PALYNOLOGICAL STUDIES IN SOUTH GEORGIA: I. POLLEN AND SPORE MORPHOLOGY OF THE NATIVE VASCULAR SPECIES

By C. J. BARROW

ABSTRACT. Illustrations and descriptions are given of pollen and spores from the 25 living taxa which comprise the present-day native vascular flora of South Georgia. The pollen and spores of 12 of these taxa are described for the first time. The material was treated by standard palynological techniques so that the appearance of the pollen and spores resembles as closely as possible that of fossil grains isolated from peat.

THE position of South Georgia in relation to oceanic boundaries, the West Wind Drift, South America and Antarctica, together with its history of only very limited and recent human interference, makes it a particularly valuable area for palynological study. Peat deposits up to 3·77 m. deep are known and, as a radiocarbon date for a sample from 1 m. depth gave an age of 6,500 ± 500 yr. B.P. (Fergusson and Libbey, 1964), it seems likely that much of the post-glacial history of the island, and certainly of its vegetation, is preserved in the organic deposits. Hence it should be possible to obtain sufficient information to compare the post-glacial period on South Georgia with that known for southern South America (Auer, 1958) and some of the sub-Antarctic islands (van Zinderen Bakker, 1967, 1969). Some preliminary observations by Cranwell (1963, 1969), which are the only information so far published on South Georgian peats, suggest that the present vegetation has been on the island for a substantial period of time.

Field work during the southern summer of 1972–73 established that organic deposits suitable for palynological analysis were present around much of the island, particularly in low sheltered areas on the north-east coast. Two localities within the Cumberland Bay area were selected for detailed study and intensive sampling, one in Sphagnum Valley and the other on the south shore of King Edward Cove. Samples were also obtained at other localities, notably from Annenkov Island off the south-west coast of South Georgia.

Palynological interpretation of past environments and correlation of deposits rests upon the accurate identification of micro-fossils, both pollen and spores. So far no descriptions have been given of native material of the pollen and spores of the native or alien vascular species currently growing on South Georgia, and it is to provide a basis for the identification of fossil material from the island's peat deposits that the descriptions and illustrations in this paper are provided. Of the 25 taxa illustrated, 12 do not appear to have been illustrated previously from any source, but descriptions and illustrations of the remainder, albeit from non-South Georgian material, can be found in Bellair (1967) and Heusser (1971).

METHODS

The pollen and spore preparations were made from material collected on South Georgia by the author as flowers or spore-bearing bodies, or from plants obtained on South Georgia and grown for some time in the United Kingdom as part of the living collections of the British Antarctic Survey, currently at the University of Birmingham. An additional source of material was the herbarium of the British Antarctic Survey. The taxa illustrated in this paper and the nomenclature used accord with the check list of the island's native vascular plants published by Greene (1964) and recently revised by Walton (1975). Naturalized alien species are not considered in this paper.

The extraction of pollen and spores from fossil deposits involves the use of chemical techniques which, in addition to the changes caused by fossilization, alter the appearance from that of fresh grains. For this reason, the fresh material used for the reference slide collection, from which the photographs were prepared, was treated in a similar manner so that the appearance of the material and the photographs would resemble, as far as possible, that of extracted fossil pollen and spores. Pollen- and spore-bearing parts of plants were treated with a solution of KOH, and with an acetolysis mixture, according to the method described by

Erdtman (1960, 1971). Chlorination was not used. After dehydration with alcohol, the treated material was mounted in silicone fluid (200/12,500 cs) without staining (Andersen, 1960; Fægri and Iversen, 1964). This viscous medium has the advantage as a mountant of permitting re-orientation of individual grains during examination and photography.

Photographs were taken with a Leitz Orthomat camera and Leitz Ortholux photomicroscope, with a × 95 oil-immersion objective of N.A. 1·32. A Leitz light green filter S520-55-90 was used to improve contrast in certain cases and the exposure was electronically determined. The film used was a 35 mm. Ilford Micro-Neg-Pan type B film, rated at ASA 6, and developed in Ilford Copyphen developer.

Descriptions

In the descriptions, a terminology based on that of Heusser (1971) has been used, the mode of occurrence (either as single grains or as multiples), the arrangement (as tetrads or polyads), the symmetry and the pollen type all being noted. The pollen type is described by the form and location of various prominent features, i.e. in spores by the laesurae and commisures and in pollen by the apertures. Shape is determined by the symmetry of the grain (and is categorized by comparing equatorial and polar axes) and the structuring and sculpturing details of the exine are also noted. The dimensions of grains, which include the processes, are quoted, with the exception of four species, as averages of at least 50 as far as possible obtained from more than one source, and within each source from more than one plant, the size range being given in parentheses.

Source of pollen and spores

Slides of the pollen and spores described are lodged in the British Antarctic Survey pollen and spore collection (herbarium specimens and slides being prefixed PS/) and, unless otherwise stated, this South Georgian material has been obtained, or has originated from four sources:

i. Material collected in the field by the author during the 1972–73 austral summer, and lodged in the Survey's herbarium (indicated by the prefix PS/f/ followed by the collection number).
ii. Material from the Survey's herbarium (indicated by the prefix PS/h/ followed by the collector's name and collection number).
iii. Material gathered from the cultivated plant collections of the British Antarctic Survey in Birmingham, and lodged in the Survey's herbarium (indicated by the prefix PS/c/ followed by the collection number).
iv. Material provided by other collectors and incorporated into the pollen and spore collection in the same numerical series as the PS/f/ specimens (indicated by the absence of a letter after the prefix PS/ but followed by the collection number).

