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The genus *Polystichum* (Dryopteridaceae) in Africa

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CONTENTS

SYNOPSIS. *Polystichum* Roth is a fern genus of 160 to 200 species occurring throughout the temperate parts of the world and the montane tropics, but absent from the arid regions as well as the lowland tropics. Although floristic accounts of *Polystichum* exist for many parts of the world, the genus remains poorly understood and a taxonomic account for the group as a whole has never been undertaken. *Polystichum* is poorly represented in Africa (including the Marion Island group) with merely 16 species and one known hybrid having been recorded from the region. Most of the species are confined to sub-Saharan Africa, occurring mainly along the eastern mountain ranges and Mt. Cameroon in the west. In this review of the African *Polystichum* species detailed observations are presented especially on the paleae, as these structures were found to provide the best characters on which a subgeneric classification can be based. Diagnostic features and relationships, variation, and the distribution and ecology of each species are included.

INTRODUCTION

The genus *Polystichum* Roth consists of between 160 (Tryon & Tryon, 1982) and 200 (Daigobo, 1972) species. It occurs throughout the temperate parts of the world as well as the montane tropics, but is mostly absent from the lowland tropics. Within the range two distinct centres of diversity can be identified, namely a larger Asiatic centre with approximately 70 species and a tropical American centre with approximately 55 species. Both these regions fall within the mountainous tropics characterized by mild, moist climates that are hardly seasonal. They also correspond with the areas of highest species diversity for homosporous ferns (Tryon, 1985).

Within the Dryopterideae *Polystichum* is most closely related to *Arachniodes* Blume, *Cyrtomium* C. Presl, *Dryopteris* Adans. and *Phanerophlebia* C. Presl. *Cyrtomium* and *Phanerophlebia* have often been included in *Polystichum* (Kramer, 1990), but it has subsequently been shown that both these genera have a closer affinity to *Polystichum* than to each other (Yatskievych, 1996).

Polystichum in a strict sense is a natural and relatively homogeneous group of plants characterized by 1-pinnate to 3-pinnate laminae with acroscopically developed ultimate segments, anadromous free venation, uni- or biseriate circular sori positioned medially, terminally or near terminally on abbreviated or unabbreviated vein branches, and peltate indusia (a number of species are exindusiate). The receptacle appears to be nude in most species.

Although *Polystichum* as a genus is easily recognized, many species are superficially very similar. The delimitation of species is further hampered by the fact that many, mostly common species are allopolyploids (Vida & Reichstein, 1975; Wagner, 1979). Also the frequent occurrence of F1-hybrids in some groups obscures species limits.

A formal subgeneric classification for the genus has thus far only been provided for the east Asian species by Tagawa (1940) and Daigobo (1972). Some of these sections have since been subdivided further by Zhang & Kung (1995, 1996*a*, *b*) and Kung & Zhang (1998) to make provision for some of the Chinese species. Since most species remain poorly known a phylogeny for the genus cannot be proposed.

Although floristic accounts of the genus have been published for many parts of the world, some being very old and outdated, no single monographic treatment exists and most species remain poorly known. Some of the modern-day regional treatments provide no detailed observations that may suggest affinities. Within the study area floristic accounts for *Polystichum* are available for North Africa (Maire, 1952), West tropical Africa (Alston, 1959), Cameroon (Tardieu-Blot, 1964), Mozambique, Malawi, Zambia and Zimbabwe (Schelpe, 1970), Rwanda, Burundi and Kivu (Democratic Republic of Congo) (Pichi Sermolli, 1985), southern Africa (Schelpe & Anthony, 1986) and Bioko (Benl, 1991).

It is a well-known fact that Africa, when compared with other tropical parts of the world, supports a floristically impoverished vascular flora. This phenomenon is also reflected in the pteridophyte flora of the continent. The cause of this floristic poverty is ascribed to the isolation of Africa from the other continents since the mid-Cretaceous and the subsequent significant changes in the climate as a result of uplift, continental drift and aridification caused by extra-tropical glaciation. All these changes may well have resulted in a

progressive elimination of the once rich tropical and subtropical forests that existed towards the late Jurassic and the establishment of extensive deserts and semi-deserts by the early Pliocene (Coetzee, 1993).

Within the study area two regions can be identified: an African and a sub-Antarctic region. The origin, composition and floristic affinities of these regions differ markedly. The African region is the largest and today there are three fundamentally different floras or biogeographical subregions which can be identified: a southern African flora, a tropical African flora and a North African flora.

The flora of the southern African subregion is believed to have evolved gradually since the mid-Tertiary, derived partly from an ancient southern African temperate flora and partly from a tropical African forest flora (Goldblatt, 1978). Elements of the southern African flora currently extend into tropical Africa along the eastern escarpment. The southern Cape forests are believed to be impoverished remnants of the tropical African forest flora (Coetzee & Muller, 1984). Also the tropical African flora is believed to be an impoverished remnant of a once much richer tropical rainforest flora that extended over a far greater area than it currently occupies.

North Africa has also experienced significant changes in its climate and vegetation. During the Palaeocene the present Sahara desert was clothed by a rich tropical lowland rainforest that also covered part of Europe (Greenway, 1973; Raven & Axelrod, 1974), but by the Oligo-Miocene it was replaced by a subtropical woodland savanna (Axelrod & Raven, 1978). From the Pliocene a desert climate established itself in the major part of the Sahara (Quézel, 1978), serving as an effective barrier to migration from the south. The formation of glaciers on the high mountains during the Pleistocene permitted the establishment of circumboreal elements. Many of these elements are present in the North African flora since it is composed of relict elements of African origin as well as elements from Eurasia, not frequent in the present sub-Saharan flora. The mediterranean influence on the flora of North Africa justifies it being considered as a biogeographical subregion of its own.

The Marion and Prince Edward Island group forms part of the sub-Antarctic region, a phytogeographical area completely different from the foregoing. This island group is of volcanic origin and is estimated to be 0.5 million years old (Verwoerd, 1971). Situated in the Southern Ocean some 1800 km from Africa, its biota consists of taxa capable of long-distance dispersal and the ability to establish themselves in habitats not always favourable for plant growth.

About two-thirds of the African pteridophytes are limited in their occurrence to the continent (Kornas, 1993). The majority of these, however, are closely related to taxa in either tropical America and/or southeast Asia. Pteridophytes of the sub-Sahara biogeographical region exhibit three discontinuous distribution patterns: an American-African disjunction, an African-Madagascan disjunction and an African-Asian disjunction.

Polystichum in Africa is largely confined to the Afromontane Phytochorion. White (1978) divided this montane archipelago into seven regional mountain systems. The North African Atlas mountain ranges are here added as an eighth. Although the sub-Saharan mountain ranges are sufficiently distinct, the systems are connected by a complex series of intermediate floras (Fig. 1). The Drakensberg system, with six *Polystichum* endemics, is the richest. This is also true for the angiosperms (White, 1978). The only other mountain systems with true endemics are the Imatongs-Usambara system with two endemics (*P. kilimanjaricum* & *P. volkensii*) and the Ethiopian system with one endemic (*P. magnificum*). Other African *Polystichum* species have wider distributions. *Polystichum zambesiacum* occurs in the Chimanimani, Uluguru-Mulanje, and Imatongs-Usambara mountain systems, whilst *P. transvaalense* and *P. wilsonii* are distributed throughout seven mountain systems. The distribution of *P. wilsonii*, however, also extends along the Himalaya mountains to Bhutan, Japan and Taiwan. *Polystichum luctuosum* has an almost similar eastern distribution but is confined to the Drakensberg and Chimanimani mountain systems in Africa. *Polystichum luctuosum* and *P. wilsonii* also show a disjunct distribution with the Madagascan region.

Based on observations taken from the systematic treatment, and judging from wide-ranging species, southern and tropical African *Polystichum* has a closer affinity with taxa from Asia than with those from the Americas. *Polystichum* in the North African phytogeographical subregion shows a closer affinity with *Polystichum* from Europe than from Africa as *P. aculeatum* and *P. setiferum* are widespread in that region. Only *P. marionense*, endemic to Marion, Prince Edward and Crozet Islands, occurs in the sub-Antarctic phytogeographical region.

MATERIALS AND METHODS

This review is based on observations made during extensive fieldwork in southern Africa and on cultivated plants collected during these travels. The collections of several herbaria were also studied. These include: B, BM, BOL, BR, ETH, GRA, K, L, M, MAL, NBG, NH, NU, P, PRE, RAB, SAM, SRGH, WAG (abbreviations follow Holmgren et al., 1990) and the private herbarium of Prof. R.E.G. Pichi Sermolli (PIC.SERM.).

Palea and indusium observations were made by removing a small number of these structures from selected specimens. These were cleaned and cleared in diluted household bleach, after which they were semi-permanently mounted in glycerine and the cover slips sealed with Entellan. Observations were made with an Olympus CH-2 light-microscope fitted with a drawing tube.

The collections studied are all listed under 'Material examined'. These are arranged alphabetically according to country of origin. South African (including Lesotho and Swaziland) collections are further arranged according to the quarter-degree square-grid system (Edwards & Leistner, 1971). In this system each one-degree square is known by a standardized name, derived from a town or other feature of importance in the square. Each one-degree square is divided into four half-degree squares (30′ × 30′), numbered A, B, C and D from left to right and top to bottom. Each half-degree square is again subdivided into quarter-degree squares (15′ × 15′), again numbered A, B, C and D. By using these co-ordinates a geographical area can immediately be identified.

Unless cited otherwise, the chromosome numbers provided here are based on the author's own observations and will be published elsewhere.

Terminology

This study is principally based on a detailed comparative morphological analysis of the sporophyte, where palea structure proved to be most informative in suggesting species groups. The terms used to describe the apex or the apical cell of the paleae are defined as:

- apex flagelliform: the apex of the palea terminates in a uniseriate series of slender cells.
- subulate cell: the apical cell is less than 0.4 mm long and the apex is usually blunt.
- acicular cell: the apical cell is slender, straight, more than 0.4 mm long, and the apex is usually sharp.

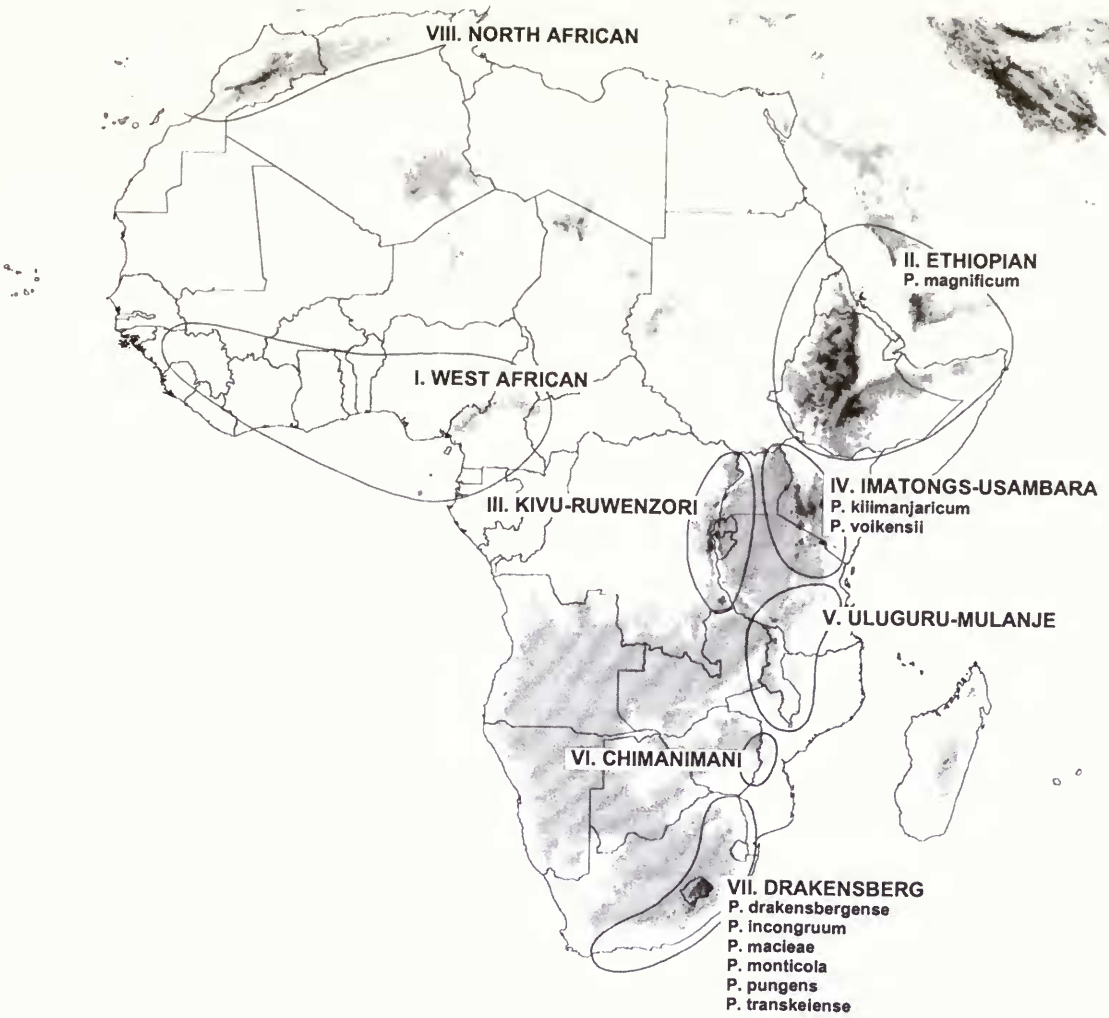

Fig. 1 Distribution of *Polystichum* in Africa.

- filiform cell: the apical cell is slender, twisted, and more than 0.6 mm long.
- thin-walled cell: these cells can vary considerably in size and the cell wall is conspicuously thinner than that of the surrounding cells, and is therefore often lost. In dry material the cellular contents are usually yellowish in colour and appear crystalline.

TAXONOMIC TREATMENT

Polystichum Roth, *Tent. fl. Germ.* **3**: 31, 69 (1799). Type species: *Polystichum lonchitis* (L.) Roth (= *Polypodium lonchitis* L.).

Hypopeltis Michx., *Fl. bor.-amer.* **2**: 266 (1803). Type species: *Hypopeltis lobulata* Bory (= *Polystichum aculeatum* (L.) Roth).

Plecosorus Fée, *Mém. foug.* **5**: 150 (1852). Type species: *Plecosorus mexicanus* Fée, nom. superfl. for *Cheilanthes speciosissima* Kunze (= *Polystichum speciosissimum* (Kunze) R.M. Tryon & A.F. Tryon).

Sorolepidium H. Christ in *Bot. Gaz.* **51**: 350 (1911). Type species: *Sorolepidium glaciale* (H. Christ) H. Christ (= *Polystichum glaciale* H. Christ).

Hemesteum H. Lév., *Fl. Kouy-Tchéou*: 450, 496 (1915), non Newm. (1851). Type species: several *Polystichum* species are listed.

Aetopteron House in *Amer. Fern J.* **10**: 88 (1920), nom. nud.

Papuapteris C. Chr. in *Brittonia* **2**: 300 (1937). Type species: *Papuapteris linearis* C. Chr. (= *Polystichum lineare* (C. Chr.) Copel.).

Acropelta Nakai in *Bull. Natl. Sci. Mus. Tokyo* **33**: 5 (1953). Type species: *Acropelta omeiensis* (C. Chr.) Nakai (= *Polystichum omeiense* C. Chr.).

Plants terrestrial, or epilithic, rarely low-level epiphytes. *Rhizome* erect to suberect and mostly unbranched, or creeping, or decumbent and branched; rarely stoloniferous; dictyostelic; set with roots, closely to widely spaced persistent stipe bases, and paleae. *Fronds* monomorphic, caespitose or closely to widely spaced, to 1.8 m long: *stipe* proximally convex adaxially, becoming slightly to deeply sulcate distally; with two larger near-circular vascular bundles dorso-laterally, ventrally with three to five smaller circular vascular bundles; initially moderately to densely paleated, becoming near glabrous later, the paleae often appearing heteromorphous, variable: *lamina* 1-pinnate to 3-pinnate, anadromous, sometimes bearing 1 to several paleated proliferous buds adaxially along the rachis near the

lamina apex: *rachis* adaxially shallowly to deeply sulcate, the sulcus proximally not open to sulci of lower order axes, moderately to densely paleated; paleae variable: *pinnae* short-stalked, opposite to alternate, closely to widely spaced, often imbricate, simple to 2-pinnate, acroscopically auricled: *pinna-rachis* adaxially sulcate, open to sulci of costae, sparsely to densely paleated; paleae variable: *pinnules* proximally mostly short-stalked, opposite to alternate, closely to widely spaced, often imbricate, the proximal acroscopic pinnule mostly longer than the next in 2-pinnate or more dissected species, herbaceous to firmly coriaceous, inaequilateral, ovate to ovate-rhomboid or trullate, often somewhat falcate, mostly acroscopically auricled in 2-pinnate or more dissected species, lobate, dentate or serrate, sharp-tipped or aristate; variously paleated. *Venation* free, pinnately branched, anadromous, terminating near or at the margin when sterile, immersed or raised. *Sori* circular, essentially uniseriate, borne medially on unabbreviated vein branches, or near or at a vein ending of mostly anadromous vein branches: *sporangium* with 8–(13)–30 indurated annulus cells; stalk with glandular cells or eglandular, 3-seriate below capsule: *indusium* absent or present, peltate, mostly persistent, the margin variously sculptured, with or without gland-like cells. *Spores* monolete, the laesura $^2/_3$ to $^3/_4$ of the spore length, the perispore irregularly folded, mostly somewhat spinulose, often perforate. *Chromosome number* n=41, 82, 164; 2n=82, 164, 328; apogamous 123, 246.

Key to the African species of *Polystichum* (including Marion and Prince Edward Islands)

1 Lamina 1-pinnate (rarely 1-pinnate-pinnatifid) ..... 1. **P. macleae**

– Lamina 2-pinnate to 3-pinnate 2

2 Rhizome short, erect to suberect, mostly unbranched 3

– Rhizome short-decumbent to widely creeping, mostly branched 10

3 Larger rhizome and stipe base paleae with long uniseriate hairs along the margin and superficially ..... 2. **P. luctuosum**

– Larger rhizome and stipe base paleae without long uniseriate hairs along the margin and superficially 4

4 Lamina with 1–3 paleated proliferous buds along the rachis near the lamina apex 5

– Lamina without proliferous buds along the rachis 6

5 Pinnule margins obtusely serrate to crenate, never aristate ..... 3. **P. volkensii**

– Pinnule auricle and apex aristate ..... 4. **P. kilimanjaricum**

6 Apices of paleae terminating in a short subulate cell or a small thin-walled cell, the margins set with short straight and/or angular outgrowths 7

– Apices of paleae always terminating in an acicular cell, the margins set with long straight and/or long twisted emarginate to forked outgrowths 8

7 Stipe and rachis moderately paleated; paleae mostly flat or irregularly folded ..... 5. **P. aculeatum**

– Stipe and rachis densely paleated; paleae mostly helically twisted ..... 6. **P. setiferum**

8 Conspicuously larger paleae mostly confined to the stipe, rugose ..... 7. **P. transvaalense**

– Conspicuously larger stipe paleae extending to the rachis, never rugose 9

9 Distal pinnae folded ventrally along the rachis (conduplicate); spores not aborted ..... 8. **P. wilsonii**

– Distal pinnae never folded ventrally along the rachis; spores aborted ..... 9. **P. × saltum**

10 Rhizome to 10 mm in diameter; sori exindusiate 11

– Rhizome more than 10 mm in diameter; sori indusiate 12

11 Rhizome to 5 mm in diameter; stipe and rachis paleae with long flagelliform outgrowths along the margin ..... 10. **P. marionense**

– Rhizome to 10 mm in diameter; stipe and rachis paleae with or without thin-walled cells along the margin ..... 11. **P. transkeiense**

12 Lamina with a proliferous bud along the rachis near the apex ..... 12. **P. magnificum**

– Lamina without proliferous buds along the rachis 13

13 Rhizome paleae conspicuously rugose, often with a few long filiform outgrowths along the margin; smaller stipe, rachis and pinna-rachis paleae basally with short and/or long filiform outgrowths along the margin ..... 13. **P. zambesiacum**

– Rhizome paleae not conspicuously rugose, mostly with short straight or curved marginal outgrowths; smaller stipe, rachis and pinna-rachis paleae basally without short and/or long uniseriate outgrowths along the margin 14

14 Proximal acroscopic pinnule to 22 mm long; larger stipe base paleae often bicolorous 15

– Proximal acroscopic pinnule usually more than 22 mm long; larger stipe base paleae never bicolorous 16

15 Rhizome short-decumbent with crowded stipe bases, closely branched; apogamous (32 spores per sporangium) ..... 14. **P. monticola**

– Rhizome decumbent, stoloniferous; sexual (64 spores per sporangium) ..... 15. **P. dracomontanum**

16 Pinnules inaequilaterally ovate to narrowly trullate, to 60 × 13 mm; sporangium stalk glandular or eglandular; indusium with or without unicellular thin-walled cells along the margin ..... 16. **P. incongruum**

– Pinnules inaequilaterally ovate, ovate-oblong, ovate-rhomboid or trullate, to 50 × 19 mm; sporangium stalk and indusium always eglandular ..... 17. **P. pungens**

1. **Polystichum macleae** (Baker) Diels in Engl. & Prantl, *Nat. Pflanzenfam.* **1**(4): 190 (1902), as *macleanii*. Type: South Africa, in convallibus humidis – Drakensbergen prope 'Pilgrim's Rest Gold Fields', *McLea* 34 sub *Bolus* 3030 (K!-lectotype, designated by Schelpe & Anthony (1986); BOL!, SAM!-isolectotypes). Fig. 2.

