の形態や数，とくに位置が異なっている。また口蓋を持つ花粉粒はモウセンゴケ科の中ではムジナモだけのようである。

□ M. J. Harvey & J. McLachlan: ***Chondrus crispus*** xiii+155 pp. Nova Scotian Institute of Science, 1973. 並製本，6カナダドル (約1,600円)，上製本，9カナダドル (約2,300円)。*Chondrus crispus* は紅藻植物，ツノマタ属の海藻で，おもに大西洋の北半球に分布し，カラゲーナン (carrageenan) の原藻としてよく知られる。カラゲーナンは粘質の多糖で，各種食品，薬品，化粧品の安定剤や分散剤，あるいは織物の糊料などに用いられ需要も大きい。カナダにおける年産額は3百万ドルに達し，さらにこの物質について二次産業が発達すれば，年産額は3千万ドル以上への飛躍が期待されるという。この本は *Chondrus crispus* について，1972年6月，カナダ植物学会と植物生理学会が共催して行ったパネルディスカッションの全内容を採録したものである。内容の主な項目は次のようである。*Chondrus crispus* の生物学，とくに分類，形態，生活史。細胞学と遺伝学。生態学。生理学と生化学。微細構造と組織化学。カラゲーナンの化学。*Chondrus crispus* に関する文献。執筆者はカナダとアメリカの学者13名よりなる。*Chondrus crispus* の総合的研究ともいうべき内容の本であり，有用藻類研究法の一つのあり方を示すものともいえる。購入申込先；The Librarian, Nova Scotian Institute of Science, c/o Science Library, Dalhousie Uniuersity, Halifax, Canada. (千原光雄)

□ 中国植物学会編：**植物分類学報** 第11巻4号。しばらく休んでいた中国植物分類学報が発行された。将・李氏の中国のキョウチクトウ科についての論文は1新属20新種がのせられている。将英氏は40年ほど前からキョウチクトウ科の研究をつづけているが，なおこれだけの新しいものがでることは，中国植物の研究の多難を思わせる。琉球のテイカカズラなど中国のものが明らかにならないとはっきりしないものもあるので今後の研究を期待する。林・陳氏の *Erigeron* 類のまとめ，向・曾氏の中国の人参属など興味深い論文がある。後者は原寛氏の *Panax* の論文も引用し，ほぼ似た見解であるが，亜種を認めていないため学名はかなり異っている。 (山崎 敬)



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