For each species described the PS numbers refer to slides derived from specimens in the pollen and spore collection.

Key to Spores and Pollen

It should be noted that in cases where the grains of two or more species are so similar as to be indistinguishable, or separable only with great difficulty, they have been "keyed out" together.

Spores

1. Spores radiosymmetric 2
   Spores bilaterally symmetric 5
2. Spores echinate 3
   Spores scabrate 4
3. Equatorial axis *c.* 40 μm. in diameter, exine *c.* 2·5 μm. thick ***Grammitis kerguelensis***
   Equatorial axis *c.* 57 μm. in diameter, exine *c.* 1 μm. thick ***Hymenophyllum falklandicum***
4. Sculpture verrucate-fossulate . . . . . ***Ophioglossum crotalophoroides***
   Sculpture reticulate . . . . . ***Lycopodium magellanicum***

5. Spores scabrate . . . . . ***Blechnum penna-marina***
   Spores echinate 6
6. Multisaccate with small (<*c.* 2 μm.) echinate processes . . ***Polystichum mohrioides***
   Not multisaccate with echinate processes up to 6 μm. long . . ***Cystopteris fragilis***

Pollen

1. Grains pear-shaped, polar axis >40 μm. 2
   Grains not pear-shaped, greatest axis 10–39 μm. 4
2. Grains periporate, exine *c.* 1–1·5 μm. thick . . . . ***Uncinia meridensis***
   Grains monoporate, exine <1 μm. thick 3
3. Polar axis *c.* 48 μm. long . . . . . ***Rostkovia magellanica***
   Polar axis *c.* 40 μm. long . . . . . ***Juncus scheuchzerioides***
   Juncus inconspicuus
4. Grains inaperturate, 4 (rarely 3) thin areas of exine (not perforations) . . . . . ***Callitriche antarctica***
   Grains aperturate 5
5. Grains porate, lacking colpi 6
   Grains with or without pores, colpate 8
6. Grains multiporate. . . . . ***Colobanthus subulatus***
   Colobanthus quitensis
   Grains monoporate 7
7. Exine with fine distinct markings, long axis *c.* 34 μm., annulus protruding *c.* 1 μm. . . . . ***Phleum alpinum***
   Exine with fine distinct markings, long axis *c.* 23–32 μm., annulus protruding <1 μm. . . . . ***Deschampsia antarctica***
   Exine with indistinct markings, long axis *c.* 23–30 μm. . . ***Poa flabellata***
   Festuca contracta
   Alopecurus magellanicus
8. With 3–4 colpi 9
   With >6 colpi 10
9. Tricolpate, sculpture gemmate . . . . . ***Ranunculus biternatus***
   Tricolporate, sculpture rugulate . . . . . ***Acaena magellanica***
   Acaena tenera
   Acaena magellanica* × *tenera
10. Pericolpate . . . . . ***Montia fontana***
    Stephanocolpate . . . . . ***Galium antarcticum***