Aspidium macleae Baker in Hook.f., *Icon. pl.*: t. 1654 (1886), as *macleaii*.

Plants terrestrial, epilithic, or rarely epiphytic. *Rhizome* decumbent, to 200 mm long × 20 mm in diameter, densely set with roots, persistent stipe bases, and paleae; paleae ferrugineous, membranous to chartaceous, narrowly ovate or lanceolate, to 7 × 2 mm. *Fronds* caespitose, to 7 per plant, arcuate, to 1.47 m long: *stipe* proximally castaneous, stramineous distally, adaxially sulcate, to 670 mm long × 8 mm in diameter, proximally densely paleated; larger paleae broadly attached, concolorous or bicolorous, the concolorous paleae ferrugineous, the bicolorous paleae centrally dark brown or black, ovate, narrowly ovate, or narrowly oblong, cordate, entire or with short and/or long marginal outgrowths proximally, the apex flagelliform, terminating in a long filiform cell or an oblong thin-walled cell, to 37 × 8 mm; smaller paleae concolorous, ferrugineous, membranous, narrowly ovate, lanceolate, narrowly triangular, narrowly oblong to acicular, cordate, cordate-imbricate, or short-stalked, proximally erose and/or with long twisted, filiform outgrowths, the

apex flagelliform, terminating in a filiform cell or an oblong thin-walled cell: *lamina* 1-pinnate (rarely 1-pinnate-pinnatifid), oblong to narrowly elliptic, with up to 37 free pinna pairs, to 840 mm long, the proximal pinnae slightly reduced, usually deflexed: *rachis* stramineous, adaxially sulcate, moderately paleated; paleae short-stalked, ferrugineous, membranous to chartaceous, narrowly ovate, narrowly lanceolate, or oblong to subulate, cordate, cordate-imbricate, proximally usually erose and/or with a few short or long twisted marginal outgrowths, the apex long-attenuate to flagelliform, terminating in an acicular cell or an oblong thin-walled cell, to 3 mm long: *pinnae* firmly herbaceous, olive-green adaxially, paler abaxially, generally not overlapping, short-stalked, narrowly oblong-attenuate, straight, auriculate acroscopically, the base unequally broad-cuneate to truncate, doubly serrate, to 168 mm long × 16 mm wide, the acroscopic auricle on proximal pinnae often free, ovate to trullate, to 24 × 22 mm; costa adaxially sulcate, sparsely paleated, the paleae taeniform, sessile or short-stalked, entire, the apex terminating in an acicular cell or an oblong thin-walled cell, to 3 mm long, abaxially moderately to densely paleated, the paleae ferrugineous, membranous, narrowly lanceolate to narrowly trullate, often bullate, cordate to cordate-imbricate, the margin proximally with short and/or long irregular outgrowths, entire distally, the apex terminating in an acicular cell or an oblong thin-walled cell, to 2.4 mm long. *Venation* raised. *Sori* circular, to 1.5 mm in diameter, variable in size, those closest to the costa largest, discrete at maturity, medial to inframedial on unabbreviated vein branches: *sporangium* with 12–(16)–28 indurated annulus cells; stalk eglandular: *indusium* brown, persistent, peltate, circular to irregular, repand to erose, often with flabellate central processes, the maximum radius 0.29–(0.49)–0.7 mm. *Spores* 64 per sporangium, brown, the perispore folded to form a sparse reticulum of low compressed ridges, variously granulate, verruculate to echinulate, closely perforated, the exospore 40–(51.31)–66 × 28–(37.89)–48 µm. *Chromosome number* 2n=164.

MATERIAL EXAMINED

SOUTH AFRICA. 2330 (Tzaneen): Tzaneen, Woodbush Forest Reserve (CC), *Balsinhas* 2166 (PRE); Wolkberg, Agatha Forest Reserve, 1500 m, *Muller* 264 (PRE); Woodbush, *Van Jaarsveld* 6110 (BOL). **2430 (Pilgrim's Rest)**: Haffenden Heights, Zoutpansberg (AA), *Junod* 4069 (P, PRE); Mariepskop (DB), *Van der Schijf* 4305, (B, NU, PRE), 5597 (PRE); Mariepskop summit, 1800 m, *Van der Schijf* 4861 (PRE); Mariepskop, below radar station, *Krynauw* 786 (PRE); Graskop, Erasmus Kop, *Hardcastle* 59 (PRE); Mariepskop, *Schweickerdt* 4305 (BOL); Ohrigstad Nature Reserve, 6000 ft (DC), *Jacobsen* 1556 (PRE); Pilgrim's Rest, Mount Sheba Nature Reserve, *Roux* 2555 (NBG); Mount Sheba Nature Reserve, *Jacobsen* 4436 (PRE); Mount Sheba Nature Reserve, *Crouch* 633 (NU); Graskop, Cigar Rock (DD), *Rauh & Schlieben* 9744 (PRE); Graskop, Kowyn's Pass, *Rauh & Schlieben* 9725 (PRE); Graskop, Driekop Gorge, *Wager* 173 (PRE); Pilgrim's Rest, *Rogers* 14925, 14927 (PRE); Blyde Bosboustasie, *Bredenkamp* s.n. (PRE); Pilgrim's Rest, *MacLea* 170 (PRE); Kowyn's Pass, *Schelpe* 1641 (BOL, NH, NU), 6092 (BOL); Graskop, Fairyland, *Roux* 2548, 2549 (NBG); Graskop, The Pinnacle, 4500 ft, *Braithwaite* 207 (BOL). **2530 (Lydenburg)**: Lydenburg, Hartbeesvlakte (BA), *Kluge* 2039, 2333 (PRE); Lydenburg, Hartbeesvlakte, 1960 m, *Mohle* 288 (PRE); Pilgrim's Rest, Mount Anderson, *Smuts* 38 (PRE); Sabie, forest at Tweefontein (BB), *Wager* 53 (PRE); Sabie/Lydenburg road, *Roux* 2242, 2561 (NBG); Witklip Staatsbos (BD), *Kluge* 806 (PRE); Belfast (CA), *Wager* s.n. (PRE); Kaapse Hoop (DB), *Van Jaarsveld* 2088*a* (NBG, PRE), 3376 (BOL); Kaapse Hoop, *Wager* 73 (BOL), 1496*c* (PRE). **2531 (Komatipoort)**: Barberton, Tiger Creek, 4500 ft (CC), *Thorncroft* 96 (BR, P, Herb. PIC.SERM., PRE); Barberton, Maid of the Mist, *Thorncroft* 50 (P, PRE), 68 (NBG, P, PRE); 17 miles SE of Barberton towards Havelock, 5000 ft, *Schelpe* 4115 (BOL, PRE); W. of Havelock, Songimvelo Game Reserve, on farm Josefsdal, 1640 m, *Kunitz & Otto* 15 (J, PRE).

SWAZILAND. 2531 (Komatipoort): New Havelock, 12 miles from Havelock (CC), *Schütte* 4 (BOL); Havelock Mine, *Dyer* 57 (NU). **2632 (Bela Vista)**: Mbabane, Ngwenya Mountain (AA), *Compton* 31405 (NBG)

WITHOUT EXACT LOCALITY: loco incerto, *Bolus* s.n. (PRE); South Africa, *Wood* s.n. (NU).

The change of the specific epithet *macleaii* to *macleae* is in concordance with Article 60.11 (Recommendation 60C.1.a) of the International Code of Botanical Nomenclature (Greuter et al., 1994).

DIAGNOSTIC FEATURES AND RELATIONSHIPS. *Polystichum macleae* is the only 1-pinnate (rarely 1-pinnate-pinnatifid) species in Africa and is quite similar to *P. kalambatitrense* Tardieu from Madagascar. Baker (1886) considered *P. macleae* to be related to *P. munitum* (Kaulf.) C. Presl from North America and *P. falcinellum* (Sw.) C. Presl from Madeira. This assumption was probably based on the 1-pinnate lamina morphology in these taxa. Both these species, however, have ciliated indusia. Also, the palea morphology of both these species differs from that in *P. macleae*. In *P. macleae* the marginal outgrowths of the lamina paleae are pluricellular whilst those of *P. munitum* and *P. falcinellum* are unicellular.

VARIATION. *Polystichum macleae* shows considerable variation in the number of indurated annulus cells per sporangium and in indusium and pinna morphology. The number of indurated annulus cells per sporangium ranges from 12 to 28. The mean number of indurated annulus cells per sporangium is 16.67 (n=650, SD=0.14) taken from 13 populations throughout the species' distribution. Some populations have a larger number of indurated annulus cells than others. Although no definite correlation could be made between habitat and the number of indurated annulus cells, plants collected from an exposed streambank on the Hartbeesvlakte near Lydenburg [*Kluge* 2039 (PRE)] have a number of indurated annulus cells that ranges from 19 to 28 (x=23.86, SD=1.91, n=50), which is significantly higher than for a plant growing in a forest habitat [*Thorncroft* 68 (NBG)], where the number of cells ranges between 12 and 16 (x=13.28, SD=0.75, n=50). Intermediates between these extremes do occur. Indusia are mostly simple, but on some plants they may bear one or more small wings, whilst on others they may bear numerous flabellate central processes. The margins vary from repand to erose.

A 1-pinnate-pinnatifid form of *Polystichum macleae* has been recorded from Mpumalanga with the central pinnae bearing up to 11 nearly free pinnule pairs. Pinnules are inaequilaterally narrowly trullate to oblong-attenuate in outline with the margins obtusely serrate. In the distal pinnae the margins are merely lobed midway to the costa. Sori are uniseriate on either side of the costa and are borne inframedially.

The size of the acroscopic auricle varies considerably, and on the proximal pinnae it is often detached from the rest of the pinna. The auricle sometimes overlaps with the pinna directly above. Pinna margins are generally obtusely serrated or doubly serrated but rarely the margins are also deeply lobed and serrated.

DISTRIBUTION AND ECOLOGY. *Polystichum macleae* is confined to the Drakensberg Escarpment and Wolkberg in the Mpumalanga province of South Africa and the northern parts of Swaziland, occurring at elevations ranging between 1350 and 1960 m. The species is largely confined to forests where it grows on banks above streams, in forest margins, among rocks and often as a low-level epiphyte. Plants often form large stands in deep shade, but rarely also occur in exposed habitats.

2. **Polystichum luctuosum** (Kunze) T. Moore, *Ind. fil.*: 95 (1858).
Type as for *Aspidium luctuosum* Kunze.
Fig. 3.

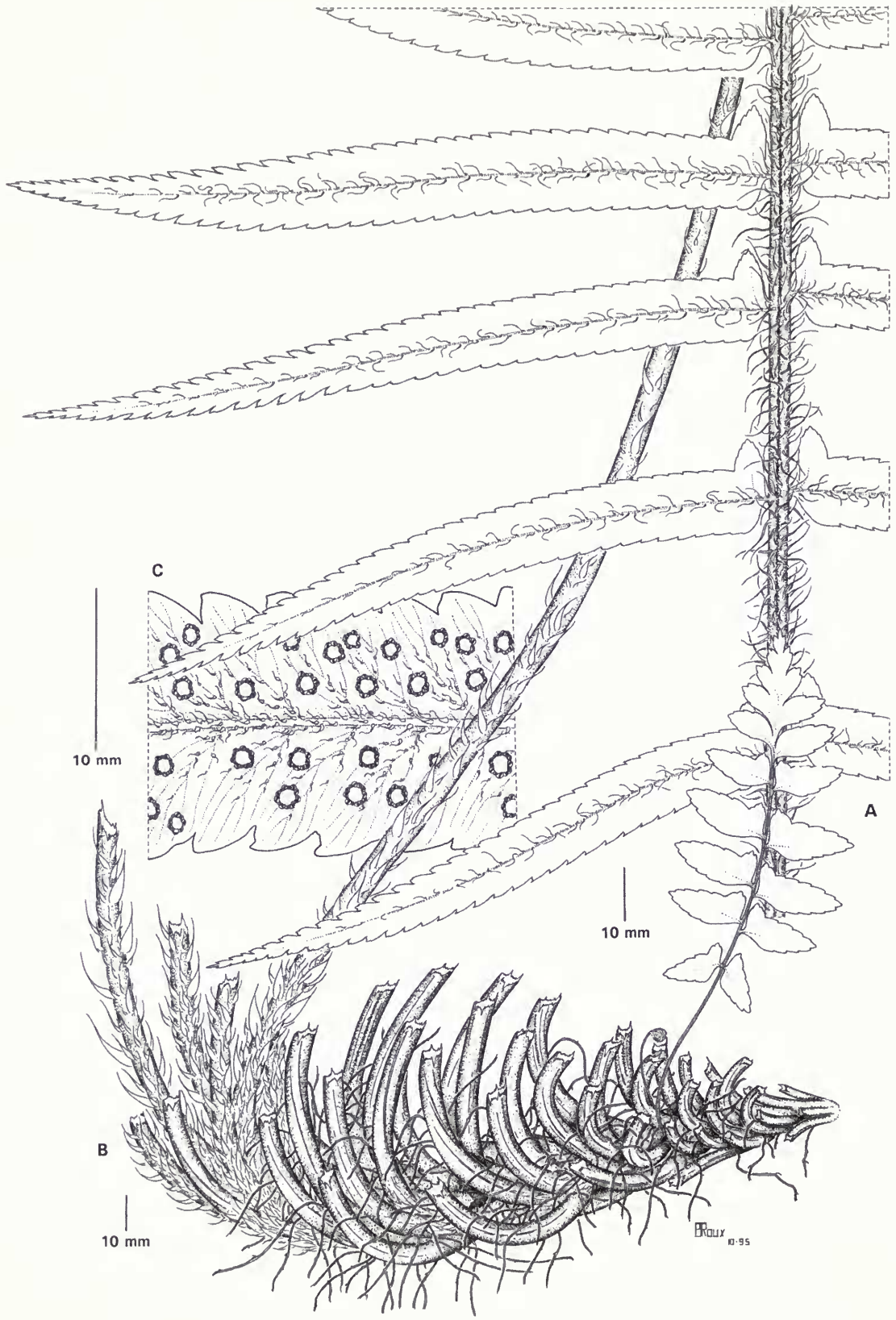

Fig. 2 *Polystichum macleae*. A, proximal part of lamina; B, rhizome; C, section of abaxial surface of fertile pinna. A & B, drawn from *Roux* 2548 (NBG); C, drawn from *Roux* 2242 (NBG).

Aspidium luctuosum Kunze in *Linnaea* **10**: 548 (1836). Type: In monte Katriviersberg in sylvis, *Ecklon* s.n. (LZ†-syntype); ad fontes fl. Katrivier prope Philipstown, in sylvis montium, *Ecklon* s.n. (LZ†-syntype).

Aspidium tsus-simense Hook., *Sp. fil.* **4**: 16, t. 220 (1862). Type: Island of Tsus Sima, in the Straits of Korea, *Wilford* s.n. (K-holotype, 2 sheets; NBG!-photograph).

Polystichum tsus-simense (Hook.) J. Sm., *Hist. fil.*: 219 (1875).

Polystichum lobatum var. *luctuosum* (Kunze) H. Christ in *Ber. Schweiz. Bot. Ges.* **3**: 34 (1893).

Plants terrestrial, epilithic, or rarely low-level epiphytes. *Rhizome* short, erect to suberect, to 10 mm in diameter, densely set with roots, persistent stipe bases, and paleae; larger paleae broadly attached, castaneous, chartaceous, ovate, narrowly ovate, or lanceolate, cordate, with long twisted uniseriate, gland-tipped hairs on the apical margin and surface, the apex flagelliform, terminating in an oblong thin-walled cell, to 10.5 × 3.3 mm; smaller paleae short-stalked, narrowly triangular to subulate, cordate, the margins proximally with numerous long and twisted uniseriate hairs, distally with widely spaced apically and basally directed marginal outgrowths that become smaller apically, the apex flagelliform, terminating in a small thin-walled cell. *Fronds* crowded, caespitose, 7–16 per plant, suberect to arching, to 0.93 m long: *stipe* proximally castaneous, stramineous distally, adaxially sulcate, to 450 mm long × 5 mm in diameter, densely paleated; proximal paleae broadly attached, castaneous, chartaceous, ovate, cordate, proximally entire or with a few short and/or long uniseriate hairs, distally with numerous multicellular hairs as for rhizome paleae; distal paleae short-stalked, narrowly oblong, narrowly triangular or subulate, cordate to hastate, the margins bearing a few long and/or short multicellular hairs proximally, distally with widely and irregularly spaced outgrowths reduced in size and number towards apex, the apex flagelliform, terminating in a small thin-walled cell, to 15 × 1.5 mm: *lamina* 2-pinnate to 2-pinnate-pinnatifid, with up to 25 free pinna pairs, to 480 mm long, firmly herbaceous to coriaceous, olive-green adaxially, paler abaxially, narrowly ovate to ovate, the proximal pinnae slightly reduced, often somewhat deflexed: *rachis* stramineous, adaxially sulcate, densely paleated; paleae short-stalked, dark brown to black, glossy, chartaceous to crustaceous, narrowly triangular to subulate, cordate to hastate, the auricles usually bearing long and twisted multicellular and uniseriate hairs some of which terminate in a thin-walled cell, the margins either distally with short, widely and irregularly spaced outgrowths that reduce in size and number towards the apex, or more or less entire in smaller paleae, to 7 mm long: *pinnae* short-stalked, 1-pinnate to 1-pinnate-pinnatifid, with up to 12 free pinnule pairs, narrowly lanceolate, proximally widely spaced, distally often somewhat overlapping, to 173 mm long: *pinna-rachis* stramineous, adaxially sulcate, densely set with paleae similar to but less complex than those on the rachis: *pinnules* widely spaced to overlapping, the proximal acroscopic pinnule the largest, often significantly longer than the next, up to 40 mm long and 12 mm wide, inaequilateral, narrowly trullate to rhomboid, basiscopically cuneate, acroscopically truncate and auricled, often somewhat falcate, lobate-serrate, aristate; proximal pinnules short-stalked, often acroscopically incised to or nearly to the costa; costa adaxially sulcate, glabrous, abaxially sparsely paleated, the paleae castaneous, chartaceous, narrowly triangular-hastate to subulate-hastate, cordate to cordate-imbricate, proximally with long and/or short filiform outgrowths often terminating in a thin-walled cell, the apex always terminating in a small thin-walled cell, to 0.3 mm long. *Venation* immersed. *Sori* circular, *c.* 1.2 mm in diameter, terminal or nearly terminal on abbreviated vein branches, essentially uniseriate: *sporangium* with 10–(13)–19 indurated annulus cells; stalk eglandular: *indusium* peltate, circular, entire, repand or crenulate, persistent, brown, pale brown and often dark centred before drying, cupulate when dry, the maximum radius 0.5–(0.73)–0.95 mm. *Spores* 32 per sporangium, brown, the perispore unevenly folded to form narrow and broad reticulate ridges, the ridges and areas between ridges echinulate, spiculate or verruculate, the exospore 30–(38.84)–50 × 22–(28.2)–36 µm. *Chromosome number* 2n=123, apogamous.

MATERIAL EXAMINED

LESOTHO. 2828 (Bethlehem): Leribe (CC), *Phillips* s.n. (SAM). **2927 (Maseru)**: Roma Valley (BC), *Schmitz* 6963 (PRE); Roma, *Ruch* 1909 A-only (PRE).

