Short communication *Bot. Bull. Academia Sinica* **18**: 179-184 (1977)

A PRELIMINARY ELECTRON MICROSCOPE STUDY OF SOME TAIWAN MOSS LEAVES

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(Received April 16, 1977; Accepted May 7, 1977)

There are estimated to be about 600 genera and between 14,000 and 25,000 species of bryophytes. Taiwan has 359 genera and 1,129 species (Lai and Wang-Yang, 1976). Only species belonging to the genus *Sphagnum* are known to have a good water holding capacity. Various species of *Sphagnum* have been found to hold between 16 to 26 times as much water as their dry weight (Bold, 1973). The scanning electron microscope (SEM) had been used in botanical studies to examine spores (Wilce, 1972; Liew and Wang, 1976), wood anatomy, seed surfaces (Liu and Pomeranz, 1975), leaf surfaces (Ledbetter and Krikorian, 1975), stems of *Equisetum* (Page, 1974; Kaufman *et al.*, 1971), and many other examples could be cited. Detailed studies have been made on plants ranging from the algae (Steaehelin and Pickett-Heaps, 1975) to the angiosperms (Pan and Chen, 1976), but by comparision little use has been made of the SEM on bryophytes. This study was undertaken to investigate the comparative nature of the leaf surfaces of the three subclasses of the mosses. *Plagiomnium acutum* was selected to represent the Bryidae, *Andreaea rupestris* to represent the Andreaidae and two species of *Sphagnum: S. palustre* and *S. cuspidatum* to represent the Sphagnidae.

Leaves were fixed in aqueous FPA (30% formalin: propionic acid: 50% ethanol = 5:5:90, v/v/v) (Pan and Chen, 1976) then dehydrated through a graded ethanol series to absolute ethanol, finally the absolute ethanol was substituted with dry isoamyl acetate. The specimens were then critical-point dried and coated with a few hundred angstrons of gold-carbon. A JEOL JSM-15 scanning electoron microscope operating at 15 KV was for observation and photography.

Plagiomnium acutum is a true moss belonging to the family Mniaceae. Under the SEM the upper surface is quite smooth, the cells are clearly outlined and arranged in fairly regular rows. Each cell is approximately 15 μ wide by 20 μ long (Fig. 1), there is a groove between each cell, and the center portion is bulged. A casual glance at the picture reminds one of a pan of rolls in a bakery. Very fine striations, which may be microfibrils, stretch across the depressions between the cells. The bulges on the lower surface are even more prominent than on the upper side (Fig. 2) and the surface of each cell is marked by fine striations. *Andreaea rupestris* belongs to a small order of mosses known as Andreaeales. The SEM shows the upper surface of this moss leaf (Fig. 3) to have many deep cups surrounded by wide lips, the cups appear somewhat compressed and are about 15 μ in length, the lips are covered with linear, wavy or branched narrow ridges. The lower surface of the leaf (Fig. 4) has row after row of nearly spherical protrusions each of which is covered with prominent irregular ridges. Between the rows of the spherical protrusion are deep grooves and streaming from each spherical protrusion are strings of straight or anastomosing ridges.

The Sphagnales are so different from all other mosses that they constitute a very distinct order. The SEM shows the differences and similarities in the two species studied.

S. palustre has very few pores on the upper surface of its leaves except near the margin and these have a diameter of about 12 μ (Fig. 9). The photosynthetic cells from the lower side are smooth and about 5 μ wide (Fig. 10). The barrel-shaped, colorless, water stroage cells are about 130 μ long and about 35 μ wide (Fig. 6), each usually has two rows of large pores which are from 10–14 μ in diameter (Fig. 10). Fig. 5, 7, show that practically the whole underside of the cell is covered with pores and the edge of each pore has a conspicuous rim which is somewhat slanting (Fig. 8).

S. cuspidatum (Fig. 11, 12) differs in having no pores on the underside of its leaves. Their photosynthetic cells appear quite smooth except for fine parallel striations which run at about 90 angle from the margin (Fig. 12). On the upper side of their leaves (Fig. 11) are a few small scattered pores, these are 5 μ in diameter.