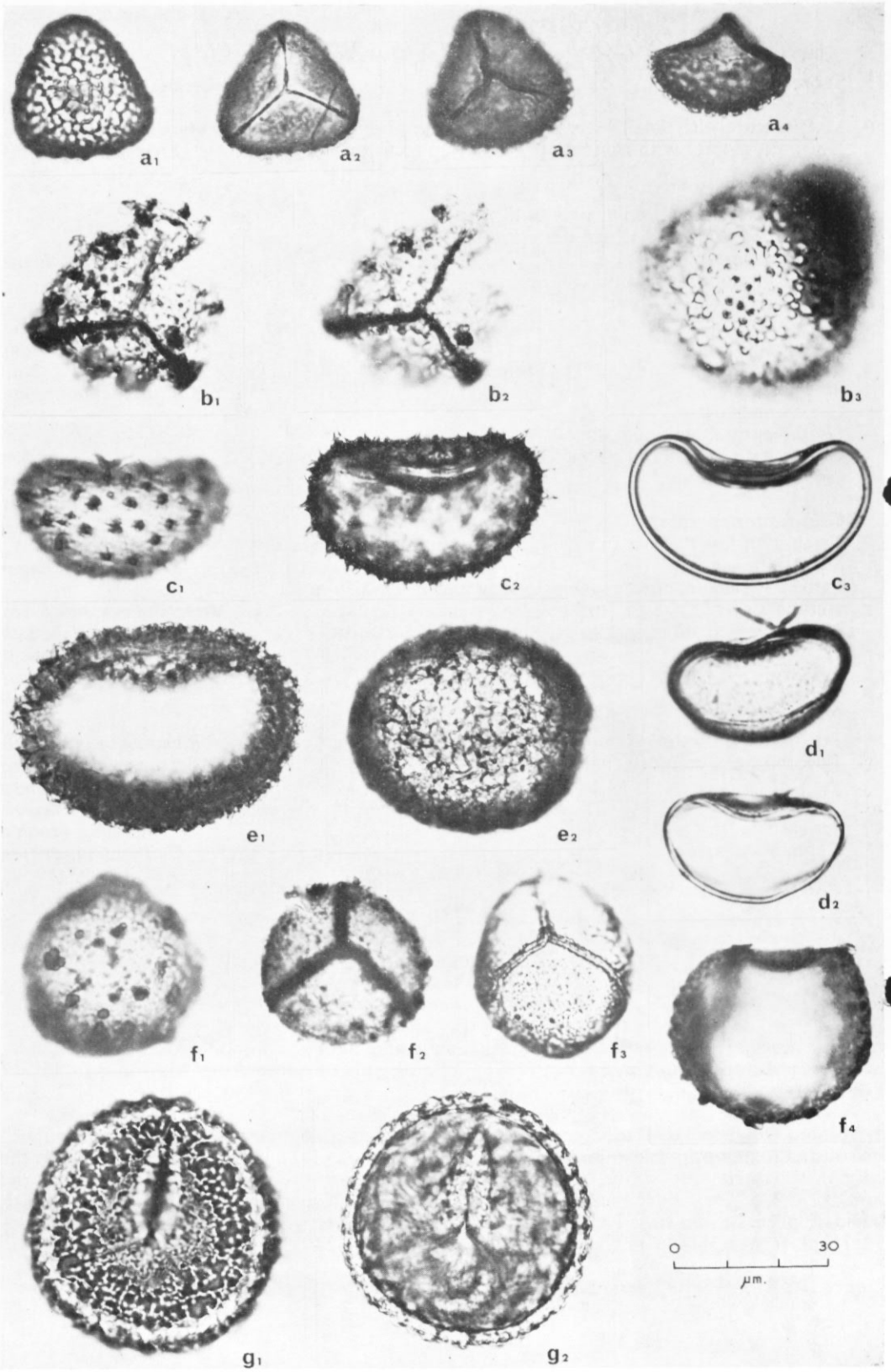
Descriptions

Lycopodium magellanicum Sw.

Previous work. Heusser (1971, pl. 2), discussion and photographs of material from Chile; Schalke and van Zinderen Bakker (1971), photograph of spore from Marion and Prince Edward Islands group.

Monad. Heteropolar. Radiosymmetric. Amb rounded-triangular with slight or pronounced interradial flattening. Trilete, laesurae straight or occasionally sinuous, narrowing towards the edge in proximal view. Exine *c.* 1–1·5 μm. thick. Sculpture reticulate on distal surface, the lumina *c.* 2–5 μm. wide, the muri *c.* 1–1·5 μm. wide discontinuous and terminated with baculate processes up to *c.* 2·5 μm. high. Dimensions (average of 50 grains): equatorial axis 39·1 μm. (range 31–44 μm.), polar axis 29·1 μm. (range 24–33 μm.). (Fig. $1a_{1-4}$.)

Source. PS/f/37; PS/h/Greene 2086.


a1
a2
a3
a4
b1
b2
b3
c1
c2
c3
d1
d2
e1
e2
f1
f2
f3
f4
g1
g2
0
30
μm.

Hymenophyllum falklandicum Baker

Monad. Heteropolar. Radiosymmetric. Amb rounded-triangular. Trilete, laesurae straight, uniform in width (up to *c.* 1 μm.), appearing to terminate *c.* ½–⅔ of the length of the equatorial radius from proximal pole. Exine *c.* 1 μm. thick, stratified. Sculpture of echinate processes, irregular in size, rounded in cross-section, extending up to *c.* 3 μm. Dimensions (average of 37 grains): equatorial axis 54·0 μm. (range 44–70 μm.), polar axis 36·2 μm. (range 34–60 μm.). (Fig. $1b_{1-3}$.)

Source. PS/f/45; PS/f/69.

Blechnum penna-marina (Poir.) Kuhn.

Previous work. Auer and others (1955), description and photograph of material of *Blechnum* sp. from Fuego-Patagonia; Harris (1955), description and drawing of New Zealand specimen; Heusser (1971, pl. 4), description and photographs of Chilean material; Schalke and van Zinderen Bakker (1971), description and photograph of spore from Marion and Prince Edward Islands group.

Monad. Heteropolar. Bilaterally symmetric. Monolete, laesura two-thirds length of greater equatorial longitudinal axis, in proximal view appearing as elongated ellipse, concave-convex in latitudinal equatorial view. Perine present, exine *c.* 1 μm. thick, stratified. Sculpture faint, scabrate. Dimensions (average of 48 grains): greater equatorial axis 37·5 μm. (range 31–39 μm.), equatorial width 25·5 μm. (range 21–30 μm.), polar axis 24·7 μm. (range 21–27 μm.). (Fig. $1d_{1-2}$.)

Source. PS/h/Greene 3153.

Cystopteris fragilis (L.) Bernh.

Previous work. Harris (1955), description and drawing of spore from New Zealand; Heusser (1971, pl. 6), description and photographs of specimens from Chile.