SOUTH AFRICA. 2430 (Pilgrim's Rest): The Downs (AA), *Junod* s.n. & 4044 (BR, P, PRE); Mt Sheba (DC), *Kluge* 2320 (NBG, PRE); Blyde Forest Reserve (DD), *Jacobsen* 4365, 4376 (PRE); Driekop Gorge, Graskop, *Wager* 178 (PRE); Pilgrim's Rest, Ponies Krantz, *Braithwaite* 229 (BOL); Sabie, just outside Ceylon Forest Reserve, *Braithwaite* 135 (BOL). **2530 (Lydenburg)**: Lydenburg District, Spitzkop, *Wilms* 1781 (B, BM); Sabie Gorge (BB), *Wager* s.n. (PRE); Lone Creek Falls, Sabie, *Burrows* 1342 (BOL); Sabie, *Rogers* 20379 (PRE); Sudwala Caves, 1500 m (BC), *Kluge* 2463 (NBG, PRE); Lydenburg, Buffelskloof Nature Reserve, *Burrows* 3860 (GRA); between Machadodorp and Badplaas (CD), *Steel* 242 (PRE). **2531 (Komatipoort)**: Rimers Creek, Barberton (CC), *Thorncroft* 35 (P); Baberton, *Pott-Leendertz* 5574 (PRE); Lomati Falls behind Barberton, *Wager* 154 (PRE); Barberton, *Thorncroft* 36, 104c (PRE); creeks near Barberton, *Thorncroft* 2475 (L). **2729 (Volksrust)**: Newcastle, Nkandu Reserve, 4900 ft (DD), *Smith* 64 (NU). **2730 (Vryburg)**: road to Lüneburg (AD), *Roux* 2268 (NBG); Pongola Bush Nature Reserve, 1500 m (BC), *Glen* 2390 (PRE); Utrecht, Donkerhoek, 5500 ft, *Devenish* 1144 (PRE); Hlobane, Mtola Forest, *Johnstone* 296 (NU). **2828 (Bethlehem)**: Farm Boschkloof (DB), *Roux* 1228 (NBG); Witsieshoek, *Junod* s.n. (P); Royal Natal National Park, *Okell* 60 (NU). **2829 (Harrismith)**: Van Reenen, 5000 ft (AD), *Schlechter* 6718 (B, BM, GRA, PRE, SAM); Van Reenens Pass, *Rehmann* 7204 (P); Van Reenen, 5000 ft, *Lidey* 42 (NU); Robinson's Bush, Oliviershoek Pass (CA), *Schelpe* 7967 (BOL); near Cathedral Peak, *Box* 3371 (BM). **2929 (Underberg)**: Giants Castle Nature Reserve (AB), *Roux* 2503 (NBG); Injasuti Nature Reserve, below Cataract Valley, *Roux* 2718 (NBG); Champagne Castle, *Bayer* 1444 (NU); Cathedral Peak, bank of Kweliquala River, 4700 ft, *Schelpe* P4 (NU); Cathedral Peak, 5700 ft, *Killick* 1155 (NU, PRE); Cathedral Peak, Rainbow Gorge, 5500 ft, *Cowan* 96 (NU); Cathedral Peak, 1550 m, *Goetghebeur* 4552 (BR, PRE); Cathedral Peak, *c.* 5000 ft, *MacGregor* 43 (NU); Cathkin Park, *Howlett* 53 (NH); Estcourt, Nolema Forest, 4200 ft, *Edwards* 2685 (NU, PRE); Cathkin Peak, Ndema Forest, 4400 ft, *Hillary* 106 & 107 (NU); Cathkin Park, *Howlett* 53 (NH); Injasuti area, 5000 ft, *Esterhuysen* 26034 (BOL, NBG, PRE); above Dalton Bridge, above Bushmans River, *c.* 4500 ft, *Wright* et al. 27 (NH, PRE); Mooi River, The Hoek, 4700 ft (BC), *Bourquin* 320 (NU); Polela District, Ndumduma, Glengariff (CB), *Rennie* 913, 940 (NU); Cobham Forest Station, Whale Rock, *Hill* 48 (GRA); Bulwer Mountain (DB), *Van Jaarsveld* 6468 (NBG, PRE); Bulwer (DD), *Clarkson* 177 (NH, NU); Bulwer, Sunset, 5200 ft, *Rennie* 546 (NU); Bulwer, *Allsopp* 839 (NU); near Bulwer, *Schelpe* P52 (NU). **2930 (Pietermaritzburg)**: Balgowan, farm Boschfontein, 4000 ft (AC), *Fisher* 638 (NH, NU), 642 (NH, NU); Lions River District, Dargle, *Smook* 624 (NU); Balgowan, *Thomas* 71 (NU); Balgowan, *Devlin* 62 (NU); Balgowan, 4000 ft, *Lindahl* 107 (NU); Balgowan District, *Thienel* 109 (NU); Balgowan, 3500 ft, *Bernele* 113 (NU); Balgowan, 3500 ft, *Crookes* 105 (NU); Nottingham Road, *McClean* 899 (NH, PRE); Nottingham Road, *sine coll.* NH-26790 (NH); Dargle, Griffin's Farm, 1500 m, *Jones* 20 (NH); Lions River, Dargle, *Esterhuysen* 26202 (BOL); Balgowan, Bosch Hoek, 1400 m, *Moll* 905 (BOL, NU, PRE); Lions River, Lions Bush Forest, *Moll* 829 (BOL, NU); Pietermaritzburg (CB), *Tyson* s.n. (PRE); Pietermaritzburg, *c.* 2200 ft, *Carnegie* 692 (NU); Pietermaritzburg, Blackridge, *F.G.C.* 692 (NU); Inanda, *Wood* s.n. (B). **3029 (Kokstad)**: Langewacht Forest Reserve near Kokstad, *c.* 1200 m (CB), *De Joncheere* s.n. (PRE); Mt Currie, Kokstad, *Stephany* 505 (BOL); Glen Hope, *Jacottet & Jacottet* 539 (BM). **3126 (Queenstown)**: Woodvale Forest, Gwatyn, 4200 ft (AA), *Galpin* 8203 (PRE). **3127 (Lady Frere)**: Engcobo (DB); *McLoughlin* 1022 (PRE); Engcobo, *Flanagan* 2781 (PRE). **3128 (Umtata)**: Maclear, farm Woodcliffs (AB), *Roux* 2479 (NBG); Engcobo,

Fig. 3 *Polystichum luctuosum*. A, proximal part of lamina; B, rhizome; C, abaxial surface of fertile pinnule. All drawn from *Roux* 2433 (NBG).

Ku-Hlophekazi Forest (AC), *Cawe* 777 (BOL); Tsolo, Gxalibomvu Forest (AD), *Cawe* 660 (BOL); Tsolo, Bele Forest (BC), *Cawe* 731 (BOL); Nqadu Forest, *Hutchings* 39 (BOL); Mount Baziya, *Baur* 644 (B). **3225 (Somerset East)**: in sylvis ad pedem montis Boschberg (DA), *Barkley* s.n. (GRA, P, SAM); in sylvis ad pedem montis Boschberg, *MacOwan* 1884 (B, BOL); Boschberg, *Bolus* 95 (BOL). **3226 (Fort Beaufort)**: Katberg Forest (BC), *Holland* s.n. (NBG); Katberg, *Hutton* s.n. (B, L); Katberg Forests, *c.* 3000 ft, *Adams* 142 (NU); Hogsback, Madonna and Child Falls (DB); *Greathead* s.n. (SRGH); Hogsback Forest, Auckland Kloof, *Griffen* x46 (PRE); Brambledene, Menziesberg, *Acocks* 11112 (PRE); Hogsback, *Gibbs-Russel* 3832 (PRE). **3227 (Stutterheim)**: Isidinge Forest (CA), *Roux* 1986 (NBG); Keiskamma Hoek, Gxulu Mountain, 5500 ft, *Story* 3509 (PRE); Kalogha Forest Station (CB), *Roux* 2433 (NBG); Pirie Forest, along Amatola trail, *Roux* 2709 (NBG); Pirie Forest, *Flanagan* 1758 (PRE); Fort Cunningham, *Roux* 2427 (NBG); Pirie (CC), *sine coll.* s.n. (GRA); Amabele (DA), *sine coll.* s.n. (PRE); Pirie, *Sim* s.n. 505, 1727c (GRA, PRE); Komgha (DB), *Flanagan* s.n. (SAM).

SWAZILAND. 2631 (Mbabane): Gobolo, *c.* 3500 ft (AC), *Dlamini* s.n. (NBG, NH, PRE); Stroma, *c.* 4000 ft, *Compton* 25822 (NBG, PRE).

ZIMBABWE: Inyanga, Nyangani, 6000 ft, *Chase* 3813 (NU, SRGH); Gweni, Mt. Cashel, *Chase* 1083 (SRGH).

WITHOUT EXACT LOCALITY: Gold Fields, *Ayres* s.n. (NH); Cap de Bonne Esperance, *Drége* s.n. (P); Johannesburg, *Westeman* s.n. (P); Cap b. Spei, *Ecklon* s.n. (P); Natal, *sine coll.* s.n. (P); Mor Bridge, *Hill* 692 (PRE); Drakensberg, *Bottomley* s.n. (PRE); Natal, *Buchanan* s.n. (BOL, M); O.F.S. TM1761c (PRE); Natal, *Wood* 504 (PRE); in vollbus montium seciis Katrivier, prope Philipstown, 3000–4000 ft, *Ecklon & Zeyher* s.n. (P); Natal, *Buchanan* 27 A-only (M); Kaffrarian forests, *Sim* s.n. (B); Natalia, *Buchanan* 74, 84 (B); Cap./Pr. b. sp., *Ecklon & Zeyher* 38.6 (B); ceded territory, Quellen des Katrivier, 3000–4000 ft, *Drége* s.n. (B); Prom. b. Spei, *Drége* s.n. B & C only (B); Natal, *Wood* s.n. (NU); Xumeri Forest, *Rycroft* 518 (NU); loco incerto, *sine coll.* s.n. NH-9785 (NH); below Mwndali, 5000 ft, *Anderson* s.n. (BM); Himalaya, Ravi Valey, Chanjú, 7000 ft, *McDonnell* 34 (BM); South Africa, *Barckley* 95 (GRA); *sine coll.* s.n. (L); loco incerto, *sine coll.* s.n. NH-26468 (NH).

The African *Polystichum luctuosum* (Kunze) T. Moore and the Asian *P. tsus-simense* (Hook.) J. Sm. have been considered either as distinct taxa (Mitui, 1965, 1968; Hirabayashi, 1969; Daigobo, 1973; Nakaike, 1975; Gibby, 1985; Punetha et al., 1988) or as synonymous (Hope, 1902; Hooker in Hooker & Baker, 1868). Plants occurring in the western Indo-Himalayan mountains have been ascribed to either *P. tsus-simense* (Dixit, 1983) or to *P. luctuosum* (Khullar, 1987; Punetha et al., 1988). Fraser-Jenkins (in Gibby, 1985) considers the two taxa as vicariants. I have studied material throughout the distribution range of these taxa and find them to be conspecific.

DIAGNOSTIC FEATURES AND RELATIONSHIPS. Diagnostic of *Polystichum luctuosum* is the olive-green colour of the adaxial surface of the lamina and the darker veins seen in living plants. It is also separated from other taxa in the region by the usually very dark and narrow paleae occurring along the stipe and rachis. The larger rhizome and stipe base paleae bear long filiform outgrowths along the margin and palea surface. Indusia are large, persistent and entire, and take on a cupulate form when mature. *Polystichum luctuosum* is furthermore a triploid apomict with 32 spores per sporangium and has a somatic chromosome number of 2n=123.

Within the study area *Polystichum luctuosum* is the only member belonging to section *Xiphopolystichum* Daigobo.

VARIATION. *Polystichum luctuosum* shows little variation in stipe, lamina and basal pinna length within the study area. A comparison of these parts with Asian material shows that African (including Madagascar) plants are slightly larger than the plants from Asia. Guard-cell length in African material shows little variation, but in Asian plants the variation is pronounced. Asian plants also have larger guard cells than African plants. Sori may be uniseriate or biseriate, variation that appears to be environmentally induced. Indusia show a large degree of variation in both African and Asian plants, with African plants having larger indusia than Asian plants. Also the number of indurated annulus cells per sporangium shows some variation. In African plants the number ranges from 10 to 19, whereas in Asian plants the number ranges between 10 and 21. Spores too show variation, with Asian plants having larger spores than African plants (Table 1). Although variations in palea colour occur, their morphology remains fairly stable throughout the distribution of the species.

DISTRIBUTION AND ECOLOGY. In South Africa *Polystichum luctuosum* occurs from the Eastern Cape through KwaZulu-Natal to the northeastern parts of the Free State, Mpumalanga, and the Northern Province. It also extends to the lower elevations in the western parts of Lesotho, the higher-lying part of Swaziland, and with isolated populations occurring along the eastern escarpment in Zimbabwe. Outside of Africa the species occurs on Réunion and the central parts of Madagascar, extending to the Indian subcontinent, Pakistan, China, Vietnam, South Korea and Japan (Honsyu, Sikoku and Kyusyu).

Polystichum luctuosum occurs in the eastern parts of the summer rainfall regions of southern Africa where it appears to be restricted to the drier forest types such as Dohne Sourveld in the Eastern Cape, Highland Sourveld along the Drakensberg foothills, 'Ngongoni Veld in the KwaZulu-Natal midlands and Northeastern Mountain Sourveld in Swaziland, and along the lowveld escarpment and Soutpansberg. In South Africa *P. luctuosum* occurs at elevations ranging from 670 m to 1740 m, whereas in Zimbabwe on Mount Nyangani it occurs at elevations as high as 1825 m.

Polystichum luctuosum mostly grows on rocks along streams, but often also as a low-level epiphyte in moist forests. Plants often also grow on rocks away from water and in fairly dry conditions.

3. **Polystichum volkensii** (Hieron.) C. Chr., *Index filic.*: 97 (1905).
Type as for *Aspidium volkensii* Hieron.
Fig. 4.

Aspidium volkensii Hieron. in H.G.A. Engler, *Pflanzenw. Ost-Afrikas*: 86 (1895). Type: Tanzania, an der oberen Grenze des Waldes über Kiboscho, 3000 m, *Volkens* 1520 (B!-holotype).

Polystichum barbatum C. Chr. in *Notizbl. Bot. Gart. Berlin-Dahlem* **9**: 178 (1924). Type: Kenya, Mt. Aberdare, pr. Kinangop, regio *Hagenia abyssinica*, *c.* 3300 m, *Rob. E. & Th. C.E. Fries* 2735 (K!-holotype; B!-isotype).

Plants terrestrial. *Rhizome* short, erect, to 10 mm in diameter, densely set with roots, persistent stipe bases, and paleae; paleae sessile or short-stalked, ferrugineous, chartaceous, narrowly lanceolate, cordate, entire, the apex terminating in an acicular cell, to 15 mm long. *Fronds* caespitose, to 14 per plant, erect, to 1.2 m long: *stipe* proximally castaneous, stramineous distally, adaxially sulcate, to 520 mm long × 10 mm in diameter, densely paleated; larger paleae short-stalked, ferrugineous, membranous, translucent, shrivelled, elliptic to ovate, cordate to cordate-imbricate, minutely fimbriate, the apex long, shrivelled, filiform, entire, terminating in an acicular cell, to 34 × 10 mm; smaller paleae short-stalked, convolute, ovate to narrowly ovate, cordate to cordate-imbricate, proximally with short straight or angular marginal outgrowths, becoming entire towards the apex, the apex subulate, terminating in an acicular cell: *lamina* 3-pinnate, herbaceous, narrowly elliptic, to 925 mm long, olive-green adaxially, slightly paler abaxially, with a single paleated proliferous bud on the rachis near the lamina apex, the proximal pinnae decrescent, often somewhat deflexed: *rachis* stramineous, adaxially sulcate, densely paleated; paleae short-stalked, convolute,

Table 1 Variation in metric characters for African and Asian *Polystichum luctuosum* (Kunze) T. Moore.

Character	African			Asian		
	x	Range	n	x	Range	n
Stipe length	197 mm	90–450 mm	35	193 mm	98–450 mm	21
Lamina length	271 mm	158–448 mm	46	235 mm	162–465 mm	29
Basal pinna length	66.8 mm	31–178 mm	46	51.8 mm	30–98 mm	21
Guard cell length	41.16 µm	30–52 µm	580	46.9 µm	36–60 µm	760
Indusium size	0.73 mm	0.56–0.95 mm	90	0.58 mm	0.31–0.80 mm	115
Number of indurated annulus cells	13.52	10–19	600	14.44	10–21	537
Spore length	38.84 µm	30–50 µm	275	40.75 µm	30–52 µm	405
Spore width	28.2 µm	22–36 µm	275	28.83 µm	22–40 µm	680

stramineous to ferrugineous, narrowly ovate, narrowly lanceolate, or transversely elliptic, cordate to cordate-imbricate, proximally erose or with short straight or angular outgrowths, becoming entire towards the apex, the apex subulate, terminating in an acicular cell, the smaller paleae to 18 × 6 mm: *pinnae* generally not overlapping at the lamina base, overlapping towards middle of the lamina, oblong-attenuate, somewhat falcate, basal pinnae to 54 mm long, the middle pinnae to 190 × 40 mm, proximal acroscopic pinnule slightly enlarged; *pinna-rachis* stramineous, adaxially sulcate, densely paleated; paleae similar to but smaller than those on the rachis: *pinnules* opposite to alternate, asymmetric, acroscopically auriculate, ovate, to 23 × 11 mm, deeply lobed, the acroscopic auricle ovate, cuneate, lobes oblong to narrowly oblong, serrate to crenate, adaxially moderately paleated; paleae castaneous to ferrugineous, chartaceous, convolute, filiform, to 15 mm long, abaxially moderately to densely paleated; paleae short-stalked, castaneous to ferrugineous, chartaceous, convolute, filiform, narrowly linear or subulate, cordate to cordate-imbricate, proximally with short angular outgrowths, entire towards apex, the apex terminating in an acicular cell, to 16.5 mm long. *Venation* immersed. *Sori* circular, <1 mm in diameter, essentially uniseriate, discrete at maturity, terminal or near-terminal on abbreviated vein branches, or dorsally on unabbreviated vein branches: *sporangium* with 12–(14)–19 indurated annulus cells; stalk eglandular: *indusium* ferrugineous to castaneous, peltate, circular, elliptic or irregular, coarsely erose, the maximum radius 0.48–(0.66)–0.92 mm. *Spores* 64 per sporangium, brown, the perispore folded to form a close reticulum of compressed ridges, the ridges and areas between granulate, verruculate or echinulate, variously perforated, the exospore 34–(42.64)–52 × 24–(30.32)–38 µm. *Chromosome number* unknown.

MATERIAL EXAMINED.

KENYA: Mt. Nyandarua, forest belt, 10800–11000 ft, *Rabb & Nightingale* 7 (K).

TANZANIA: Kilimanjaro, highest forest above Kibosho, *Uhlig* 186 (B), *Uhlig* 242 (B, K); Kilimanjaro, cave above Moschi, *Uhlig* 76 (B, K); Kilimanjaro, forested area just below 1st hut and also above Machame route, 1820 m, *Schippers* T1452 (WAG); Kilimanjaro, Machame route, 3450 m, *Pócs* s.n. (WAG); Kilimanjaro, B-only, *Brenner* s.n. (P); Kilimanjaro, S. slope along the Mweka route, near Mweka base hut, 2850 m, *Pócs* 6718/A (K).

WITHOUT EXACT LOCALITY: loco incerto, *sine coll.* BOL-5726 (BOL).

DIAGNOSTIC FEATURES AND RELATIONSHIPS. *Polystichum volkensii* is unique among African *Polystichum* species in the narrowly elliptic lamina outline and the long-decrescent, deflexed or arcuate pinnae. The densely paleated stipe and rachis, and the single proliferous bud borne near the frond apex are also characteristic. The finely divided pinnules and the morphology of especially the smaller paleae ensure that it cannot be mistaken for any other species in the region.

The affinity of *Polystichum volkensii* is yet to be determined.

VARIATION. *Polystichum volkensii* shows little infraspecific morphological variation. Variation is largely restricted to pinnule size and pinna orientation and this may be ascribed to environmental influences.

DISTRIBUTION AND ECOLOGY. *Polystichum volkensii* appears to be confined to Mount Kilimanjaro in Tanzania and the Aberdare Mountain Range in Kenya. At lower elevations (1820 m) on Mount Kilimanjaro it occurs in Undifferentiated Afromontane forests but higher up, at 3450 m, it occurs in the Ericaceous belt with *Erica arborea* and *Podocarpus milanjianus*. On the Aberdare Mountain Range the species occurs in Undifferentiated Afromontane forests but also in Single-dominant Afromontane forests such as *Hagenia abyssinica*-forests at elevations ranging between 3300 and 3610 m (White, 1983).

4. **Polystichum kilimanjaricum** Pic.Serm. in *Webbia* **27**: 445 (1972). Type: Tanzania, Kilimanjaro, presso la Bismarck's Hut, terrestre, nel sottobosco rado nella parte piú alta della foresta umida montana a *Podocarpus milanjianus*, *Hagenia abyssinica* ed *Ilex mitis*, *c.* 2850 m, 8 July 1956, *Pichi Sermolli* 5171 (Herb. PIC.SERM. 20640-holotype; Herb. PIC.SERM. 25150!, K!-isotypes).

Fig. 5.

Plants terrestrial. *Rhizome* erect to suberect, to 180 mm long, closely set with roots, persistent stipe bases, and paleae. *Fronds* 8–12 per plant, caespitose, suberect to arching, to 1.05 m long: *stipe* proximally castaneous, stramineous distally, adaxially sulcate, to 430 mm long × 8 mm in diameter, proximally densely paleated; proximal paleae broadly attached, ferrugineous, crustaceous, narrowly triangular, truncate to cuneate, the margins irregularly set with large recurved outgrowths, the apex terminating in an acicular cell, to 9 × 0.8 mm; distal paleae of two types, the larger broadly attached, bicolorous, with a central ebeneous to castaneous, glossy, crustaceous band, and a dull brown, chartaceous margin, narrowly ovate to broadly ovate, truncate to cuneate, the margins minutely fimbriate, the fimbriae straight or twisted, simple or apically forked, the apex terminating in an acicular cell, to 18 × 7 mm, the smaller short-stalked, concolorous, ferrugineous to stramineous, chartaceous, narrowly ovate to subulate, the margins minutely fimbriate, the subulate paleae always with long and/or short, simple or branched, often apically forked fimbriae at the base and widely spaced, recurved or apically directed outgrowths distally, the apex terminating in an acicular cell: *lamina* 2-pinnate, with up to 35 free pinna pairs, triangular to ovate, to 685 mm long, with 1–3 often widely spaced proliferous buds in pinna axils near the apex: *rachis* stramineous, adaxially sulcate, moderately to densely set with paleae similar to but smaller and paler than those on the stipe: *pinnae* 1-

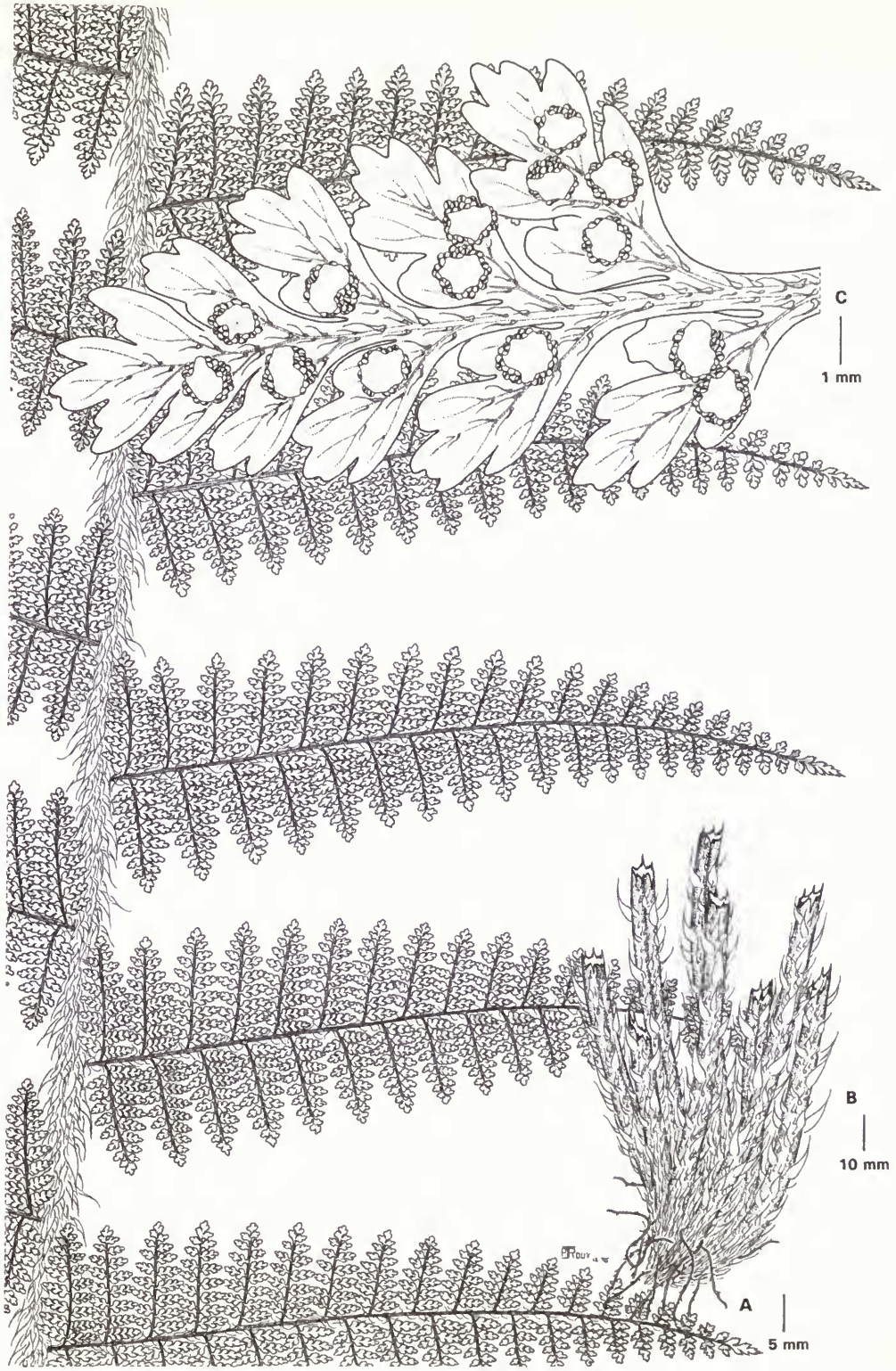

Fig. 4 *Polystichum volkensii*. A, middle pinnae of lamina; B, rhizome; C, abaxial surface of fertile pinnule. A, drawn from *Volkens* 1520 (B); B, drawn from *Radd & Nightingale* 7 (K); C, drawn from *Pócs* s.n. (WAG).