Since the undersurface of *S. palustre* is practically covered with large pores (Fig. 8, 10) and its leaves, it is not surprising that it can absorb water much more quickly than *S. cuspidatum* which has no pores on its underside and only a few scattered pores on its upper side (Pan, 1977, unpublished data).

Acknowledgment

I wish to thank Mr. M. J. Lai for providing the experimental materials and identification and Mr. T. S. Wang of Fu Jen University for skillful technical assistance. Drs. S. H. Tsai Chiang and W. C. Chang for helpful discussion, and Dr. C. E. DeVol for critically reading the manuscript are gratefully appreciated.

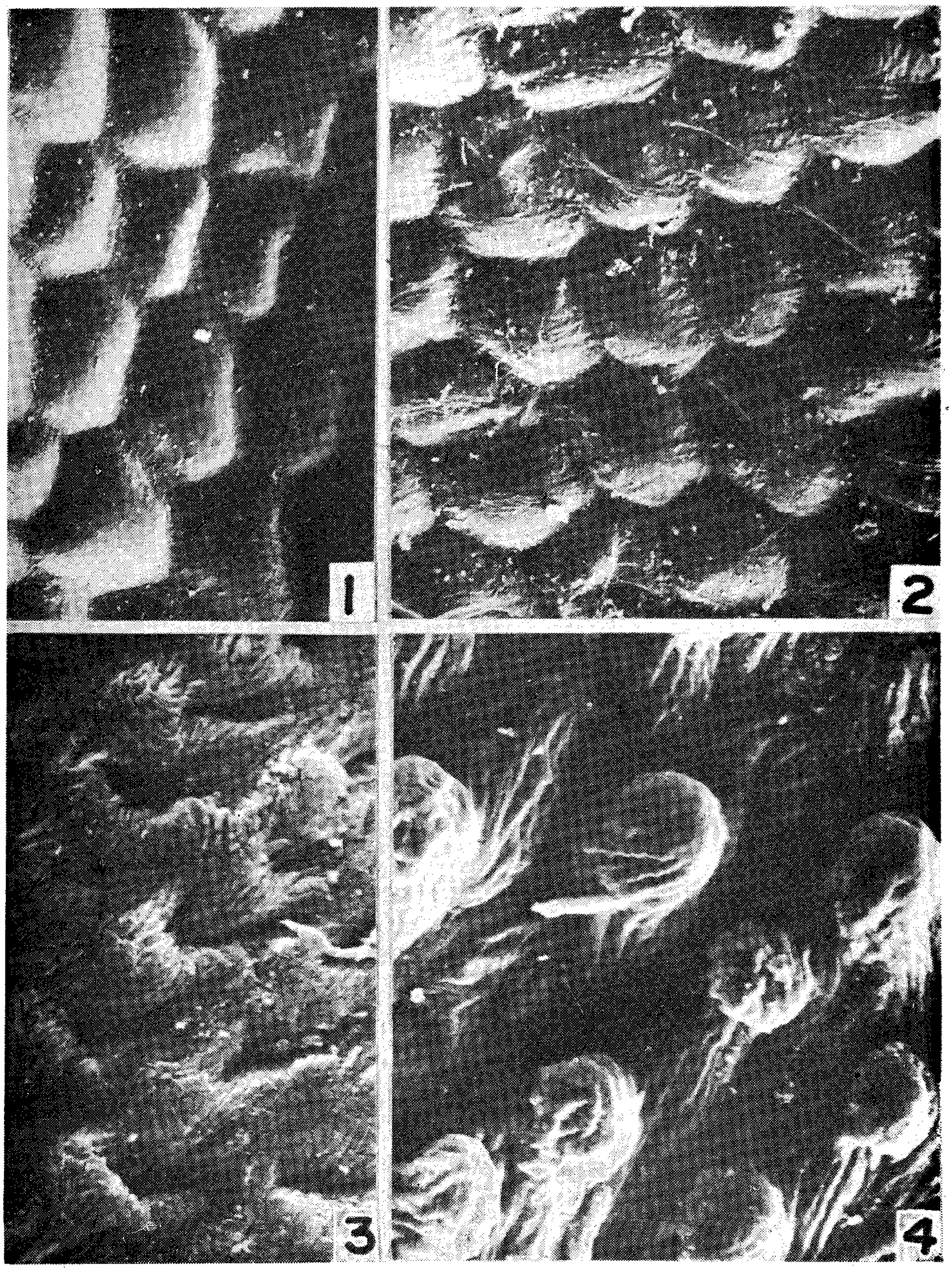

Fig. 1. A portion of upper surface of leaf of *Plagiomnium acutum*. ×1000.
Fig. 2. A portion of lower surface of leaf of *Plagiomnium acutum*. ×1000.
Fig. 3. A portion of upper surface of leaf of *Andreaea rupestris*. ×1000.
Fig. 4. A portion of lower surface of leaf of *Andreaea rupestris*. ×1000.