Monad. Heteropolar. Bilaterally symmetric. Monolete, laesura ½–⅔ length of greater equatorial axis, *c.* 2·5–3 μm. wide at mid-point, in proximal view an elongated ellipse, concave-convex in latitudinal equatorial view. Exine *c.* 4–5 μm. thick, clearly stratified. Sculpture of echinate processes, varying in length, size and orientation, up to *c.* 2 μm. wide at base and *c.* 6 μm. long. Dimensions (average of 59 grains): greater equatorial axis 53·6 μm. (range 46–60 μm.), equatorial width 39·0 μm. (range 30–41 μm.), polar axis 34·1 μm. (range 25–44 μm.). (Fig. $1c_{1-3}$.)

Source. PS/f/31; PS/c/2.

Fig. 1. Photomicrographs of spores of pteridophytes from South Georgia.
- a. *Lyocopodium magellanicum* (a_1 distal view, high focus; a_2 proximal view, mid focus; a_3 proximal view, high focus; a_4 equatorial view, mid focus).
- b. *Hymenophyllum falklandicum* (b_1 proximal view, high focus; b_2 proximal view, mid focus; b_3 proximal view, high focus).
- c. *Cystopteris fragilis* (c_1 latitudinal view, high focus; c_2 latitudinal view, mid focus; c_3 latitudinal view, mid focus, without perine).
- d. *Blechnum penna-marina* (d_1 latitudinal view, high focus; d_2 latitudinal view, mid focus).
- e. *Polystichum mohrioides* (e_1 latitudinal view, mid focus; e_2 distal view, high focus).
- f. *Grammitis kerguelensis* (f_1 distal view, high focus; f_2 proximal view, mid focus; f_3 proximal view, high focus, note the papillus at the proximal pole; f_4 equatorial view, mid focus).
- g. *Ophioglossum crotalophoroides* (g_1 proximal view, high focus; g_2 proximal view, mid focus).

Polystichum mohrioides (Bory) C. Presl var. *plicatum* (Poepp.) C. Chr.

Monad. Heteropolar. Bilaterally symmetric. Monolete, laesura *c.* two-thirds length of greater equatorial axis, elliptical with wide mid-section in proximal view, equatorially plano-convex. Exine *c.* 1–1·5 μm. thick. Sculpture multisaccate, sacci sinuous (*c.* 4–6 μm. long, *c.* 0·5–1 μm. wide and up to 8 μm. high) with small (*c.* 2 μm.) echinate processes. Dimensions (average of 57 grains): greater equatorial axis 63·2 μm. (range 52–71 μm.), equatorial width 49·5 μm. (range 41–52 μm.), polar axis 47·0 μm. (range 40–52 μm.). (Fig. $1e_{1-2}$.)

Source. PS/f/15.

Grammitis kerguelensis Tard.

Previous work. Schalke and van Zinderen Bakker (1971), photographs of material from Marion and Prince Edward Islands group.

Monad. Heteropolar. Radiosymmetric. Rather rounded proximally and equatorially. Trilete, laesurae *c.* 2–3 μm. wide, straight or with slightly wavy edges, extending almost to edge in proximal view. Papillus *c.* 3 μm. high extending from the proximal pole. Exine *c.* 2·5 μm. thick. Sculpture of echinate processes up to *c.* 4 μm. long and *c.* 2 μm. in cross-section. Dimensions (average of 56 grains): equatorial axis 40·3 μm. (range 32–60 μm.), polar axis 33·8 μm. (range 27–41 μm.). (Fig. $1f_{1-4}$.)

Source. PS/h/Greene 2043; PS/c/4.

Ophioglossum crotalophoroides Walt.

Previous work. Hafsten (1960), photographs of *O. opacum* Carm. (= *O. crotalophoroides* Walt.) from Tristan da Cunha; Heusser (1971, pl. 3), description and photographs of material from Chile.

Monad. Heteropolar. Radiosymmetric. Amb circular. Trilete, laesurae *c.* 1–1·5 μm. wide at proximal pole narrowing towards equator with a margo up to *c.* 6 μm. wide. Exine *c.* 3–4 μm. thick, stratified. Sculpture verrucate and irregularly fossulate, extending up to *c.* 2 μm. Dimensions (average of 56 grains): equatorial axis 61·7 μm. (range 51–76 μm.), polar axis 39·0 μm. (range 30–53 μm.). (Fig. $1g_{1-2}$.)

Source. PS/f/42; PS/h/Longton 322.

Ranunculus biternatus Sm.

Previous work. Schalke and van Zinderen Bakker (1971), photographs of material from Marion and Prince Edward Islands group.

Monad. Isopolar. Radiosymmetric. Shape prolate-spheroidal, amb circular. Tricolpate (rarely 4-colpate), the colpi *c.* 1 μm. wide intruding slightly in polar view. Exine *c.* 1 μm. thick. Sculpture coarse, granular or gemmate up to *c.* 0·5 μm. Dimensions (average of 56 grains): equatorial axis 34·4 μm. (range 28–39 μm.), polar axis 31·3 μm. (range 21–35 μm.). (Fig. $2a_{1-3}$.)

Source. PS/f/87; PS/h/Longton 167.