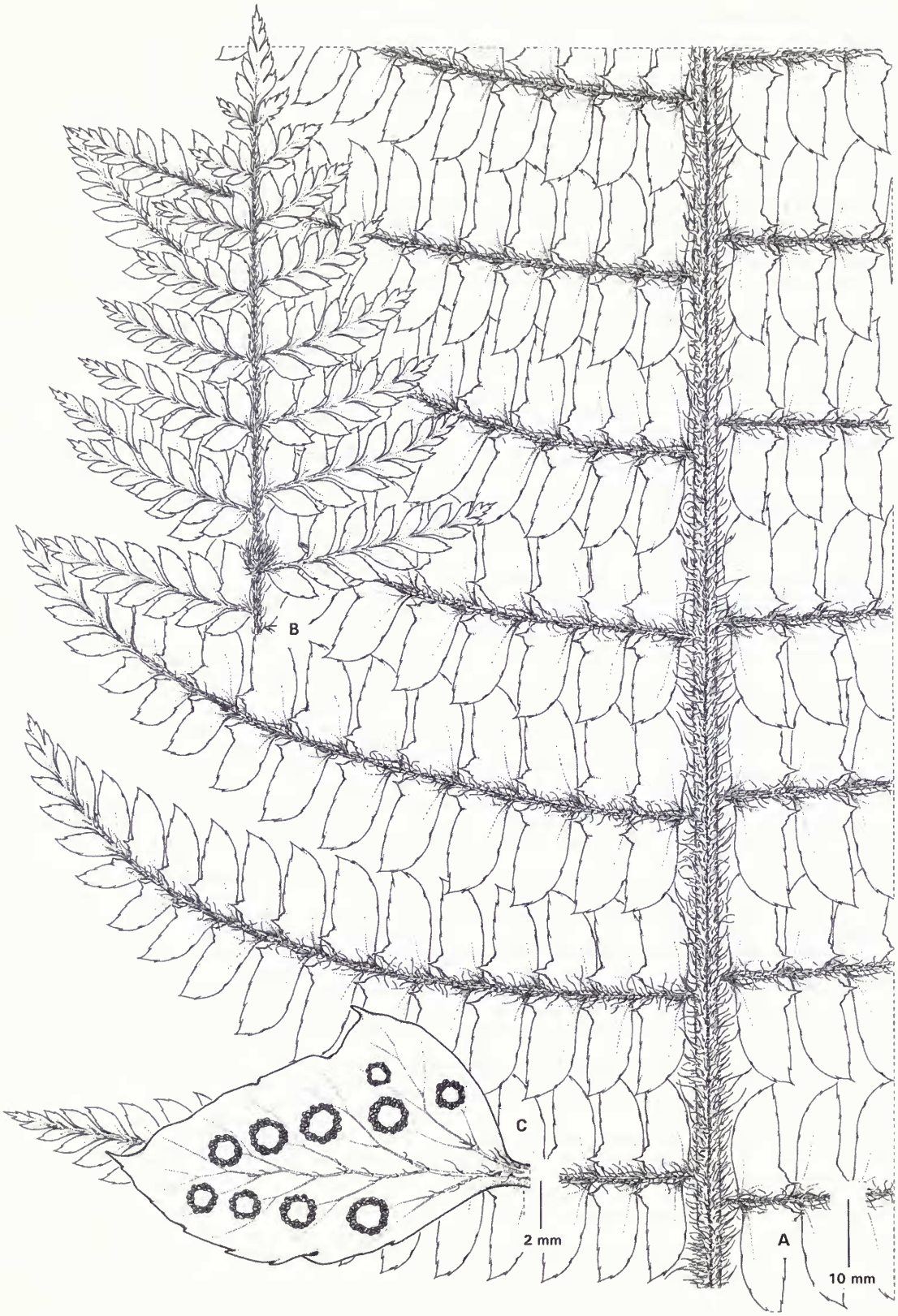

Fig. 5 *Polystichum kilimanjaricum*. A, proximal pinnae of lamina; B, lamina apex showing proliferous bud; C, abaxial surface of fertile pinnule. All drawn from *Pichi Sermolli* 5171 (Herb. PIC.SERM.).

pinnate, with up to 14 free pinnule pairs, not overlapping proximally, the basal pinnae not or slightly reduced in size, often somewhat deflexed, ovate, narrowly ovate or oblong-attenuate, to 140 × 35 mm: *pinna-rachis* stramineous, adaxially sulcate, set with acicular paleae with numerous long and often twisted outgrowths at the base, the apex terminating in an acicular cell, to 7 mm long: *pinnules* slightly imbricate, short-stalked proximally, firm-herbaceous to subcoriaceous, adaxially olive-green, somewhat paler abaxially, inaequilateral, ovate-rectangular to ovate-rhomboid, basiscopically cuneate, acroscopically truncate and weakly auriculate, shallowly undulate or serrate, the teeth and aristae bent inwards, the auricle and apex aristate, the proximal acroscopic and basiscopic pinnules on basal pinnae often slightly reduced in size, the proximal acroscopic and basiscopic pinnules on upper half of lamina slightly larger than the next, to 20 × 10 mm; adaxially sparsely set with short-stalked, acicular, somewhat twisted paleae, often with a few long straight or twisted, often branched outgrowths at the base, the apex terminating in an acicular cell, to 2.5 mm; abaxial surface with similar paleae but more densely set. *Venation* immersed or raised. *Sori* circular, *c.* 1.4 mm in diameter, terminal on abbreviated vein branches, uniseriate or biseriate on acroscopic auricle, discrete: *sporangium* with 8–(13)–20 indurated annulus cells; stalk eglandular: *indusium* peltate, subcircular to irregular, the maximum radius 0.73–(0.87)–1.02 mm, persistent, brown. *Spores* brown, the perispore folded to form inflated or compressed tubercles, echinulate, verruculate to echinulate, sparsely to closely perforated, the exospore 34–(43.44)–56 × 26–(32.45)–44 µm. *Chromosome number* unknown.

MATERIAL EXAMINED

TANZANIA: Kilimanjaro, below 1st hut, Machame Route, 2950 m, *Schippers* T1465 (WAG); Kilimanjaro, above Mandare Hut, 1830 m, *Schippers* T1234A (WAG).

DIAGNOSTIC FEATURES AND RELATIONSHIPS. *Polystichum kilimanjaricum* is characterized by the proliferous buds on the lamina and the palea morphology. Paleae on the proximal part of the stipe are narrowly triangular and are either castaneous throughout, or may often have a very narrow paler brown margin. Larger paleae higher up the stipe have an ebeneous to castaneous centre and a broader ferrugineous to stramineous margin. These paleae are mostly oblique in outline. Larger paleae on the upper two-thirds of the stipe are ovate to broadly ovate in outline with only the central part of the apices being ferrugineous to castaneous in colour.

Pichi Sermolli (1972) considered this species to closely resemble *P. pauciaculeatum* Bonap. (as *P. coursii* Tardieu) and *P. tsaratananense* Tardieu from Madagascar and went on to describe how *P. kilimanjaricum* can be distinguished from them. Morphologically *P. kilimanjaricum* is more similar to *P. tsaratananense* than it is to *P. pauciaculeatum*. *Polystichum kilimanjaricum* belongs to section *Lasiopolystichum* Daigobo.

DISTRIBUTION AND ECOLOGY. *Polystichum kilimanjaricum* appears to be endemic to Mount Kilimanjaro in Tanzania, occurring at elevations ranging between 1830 and 2950 m. The species is evidently confined to the *Hagenia abyssinica* montane forests and thickets associated with the Ericaceous belt where it mostly occurs on the forest floor and on rocky streambanks.

5. **Polystichum aculeatum** (L.) Roth, *Tent. fl. Germ.* **3**(1): 79 (1799). Type as for *Polypodium aculeatum* L.

Fig. 6.

Polypodium aculeatum L., *Sp. pl.*: 1090 (1753). Type: Habitat in Europa. H.L.B. 908,311.72 (L-lectotype, designated by Alston (1940)).

Polypodium lobatum Huds., *Fl. angl.*: 390 (1762). Type: Habitat in umbrosis et ad sepes. Haller, *Hist. stirp. Helv.*: 1712 (1768); Pluk., *Phytographia*: 180, f. 1 (1691); Ray, *Syn. meth. stirp. brit.*: 121 (1690)-syntypes.

Aspidium aculeatum (L.) Sw. in *Jl. Bot. (Schrader)* **1800**(2): 37 (1801).

Aspidium lobatum (Huds.) Sw. in *Jl. Bot. (Schrader)* **1800**(2): 37 (1801).

Polystichum lobatum (Huds.) Bastard, *Essai fl. Maine et Loire*: 367 (1809). Chevall., *Fl. Belg., Ptérid.*: 107 (1950).

Dryopteris aculeata (L.) Kuntze, *Revis. gen. pl.* **2**: 812 (1891).

Dryopteris setifera subsp. *lobata* (Huds.) Maire in E. Jahandiez & R.C.J.E. Maire, *Cat. pl. Maroc* **1**: 3 (1931).

Plants terrestrial or epilithic. *Rhizome* short, erect to suberect, to 120 mm long, to 15 mm in diameter, set with roots, closely spaced persistent stipe bases, and paleae. *Fronds* crowded, caespitose, 8–11 per plant, erect to arching, to 935 mm long: *stipe* proximally castaneous, stramineous distally, adaxially sulcate, to 170 mm long × 6 mm in diameter, proximally densely set with conspicuously larger and smaller paleae, moderately paleated distally; larger paleae sessile, castaneous, chartaceous, broadly ovate, cordate, the margins proximally closely set with short curved outgrowths, the apex usually short-flagelliform, terminating in a small thin-walled cell, to 15 × 9 mm; smaller paleae sessile, castaneous to stramineous, chartaceous, lanceolate or narrowly to broadly ovate, cordate to cordate-imbricate, the margins proximally with short curved outgrowths, the apex terminating in a subulate cell or a small thin-walled cell: *lamina* 2-pinnate, with up to 41 free pinna pairs, coriaceous, adaxially dark green, slightly paler abaxially, narrowly elliptic, to 770 mm long, closely spaced and often imbricate distally, proximally more widely spaced, the proximal pinnae reduced, often slightly deflexed: *rachis* stramineous, adaxially sulcate, moderately paleated; paleae sessile, ferrugineous, chartaceous, broadly ovate, ovate, narrowly elliptic or hastate, cordate to cordate-imbricate, the margins with short, somewhat curved outgrowths extending nearly to the apex, the apex terminating in a subulate cell, a long acicular cell, or a small thin-walled cell, to 6 × 3 mm: *pinnae* short-stalked, pinnatifid to 1-pinnate, with up to 16 free pinnule pairs, narrowly oblong-attenuate, the middle pinnae to 110 mm long, the proximal pinnae to 88 mm long: *pinna-rachis* stramineous, adaxially sulcate, moderately paleated; paleae sessile or short-stalked, ferrugineous, chartaceous, ovate, narrowly lanceolate to hastate, cordate to cordate-imbricate, the margins proximally with short or long, usually curved outgrowths, the apex terminating in a subulate cell or a small thin-walled cell, to 2 × 0.8 mm: *pinnules* opposite to alternate, somewhat imbricate, the proximal acroscopic pinnule usually slightly longer than the next, asymmetric, trullate to narrowly trullate, basiscopically cuneate, acroscopically cuneate to truncate and auriculate, serrate to long-aristate, to 15 mm long; adaxially with a few membranous, filiform paleae terminating in a subulate or thin-walled cell confined to proximal part of pinnule, to 1.75 mm long; abaxially moderately set with membranous, narrowly trullate or narrowly lanceolate paleae with a few short and straight marginal outgrowths, or the paleae filiform, short-stalked, with the apex terminating in a subulate cell or a small thin-walled cell, to 2.5 mm long. *Venation* immersed. *Sori* circular, to 1.5 mm in diameter, terminal or near terminal on abbreviated vein branches, essentially uniseriate, discrete to confluent at maturity: *sporangium* with 12–(13)–17 indurated annulus cells; stalk eglandular: *indusium* chartaceous, peltate, circular, entire to repand, the maximum radius 0.63–(0.92)–1.26 mm, persistent, brown. *Spores* brown, the perispore folded to form short echinate ridges or crests, the areas between

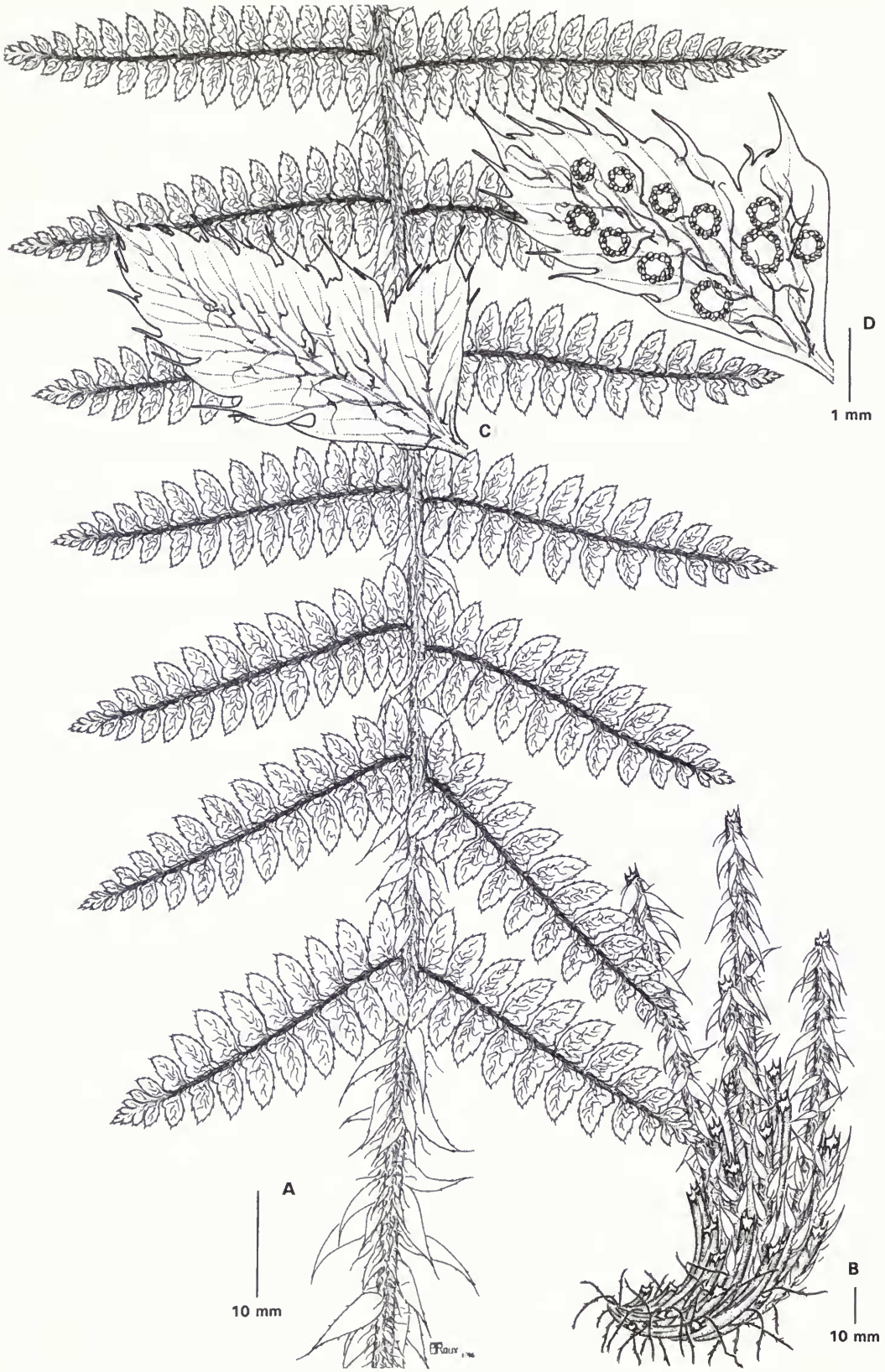

Fig. 6 *Polystichum aculeatum*. A, proximal part of lamina; B, fertile pinnae; C, rhizome. A & B drawn from *Lindberg* 2793 (B); C, drawn from *Cosson* s.n. (S).

fenestrate with pores of variable sizes, the exospore 32–(37.46)–48 × 24–(27.93)–34 µm. *Chromosome number* 2n=164 (Manton, 1950).

MATERIAL EXAMINED

ALGERIA: Montagnes du Djurdjura, cercle de Dra el Mizan, *Cosson* s.n. (B); La Gourraya de la Bougie, *Còrzeillea Terè* s.n. (S).

MOROCCO: Haut Atlas, Ourika, 1400 m, *Litardière* s.n. (M, P); Great Atlas Mountains, Si Chamharouch, ± 2280 m, *Polunin* 2184 (BM); N. face Gbou Orionl, 2950 m, *Newbould* 109, 110 (BM); Arromiel, *Balls* 2972 (B, BM, S); Taddert, Marrakesh-Quarzazat road, High Atlas, 1600 m, *Chatworth-Musters* 362 (BM); Atlas Magnum, Amismiz, ± 1400 m, *Lindberg* 2793 (B, S); Meknès, Aguelmane Azigza, 1600 m, *Casas* et al. s.n. (B); Grand Atlas, Ourika, 1300–1400 m, *Maire* s.n. (RAB); Haut-Atlas, Ourika, ± 2600 m, *sine coll.* s.n. 18633 (RAB); env. de la maison forestièr de Khanolak-Anasar, *Jovet-Ast* et al. 13313 (RAB).

Variation in *Polystichum aculeatum* and *P. setiferum* and the occurrence of intermediate forms and hybrids (*P.* × *bicknellii* (H. Christ) Hahne) between these species have resulted in diverse interpretations as to their delimitation. The result has been some nomenclatural confusion (Newman, 1844; Alston, 1940; Elliot, 1950; Meyer, 1960).

Hudson (1762), unaware of the existence of the name *Polypodium setiferum* Forssk., recognized two forms in European *P. aculeatum* and divided plants into two species. The rigid and less divided form he named *Polypodium lobatum*, and the lax and more divided form he retained in *P. aculeatum*. Hudson's interpretation of *P. aculeatum* is therefore synonymous with *P. setiferum* (Forssk.) T. Moore ex Woyn. and *P. lobatum* with *P. aculeatum* as now interpreted. Although the name *P. lobatum* never became well-established, arguments in favour of its retention were made by Meyer (1960).

DIAGNOSTIC FEATURES AND RELATIONSHIPS. *Polystichum aculeatum* is a fertile sexual species intermediate in morphology between *P. lonchitis* (L.) Roth and *P. setiferum* (Forssk.) T. Moore ex Woyn., although it is closer in appearance to the latter. Manton (1950) demonstrated *P. aculeatum* to be a tetraploid of hybrid origin between the putative parents *P. lonchitis* and *P. setiferum*. Daigobo (1972) placed this species and *P. setiferum* in different sections, but their palea morphology suggests them to be related. Both belong to section *Metapolystichum* Daigobo.

