NOTES ON ANTARCTIC BRYOPHYTES: IV. *Encalypta* Hedw.

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ABSTRACT. Two species of *Encalypta* hitherto unrecorded from the Antarctic botanical zone are reported from the South Orkney Islands and the Antarctic Peninsula. Brief descriptions of *E. patagonica* Broth. and *E. procera* Bruch are included with a discussion of their taxonomy and details of their Antarctic distribution.

THE genus *Encalypta* would appear to be an uncommon constituent of the Antarctic flora, having been rarely collected. The material in the British Antarctic Survey herbarium (AAS), at present housed in the Department of Botany, University of Birmingham, clearly represents two species, which have been compared with type and other specimens loaned by the herbaria mentioned in the text. Duplicates of the Antarctic specimens have been distributed to world herbaria, as indicated by the abbreviations adopted by Lanjouw and Stafleu (1964) and Greene (1973).

Despite bearing some superficial resemblance to species of *Tortula* in the vegetative state, species of *Encalypta* may be distinguished readily by means of the sharp demarcation between small, highly ornamented photosynthetic cells in the upper part of the leaf and larger, less ornamented hyaline cells in the lower part, the presence of collenchymatous lower cell walls and of a large cylindrical calyptra that completely encloses the capsule.

Material from the Scotia Ridge–Antarctic Peninsula section of the Antarctic may be diagnosed as follows:

Leaves lingulate to sub-pandurate, apex rounded-obtuse, shortly apiculate or piliferous, margin recurved about mid-leaf or plane throughout. Nerve disappearing below rounded apex, continued into an apiculus of laminar tissue, or excurrent as a hyaline hair point. Upper leaf cells quadrate-hexagonal with prominent compound papillae and/or mamillae, lower leaf cells large, quadrate-rectangular, very thin-walled but collenchymatous, transverse walls orange, ± smooth or with scattered ornamentation, several rows of marginal cells narrower. Capsule, where known, erect, cylindrical, vertically striate when dry. Calyptra cylindrical, completely enclosing capsule, whitish brown with blackish tip, operculum rostrate, erect.

Sporophyte characters are widely held to be essential for the delimitation of species of *Encalypta* and, since fruit is common on Signy Island, South Orkney Islands, *E. patagonica* Broth. can be added to the known flora of the Antarctic botanical zone, as defined by Greene (1968). Only non-fruiting specimens of a second species, which is common to Signy Island, the Antarctic Peninsula and the sub-Antarctic island of South Georgia, have been seen and they are best referred to *E. procera* Bruch. The two species may be distinguished by reference to the characters given in Table I.

Encalypta patagonica Broth.

As known on Signy Island, *E. patagonica* is a typical but seldom abundant component of the flora of fairly stable moist to dry basic soil associated with marble and amphibolite outcrops and rock ledges. It is loosely caespitose or occurs as scattered stems, *c.* 0·2–2·5 cm. tall, bright to dark green above and orange-brown towards the base. The leaves are erecto-patent when wet, becoming closely appressed and spirally twisted at the stem apices on drying, their size lying within the limits of 1·50–3·50 × 0·50–1·00 mm.

Brotherus (*in* Dusén, 1905, 1906) described this species as a member of the section *Rhabdotheca* C. Muell. in view of its striate capsule and he characterized it by the nerve, excurrent as a hyaline hair point, the plane leaf margin, the apically papillose unfringed calyptra, the gymnostomous capsule and the brown tuberculate spores, all characters exhibited by material from Signy Island. Papillosity of the calyptra is variable, however, usually extending over the entire surface but being occasionally obscure or confined to the tip, and one specimen (R.

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TABLE I. VEGETATIVE DIFFERENCES BETWEEN *Encalypta patagonica* AND *E. procera* IN THE ANTARCTIC BOTANICAL ZONE

Characters	*E. patagonica*	*E. procera*
Leaf apex	Acute with hyaline hair point, or rounded	± Cucullate, narrowly obtuse to shortly apiculate
Leaf margin	Plane throughout	± Recurved about mid-leaf
Margin in lower (hyaline) part of leaf	± Entire	Serrulate to serrate
Border of lower (hyaline) part of leaf	Poorly defined, thin-walled cells only slightly narrowed	Well-defined, incrassate cells conspicuously narrowed
Upper (photosynthetic) laminar cells	Mamillose	Papillose
Rhizoidal gemmae on stem	Absent	Present