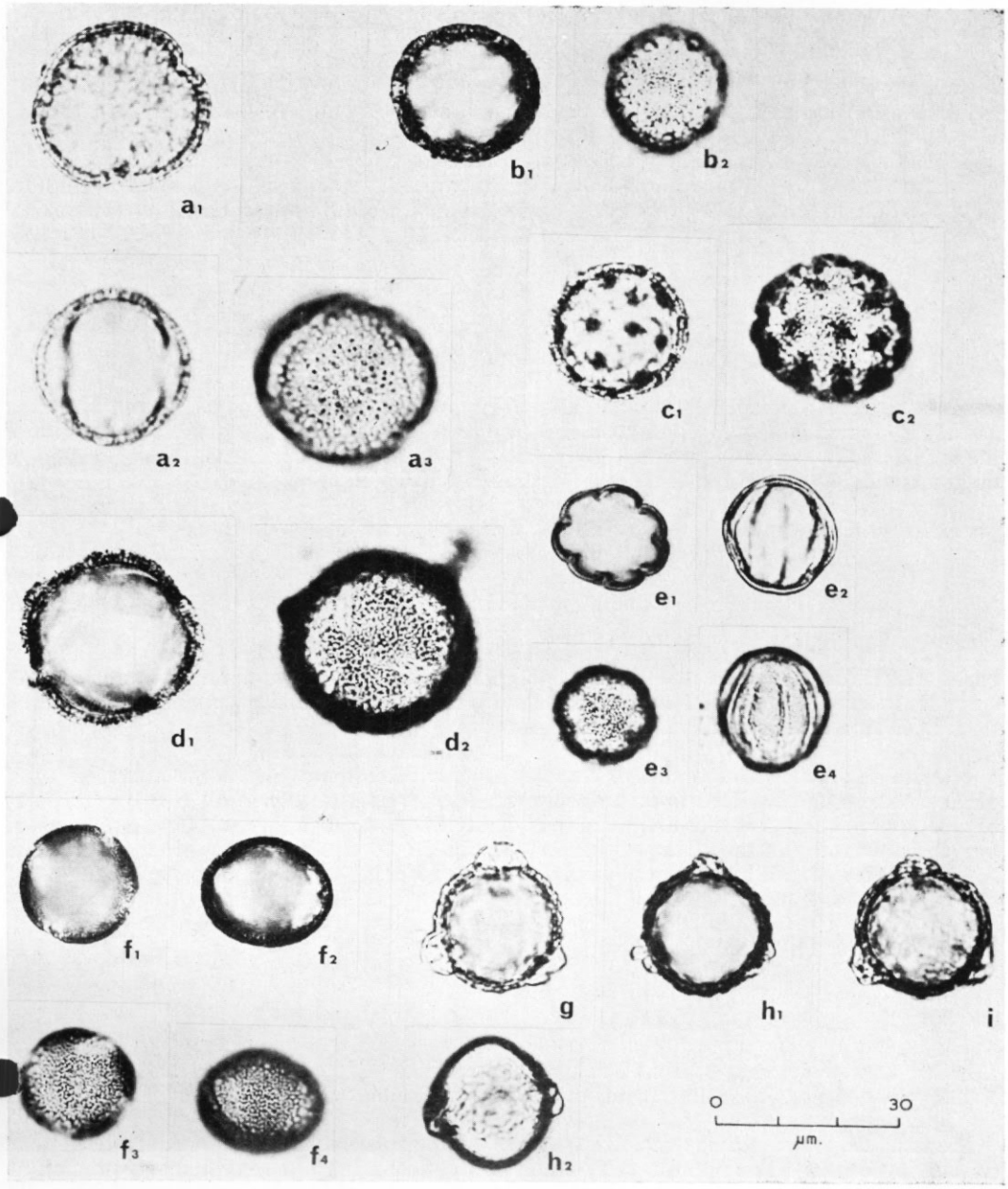


Fig. 2. Photomicrographs of pollen of herbs and dwarf shrubs from South Georgia.

a. *Ranunculus biternatus* (a_1 polar view, mid focus; a_2 equatorial view, mid focus; a_3 equatorial view, high focus).
b. *Colobanthus quitensis* (b_1 mid focus; b_2 high focus).
c. *Colobanthus subulatus* (c_1 mid focus; c_2 high focus).
d. *Montia fontana* ssp. *fontana* (d_1 mid focus; d_2 high focus).
e. *Galium antarcticum* (e_1 polar view, mid focus; e_2 equatorial view, mid focus; e_3 polar view, high focus; e_4 equatorial view, high focus).
f. *Callitriche antarctica* (f_1 polar view, mid focus; f_2 equatorial view, mid focus; f_3 polar view, high focus; f_4 equatorial view, high focus).
g. *Acaena magellanica* (polar view, mid focus).
h. *Acaena tenera* (h_1 polar view, mid focus; h_2 equatorial view, mid focus).
i. *Acaena magellanica* × *tenera* (polar view, mid focus).

Colobanthus quitensis (Kunth) Bartl.

Previous work. Heusser (1971, pl. 20), description and photograph of material from Chile.

Monad. Apolar. Shape near spheroidal. Periporate, *c*. 20–30 pores of *c*. 2 μm. diameter, each surrounded by a vague annulus *c*. 0·5 μm. wide. Exine *c*. 1·5–2 μm. thick. Sculpture of numerous small echinate processes giving a granular appearance. Dimensions (average of 60 grains): 30·0 μm. (range 24–33 μm.) in diameter. (Fig. $2b_{1-2}$.)

Source. PS/c/33.