Polystichum aculeatum is characterized by having a coriaceous lamina and smooth, shiny, dark green pinnules. The longest pinnae occur at or near the middle of the lamina with the most proximal pinna pair distinctly shorter than the middle pinnae. The stipe/lamina ratio in *P. aculeatum* is 1:3.27 (n=12). Palea density and morphology are also diagnostic and differ from that of *P. setiferum* with which it may be confused. In *P. aculeatum* the stipe, rachis and pinna-rachis are moderately paleated, whereas in *P. setiferum* they are usually densely set with twisted paleae. Marginal outgrowths in larger paleae are short and curved, and gradually phase out towards the apex. Smaller paleae are mostly broad-based and have short curved marginal outgrowths, but distally they terminate abruptly in an almost simple subulate apex. Paleae occurring abaxially on the pinnules are short and proximally bear a few small, straight or curved, marginal outgrowths, with the apex terminating in a subulate cell or a small thin-walled cell. *Polystichum aculeatum* also differs from *P. setiferum* in a number of micromorphological characters, with the mean adaxial epidermal cell length, guard cell length, maximum radial length of the indusium, and the spores being larger than those in *P. setiferum*.

VARIATION. *Polystichum aculeatum* varies in the degree to which the pinnae reduce in size towards the base of the lamina and in the length of the stipe in relation to the length of the lamina. European plants appear to have shorter stipes than plants from Africa. Pinnules of plants from the study area are remarkably stable and show little variation.

DISTRIBUTION AND ECOLOGY. *Polystichum aculeatum* is widespread in Europe but in North Africa its distribution is more restricted. Hansen & Sunding (1993) and Derrick et al. (1987) considered the species to also occur on Madeira and the Canary Islands, but no material originating from Madeira could be traced by Manton et al. (1986), Gibby & Paul (1994), or myself. I have also not seen any material of this species from the Canary Islands.

In Algeria and Morocco *Polystichum aculeatum* is restricted to the High Atlas Mountains. The lithology of the region consists largely of basement rock and unconsolidated clay marls (White, 1983). The rainfall is low and seasonal at lower elevations but at higher elevations precipitation may occur throughout the year. The species occurs at elevations ranging between 1400 m and 2950 m, where it is confined to moist shaded rock crevices along streams and at waterfalls.

6. **Polystichum setiferum** (Forssk.) T. Moore ex Woyn. in *Mitt. Naturwiss. Vereines Steiermark* **49**: 181 (1913). Type as for *Polypodium setiferum* Forssk.

Fig. 7.

Polypodium setiferum Forssk., *Fl. aegypt.-arab.*: 185 (1775). Type: Turkey, Dardanelles ('Ad Dardanellos'), *Forsskål* 814 (C!-lectotype, designated by Hepper & Friis (1994)).

Aspidium angulare Kit. ex Willd., *Sp. pl.* 4, **5**(1): 257 (1810). Type: Habitat in Hungaria, *sine coll.* s.n. (B-Willd.-holotype, NBG!-photograph).

Aspidium hastulatum Ten., *Semina 1830*: 15 (1830). Type: In nostri regni nemoribus, et abunde in vallibus circa Neapolim, *S. Rocco, Ponti Rossi & Camaldoli* s.n. (not located).

Polystichum angulare (Kit. ex Willd.) C. Presl, *Tent. pterid.*: 83 (1836).

Aspidium aculeatum subsp. *angulare* (Kit. ex Willd.) Asch. in P.F.A. Ascherson & K.O.R.P.P. Graebner, *Syn. mitteleur. Fl.* **1**: 39 (1896).

Polystichum aculeatum subsp. *angulare* (Kit. ex Willd.) Vollm., *Fl. Bayern*: 9 (1914).

Dryopteris aculeata subsp. *angularis* (Kit. ex Willd.) Schinz & Thell. in H. Schinz & R. Keller, *Fl. Schweiz* 3rd ed., **2**: 3 (1914).

Dryopteris setifera (Forssk.) Woyn. ex Schinz & Thell., *Vierteljahrsschr. Naturf. Ges. Zürich* **60**: 340 (1915).

Dryopteris setifera subsp. *angularis* (Kit. ex Willd.) Maire in É. Jahandiez & R.C.J.E. Maire, *Cat. pl. Maroc* **1**: 3 (1931).

Plants terrestrial or epilithic. *Rhizome* erect to suberect, short, to 18 mm in diameter, set with roots, closely spaced stipe bases, and paleae; paleae broadly attached, stramineous to ferrugineous, chartaceous, ovate to broadly ovate, often somewhat bullate, cordate, the margins minutely fimbriate to erose, the apex generally entire, terminating in a subulate cell or a small thin-walled cell. *Fronds* 8–22 per plant, suberect to arching, to 1.2 m long: *stipe* proximally castaneous, stramineous distally, adaxially sulcate, to 520 mm long × 6 mm in diameter, densely paleated; paleae ferrugineous, chartaceous, the larger paleae sessile, narrowly ovate, ovate, or broadly ovate, often somewhat bullate, cordate, the margins finely fimbriate to erose, the apex entire, terminating in a subulate cell or a thin-walled cell, to 20 × 11 mm, the smaller paleae narrowly oblong, narrowly ovate, or subulate, mostly helically twisted, short-stalked, cordate-imbricate, the margins proximally with short and/or long outgrowths, the outgrowths straight, narrowly triangular, or angular, reduced in size towards the apex, the apex terminating in a

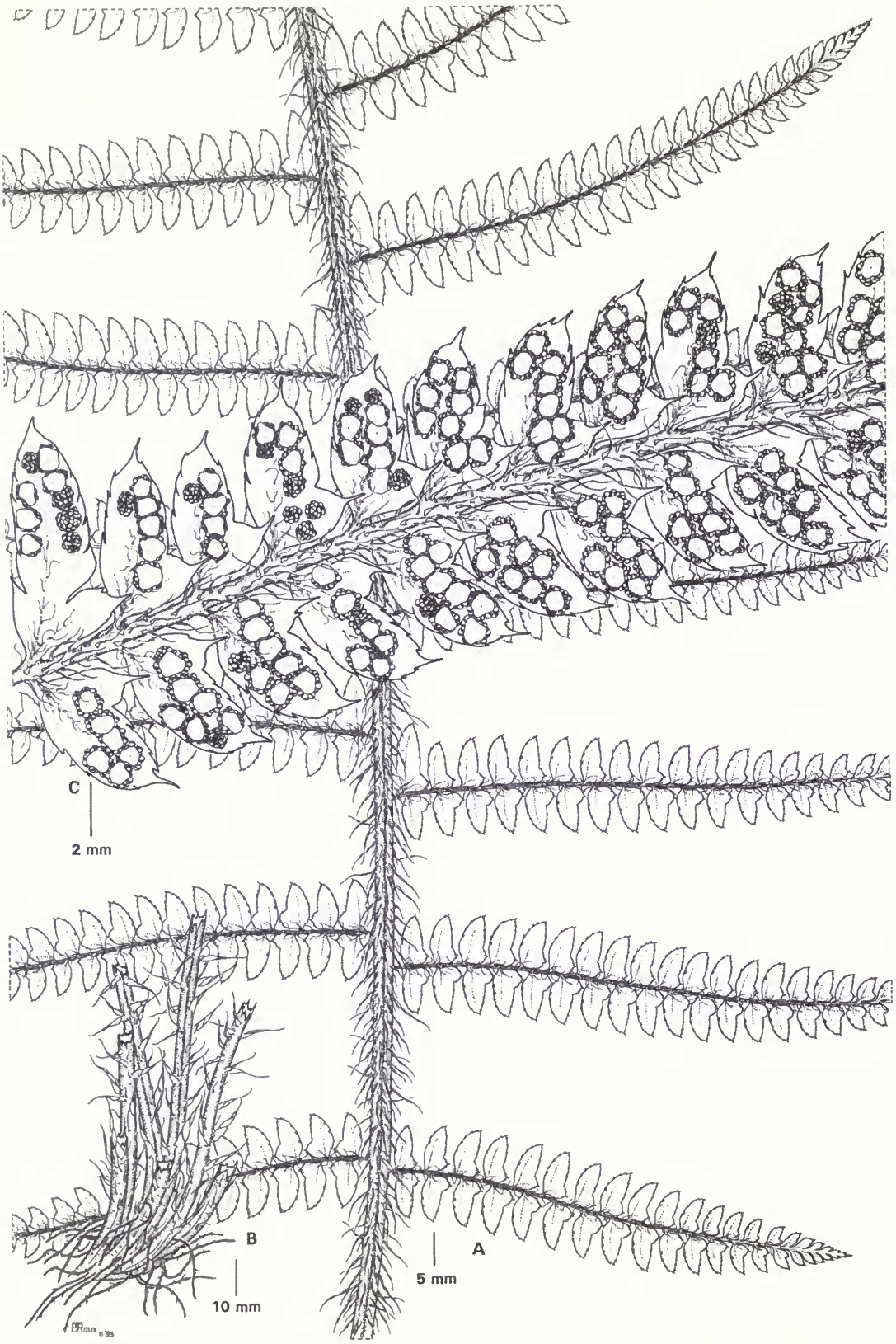

Fig. 7 *Polystichum setiferum.* A, proximal part of lamina; B, rhizome; C, abaxial surface of fertile pinna. A & C drawn from *Mandon* 291 (S); B, drawn from *Tullgren* 21 (S).

subulate cell or a small thin-walled cell: *lamina* 2-pinnate to 2-pinnate-pinnatifid, with up to 45 free pinna pairs, firmly herbaceous to coriaceous, dark green adaxially, somewhat paler abaxially, ovate to elliptic, to 830 mm long, the proximal pinnae reduced, often somewhat deflexed: *rachis* stramineous, adaxially sulcate, densely paleated; paleae narrowly oblong, narrowly ovate, narrowly lanceolate, or subulate-hastate, helically twisted, short-stalked, cordate to cordate-imbricate, the margins proximally with short and/or long straight, curved or angular outgrowths that reduce in size towards a usually entire apex, the apex terminating in a subulate cell or a small thin-walled cell, to 6 × 2 mm: *pinnae* with up to 26 free pinnule pairs, closely to widely spaced, often overlapping towards the apex, narrowly oblong-attenuate, the middle pinnae to 162 mm long, the proximal pinnae to 140 mm long: *pinna-rachis* stramineous, adaxially sulcate, moderately to densely set with paleae similar to but smaller than those on the rachis: *pinnules* opposite to alternate, closely spaced, the proximal acroscopic pinnule not or slightly enlarged, inaequilateral, acroscopically auriculate, trullate or oblong-acuminate, lobate-dentate, aristate, to 13 × 5 mm; adaxially with a few twisted filiform paleae confined to the costa on the proximal part of the pinnule, these terminating in a subulate cell or a small thin-walled cell, to 4.5 mm long; abaxially moderately set with narrowly triangular, subulate-hastate, or filiform paleae, the larger paleae proximally usually with a few long marginal outgrowths, the apex entire, terminating in a subulate cell, to 2.9 mm long. *Venation* immersed. *Sori* circular, *c.* 1 mm in diameter, terminal or near terminal on abbreviated vein branches, essentially uniseriate, discrete to confluent at maturity: *sporangium* with 11–(14)–20 indurated annulus cells; stalk eglandular: *indusium* pale brown, persistent, peltate, circular, repand, the maximum radius 0.48–(0.85)–1.21 mm. *Spores* 64 per sporangium, brown, the perispore folded to form inflated tubercles and ridges, echinulate to verruculate, sparsely perforated, the exospore 26–(34.52)–44 × 18–(25.92)–36 µm. *Chromosome number* 2n=82 (Manton et al., 1986).

MATERIAL EXAMINED

ALGERIA: Mont Magnis, 1500 m, *Reverchon* 371 (BM, P); Djebel Edough, *Cosson* s.n. (P); gorge de la Chiffa, *Cosson* s.n. (P); Djebel Marouf, petite Kabylie, Prov. de Constantine, *Cosson* s.n. (P); dans la fout du Dirah aux environs d'Aumale, *Chaoy* 834 (P); montagnes du Djurdjura, cerde de Dra el Mizan, Prov. d'Alger, *Cosson* s.n. (P); 3 miles W. of the Hotel Lambert, Adekar, *c.* 900 m, *Alston & Simpson* 37578 (BM); Djebel, *Stephenson* s.n. (BM); Romain, Nud el Kebin, Alwah, *sine coll.* s.n. (BM); Algeria, *Eichard* s.n. (WAG).

MOROCCO: entre les rochers humides et umbrage du mont Amareza, Atlas, *Bové* s.n. (P); Al Hoceima. cerca de Ketama, subiendo al monte Koudiet Imoûgrâs, 1880 m, *Casas* 7237 (B); Hafa-es-Sabbaba (Ben-Hosmar), ad 500 m, *Quer* s.n. (B, S).

TUNISIA: NV d'aïn-Draham, *Cosson* s.n. (P); Massif d' El-Fedja, *Cosson & Duval* s.n. (P); Ain Draham, open cork-oak forest, *c.* 900 m, *Simpson* 38370 (BM); forêt du Feidja, 20 km W. of Ghardimaou, 800 m, *Jansen* 462 (WAG).

WITHOUT EXACT LOCALITY: Herb. Luerssen 5242, *sine loc.* (P); loco incerto, *sine coll.* B-96812 (B); loco incerto, *De Buch* s.n. (B); Kaap de Goede Hoop [error, not a native of the Cape], *sine coll.* 9 (L).

DIAGNOSTIC FEATURES AND RELATIONSHIPS. Problems are frequently experienced in separating *Polystichum setiferum* from *P. aculeatum.* The former, however, has larger fronds that are softer in texture. Also the proximal pinnae are not usually markedly reduced in *P. setiferum* as they are in *P. aculeatum.* In *P. setiferum* the paleae are characteristically helically twisted and the apices more frequently terminate in a small thin-walled cell than those of *P. aculeatum.* Micromorphological characters separating the two taxa are reported under *P. aculeatum.*

VARIATION. Considering the wide geographical distribution of the species, it shows remarkably little variation. Dyce (1963) reported that a wide range of minor variations in shape and habit can be expected in any colony of this species. I found variations in the size and shape of the fronds to be most pronounced, but since no obvious geographic pattern was detected, it is here considered to be environmentally induced. Plants from drier areas, in particular the North African region, have fronds that are often merely 1-pinnate or 1-pinnate-pinnatifid. In large specimens from moist areas, however, the lamina may be 2-pinnate-pinnatifid with the proximal acroscopic pinnule being 1-pinnate and often twice as long as the next pinnule. Irrespective of habitat and environmental conditions, the palea structure shows little variation.

DISTRIBUTION AND ECOLOGY. *Polystichum setiferum* is widespread in Britain, Europe south of 53° N latitude, the Crimea, Macaronesia (Azores, Canary Islands and Madeira), and Africa north of the Sahara.

In North Africa *P. setiferum* occurs at elevations ranging between 500 and 1880 m in the Saharan Atlas-, High Atlas- and Anti-Atlas Mountain ranges in Tunisia, Algeria and Morocco. In this region of low rainfall plants are restricted to well-protected rock crevices and moist banks. In Tunisia, however, the species also occurs in open cork-oak (*Quercus suber* L.) forests.

7. **Polystichum transvaalense** N.C. Anthony in *Contr. Bolus Herb.* **10**: 146 (1982). Type: South Africa, Transvaal (Northern Province), Pietersburg District, Woodbush Forest Reserve, *Bredenkamp & Van Vuuren* 450 (BOL!-holotype; PRE!-isotype). Fig. 8.

Plants terrestrial or epilithic. *Rhizome* short, erect, to 8 mm in diameter, densely set with roots, persistent stipe bases, and paleae; paleae broadly attached, castaneous, chartaceous, narrowly linear to narrowly lanceolate, the margins proximally entire, distally with numerous short, apically or basally directed outgrowths, the apex terminating in an acicular cell, to 14 × 1 mm. *Fronds* caespitose, 5–17 per plant, suberect to arching, to 1.045 m long: *stipe* proximally castaneous, stramineous distally, adaxially sulcate, to 535 mm long × 5 mm in diameter, densely paleated, the paleae twisted; larger paleae mostly confined to the stipe, concolorous or bicolorous, castaneous to ferrugineous or with the central part castaneous to black, rugose, narrowly ovate-acuminate to ovate-acuminate, short-stalked, the margins irregularly lacerate-fimbriate, the apex terminating in an acicular cell, to 20 × 6 mm; smaller paleae short-stalked, narrowly ovate to narrowly lanceolate, the margins proximally lacerate, distally irregularly lacerate-fimbriate, the apex terminating in an acicular cell, to 6.5 × 1.4 mm: *lamina* 2-pinnate, with up to 26 free pinna pairs, herbaceous, ovate to narrowly ovate, to 670 mm long, pale green adaxially, paler abaxially, the proximal pinnae often slightly reduced, often deflexed: *rachis* stramineous, adaxially sulcate, often flexuous distally, densely paleated; paleae short-stalked, twisted, castaneous to ferrugineous, narrowly ovate, narrowly triangular, or linear, the margins proximally lacerate, distally irregularly and widely fimbriate, the apex terminating in an acicular cell, to 4.5 mm long: *pinnae* 1-pinnate, with up to 20 free pinnule pairs, proximally widely spaced, distally closely spaced and somewhat overlapping, oblong-attenuate, the basal pinnae to 140 mm long × 28 mm wide, proximally often slightly reduced, the basalmost acroscopic pinnules longer towards the middle of the lamina: *pinna-rachis* stramineous, adaxially sulcate, densely paleated; paleae similar to but smaller than those on the rachis: *pinnules* opposite to alternate, inaequilateral, acroscopically auriculate, ovate to obliquely transversely rhomboid, to 15 mm long,

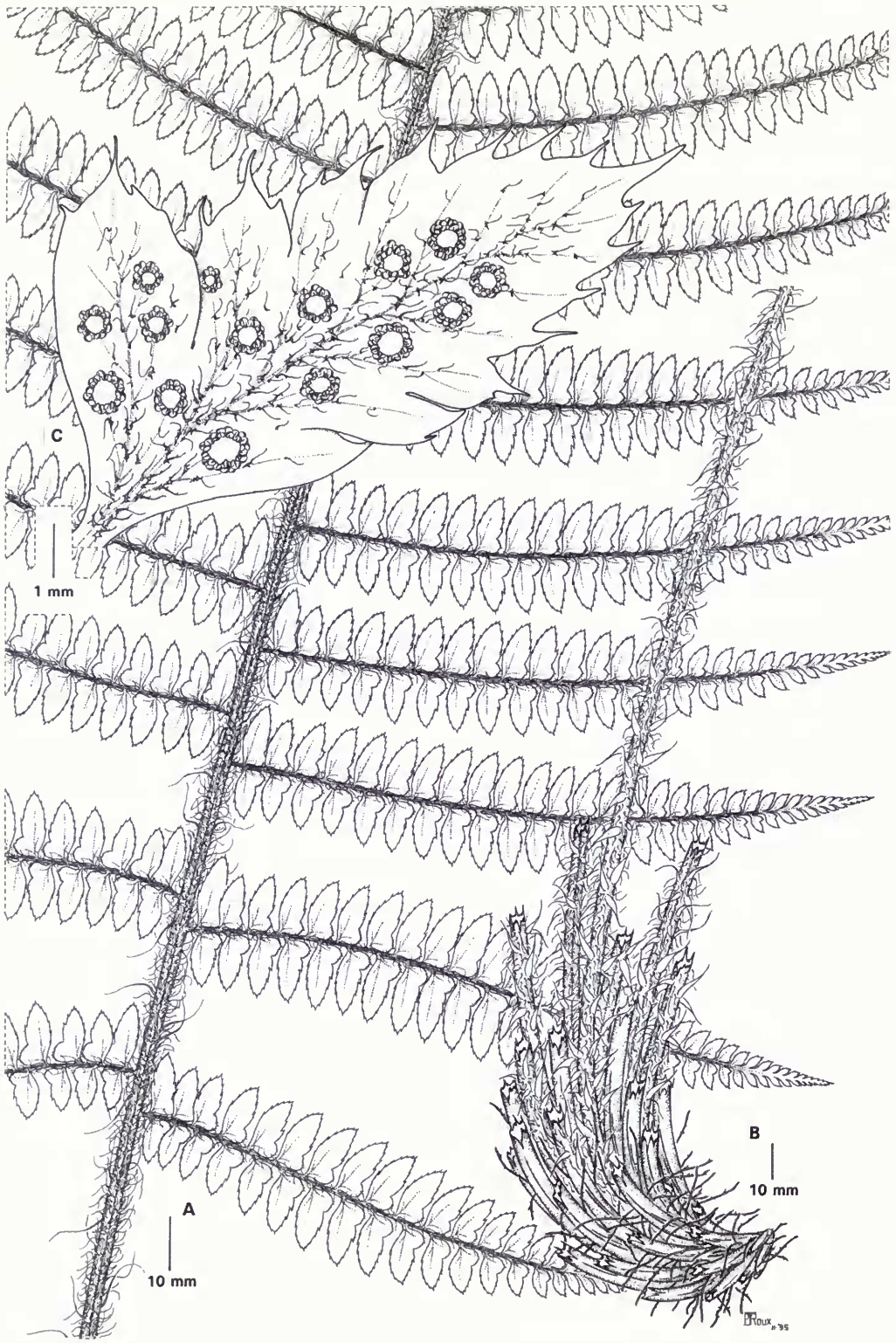

Fig. 8 *Polystichum transvaalense*. A, proximal part of lamina; B, rhizome; C, abaxial surface of fertile pinnule. All drawn from *Roux* 2414 (NBG).

serrate to lobate-serrate, often short-aristate, the proximal pinnules often pinnatifid; adaxially subglabrous or with a few twisted, filiform paleae proximally on costa, the apex terminating in an acicular cell, to 2 mm long; abaxially moderately paleated; paleae short-stalked, twisted, narrowly linear to narrowly triangular, the margins proximally long-lacerate or fimbriate, the apex terminating in an acicular cell, to 2.5 mm long. *Venation* immersed. *Sori* circular, *c.* 1 mm in diameter, terminal or near terminal on abbreviated vein branches, discrete at maturity: *sporangium* with 10–(14)–22 indurated annulus cells; stalk eglandular: *indusium* stramineous, peltate, circular, simple or often with a few long central processes, repand to erose, persistent, the maximum radius 0.48–(0.76)–0.97 mm. *Spores* 64 per sporangium, brown, the perispore folded to form tubercles and inflated or compressed reticulate ridges, echinulate, closely perforated, the pores to 1.5 μm in diameter, the exospore 30–(38.54)–48 × 22–(28.86)–38 μm. *Chromosome number* 2n=164.