Smith 378) has more or less completely glabrous calyptrae. The spores, *c.* 33·5–50·5 μm. in diameter, coincide closely with the 0·04 mm. quoted by Brotherus (*in* Dusén, 1906) but there is a discrepancy in leaf ornamentation. The compound papillae illustrated by Brotherus (*in* Dusén, 1906, table 12, fig. 10) are without subtending mamillae, whereas Signy Island specimens are invariably compoundly mamillose, sometimes with small subtended papillae, the ornamentation appearing lunate or as rings in surface view (Fig. 1). However, examination of the type specimen (P. Dusén 31, S-PA, Patagonia, Punta Arenas) and a probable duplicate (No. 31, BM, Patagonia australis ad Punta Arenas emporium in terra) confirms that leaf ornamentation is indistinguishable from that of Antarctic material, having papillae subtended by mamillae. In addition, duplicates of a second specimen mentioned by Brotherus (*in* Dusén, 1906) (P. Dusén, S-PA, Patagonia australis, Lago San Martin, Rio Fossiles in terra, c. 900 m.s.m., 10.iv.1905; P. Dusén 5991, S-PA, Sydpatagonien, Rio Fossiles, 32 Kampun, 900 m., 10.iv.1905, det. V. F. Brotherus) fall within the variation of cell ornamentation known from Signy Island.

Five specimens from Signy Island are highly mamillose plants in which the nerve ends far below the rounded leaf apex. Three of these specimens (Longton 1098, Longton 1201, Webb 127) possess mature capsules which, unlike those of the gymnostomous, piliferous material, are haplolepidous. Their recognition as a separate species could be justified by analogy with European and North American treatments of the genus, the existence of a correlation between presence or absence of a peristome and the shape of the leaf apex having been accepted in some groups. However, it is well known that these can be highly variable characters (Flowers, 1938; Nyholm, 1954) and Dixon (1924) was of the opinion that the two are uncorrelated, for example, in *E. vulgaris* Hedw. Since an inadequate sample of specimens is available to test whether a significant correlation exists in the Signy Island material, it is proposed to recognize both types of plants as expressions of the variation inherent in *E. patagonica*.

Brotherus (*in* Dusén, 1905) distinguished *E. patagonica* from *E. tasmanica* C. Muell. et Hamp. by its rough calyptra and the possession of a leaf hair point. The validity of the latter species, based on the absence of these two characters, has since been questioned and its reduction to synonymy with *E. vulgaris* (Dixon, 1926) indicates the need to compare *E. patagonica* with *E. vulgaris*. In this context, the possible systematic importance in *Encalypta* of the distinction between leaf mamillae and papillae is highly relevant. Flowers (1938) illustrated lunate cell ornamentation in North American *E. vulgaris* and referred to papillae, whereas a small sample of British specimens (BIRM) has revealed the presence of rounded-quadrate papillae subtended by mamillae of very low profile. It is therefore considered that an intensive study of Northern Hemisphere *E. vulgaris* could be expected to have some bearing on the status of *E. patagonica*, particularly as no other character presents an obvious bar to the recognition of synonymy.