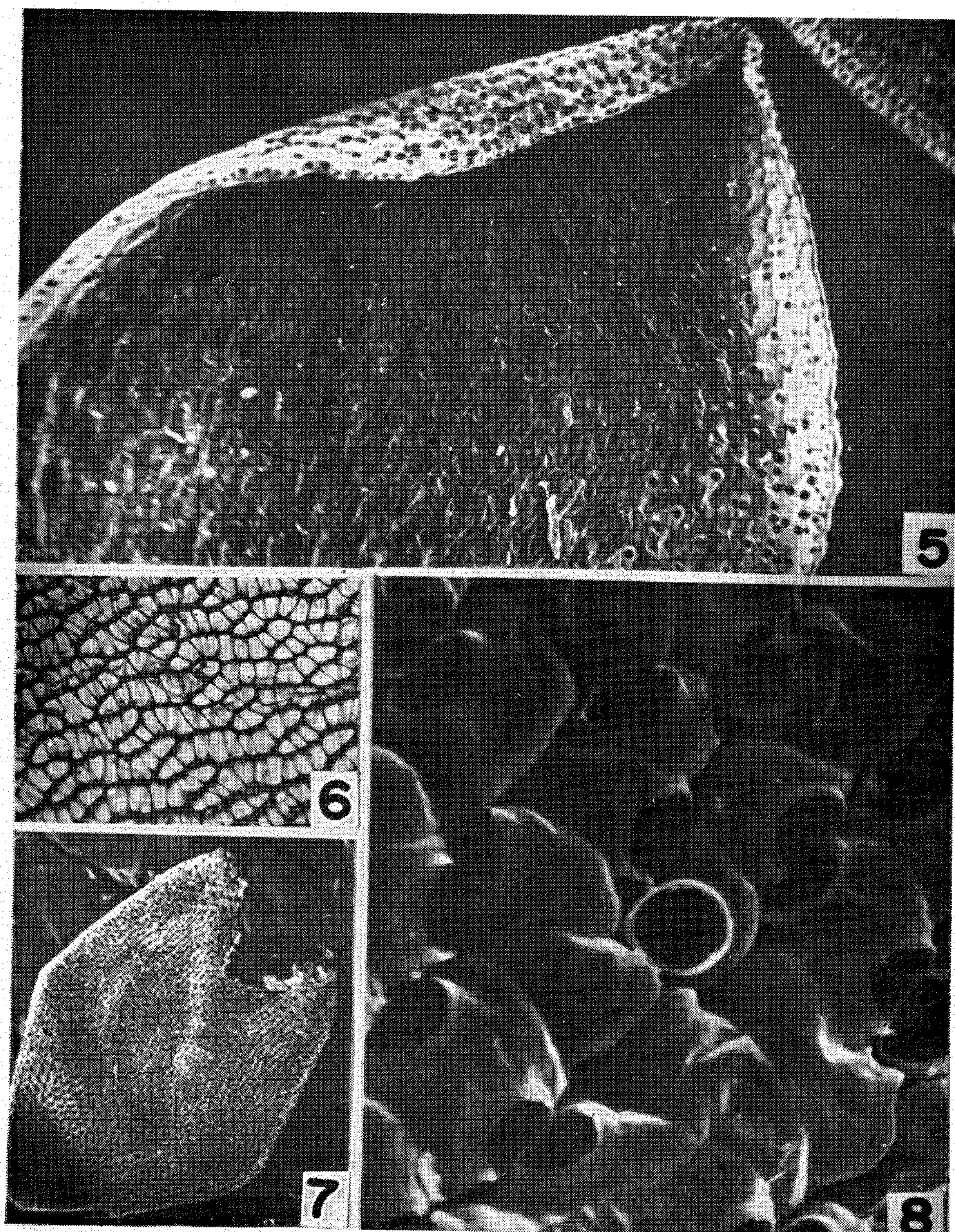

Fig. 5. The leaf surfaces of *S. palustre*, showing the upper surface and a portion of lower surface. ×120.

Fig. 6. *S. palustre*. Leaf cell dimorphism; show large, colorless water storage cells and interspersed photosynthetic cells. ×125.

Fig. 7. Total lower surface of leaf of *S. palustre*. ×30.

Fig. 8. The enlarged view of pores in the lower surface showing the circular pore with rim. ×1000.