MATERIAL EXAMINED

BIOKO: Bioko (Fernando Po), 9000 ft, *Mann* 340 (K); carratera del pico Basilé, km 18–19, nacimento del río Cope, 32NMJ7597, 2470 m, *Carvalho* 3682 (B, BR).

CAMEROON: Pisted'Acha-Abaw au lac Oku, 40 km NE Bamenda, *Letouzey* 13439 (P); montane forest between hut 1 and hut 2, 1950 m, *Breteler* et al. 266 (K, P, WAG); Buea, *Preuss* 719 (B); Mannsquell, *Luckhardt* 636 (B); Mount Cameroon, *Kalbreyer* 133 (B); Uauenzuba, 1900 m, *Schaeter* 90 (B).

DEMOCRATIC REPUBLIC OF CONGO: Mare de Kikeri, Volcan Hekeno, *Jean-Louis* 5191 (BR, P, PRE); entre le Hikeno et le Heisfumangabo, *Jean-Louis* 5002 (BR, P, PRE); Kivu Province, Goma, petite mare de Kikeri, au pied du Mikeno Parc National Albert, 2200 m, *Lebrun* 7225, 7228 (BR, K, P); entre Kibumba et le Ngamuragira, *Lebrun* 7087 (BR, P); Kivu, Parc des Virunga, Karisimbi, vers le SW Zaïre, 3465 m, *Van der Veken* PV 9130 (B); Kivu, Buhavu-Goma, *Gupffert* 169 (BR); 7°48′S, 29°44′E, Marungu route Kieluzi-Mwela km 45 Ravin Lukole, 1890 m, *Bodenghiem & Malaisse* 1459 (BR); Parc National Albert, versant S. du Mikens, 2400–2600 m, *Lebrun* 7307 (BR); Omigi, Mickule, *Bequaert* 6294 (BR); route Goma-Rwindi 30 km, *Breyne* 1785 (BR); Volcan Niamlagyra, *c.* 2000 m, *Germain* 1381 (BR); Kivu, Rumangabo, 1525 m, *Germain* 3025 (BR); Numbi territory, Kalehe, 2300 m, *Leonard* 4554 (BR); Mt. Kiniki territory, 1960 m, *Gutzwiller* 1236 (BR); Mt. Kiniki, Wambalyro, 1960 m, *Gutzwiller* 1106 (BR); Parc National Albert, Kalonge, Butahu, vallée du la Nyamwumba, 2010 m, *Demaret* 5192 (BR).

ERITREA: Eritrea-Assaorta: bosco del Caribozza, *c.* 2700 m, *Pappi* 2812 (BOL, BR).

ETHIOPIA: *c.* 5 km NW of Addis Ababa, *c.* 2500 m, *De Wilde* 5981 (BR, ETH, WAG); Kaffa Province, 35 km W. of Bonga along the road to Shewa Ghimmira, *c.* 1950 m, *Friis* et al. 2171 (ETH, K); near Wush-Wush, *c.* 20 km NW of Bonga, *c.* 1800 m, *De Wilde* 7756 (BR, ETH, WAG); Gara Ades, *Burger* 2580 (K); Mount Wachacha, near Addis Ababa, 2400 m, *Mooney* 7895 (K); Wofasha Forest, Shoa, *Mooney* 7003 (K); Bellete State Forest, ± 40 km SW of Jimma, *c.* 2000 m, *De Wilde* 6999 (BR, WAG); Kaffa Province, village *c.* 2 hours walk NW of Maji, 2200 m, *De Wilde* 6194 (BR, WAG); W. slope of Mount Uociacia, *c.* 15 km W. of Addis Ababa, 2700 m, *De Wilde* 9580 (WAG); Mount Uociacia, *c.* 15 km W. of Addis Ababa, *c.* 2600 m, *De Wilde* 8532 (WAG); Kaffa Province, Limmu, Monti Botor, *c.* 2250 m, *Pichi Sermolli* 7069 (SRGH); 7°17′N, 36°5′E, Kaffa Province, 35 km W. of Bonga along the road to Shewa Ghimmira, 1950 m, *Friis* 2171 (BR).

KENYA: Nyambeni Hills, base of Kirima, 6400 ft, *Polhill & Verdcourt* 295 (BR, K, PRE); Aberdares, Cave Waterfall, *Coe* 794 (PRE); Molo, Maü Escarpment, 2440 m, *Alluaud* 55 (BR, P, PRE); Kiambu District, Katamayu River Forest, 2200–2250 m, *Faden & Evans* 69/236 (BOL); Meru District, Ngambeni Hills, above Kiegoi, 2250 m, *Faden* et al. 69/678 (K); Aberdares, S. Kinangop, 8600 ft, *Molesworth-Allen* 3637 (K); Kericho District, crossing at the Kitinges River, *c.* 8 km ENE of Kericho, 2060 m, *Faden* 72/302 (K); Kericho District, W. Mau Forest, SW of Mt. Blacket, *Faden* et al. 72/356 (K); Samburu District, Nyiro Mountain, 2400 m, *Bono* 23 (K); Taita Hills, Vuria Hill, 1920–2200 m, *Faden* 72/255 (BOL, K); Kinangop, Brown Trout Inn, 9000 ft, *Verdcourt* 880 (K); S. Kinangop, near Brown Trout Inn, *Molesworth-Allen* 3620 (K); Kinangop, above Isanga farm, 8500 ft, *Andrews* 4461 (K); Chyulu Hills, 6800 ft, *Van Someren* 7572 (K); Chyulu Hills, 2250 m, *Bally* 1163 (K); Mount Meru, 5000–6000 ft, *Leighton* s.n. (K); Aberdare Range, base of Mount Kenya, *Dawson* 96a (K); Taita Hills, Vuria Forest, *c.* 7000 ft, *Schippers* K271 (WAG); Thompson Falls, *c.* 7600 ft, *Schippers* K17 (WAG); Kinangop, Brown Trout Inn, *Verdcourt & Moggi* 2486 (B, SRGH); Elgon Forest, *Webster* 9055 (K); prope 'West Kenia Forest Station', 2300 m, *Friis* 594 (B, BR, S); Mount Elgon, 4300 ft, *Barrele* 92 (NU); Aberdare Range, near W. part of the Nyeri track, 3100 m, *Hedberg* 1533 (S); Samburu District, Mt. Nyiru, 8000 ft, *Cameron* 147 (BR).

LESOTHO. 2927 (Maseru): gorge dans la montagne Ma-Khrarane, au dessus de la station missionaire de Morija (DA), *Dieterlen* 1309 (P, PRE).

MALAWI: Nyika, Zovochipolo, 2225 m, *La Croix* 4634 (PRE); Nyika Plateau, Zovochipolo forest patches, 2200 m, *Dowsett-Lemaire* 297 (MAL); Kirk Range, Dzonze Forest, 1750–1800 m, *Dowsett-Lemaire* 1079 (K); Mwanembu Mountain, *McClounie* 6 (K); S. region, Malosa Mountains (N. of Zomba), 1900 m, *Dowsett-Lemaire* 973 (K); Mount Mulanje, Tuchila Plateau, 6000 ft, *Newman & Whitemore* 214 (SRGH).

MOZAMBIQUE: Penhalonga Waterfall, *Chase* 3247 (NU, SRGH); Penhalonga Forest, *Chase* 3219 (SRGH).

RWANDA: Plantation Gasiza au N. de Ruhengeri au pied Ngahinga et du Muhavura, 2350 m, *Van der Veken* PV 10265 (B, BR); Kirunga Vulcan, 2500 m, *Poetsen* 81 (B); Dalinghi, *Zappelli* 262 (BR); Kissenyi, Sake, *Zappelli* 177 (BR); Chaîne des Birunga, pied SE du Gahinga, 2500 m, *Lambinon* 74/1534 (BR).

SOUTH AFRICA. 2329 (Pietersburg): Louis Trichardt, Hanglip Forest Station (BB), *Roux* 2572 (NBG); Louis Trichardt, Zoutpansberg Süds, farm Rustfontein, *c.* 1400 m, *Schlieben* 7342 (BR); Tzaneen, Dap Naude Dam, Woodbush (DD), *Burrows* 3269 (BOL, PRE). **2330 (Tzaneen)**: Duiwelskloof, Westfalia Estate (CA), *Scheepers* 419 (PRE); De Hoek Forest Station (CC), *Roux* 2563 (NBG); Woodbush Forest Reserve, Grootbos, *Roux* 2564, 2570 (NBG); Magoebaskloof near De Hoek Forest Station, *Van Jaarsveld* 6093A (BOL, NBG); Woodbush, *Jenkins* s.n. TM 919c (PRE); Woodbush, *Wager* s.n. CH7464 (PRE); Woodbush, *Reynolds* s.n. CH10246 (PRE); De Hoek, *Schweickerdt* s.n. (NBG, PRE); Pietersburg, Woodbush, *Schelpe* 6050 (BOL). **2430 (Pilgrim's Rest)**: Mariepskop, base of Klaserie Waterfall (DB); *Burrows* 3113 (BOL, PRE); Mount Sheba Nature Reserve (DC), *Roux* 2556 (NBG); Mount Sheba, *Kluge* 2320 (NBG); Mount Sheba Nature Reserve, *Jacobsen* 4420, 4428 (PRE); Ohrigstad Nature Reserve, *Jacobsen* 1413 (PRE); Pilgrims Rest (DD), *Collins* s.n. TM895c (PRE); Graskop, Blyde River Forest Reserve, *Jacobsen* 4363 (PRE). **2530 (Lydenburg)**: Lydenburg, Coromandel farm (AD), *Roux & Burrows* 13 (BOL); Coromandel farm, *Burrows* 1309 (BOL); Sabie, Tweefontein (BB), *Wager* 48 (PRE); Sabie Gorge, *Wager* 25 (PRE); Sudwala Caves, forest 2 km N. of caves, 1500 m (BC), *Kluge* 2465 (PRE); Sudwala Caves, *Burrows* 3193 (BOL); Nelspruit, Witklip Staatsbos (BD), *Kluge* 853 (PRE); Kaapsehoop (DB), *Wager* s.n. TM149c (PRE); Lydenburg, Clivia Pass (DD), *Edwards* 1149 (NU). **2531 (Komatipoort)**: Lomati falls and kloof behind Barberton (CC), *Wager* 151 (PRE); Barberton, *Williams* 104 (P); Baberton, *Thorncroft* 104 (GRA). **2630 (Carolina)**: Marieriestad (CA), *Pott-Leendertz* 4848 (BOL, PRE). **2730 (Vryheid)**: Piet Retief-Wakkerstroom road, 6 km from turnoff to Lüneburg (AD), *Roux* 2269 (NBG); Wakkerstroom, Oshoek, *Devenish* 2 (PRE). **2828 (Bethlehem)**: Royal Natal National Park, Goodoo Forest (DB), *Doidge* s.n. (PRE); Tugela Valley, *Hafström & Acocks* 1970 (PRE); Royal Natal National Park, Devils Hoek, 5000 ft, *Schelpe* 7973 (BOL). **2829 (Harrismith)**: Van Reenens Pass (AD), *Rehmann* 7205 (B, P); Oliviershoek Pass, Begonia Falls (CA), *Roux* 2514 (NBG); Qualeni Valley, 800 ft (CC), *Schelpe* 7270 (NU, PRE). **2929 (Underberg)**: Cathedral Peak Forest Research Station, 6050 ft (AB), *Killick* 1134 (PRE); Lions River, Lions Bush (BD), *Moll* 829 (PRE). **2930 (Pietermaritzburg)**: Lidgetton (AC), *Mogg* CH1764 (PRE); Lions River District, Karkloof, 'Braco', 4300 ft, *Schelpe* 5119 (BOL); Lidgetton, *Roberts* 871 (PRE); Zwaartkop (CB), *Sim* s.n. PRE-9045 (PRE); Zwaartkop, 4500 ft, *Sim* s.n. (NU); Pietermaritzburg, Ferncliff Nature Reserve, *Crouch* 593 (NU). **3029 (Kokstad)**: Kokstad (CB), *McLoughlin* 753 (BOL). **3127 (Lady Frere)**: Cala (DA), *Young* 511 (PRE); Engcobo (DB), *McLoughlin* s.n. CH7677 (PRE). **3128 (Umtata)**: Maclear, farm Woodcliffs (AB), *Roux* 2482 (NBG). **3129 (Port St Johns)**: Port St Johns (DA), *Wager* s.n. CH2905 (PRE). **3226 (Fort Beaufort)**: Katberg Forest Reserve (BC), *Roux* 2700 (NBG); Hogsback Forest Reserve, Fern Walk, 800 m (DB), *Dahltrand* 1853

(PRE); Hogsback, Zingcuka Forest, *Roux* 2414 (NBG). **3227 (Stutterheim)**: Stutterheim, Isidinge Forest (CA), *Roux* 1982 (NBG); Keiskamma Hoek, *Ely* 526 (PRE); Cathcart, Fort Cunnyngham Forest Reserve (CB), *Roux* 2431 (NBG); Pirie, *Sim* s.n. TM514 (PRE); Kingwilliamstown, Pirie Forest along Amatola trail, *Roux* 2708 (NBG). **3325 (Port Elizabeth)**: Johana Kloof (BC), *Breutel* s.n. (L). **3419 (Caledon)**: Riviersonderend, farm 'Oubos' (BB), *Roux* 2585 (NBG).

SUDAN: Gilo, Imatong Mountains, Ngairigi River, 5000 ft, *McLeay* 455 (K).

TANZANIA: Station Kyimbila, Fundort Rungwe, 1300 m, *Stolz* 889 (B, L, P, S, WAG); Kilimanjaro, environs de Kibosho, 2500 m, *Daubenberger* s.n. PRE-6788 (PRE); Kilimanjaro, Kibosho, 2000–4000 m, *Daubenberger* 35 (B, BR, P, PRE, S); Mt. Meru, NE end of the caldeira wall, *c.* 8500 ft, *Greenway & Fitzgerald* 13613 (K, PRE); Kilimanjaro-Süd, *c.* 1900 m, *Schlieben* 4596 (BOL, BR, PRE, SRGH); region de Kilimanjaro, environs de Kibosho, Kilema-Machame, *Daubenberger* s.n. (BR, P); Kilimanjaro, 2800 m, *Alluaud* 310 (P); British East-Africa, forêts de Lamoru, *Le Petit* s.n. (P); forêts de plateau Kikuyu, 2000 m, *Le Petit* s.n. (P); Usambara Mountains, Mahali Mountains, 6000 ft, *Newbould & Jefford* 1731 (K); Morogoro, *Glover* 268 (K); Marangu, SE Kilimanjaro, 4600 ft, *Beesley* 14 (K); Mbeya District, Kikondo camp, Poroto Mountains, 1950 m, *Richards* 13972 (B, BR, K); Moshi District, Kilimanjaro, *c.* 1900 m, *Schlieben* 4596 (K); Arumeru District, banks of Engare Olmotonyi River, *c.* 4 km N. of Olmotonyi Forestry Institute, *Mtui* 143 (K); Mount Meru, Engarenanyuki, 7600 ft, *Vesey-FitzGerald* 3031 (K); Mbeya District, Mount Kikondo, 6500 ft, *M.R.* 13972 (K); Mount Meru, end of Olmotonyi, *Schippers* T778 (WAG); Mount Meru, 2090 m, *Schippers* T729 (WAG); South Pare Mountains, Mugambo Forest Reserve, 1480 m, *Schippers* T951 (WAG); W. Usambara Mountains, on hill above Shume Forest Meteorological Station, 2050 m, *Schippers* T1506 (WAG); Kilimanjaro, oberhalb Marangu, *Volkens* 1266 (B); Kilimanjaro, 1900 m, *Schlieben* 4596 (B); Usambara, Lutindi, *Liebush* s.n. (B); Kondoa-Frangi, Ndiomeberg, 1800 m, *Ledemann* s.n. (S); Kilimanjaro, above Marungu, 2000 m, *Pedersen* 527 (BR); Morogoro Mountains, 2300 m, *Chisongela* 9 (BR).

UGANDA: near Luhiza-Kigezi, 7000 ft, *Rose* 10311 & 10312 (K); forest near Mt. Debasien, 6000 ft, *Eggeling* 2683 (K); Ruwenzori Mountains, 7000 ft, *Hazel* 114 (K); Luhiza-Kigezi, 7000 ft, *Rose* 10299B (K).

ZAMBIA: Nyika Plateau, Chowe Forest, 2100 m, *Dowsett-Lemaire* 220 (K).

ZIMBABWE: near Umtali, *Holland* s.n. (NBG); Vumba Mountains, near Umtali, 6000 ft, *Obermeyer* 2099 (K, PRE); Melsetter, Bridal Veil Falls, *Jacobsen* 3087 (PRE); Melsetter, in gulley border of 'Skyline' & 'Thornton' areas, *Chase* 7482 (BOL, K); Umtali, Banti south, 5800 ft, *Jacobsen* 3864, 3879 (SRGH); Inyanga, above Pungwe rest hut 2, 5300 ft, *Chase* 5655 (BOL, PRE, SRGH); Melsetter, Musapa mountain, *Grosvenor* 264 (BOL, SRGH); Melsetter, Gwendingwe, *Müller* 2880 (SRGH); Umtali District, Cashel, Black Mountain Inn, *Chase* 4021 (NU); Melsetter District, Bridal Veil Falls, *Chase* 4020 (NU); Inyanga, *Patterson* 24 (GRA); Inyanga, Pungwe Rest Huts, 5300 ft, *Schelpe* 5679 (BOL).

WITHOUT EXACT LOCALITY: Natal, *Tyson* s.n. CH2168 (PRE); Natal, *Gerrard* 1931 (P); Zululand, *Gerrard & McKen* s.n. (P); Zimbabwe, *Wild* 1470 (K); loco incerto, *Mann* 2067 – pro parte (K); near Bamenda, 7500 ft, *Migeod* 383 (K); Natal, *sine coll.* s.n. (NBG); Natal, *Buchanan* 27 (B-only) (M); Natal, *Plant* 328 (B); Natal, *Buchanan* 75 (B); loco incerto, *Bergius* s.n. (B); Rebfall bei Gaffat, *Haidner* s.n. (B, S); Kissenye, Ninagongo, 2500–2900 m, *Mildbraed* 1341 (B); loco incerto, *Holst* 3837 (B); loco incerto, *Sim* s.n. CH4171 (PRE); Gold Fields, *Ayres* s.n. (NH); Burungo, *De Witte* 1472 (BR); Natal, *Holub* s.n. (BR); Kikuku, 1750 m, *Ban* 367 (BR); Natal, *Buchanan* s.n. (BOL).

Polystichum transvaalense and *P. wilsonii* are often confused. Pichi Sermolli (1977, 1985) ascribed material of *P. transvaalense* to *P. fuscopaleaceum* Alston var. *fuscopaleaceum,* while Schelpe (1967, 1970, in part) and Jacobsen (1978) ascribed material of this species to *P. setiferum* var. *fuscopaleaceum* (Alston) Schelpe. Jacobsen & Jacobsen (1989), however, considered *P. fuscopaleaceum* and *P. transvaalense* to be conspecific.

Aware that two forms exist, Schelpe (1967) concluded that no clear differentiation at the specific level was possible and considered plants with dark stipe base paleae as *P. setiferum* var. *fuscopaleaceum.* This classification was largely followed by Jacobsen (1978), although he considered the high elevation collections a Drakensberg form. Although he ascribed several collections to this form he refrained from giving it any formal taxonomic status. Pichi Sermolli (1977), however, considered *P. fuscopaleaceum* distinct from *P. setiferum.* He also recognized two 'altitudinal vicariants' with *P. fuscopaleaceum* var. *fuscopaleaceum* occurring at lower elevations than *P. fuscopaleaceum* var. *ruwensoriense*, a subdivision he retained in 1985. I consider the two groups sufficiently distinct to warrant specific status, a conclusion supported by the discovery of a sterile hybrid between these putative parents.

DIAGNOSTIC FEATURES AND RELATIONSHIPS. Diagnostic of *Polystichum transvaalense* is its confinement to moist forests, the presence of up to 17 caespitosely arranged, suberect to arching fronds that may reach a length of up to 1.045 m on a short erect to suberect rhizome, the stipe, rachis and pinna-rachises bearing mostly ferrugineous, twisted and somewhat shrivelled, proximally lacerate paleae terminating in an acicular cell, and the mostly fimbriated but often erose and rarely repand indusium. The perispore is highly porate.

Polystichum transvaalense appears to be most similar morphologically to *P. wilsonii* H. Christ; the two belong to section *Lasiopolystichum.* An analysis of the differences between these species is provided under *P. wilsonii.*

VARIATION. *Polystichum transvaalense* shows considerable variation in the length of the frond, stipe, lamina and basal pinna (Table 2). This may be ascribed to the diverse altitudes, climates and vegetation types it occupies throughout its broad range. The species, however, shows little variation in pinnule outline and palea structure, distribution and density. Stipe-base paleae are mostly ferrugineous, but in rare cases the larger paleae are densely impregnated with secondary compounds giving them a dark brown colour. The indusium also shows significant variation in size, shape and the presence or absence of central processes. Basal pinnae may be deflexed or not. Possible causes of these variations in plants occurring in close proximity under similar growing conditions remain unknown.