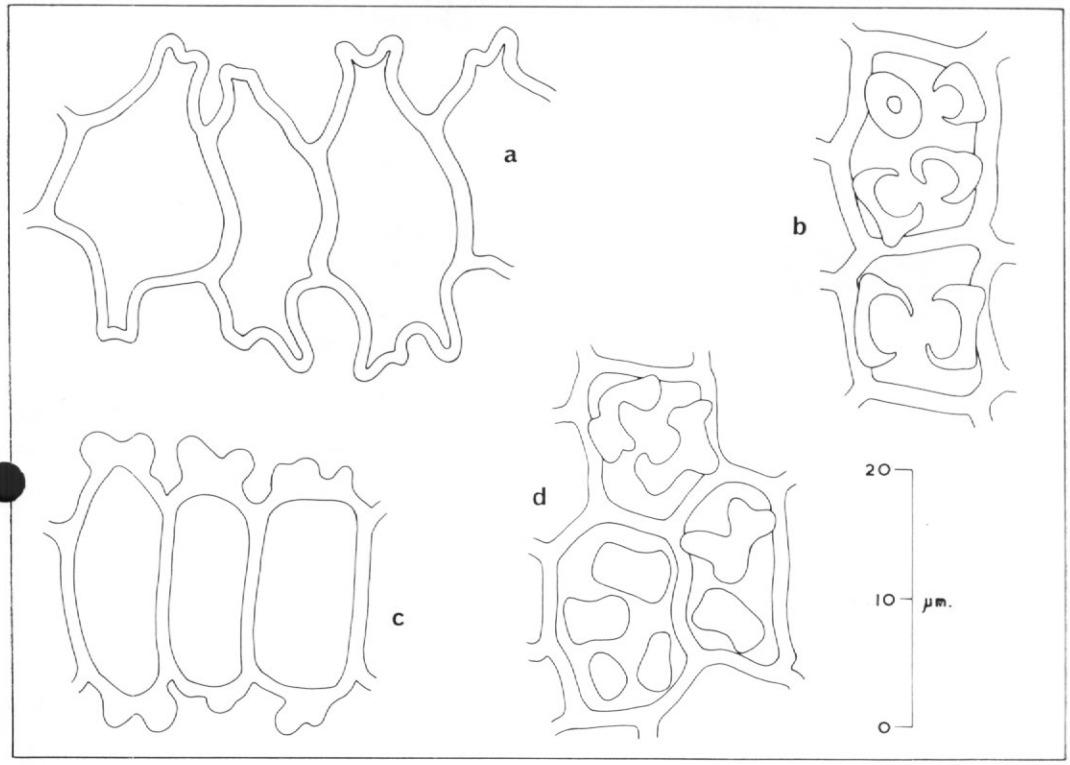

Fig. 1. Ornamentation of upper leaf cells of Antarctic *Encalypta*. Mamillae of *E. patagonica*, as seen in transverse section (a) and surface view (b). Papillae of *E. procera*, as seen in transverse section (c) and surface view (d).

Distribution in the Antarctic botanical zone

South Orkney Islands *Signy Island:* North Point, Longton 1201 (AAS, BA, H, LE, MEL, NY, S-PA, TNS); south-east of North Point, R. Smith 659 (BM); south-west of Stygian Cove, Webb 28 (AAS); Three Lakes Valley, Holdgate 144a (AAS, BA, INACH, S-PA), Longton 1177 (AAS, B, CHR, MEL, NY, O, TNS), Longton 1178 (BA, BM, H, LE, PRE, S-PA), Webb 88a (AAS); north of Elephant Flats, R. Smith 377 (AAS), R. Smith 378a (BM, CHR, S-PA); Borge Bay, Webb 80 (BM); Knife Point, Webb 15 (AAS), Webb 115 (BM); Factory Cove, Longton 839 (BA, BM, MSC, PC); between Thulla Point and Port Jebsen, Holdgate 163 (AAS, CHR, INACH, S-PA); Thulla Point, Holdgate 769 (BA, BM); south of hut at Foca Point, Webb 127 (BA, BM); south of Foca Point, Longton 1098 (AAS, B, CHR, H, INACH, MSC, PC, S-PA); Foca Point, R. Smith 334 (BM, INACH, MSC, PC), R. Smith 335 (AAS, CHR).

Encalypta procera Bruch

In the Antarctic botanical zone, *E. procera* is a colonist of melt-water niches, rock ledges and crevices and moist gravelly soil. The dense turves, *c.* 1·8–4·7 cm. tall and dark green above, are interwoven below by copious reddish brown rhizoids bearing brown filiform to narrowly fusiform gemmae. The spreading leaves, semi-sheathing below, reflexed above when wet and becoming somewhat incurved on drying with little or no tendency to twist spirally, have slightly revolute margins and fall within the range of *c.* 2·50–5·50×0·75–1·25 mm. More or less cucullate leaf apices, that vary from rounded to narrowly obtuse or shortly apiculate, typify *E. procera*. The nerve is often spinous-dentate dorsally, rarely excurrent, and it

usually disappears in the apiculus or below an obtuse apex. Compound papillae, appearing rounded-quadrate or irregularly lunate in surface view (Fig. 1), are characteristic of *E. procera*, as is the distinctive basal leaf areolation, a border of narrow cells being clearly defined and incrassate, producing a margin that is serrulate to serrate.