Colobanthus subulatus (D'Urv.) Hook. f.

Monad. Apolar. Shape near spheroidal. Periporate, *c*. 20–30 pores of *c*. 1·5 μm. diameter, each surrounded by a vague annulus *c*. 0·5 μm. wide. Exine *c*. 1·5–2 μm. thick. Sculpture of numerous small echinate processes giving a granular appearance. Dimensions (average of 66 grains): 28·8 μm. (range 22–32 μm.) in diameter. (Fig. $2c_{1-2}$.)

Source. PS/h/Longton 271.

Montia fontana L. ssp. *fontana*

Previous work. Nilsson (1967), description and photograph of material from a number of Northern Hemisphere sources; Heusser (1971, pl. 46), description and photographs of Chilean specimens; Schalke and van Zinderen Bakker (1971), description and photographs of material from Marion and Prince Edward Islands group.

Monad. Apolar. Spheroidal. Pericolpate (usually 12-colpate, the colpi arranged as if outlining six squares spaced upon a sphere, an arrangement described by Nilsson (1967) as pantocolpate), colpi *c*. 8 μm. long, *c*. 1 μm. wide. Exine up to *c*. 3 μm. thick. Sculpture of fine spinules and punctae both varying in size but *c*. <0·5 μm., and with larger baculate spines (up to *c*. 2 μm.) in mesocolpia. Dimensions (average of 22 grains): 35·9 μm. (range 29–46 μm.) in diameter. (Fig. $2d_{1-2}$.)

Source. PS/f/76; PS/c/5; PS/f/116.

Acaena magellanica (Lam.) Vahl

Previous work. Auer and others (1955), description and photographs of *Acaena adscendens* Vahl (= *A. magellanica* (Lam.) Vahl) of Fuego-Patagonian origin.

Monad. Isopolar. Radiosymmetric. Shape oblate-spheroidal, amb rounded-triangular (in varying degree). Tricolporate (very rarely 2- or 4-colporate), the colpi short, situated at mid point of the sides, often ill-defined and tapering towards the poles; pores equatorially situated at mid point of colpi, with an irregular lip forming a *c*. 4–5 μm. protrusive process around the pore. Exine *c*. 2–2·5 μm. thick. Sculpture coarse, rugulate. Dimensions (average of 50 grains): equatorial axis* 28·8 μm. (range 24–34 μm.), polar axis 28·3 μm. (range 22–30 μm.), there being much variation in size. (Fig. 2g.)

Source. PS/h/Walton 454; PS/c/6 (of Tierra del Fuego origin); PS/c/7.

* Measured from the junction of the pore protrusion and exine, across to the opposite side.

Acaena tenera Alboff

Monad. Isopolar. Radiosymmetric. Shape oblate-spheroidal, amb rounded-triangular (in varying degree). Tricolporate, the colpi short, situated at mid point of the sides, often ill-defined and tapering towards the poles; pores equatorially situated at mid point of colpi with an irregular lip which forms a *c.* 4·5–5 μm. protrusive process around the pore. Exine *c.* 2–2·5 μm. thick. Sculpture coarse, rugulate. Dimensions (average of 50 grains): equatorial axis* 24·0 μm. (range 19–31 μm.), polar axis 23·4 μm. (range 21–25 μm.). (Fig. $2h_{1-2}$.)

Source. PS/130; PS/131; PS/132; PS/137.

Acaena magellanica × *tenera*

Monad. Isopolar. Radiosymmetric. Shape oblate-spheroidal, amb rounded-triangular (in varying degree). Tricolporate (very rarely 4-colporate), the colpi short, situated at mid point of the sides, often ill-defined and tapering towards the poles; pores equatorially situated at mid point of colpi with an irregular lip which forms a *c.* 4 μm. protrusive process around the pore. Exine thickness very variable, *c.* 1·0–2·9 μm. Sculpture coarse, rugulate. Dimensions (average of 51 grains): equatorial axis* 26·0 μm. (range 20–34 μm.), polar axis 25·7 μm. (range 18–27 μm.). (Fig. 2i.)

The size range of these hybrid grains is large, the features variable and the grains are generally difficult to differentiate from those of the parent species.

Source. PS/h/Walton 469; PS/138.

Callitriche antarctica Engelm.

Previous work. Moar (1960), description and drawing of material from Campbell Island; Schalke and van Zinderen Bakker (1971), photographs of material from Marion and Prince Edward Islands group.

Monad. Apolar. Shape oblate, amb circular. No distinct apertures but with four (occasionally three) rift-like thin areas, which do not fully penetrate the outer exine, up to *c.* 4 μm. wide. Exine *c.* 1·5 μm. thick. Sculpture fine, reticulate. Dimensions (average of 50 grains): equatorial axis 26·0 μm. (range 22–30 μm.), polar axis 23·4 μm. (range 18–25 μm.). (Fig. $2f_{1-4}$.)

Source. PS/c/21.

Galium antarcticum Hook. f.

Previous work. Auer and others (1955), description and photograph of material of Fuego-Patagonian origin; Schalke and van Zinderen Bakker (1971), description and photographs of specimens from Marion and Prince Edward Islands group.