Table 2 Variation in frond, stipe lamina and basal pinna length in *Polystichum transvaalense* N.C. Anthony.

	Ramge (mm)	x (±S.D.)	n
Frond	212–1045	713.9 (204.1)	41
Stipe	77–535	283.3 (101.6)	42
Lamina	135–670	422 (116.1)	52
Pinna	25–140	86.3 (27.2)	52

DISTRIBUTION AND ECOLOGY. *Polystichum transvaalense* is widely distributed in temperate and tropical Africa. The distribution largely follows the escarpment and mountain ranges on the eastern parts of the continent. In South Africa it occurs from the Drakensberg foothills in the Eastern Cape along the KwaZulu-Natal Drakensberg escarpment, the Eastern Cape and southern KwaZulu-Natal midlands, the Free State-KwaZulu-Natal and Mpumalanga-Northern Province escarpments to the Soutpansberg in the Northern Province. A single collection is also known from the foothills of the Riviersonderend Mountains in the southern Cape. In Zimbabwe it is found in the Chimanimani and Vumba Mountains extending to the Zomba Plateau, the Kirk Mountains and the Nyika Plateau in Malawi and Zambia. In Tanzania it occupies the Uluguru- and

Usambara Mountains, Mt. Meru and Mt. Kilimanjaro. Further north it occurs in the mountainous areas of Kenya, Uganda, Ethiopia, the Imatong Mountains in Sudan and the Kivu Ridge in the Democratic Republic of Congo. A disjunction in this pattern arise in that *P. transvaalense* is also found on Mt. Cameroon and Bioko in the Gulf of Guinea.

The lithology, climate and vegetation associated with *Polystichum transvaalense* varies considerably throughout its range. In the southern Cape it occupies isolated forest patches in Mesic Mountain Fynbos (Moll et al., 1984) at *c.* 365 m in acidic sandy soils and on rocks of the Table Mountain Sandstone formation. *Polystichum transvaalense* is an exclusively forest growing species, generally growing as individuals on streambanks or on rocks along streams but rarely also as low-level epiphytes. *Polystichum transvaalense* occurs in several forest types as defined by Acocks (1988). In the Eastern Cape it is found in Pondoland Coastal Plateau Sourveld forests and rarely in Typical Coast-belt forests. In the Natal midlands and Drakensberg escarpment where it may appear at elevations up to 1840 m it occurs in 'Ngongoni Veld forests and Highland Sourveld forests. In Mpumalanga these forests are replaced by Northeastern Mountain Sourveld forests that extend to the Soutpansberg. North of the Limpopo the species is found at elevations ranging between 1300 and 2825 m in largely Undifferentiated Afromontane forests, as defined by White (1983), but often also in single-dominant Afromontane forests such as *Juniperus procera* forests at 2400 m in Ethiopia and in Afromontane bamboo at 1828 m on Mt. Malati in Tanzania and at 2745 m at Kinangop in Kenya.

8. **Polystichum wilsonii** H. Christ in *Bot. Gaz.* **51**: 353 (1911). Type: China, Szechuan Province, Mupin, woodlands, 4000–6000 ft, *Wilson* 2614 (BM!-holotype).

Fig. 9.

Polystichum lobatum var. *ruwensoriense* Pirotta in L.A. di Savoia, *Il Ruwensori* **I**: 478 (1909). Type: Ruwenzori, nella foresta scendendo da Kichuchu a Nakitava, *Roccati et Cavalli-Molinelli* s.n. (TO-holotype).

Polystichum aculeatum var. *mildbraedii* Brause in *Bot. Jahrb. Syst.* **53**: 379 (1915). Type: Fernando Po (Bioko), Nordseite des Pics Sta. Isabel oberhalb Basilé, Grasflur-Region des Gipfels mit viel *Ericinella*, zwischen Gras, *c.* 2700 m, *Mildbraed* 7180 (B!-holotype).

Polystichum aculeatum var. *rubescens* Bonap., *Notes Ptérid.* **14**: 214 (1923). Type: Tanzania, Kilimanjaro, zone supér des forêts, 2760 m, *Alluaud* 48 (P!-holotype).

Polystichum aculeatum var. *stenophyllon* Bonap., *Notes Ptérid.* **14**: 215 (1923). Type: Kenya, Mont Kênya, versant ouest, forêt inférieure, 2400 m, *Alluaud* 241 (P!-holotype).

Polystichum fuscopaleaceum Alston in *Bol. Soc. Brot.* sér. 2, **30**: 22 (1956). Type: Cameroon, Victoria District, Cameroon Mountain, SW of hut 2, in gully woodland, 9100 ft, *Keay* FHI 28602 (BM!-holotype).

Polystichum setiferum var. *fuscopaleaceum* (Alston) Schelpe in *Bol. Soc. Brot.* sér. 2, **41**: 216 (1967).

Polystichum fuscopaleaceum var. *ruwensoriense* (Pirotta) Pic.Serm. in Webbia **32**: 90 (1977).

Polystichum alticola Schelpe & N.C. Anthony in *Contr. Bolus Herb.* **10**: 144 (1982). Type: South Africa, Ladismith, Swartberg, Toverkop, 2160 m, *Esterhuysen* 26699 (BOL!-holotype; NBG!, PRE!, isotypes).

Plants terrestrial or epilithic. *Rhizome* short, to 130 mm long, erect to suberect, to 10 mm in diameter, rarely branched, set with roots, crowded, persistent stipe bases, and paleae; paleae broadly attached, castaneous, chartaceous, narrowly linear, the margins with small, widely spaced cellular outgrowths, the apex mostly terminating in an acicular cell, rarely in a small thin-walled cell, to 12 × 1 mm. *Fronds* caespitose, 8–12 per plant, suberect to arching, to 1.05 m long; *stipe* proximally castaneous, stramineous distally, adaxially sulcate, to 450 mm long × 5 mm in diameter, sparsely to densely paleated; larger paleae broadly attached, often slightly bullate, spreading, extending to the rachis, concolorous or bicolorous, chartaceous to crustaceous, broadly ovate-acuminate to ovate-acuminate, cordate to cordate-imbricate, the margins widely to closely fimbriate, fimbriae generally straight, the apex entire, terminating in an acicular cell, to 23 × 9 mm; smaller paleae apically or basally directed, stramineous, chartaceous, narrowly triangular to subulate, short-stalked, often somewhat auricled, the margins proximally with long straight, angular or curved outgrowths, distally with few widely spaced, short or long marginal outgrowths, the apex entire, terminating in an acicular cell, to 13 × 7 mm: *lamina* 2-pinnate, with up to 29 free pinna pairs, herbaceous to firmly herbaceous, pale to dark green adaxially, paler abaxially, narrowly elliptic, to 625 mm long, the proximal pinnae reduced, deflexed: *rachis* stramineous, adaxially sulcate, densely set with paleae similar to but smaller than those on the stipe, paleae restricted to the abaxial surface, to 9 × 3 mm: *pinnae* 1-pinnate, with up to 12 free pinnule pairs, proximally widely spaced, distally closely spaced and somewhat overlapping, folded ventrally along the rachis (conduplicate), narrowly triangular to oblong-attenuate, the proximal pinnae to 88 mm long × 20 mm wide: *pinna-rachis* stramineous, adaxially sulcate, densely paleated; paleae short-stalked, narrowly ovate to narrowly triangular, the margins proximally with long straight or angular outgrowths, apically with few widely spaced short or long outgrowths, the apex entire, terminating in an acicular cell: *pinnules* asymmetric, acroscopically auriculate, narrowly trullate to trullate, to 12 mm long, serrate, long-aristate; adaxially with straight or slightly twisted filiform paleae, simple or proximally with short straight or curved marginal outgrowths, the apex terminating in an acicular cell; abaxially with straight or proximally somewhat twisted, subulate-hastate paleae, the margins with short straight or angular outgrowths at the base, the apex entire, terminating in an acicular cell. *Venation* raised. *Sori* circular, *c.* 1 mm in diameter, terminal or near terminal on abbreviated vein branches: *sporangium* with 11–(15)–24 indurated annulus cells; stalk eglandular: *indusium* stramineous, peltate, circular or reniform, repand to erose, often with small central processes, persistent, the maximum radius 0.51–(0.75)–1.09 mm. *Spores* 64 per sporangium, brown, the perispore smooth or tuberculate, spiculate, closely perforated, the exospore 32–(41.74)–52 × 24–(30.16)–40 µm. *Chromosome number* 2n=164.

MATERIAL EXAMINED

BIOKO: Fernando Po, *Mann* s.n. (K); cratera del pico Basilé, km 23, junto a la cumbre, 3000 m, *Carvalho* 3652 (B, BR).

CAMEROON: Mt. Cameroon, 3700 m, *Breteler* et al. 69 (K, P, WAG); Mt. Cameroon, 1950 m, *Breteler* et al. 75 (K, P, WAG); Bambutos, 2600 m, *Félix* 5430 (P); Mt. Cameroon, 3600 m, *Annet* 126 (P); Cameroon, mont versant, 3000 ft, *Meurillon* 1158 (BR, K, P); piste du village d'Okon au mert Okon, 3008 m (45 km SSO de Nkambé), *Letouzey* 8940 (K, P); Mt. Cameroon, haut plateau, 3600 m, *Annet* 128 (P); Bambutos, station mi-ombrageé, vers 2300 m, *sine coll.* 30 (P); Mt. Cameroon, 7–10000 ft, *Mann* 1376 (K); Cameroon Mountain, above 2nd hut, 12000 ft, *Hutchinson & Metcalfe* 48 (K); Mt. Cameroon, 11000 ft, *Steele* 22, 27 (K); Mt. Cameroon, 11000 ft, *Migeod* 190 (K); Mt. Cameroon, oberhalb Buea, 2800 m, *Mildbraed* 10883 (B, K); Buea, 3000 m, *Preuss* 787 (B), 788 (B, S); Kamerun-Berg, standort über Buea, unteren Fako Plateau, 2800 m, *Mildbraed* 3377 (B); Kamerungebirge, Buea, *Deistel* s.n. (B); Kamerun-pitz, 3500–3600 m, *Bornmüller* 26 (B); Mt. Cameroon, 3800 m, *Hintz* 29 (B); Buea, Wonjombia faco, *Reder* 1026 (B).

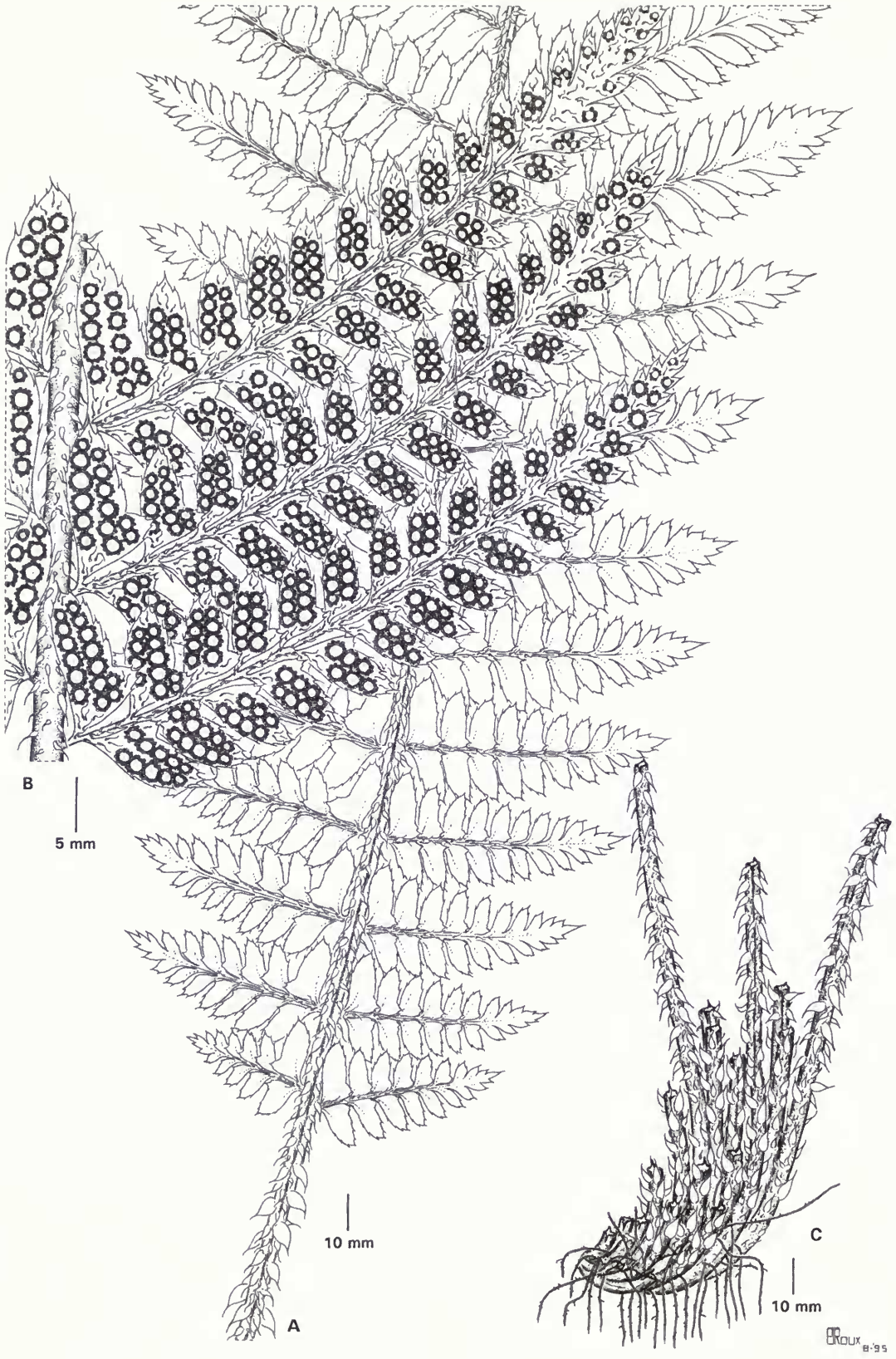

Fig. 9 *Polystichum wilsonii*. A, proximal part of lamina; B, rhizome; C, adaxial surface of pinnule; D, abaxial surface of fertile pinnule. All drawn from *Roux* 2529 (NBG).

DEMOCRATIC REPUBLIC OF CONGO: Kivu District, Virunga west, Nyamuragira, *Stauffler* 178 (BR, PRE); P.N.A. Kabara, flanc N. du volcan Karisimbi, 3000 m, *Jean Louis* 5301 (BR, K, P); Volcan Karisimbi (au NE du lac Kivu), 3500 m, *Humbert* 8563 (BR, P); Kivu, Volcan Mikeno, 2500–3400 m, *Humbert* 8010 (BR, P); Mt. Kinangop, 2800 m, *Alluaud* 262 (P, S); P.N.A. Nyamlagira, 3000 m, *Germain* 3476 (BR); Kivu District, SW side of Mt. Mikeno, 10500 ft, *Chaplin* 373 (BR); 1°29′S, 29°26′E, Goma territory, versant ouest du Karisimbi, 3360 m, *Bamps* 2984, 2995 (BR); Parc National Albert, ruisseau affl. de la Nososa, (a l'est de Mahungu), 3180 m, *Fredericq* 9152 (BR); Viroenga Park, Karisimbi-massif, 3465 m, *Van der Veken* 9130, 9135 (BR); Kivu, upper Ruamoli Valley, 1180 ft, *Ross* 778 (BR); Viroenga Park, Karisimbi-massif, ±3 km van de gîte Rukumi, ±3330 m, *Van der Veken* 9140 (BR); massif du Karisimbi, à 500 m env. du gîte de Rukumi, 3500 m, *Auquier* 2290 (BR); Kivu Province, upper Ruamoli Valley, 12 500 ft, *Ross* 743 (BR); Parc National Albert, selle de Kabora entre le Karisimbi et le Mikeno, 3000–3100 m, *Lebrun* 7344 (BR).

ETHIOPIA: Bale Region, 45 km N. of Goba, Sannetti Plateau, 3900 m, *Tadesse* 5545 (ETH); SE of Dinsho on road from Goba to Shashemene near proposed HQ of Bale National Park, 10400 ft, *Gilbert* 1812 (ETH, K); Bale Province, Bale Mountain National Park, E. of Garba Goracha camp, 4070 m, *Hedberg* 5649 (ETH); pass just N. of the summit of Cara Mulatta Mountain, *c.* 10200 ft, *Burger* 1480 (ETH); Choké Mountain, Gojjam, vicinity of the upper Ghiedeb Valley, *Flenley & Evans* 327 (ETH, K), Begemdir Province Simien, Buahit, 3870 m, *Hedberg & Aweke* 5461 (ETH); Bale Mountains, Finchaya Habera, 3510 m, *Miehe* 266, 335 (ETH); Bale Mountains, above Goba, 3500 m, *Miehe* 3086 (ETH); Bale Mountains, above Rira, 3530 m, *Miehe* 2343 (ETH); Shoa Province, Arussi Mountains, 35 km S. of Mount Chillalo 32 km on track to Ticcio via Robie turnoff, 35 km S. of Asella, 3275 m, *Ash* 2330 (ETH); Bale region, Mendeyou Auraja, *c.* 5–7 km on Fincha Haberra-Soddota track, 3500–3580 m, *Tadesse* 7813 (ETH); Shoa, Lake Wonchi, outer rim of caldeira, *Gilbert & Tewolde* 3279 (ETH, K); Bale region, Mendeyou Awraja Fincha Heberra, 3490–3510 m, *Tadesse* 7713 (ETH); in rupibus umbrosis Demeski, 10500 ft, *Schimper* 244 (P); Matssehe Dedschem, 12000 ft, *Schimper* 1398 (P); Arussi Prov., Chillalo Awraja, Galama Mountains (30 km ESE of Asella) *c.* 3 km E. of Boraluco, 3750 m, *Hedberg* 4233 (K, PIC.SERM.); Bale region, Dello Awraja, *c.* 3.7 km N. of Kecha towards Rira, 2620 m, *Tadesse* 5143 (ETH); Shewa region, Wonchi Mountains, edge of volcanic crater 20 km to SSE of Ambo, *Pavlov & Petelin* 138 (ETH); in regio media montis, *Schimper* 180 (B, K, P, S); Begemder Province, Semian Mountains, *De Wilde* 175 (BR, WAG); Mt. Borullccu, along road to Ticco *c.* 30 km SE of Asella, *c.* 4000 m, *De Wilde* 9039 (WAG); *c.* 25 km SE of Asella, W. slope of Mt. Boruluccu, *c.* 3800 m, *De Wilde* 8089 (WAG); *c.* 3 km E. of Asella, *c.* 175 km SSE of Addis Ababa, W. slope of Mt. Cilalo, *c.* 2700 m, *De Wilde* 6623 (BR, WAG); Shoa Province, Menagesha State Forest on the W. slope of Mt. Wuchacha, 2600 m, *Friis* 1209 (K); *c.* 175 km from Addis Abeba on Dessie road, 10500 ft, *Gilbert* 454 (K); Bale region, 10–15 km SE of Goba on road towards Masslo, 3200–3400 m, *Thulin* 3678 (K); Gara Mullato Mountains, 10800 ft, *Burger* 1907 (K); Scioa, Monte Wochacha, 3250–3300 m, *Pichi Sermolli* 6740 (B, BR, K); Mussolini Pass, between Dera Sina and Debra Berhan, *c.* 3000 m, *De Wilde* 9654 (WAG); Ethiopia, *Schimper* 1398 (B); ad rupes locis humidis umbrosis pr. Demerts, 10500 ft, *Schimper* 244 (B); Arussi, Catena dei Monti Galamo-Sagatu, *c.* 3100 m, *Pichi Sermolli* 6828 (BR).

KENYA: Mt. Kenya, forest end, 9600 ft, *McLoughlin* 676 (BOL, PRE); Mt. Elgon, versant est, *Arambourg* et al. 134, pro parte (P); W. slopes of Mt. Kenya, along the trail from West Kenya Forest Station to summit, *c.* 3630 m, *Mearns* 1421, 1502, (P); W. slopes of Mount Kenya, along trail from West Kenya Forest Station to summit, *c.* 3000 m, *Mearns* 1702 (B, P, S); Mt. Kenya, *c.* 7500 ft, *Schippers* K164 (WAG); Aberdares National Park, *c.* 10500 ft, *Schippers* K110 (WAG); Aberdares National Park, *c.* 10300 ft, *Schippers* K78 (WAG); Shira Plateau, W. Kilimanjaro, 3200 m, *Schippers* T1052 (WAG); Mt. Meru, *c.* 2000 m, *Schippers* T777 (WAG); Mt. Kenya, Kinangop, Aberdare, 8800–8900 ft, *Chandler* 2266 (K); Aberdare Mountains, *James* s.n. (K); Aberdare Mountains, *Ramsden* s.n. (K); Aberdare range, near W. part of the Nyeri track, 3100 m, *Hedberg* 1533 (K); near Molo, Mau Forest, 8000 ft, *Gardner* 975 (K); Narok District, 20 miles from Olokurto on road to Elburgon, *c.* 9600 ft, *Glover* et al. 1096 (K); SE Aberdares, Kitikuya, 8500 ft, *Gardner* s.n. (K); Rift Valley, Nakuru District, E. Mau Forest Reserve, 2750 m, *Geesteranus* 5908 (BR, K, L, PRE, S); Mt. Elgon, E. slope above Tweedie's saw-mill, 2550 m, *Hedberg* 68 (K, S); North Forest, 9200 ft, *Schippers* K364 (WAG); Mt. Aberdare, *c.* 3200 m, *Fries* 2644 (B); Mt. Elgon, 2700 m, *Gravik* s.n. (S); Mt. Elgon, 3800 m, *Gravik* s.n. (S); Mt. Kenya, Sagana Valley, 10500 ft, *Schelpe* 2713 (BR); Mt. Aberdare, pr. 'West Kenya Forest Station', 2350 m, *Fries* 775 (BR); Mt. Kenya, 10000 ft, *Meyerscough* K2, K3, K16, K18, K22, K26, K30, K31 (BOL).