In view of the limited amount of material from the Antarctic botanical zone, 15 specimens of South Georgian *Encalypta* (including Greene 2323 and R. Smith 1226), typical of similar habitats, were compared and found to be identical, although stem length is more variable, being 1·6–5·4 cm. The ultimate divisions of the compound papillae of this sub-Antarctic material also tend to be smaller in optical area as seen in surface view but this is considered to be a difference of degree not incompatible with the recognition of a single species.

Recognition of type material of *E. procera* has been somewhat confused because its date of collection has been variously quoted as 1827 and 1828. Bruch's (1832) original description made no mention of a date but many subsequent authors (e.g. Bruch and others, 1838; Müller, 1849; Roth, 1904) have given it as 1827, a date for which a specimen has not been traced. However, when reviewing Norwegian collections of *E. procera*, Hagen (1910) reported that Bruch's species was based on a gathering made in 1828 and it is therefore considered that a specimen in the British Museum (Nat. Hist.) (Kurr, BM, rûd Norwegan, Häbner, 1828) can be regarded as an isotype. This specimen, which was confirmed as being autoecious, has been found to coincide with the Antarctic and South Georgian species in every respect, inclusive of nerve structure (Fig. 2) which agrees with that illustrated by Flowers (1938) for North American *E. procera*. It may be mentioned, that neither type, nor Antarctic and sub-Antarctic material conforms to Flowers' description and illustration of evenly thickened transverse cell walls in the basal part of the leaf. They are strongly collenchymatous but, because of their intense coloration, give an illusion of being incrassate when the plane of focus lies above or below the middle lamellae.

The dark brown, multicellular, filiform to narrowly fusiform propagules, frequent on lateral branches of straight rhizoids borne along the stem of the present species, were not mentioned by Bruch (1832) when describing *E. procera*. Bruch and others (1838) drew attention to these structures not only in *E. procera* but also in *E. streptocarpa*, the type description of which also failed to include them (Hedwig, 1801), and subsequent authors have recognized that their abundance is typical of these two diplolepidous species although they are also known in other species. Specific identification of sterile material such as the Antarctic specimens is less straightforward, however, because the monoecious state of *E. procera* is regarded as the main distinction from dioecious *E. streptocarpa*, and attempts to define correlations with vegetative characters have proved unsatisfactory.

Flowers (1938) pointed out that a well-developed central cylinder in the stem of *E. procera* provided a reliable means of separation from *E. streptocarpa* in which the central cylinder was said to be absent or scarcely developed and this was confirmed by Nyholm (1954). Experience with the Antarctic and sub-Antarctic specimens suggests that the difference is not clear-cut and cannot be relied upon when only a few specimens are available. For instance, the central cylinder of a stem taken from a specimen, originally determined as *E. streptocarpa*, re-determined as *E. procera* by Flowers and confirmed as the latter by the author (T. Drummond 48 BM, rocks and banks amongst the Rocky Mountains, 1832, Musc. Amer.), showed no greater development than that of a stem of one of the specimens from which the lectotype of *E. streptocarpa* must be chosen (G, *ex herb.* Hedwig-Schwaegrichen, F———,* Scripsit: Hedwig.) and in which evidence of autoecism was not detected. This and other possible lectotypes (G, ——*860 f. grandis Hedwigii, Starke dedit Hedwigio 1800; Specimina Carinshire ad Plaganfurd), neither of the two latter having been dissected for inflorescences, however, differ from the Antarctic and sub-Antarctic species in their distinctly smaller cells both dorsally and ventrally, as seen in transverse section of the leaf nerve (Fig. 2). These cells are more or less confined to the dorsal side of the nerve in the southern plant. Moreover, the width of the nerve of *E. streptocarpa*, as seen in transverse section, is approximately twice its height, whereas these dimensions are more nearly equal in Antarctic and sub-Antarctic specimens. The value of such a distinguishing character, between *E. procera* and *E. streptocarpa*, involving