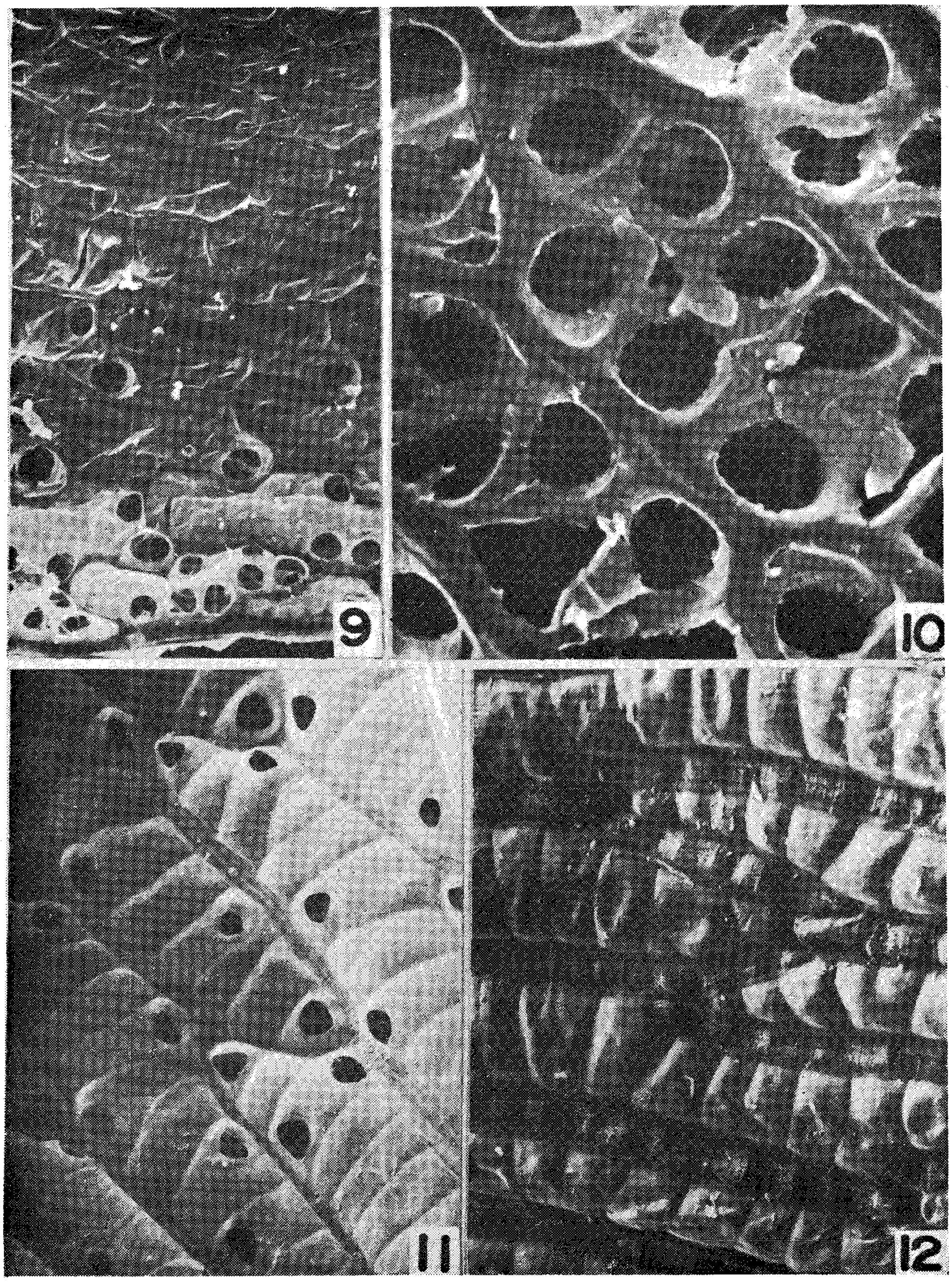

Fig. 9. The enlarged view of upper leaf surface of *S. palustre.* ×400.
Fig. 10. The more flattened leafof *S. palustre,* showing the annular-spiral marking inside the cell. ×1000.
Fig. 11. A portion of upper surface of leaf of ***S. cuspidatum.*** ×1000.
Fig. 12. A portion of lower surface of leaf of ***S. cuspidatum.*** ×1000.

Literature Cited

BOLD, H. C. 1973. Morphology of Plants. Harper and Row, New York, 668 p.

KAUFMAN, P., B. BIGELOW, R. SCHMID, and N. S. GHOSHEH. 1971. Electron Microprobe analysis of silica in epidermal cells of *Equisetum*. Amer. J. Bot. **58**: 309-316.

LAI, M. J. and J. R. WANG-YANG. 1976. Index Bryoflorae Formossensis. Taiwania **21**: 159-203.

LEDBETTER, M. C. and A. D. KRIKORIAN. 1975. Trichomes of *Cannabis sativa* as viewed with scanning electron microscopy. Phytomorphology **25**: 166-176.

LIEW, F. S. and S. C. WANG. 1976. Scanning electron microscopical studies on the spores of Pteridophytes. The tree fern family (Cyatheaceae) and its allied species found in Taiwan. Taiwania **21**: 251-267.