Monad. Isopolar. Radiosymmetric. Shape prolate-spheroidal. Stephanocolpate, 6–7 (rarely 8) colpi, long, narrow, longitudinally situated, evenly spaced around grain. Exine *c.* 1 μm. thick. Sculpture fine, reticulate. Dimensions (average of 50 grains): equatorial axis 18·1 μm. (range 16–22 μm.), polar axis 23·0 μm. (range 16–26 μm.). (Fig. $2e_{1-4}$.)

Source. PS/f/111; PS/f/120; PS/h/Longton 347.

* Measured from the junction of the pore protrusion and exine, across to the opposite side.

Juncus scheuchzerioides Gaudich.

Previous work. Schalke and van Zinderen Bakker (1971), photograph of individual grain from Marion and Prince Edward Islands group.

Tetrad. Heteropolar. Individual grains pear-shaped. Monoporate, pore at broad apex of grain, *c*. 5–8 μm. in diameter, with ill-defined ragged edge. Exine fragile *c*. 0·5–1 μm. thick. Sculpture faint, granular. Dimensions of individual grain (average of 50): polar axis 40·4 μm. (range 36–46 μm.). (Fig. 3b.)

Source. PS/f/43.

Juncus inconspicuus (D'Urv.) Hook. f.

Tetrad. Heteropolar. Individual grains pear-shaped. Monoporate, pore at broad apex of grain, *c*. 6–8 μm. in diameter, with ill-defined ragged edge. Exine fragile *c*. 0·5–1 μm. thick. Sculpture faint, granular. Dimensions of individual grain (average of 50): polar axis 40·9 μm. (range 35–47 μm.). (Fig. 3c.)

Source. PS/h/Longton 414.

Rostkovia magellanica (Lam.) Hook. f.

Previous work. Heusser (1971, pl. 12), description and photographs of material from Chile.

Tetrad. Heteropolar. Individual grains pear-shaped. Monoporate, pore at broad apex of grain, *c*. 6–8 μm. in diameter, with ragged edge. Exine <1 μm. thick. Sculpture faint, granular. Dimensions of individual grain (average of 50): polar axis 48·8 μm. (range 39–56 μm.). (Fig. $3d_{1-2}$.)

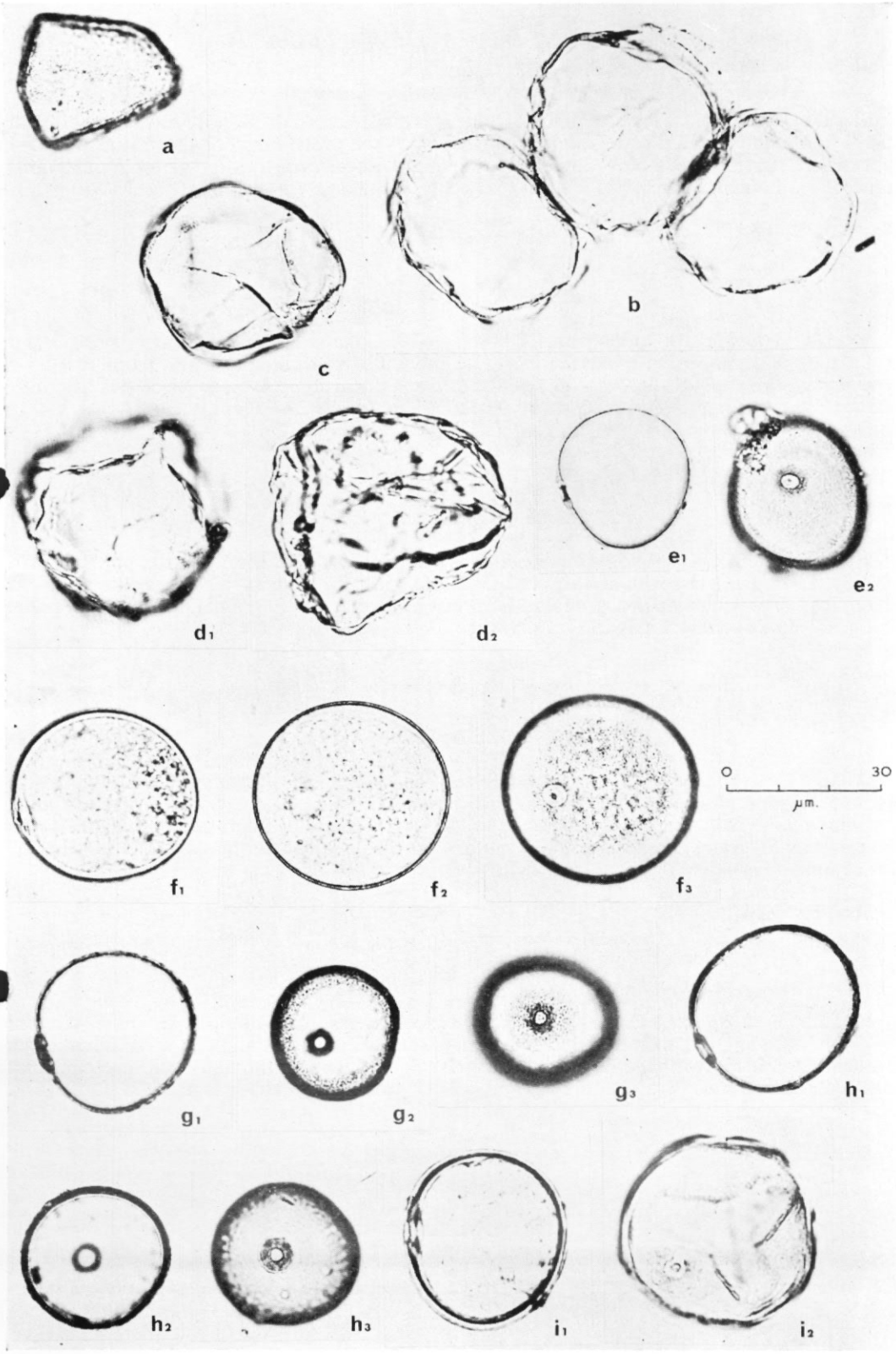
Source. PS/f/41; PS/h/Greene 2356.