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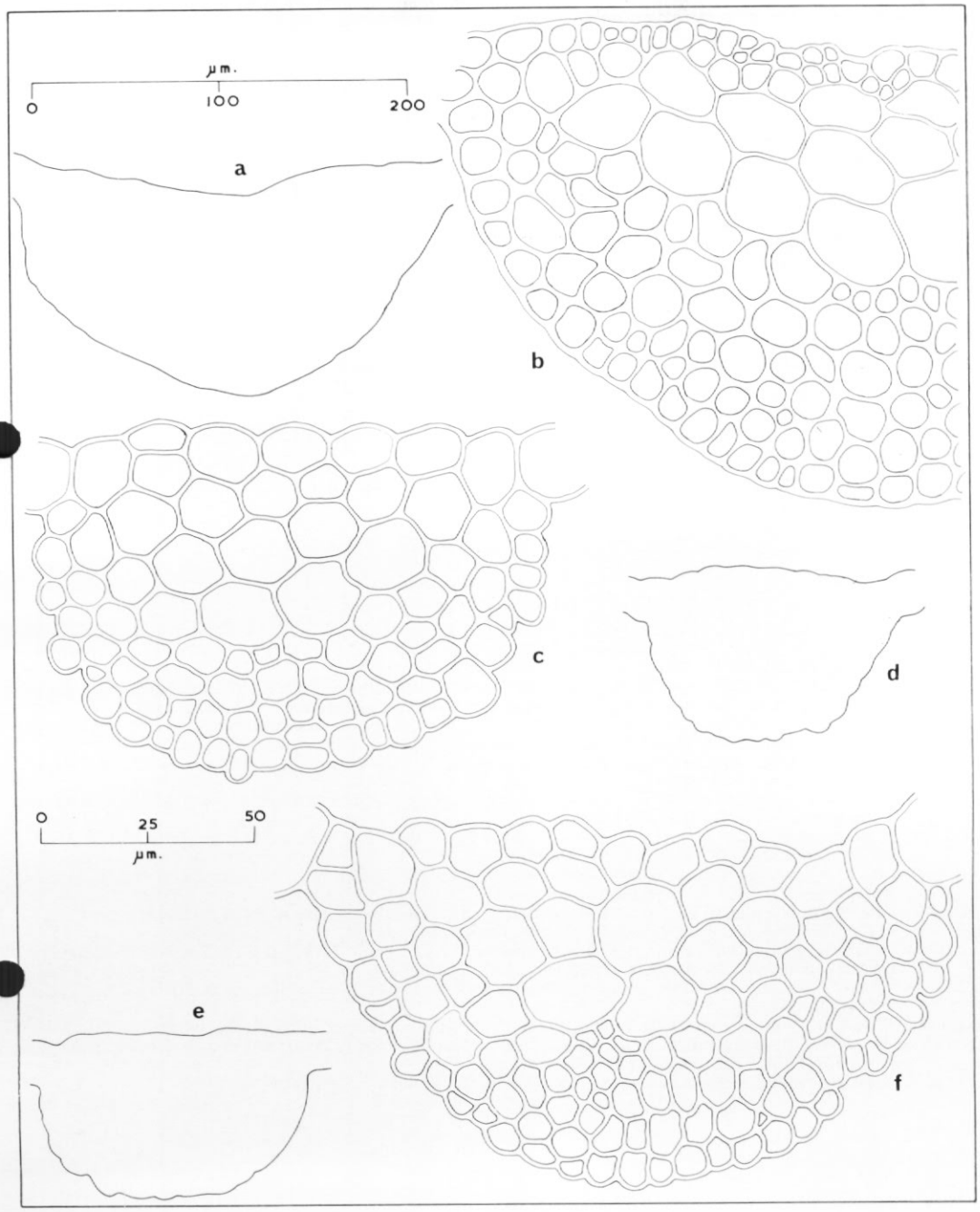

Fig. 2. Transverse section at mid length of leaf showing nerve in authenticated *Encalypta streptocarpa* (a and b), authenticated *E. procera* (c and d) and Antarctic *E. procera* (e and f).
Scales: upper for a, d and e, lower for b, c and f.

both nerve shape and distribution of cell types as seen in transverse section, requires further study, although the Antarctic and sub-Antarctic specimens examined show complete agreement with the former but differ from the latter.

Distribution in the Antarctic botanical zone

South Orkney Islands *Signy Island:* Paal Harbour, R. Smith 678 (AAS); east of Jebsen Point, R. Smith 594a (AAS, CHR, NY).

Antarctic Peninsula, west coast *Alexander Island:* Eros Glacier, Taylor 525 (AAS, BA, INACH, MSC, PC, S-PA); Uranus Glacier, Taylor 522 (AAS, B, BM, H, LE, MEL, O, PRE, TNS).

Antarctic Peninsula, east coast *Wilkins Coast area:* Finley Heights, Cousins 2 (AAS, CHR), Cousins 7 (AAS).

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