LIU, D. J. and Y. POMERANZ. 1975. Distribution of minerals in barley at the cellular level by X-Ray analysis. Cereal Chem. **52**: 620-629.

PAGE, C. N. 1974. *Equisetum* subgenus *Equisetum* in the Sino-Himalayan Region. Fern Gaz. **11**: 25-47.

PAN, S. M. and S. S. C. CHEN. 1976. Scanning electron microscopy of chloroplasts from duckweed cells. Taiwania **21**: 248-250.

STEAEHELIN, L. A. and J. D. PICKETT-HEAPS. 1975. The ultrastructure of *Scenedesmus* (Chlorophyceae). I. Species with the "reticulate" or "warty" type of ornamental layer. J. Phycol. **11**: 163-185.

WILCE, J. H. 1972. Lycopod Spores. I. General spores patterns and the generic segregates of *Lycopodium*. Amer. Fern Journ. **62**: 65-79.

掃描電子顯微鏡觀察臺灣幾種苔類的葉表面構造

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以臺灣產的四種苔類 *Plagiomnium acutum, Andreaea rupestris, Sphagnum palustre* 及 *Sphagnum cuspidatum,* 做爲苔類三個亞綱的代表。以掃描電子顯微鏡觀察其葉表面的構造。發現苔類三個亞綱的代表各具有完全不同的葉面構造。只有水苔類的植物葉表面的貯水細胞壁具有孔的構造。雖然這種孔在葉表面貯水細胞壁上的數目，大小及分佈因種類而稍有差異。但此種葉面構造與水苔類的高度吸水能力有密切的關係存在。