Uncinia meridensis Steyermark

Pseudomonad but grains separate during treatment. Heteropolar. Pear-shaped. Periporate with (usually four) very indistinct pores, latitudinally situated at the widest girth. Exine *c*. 1–1·5 μm. thick. Sculpture distinct, scabrate, the pits <1 μm. Dimensions (average of 20 grains): polar axis 41·9 μm. (range 36–45 μm.), equatorial axis (i.e. greatest girth) 35·2 μm. (range 30–39 μm.). (Fig. 3a.)

Source. PS/c/26.

Fig. 3. Photomicrographs of pollen of graminoid species from South Georgia.
a. *Uncinia meridensis* (equatorial view, high focus).
b. *Juncus scheuchzerioides* (three grains unseparated, mid focus).
c. *Juncus inconspicuus* (polar view, mid focus).
d. *Rostkovia magellanica* (d_1 polar view showing pore, high focus; d_2 equatorial view, mid focus).
e. *Deschampsia antarctica* (e_1 mid focus; e_2 high focus).
f. *Poa flabellata* (f_1 mid focus; f_2 mid focus; f_3 high focus).
g. *Phleum alpinum* (g_1 mid focus; g_2 mid focus; g_3 high focus).
h. *Alopecurus magellanicus* (h_1 mid focus; h_2 mid focus; h_3 high focus).
i. *Festuca contracta* (i_1 mid focus; i_2 high focus).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Festuca contracta T. Kirk

Monad. Heteropolar. Radiosymmetric. Shape near-spheroidal. Monoporate, pore circular *c.* 1–1·5 μm. in diameter, with annulus *c.* 1–1·5 μm. wide, protruding *c.* 2 μm. Exine *c.* 0·75–1 μm. thick, stratified. Sculpture indistinct and fine. Dimensions (average of 50 grains): long axis 33·0 μm. (range 29–36 μm.), short axis 30·6 μm. (range 27–33 μm.). (Fig. $3i_{1-2}$.)

Source. PS/f/83; PS/134; PS/135; PS/136.

Poa flabellata (Lam.) Hook. f.

Monad. Heteropolar. Radiosymmetric. Shape near-spheroidal. Monoporate, pore circular *c.* 1·5 μm. in diameter, with annulus *c.* 1–1·5 μm. wide, protruding *c.* 1 μm. Exine *c.* 0·75–1 μm. thick, stratified. Sculpture indistinct and fine. Dimensions (average of 50 grains): long axis 31·2 μm. (range 27–33 μm.), short axis 28·1 μm. (range 24–31 μm.). (Fig. $3f_{1-3}$.)

Source. PS/f/14; PS/f/47; PS/c/24.

Deschampsia antarctica Desv.

Monad. Heteropolar. Radiosymmetric. Shape near spheroidal. Monoporate, pore circular, *c.* 1·5 μm. in diameter, with annulus *c.* 1·5–2 μm. wide, protruding <1 μm. Exine *c.* 1 μm., thick, stratified. Sculpture fine, granular. Dimensions (average of 50 grains): long axis 32·2 μm. (range 27–36 μm.), short axis 29·2 μm. (range 23–32 μm.). (Fig. $3e_{1-2}$.)

Source. PS/f/121.

Phleum alpinum L.

Monad. Heteropolar. Radiosymmetric. Shape near spheroidal, but may be a little elongated. Monoporate, pore circular *c.* 0·75–1 μm. in diameter, with annulus *c.* 1·5 μm. wide, protruding *c.* 1 μm. Exine *c.* 1 μm. thick, distinctly stratified. Sculpture distinct, granular. Dimensions (average of 51 grains): long axis 34·2 μm. (range 30–38 μm.), short axis 32·7 μm. (range 28–35 μm.). (Fig. $3g_{1-3}$.)

Source. PS/c/23; PS/f/72.

Alopecurus magellanicus Lam.

Monad. Heteropolar. Radiosymmetric. Shape spheroidal. Monoporate, pore circular *c.* 2 μm. in diameter, with annulus *c.* 2 μm. wide and having a slightly wavy outer edge, protruding *c.* 0·5 μm. Exine *c.* 1·5–2 μm. thick, not distinctly stratified. Sculpture indistinct and fine. Dimensions (average of 56 grains): 37·4 μm. on any axis (range 35–39 μm.). (Fig. $3h_{1-3}$.)

Source. PS/c/25.

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