LESOTHO. 2828 (Bethlehem): Butha Buthe District, Khatibe B camp, 9500 ft (DC), *Troughton* B26 (GRA); Leribe, *Dieterlen* 167 (BOL, P, pro parte); 1 km from Moteng store, *Roux* 1294 (NBG). **2927 (Maseru)**: between Blue Mountain Pass and Likholaneng, 8700 ft (BD), *Schmitz* 7266 (PRE); Morija, *Dieterlen* 1309 B-only (PRE). **2928 (Marakabei)**: Mamalapi, 8000 ft (AC), *Jacot-Guillarmod* 690 (PRE); Mamalapi, 9000 ft, *Compton* 21331, 21334, 21339 (NBG); hill at Bushmen Pass, beyond little Bokong, 9000 ft, *Bevis* 102 (PRE); Blue Mountain Pass, *Roux* 2227 (NBG); mountain road, 60 miles from Maseru, 8000 ft, *Bowmaker* 23 (BOL); mountain road, 38 miles from Maseru, 7500 ft, *Bowmaker* 25 (BOL); Lehaha-la-Sekhomgana, 9100 ft (AD), *Jacot-Guillarmod* 206 (PRE); Semonkong, waterfall gorge, *c.* 7000 ft (CC), *Davidson* 3023 (PRE); Semonkong, at Le Bihan Waterfall, *Roux* 1493 (NBG). **2929 (Underberg)**: Between Mokhotlong and Sani top, ± 15 km from Mokhotlong, 2200 m (AC), *Matthews* 887 (NBG, PRE); ± 15 km past Thaba-Tseka turnoff on Sani road, *Roux* 1344 (NBG); Sehlabathebe National Park (CC), *Schmitz* 7122 (PRE); Sehlabathebe National Park, *Matthews* 987 (NBG); Sehlabathebe area, on way to Devils Knuckles, 9500 ft, *Davis* 181 (NU); Sehlabathebe area, Devils Knuckles, *c.* 9000 ft, *Davis* 176 (NU); Sehlabathebe National Park, 2250 m, *Hoener* 1658 (BOL).

SOUTH AFRICA. 2730 (Vryheid): Wakkerstroom, Oshoek, 6400 ft, (AD), *Devenish* 195, 638 (PRE). **2731 (Louwsburg)**: Nongoma, *c.* 1000 ft (DC), *Tosh* s.n. (NU). **2828 (Bethlehem)**: Clarence (CB), *Van Hoepen* s.n. TM18230 (PRE); gully between the Witches and the Sentinel (DB), *Roux* 1906, 2529 (NBG); versant N. du Mont-aux-Sources, région de Witzies Hoek, *c.* 1800 m, *Junod* 14 (P); Royal Natal National Park (DB), *Hafström & Acocks* 1699 (PRE); Royal Natal National Park, Gudu Forest, *Roux* 2510a, 2511 (NBG); Mont-aux-Sources, 8000 ft (DD), *Dyke* 5489a (NBG); Royal Natal National Park, Plowmans Kop, *Aerck* 1966 (S); Mont-aux-Sources, 10000 ft, *Sim* s.n. TM521c (PRE); Mont-aux-Sources, *Mogg* 4222 (PRE); Mont-aux-Sources, 3100 ft, *Marloth* 2862 (BOL). **2829 (Harrismith)**: Harrismith, Platberg, Zig-Zag Pass, 1800 m (AC), *Jacobsz* 4715 (PRE); Harrismith, Platberg, Donkie Pass, 1850 m, *Jacobsz* 4729, 4730 (PRE); Platberg, 6800 ft, *Roux* 782 (NBG); Harrismith, Platberg, *Roux* 2521, 2524, 2526 (NBG); Harrismith, farm Bosch Hoek (AD), *Roux* 892 (NBG); Harrismith District, farm Klavervlei (CA), *Roux* 876 (NBG); Oliviershoek Pass, S. of Seheletwane, *Roux* 2516, 2517 (NBG); MnWeni Pass, 8000–9000 ft (CB), *Esterhuysen* 27838 (BOL); MnWeni area, Pinnacles Gully, 9000 ft, *Esterhuysen* 29595 (BOL); MnWeni area, Mbunduni scree, *c.* 6000 ft, *Esterhuysen* 27816 (BOL); Drakensberg, Injasuti area, 6500–8500 ft (CC), *Esterhuysen* 26045 (BOL, K, NBG, PRE); along Cathedral Peak path, 1550 ft, *Goetghebeur* 4571 (BR, PRE); Cathedral Peak, *Ruch* 2030, 2300 (PRE); Cathedral Peak area, 5000 ft, *Harding* 38 (NU); Cathedral Peak Forest, *Killick* 981 (NU). **2929 (Underberg)**: Cathedral Peak Forest Research Station, 6100 ft (AB), *Killick* 981 (PRE); summit of Cathedral Peak, 7700 ft, *Schelpe* p.30 (NU); Cathedral Peak area, Cleft Peak path, 8000 ft, *Schelpe* 557 (NU); upper Tsanatalana Valley, near Cleft Peak, 9800 ft, *Schelpe* 7227 (BOL); Champagne Castle, *Bayer* 1443 (PRE), 1445 (NU, PRE); Giants Castle (AD), *Symons* 134 (PRE); Mpendhle Distr., Mulangane Ridge, above Carter's Nek, 7000–7300 ft (BC), *Hilliard & Burtt* 16951 (BOL, NU), 16969 (BOL, NU, PRE); Mpendhle District, Highmoor Forest Reserve, ridge SE of Giants Castle, headwaters of Elandshoek River, *c.* 8100 ft, *Hilliard & Burtt* 16192 (BOL, NU); near Rosetta, 5000 ft (BD), *Thode* s.n. (NBG); Drakensberg Garden State Forest Reserve, 9500 ft (CA), *Van Jaarsveld* 6531 (NBG); Garden Castle Forest Reserve, Mlambonya Valley, 6200 ft, *Hilliard & Burtt* 14972 (BOL, NU); upper tributaries S. of Mkomazi River (CB), *Hilliard & Burtt* 15853 (NU, PRE); Bamboo Mountain, *McClean* 684 (PRE); Sani Pass, wet slope below waterfall, 6900 ft, *Hilliard & Burtt* 17976 (NU, PRE), 17983 (BOL, NU, PRE); Sani escarpment, *c.* 9000 ft, *Marker* s.n. (GRA); Underberg District, 5–7 miles NNW of Castle View farm, headwaters of Mlahlangubo River, 8500 ft, *Hilliard & Burtt* 15331 (BOL, K, NU); headwaters of Mlahlangubo River, *c.* 7800 ft, *Hilliard & Burtt* 13714 (NU); Underberg District, Gxalingenwa Valley between Sani Pass and Polela Valley, 7400 ft, *Hilliard & Burtt* 17199 (BOL, NU); Ndumeni area (CC), *Everson* s.n. (BOL);

Bulwer (DD), *Allsopp* 850, A-only (NU); Bulwer, *Henkel* s.n., A-only (NU); Xumeni Forest, *Rycroft* 519 (NU). **2930 (Pietermaritzburg)**: Nottingham Road District, 'Drayton', 5400 ft (AC), *Smith* 147 (NU); York, 'Benuie', *c.* 4000 ft (AD), *Fisher* 1040 (NU); Impendhle, Boston, 4500 ft (CA), *Beattie* 77 (NU); Pietermaritzburg, Zwaartkop (CB), *Sim* s.n. (NU, PRE). **3027 (Lady Grey)**: Lady Grey, mountain left of summit of Jouberts Pass on road to Barkley East (CA), *Roux* 1136 (NBG); Wittebergen, Ben McDhui, 9550 ft (DB), *Galpin* 6934 (BOL, GRA, PRE), 6935, 6939 (BOL, PRE); road between Naude's Nek and Ben McDhui, *Roux* 1180 (NBG); Barkley East District, Ben McDhui, Bell River Gorge, *c.* 8000 ft, *Hilliard & Burtt* 16526 (BOL, K, NU); zwischen Passtrasse Maclear und Naude's Nek, *Werdermann & Oberdieck* 1118 (B); Barkley East District, Ben McDhui, 9550 ft, *Galpin* 6939 (B); Ben McDhui, *c.* 9000 ft, *Hilliard & Burtt* 16406 (BOL, NU); Ben McDhui, 8900 ft, *Hilliard & Burtt* 16495 (NU). **3028 (Matatiele)**: near summit of Ongeluks Nek Pass (AD), *Roux* 1383 (NBG); Rhodes, Naude's Nek Pass (CA), *Roux* 2475, 2477 (NBG). **3029 (Kokstad)**: upper slopes of Inungi Range, Matatiele, *c.* 5500 ft (CA), *Acocks* 12207 (PRE); Kokstad (CB), *McLoughlin* S38 (PRE); Mt Currie Nature Reserve, Kokstad, *Crouch* 511 (NU); Kokstad, *McLoughlin* 746, 753 (BOL). **3030 (Port Shepstone)**: Oribi Gorge (CB), *Slinger* 59 (NU). **3127(Lady Frere)**: Barkley Pass between Elliot and Barkly East (BB), *Roux* 2469 (NBG); Bastervoetpad, between Ugie and Barkley Pass, *Roux* 2471, 2474 (NBG). **3128 (Umtata)**: summit of Biziya Mountain, 1250 m (AD), *Stever* 898 (PRE). **3225 (Somerset East)**: near Somerset East (DA), *MacOwen* s.n. (P). **3226 (Fort Beaufort)**: Upper Zwart Kei, Mount Hope farm, 5300 ft (BC), *Galpin* 5621 (GRA, PRE); Katberg Pass summit, farm Pleasant View, *Roux* 2698 (NBG). **3319 (Worcester)**: Hex River mountains, shale band between Buffels Dome and Milner Peak, 5000 ft (AD), *Esterhuysen* 28708 (BOL, NU, PRE); Roodeberg (Matroosberg group), 6000 ft (BC), *Esterhuysen* 27695a (BOL); Worcester Division, shale band below Milner Peak, 5000 ft (CB), *Esterhuysen* 14885 (PRE); Hex River Mountains, Moraine kloof, 4000 ft (DD), *Esterhuysen* 28075 (BOL). **3321 (Ladismith)**: Swartberg near Ladismith, Toverkop (AD), *Esterhuysen* 28241 (BOL).

TANZANIA: Mt Meru, Arumeru District, *Gereau* 1623 (PRE); Kilimandjaro-Süd, Korongo, *c.* 3000 m, *Schlieben* 4869 (B, K, PRE, SRGH); Kilimanjaro, tra la Peters Hut a la Bismarks Hut, *c.* 2900 m, *Pichi Sermolli* 5136 (BR, K, P); Ob. Urwald über Kibosho, *c.* 2800 m, *Uhlig* 185 (B, K); Mt. Meru, W. slopes above Olkakola Estate, 3300 m, *Hedberg* 2306 (K, S); Kilimanjaro, above Marungu, *c.* 2 km from Peter's Hut, 3700 m, *Hedberg* 1288 (BR, K, S); Mbeya, Kilando, 8000 ft, Herb. I.R.L.C.S. 6700 (K); Kilimanjaro, Petershutte, 4100 m, *Peter* 1212 (B); Kilimanjaro, 2000–3000 m, *Meyre* s.n. (B); Kilimanjaro, *Volkens* 1155 (B); Usambara, *Holst* 3824 (B); Kissenye, Ninagongo, 3000 m, *Mildbraed* 1372 (B); NO Kivu, W. Kalago, *c.* 2300 m, *Mildbraed* 1651 (B); Arusha National Park, crater of Mt. Meru, below Njeku Hut, 2560 m, *Pócs & Kornas* 6521/A (BR).

UGANDA: Mt. Elgon, 9000 ft, *Dümmer* 3560 (BOL, K, NBG); Ruwenzori Mountains, Nyamagasani Valley, 12500 ft, *Loveridge* 197 (K, SRGH); Ruwenzori, Lanuri *c.* 3500 m, *Bequaert* 4544 (P); Ruwenzori, le vallée du Mobuku, Val de Kabuamba, 3500 m, *Alluaud* 274 (P); Ruwenzori, vall. du Mobuku, abri sous roche de Buamba, 3500 m, *Alluaud* 275, (K, P); Ruwenzori (Est), vallée du Mobuku, rocher de Kichuchu, 3000–3200 m, *Alluaud* 310 (P); Ruwenzori (Est), vallée du Mobuku, abri sous roche de Buamba, 3500 m, *Alluaud* 276 (P); Toro District, Ruwenzori, Bigo, 3350 m, *Osmaston* 3921 (K); Ruwenzori, Nyamudamba, *c.* 10000 ft, *Scott Elliot* 8094 (K); NE Elgon, *Tweedie* 2745 (K); Ruwenzori, Mijusi Valley, 3500 m, *Hedberg* 613 (K, S); Mt. Elgon, *c.* 11 000 ft, *Allen* 3676 (K); on Elgon at Benet, 9100 ft, *Eggeling* 2454 (K); Mt. Elgon, *Rose* 10267 (K); Western Province, Bigo, R. Bujuku Valley, 3550 m, *Osmaston* 1738 (BR); Ruwenzori, *c.* 3500 m, *Bequaert* 4544 (BR).

ZIMBABWE: Inyanga District, 6500 ft, *Chase 5100* (NU); Inyanga, 7000 ft, *Patterson 29* (GRA); Vumba Mountains, Umtali District, Eagle School road, *Jackson* 29 (GRA).

WITHOUT EXACT LOCALITY: Natalia, *Buchanan* 83 (B); loco incerto, ex Herbario Natalensi, *sine coll.* s.n. (S); loco incerto, *Buchanan* s.n. TM522c (PRE); Natal, *Medley-Wood* s.n. TM520c (PRE); loco incerto, *Dinter* 575, A-only (B); Muhonora, 3500 m, *De Witte* 1962 (BR); Karisimbi (versant sud) nr. Biuri, *c.* 3000 m, *De Witte* 1246 (BR); South Africa, ?Rivier, *Lincke* 57 (BR); Basutuland, *Koopoeitz* s.n. (GRA); loco incerto, *sine coll.* s.n. NH-9784 (NH).

Sledge (1973) cited *Polystichum fuscopaleaceum* as synonymous with *P. setiferum* var. *nigropaleaceum* (H. Christ) Sledge [= *P. nigropaleaceum* (H. Christ) Diels]. Christ (1893) described this variety from a single specimen collected by H.F. Blanford at 4000 ft in the Jumna valley between Mussoorie and Lokwah, western Himalayas. Sledge did not examine the type of this variety as he was unable to locate it. Fraser-Jenkins (Fraser-Jenkins & Khullar, 1985) reported he had studied the type in the Manchester Herbarium (MANCH). A Blanford specimen from the same locality has since been located in the Paris Herbarium (P!) and may serve as an isotype. This plant shows no clear affinity with either *P. fuscopaleaceum* or *P. setiferum,* but rather to the *P. luctuosum* group (section *Xiphopolystichum*) as was suggested by Christ. Fraser-Jenkins & Khullar (1985) consider it synonymous with *P. discretum* (D. Don) J. Sm.

DIAGNOSTIC FEATURES AND RELATIONSHIPS. *Polystichum wilsonii* and *P. transvaalense* occur sympatrically and often grow side by side. This has led to a great deal of confusion in separating the two taxa from one another. Pichi Sermolli (1977) referred to them as altitudinal vicariants, with *P. wilsonii* (as *P. fuscopaleaceum* var. *ruwensoriense*) occurring at higher elevations, having narrower blades, and a denser covering of wider, approximately rounded, acuminate paleae with those on the stipe being pale. In 1985 Pichi Sermolli added further observations as to how the two taxa differ. In var. *ruwensoriense* (= *P. wilsonii*) he found the apical part of the pinnae to be acute, moderately incised and usually provided with sori, whereas in var. *fuscopaleaceum* (= *P. transvaalense*) it is acuminate, deeply incised and devoid of sori.

Jacobsen (1978), who refers to *P. wilsonii* as the 'Drakensberg Form' of *P. setiferum* var. *fuscopaleaceum*, provides some characteristics of the species and ascribes several collections in the National Herbarium, Pretoria (PRE) to it. Many of these collections, however, belong to other species.

Polystichum wilsonii is separated from *P. transvaalense* by the slightly shorter and narrower fronds, shorter stipe, a more pronounced reduction and deflexing of the basal pinnae, and in the paleae. Larger paleae in *P. wilsonii* extend from the stipe to the rachis, are generally complanate at maturity and somewhat polished. The smaller paleae are more rigid with shorter and less divided marginal outgrowths. In *P. transvaalense* the larger paleae are mostly restricted to the stipe and proximal part of the rachis and become somewhat shrivelled at maturity. The marginal outgrowths on the proximal part of the smaller stipe paleae are also longer, more divided, and more twisted. *Polystichum wilsonii,* although often present in forests at lower elevations with *P. transvaalense,* is predominantly a high altitude species occurring in exposed conditions. A natural hybrid between the putative species was described as *P.* × *saltum* (Roux, 1997*a*).

Polystichum wilsonii forms part of the section *Lasiopolystichum* Daigobo assemblage of species. More recently (Kung & Zhang, 1998) *P. wilsonii* has been placed as a synonym of *P. sinense* H. Christ. I choose to maintain the two as distinct species pending critical study.

VARIATION. Morphological variation in *Polystichum wilsonii* is mostly restricted to the larger paleae present on the stipe and abaxially on the rachis. Variation is most apparent in the size, density and colour of the paleae. Larger paleae are broad in plants growing in more exposed habitats; they are more densely set. In plants from deeply shaded forest habitats, however, the larger paleae cannot be readily separated from the smaller paleae, especially on the rachis. Palea size and density thus appear to be environmentally influenced. No correlation could be drawn between habitat and

palea colour, consistent with Schelpe's (1967) remark that forms with dark paleae intergrade with forms with pale stipe paleae. The large paleae are generally stramineous and concolorous. In some plants, however, the larger stipe paleae are bicolorous with the proximal central part of the paleae being densely impregnated with phenolic substances and castaneous. In some plants these bicolorous paleae are restricted to the proximal part of the stipe, whereas in others they may extend to the basal pinnae. More rarely the larger paleae on the rachis are nitid, densely impregnated throughout, almost black, and extend to the lower half of the rachis.

Schelpe & Anthony (1986), in their key to the South African *Polystichum* species, used the direction and length of the pinnule aristae to distinguish between taxa. In some plants the basal basiscopic aristae of each pinnule may fold over the adaxial surface of the pinnule lamina, but in others they may not. Arista length also varies considerably. In some plants it may be relatively short but in others unusually long. In some plants the basal basiscopic aristae curve away from the pinnule lamina. Indusium size shows some variation with the margins ranging from repand to erose.

DISTRIBUTION AND ECOLOGY. *Polystichum wilsonii* has a wide distribution ranging from Africa to the Uttar Pradesh mountains in northern India, and to Bhutan, China (Szechuan) and Taiwan (Ilan, Taichung, Hsinchu). In the study area *P. wilsonii* has a disjunct distribution. In South Africa it occurs on the southern Cape mountains, along the KwaZulu-Natal Drakensberg and into Lesotho, extending along the Free State-KwaZulu-Natal escarpment as far north as the Vryheid District. To the north it occurs in the mountainous areas of Zimbabwe, Tanzania, Kenya, Uganda, Ethiopia and the Kivu Ridge in the Democratic Republic of Congo. The species is also known from Mt. Cameroon and the island of Bioko, 32 km from the mainland in the Gulf of Guinea. It has furthermore been recorded from Grande Comore *c.* 300 km from the mainland in the Mozambique channel. Although the higher ground of the Zambezian Region, which includes Zimbabwe and Malawi, supports Afromontane plant communities (White, 1983), it is rare in this region with only one collection known from Zimbabwe.

The lithology, climate and vegetation associated with *Polystichum wilsonii* vary considerably through its range. In the southern Cape *P. wilsonii* occurs at 1500–2000 m in acidic sandy soils derived from sediments of the Cape Supergroup. These soils support the unique Mesic Mountain Fynbos (Moll et al., 1984). This area is the only part of the distribution range of the species that experiences winter rainfall (April–September).

In the Drakensberg *Polystichum wilsonii* is associated with the Clarens Sandstone formation, the Drakensberg Basalt Formation and the intrusive Karoo dolerites. At lower elevations in the Drakensberg (1250–1800 m) the species commonly occurs along streambanks or on rocks in Undifferentiated Afromontane forests and scrub forests confined to sheltered ravines and mountain slopes. These forests are largely associated with the Clarens Sandstone Formation. At higher elevations (>1600–1800 m) the Drakensberg Basalt formation and the intrusive Karoo dolerites are prevalent. These formations support the *Themeda-Festuca* Alpine veld (Acocks, 1988). Here *P. wilsonii* occurs among boulders along streams, in dry exposed rock crevices or in wet and shaded rock overhangs.

The Ethiopian and Kenyan highlands, Mt. Elgon, Mt. Meru, Mt. Kilimanjaro, Mt. Cameroon, Bioko and the Comoro Islands are all of volcanic origin or consist in part of volcanic deposits. Many of the isolated mountains are still volcanically active today. Also the Kivu Ridge, which is largely composed of Precambrian rocks, has local exposures of volcanic deposits. On all these mountains the vegetation diminishes in structure from the lower slopes to the summit. Local features such as aspect, exposure incidence of frost, depth of soil and overall patterns of climate contribute to modify the vegetation (White, 1983). At these elevations the plants become smaller and the apical pinnae more pronouncedly conduplicate along the rachis.

In tropical Africa *Polystichum wilsonii* occurs in a wide range of vegetation types. At lower elevations on Mt. Elgon (2550 m) and the Ethiopian highlands (2700 m) it occurs in Undifferentiated Afromontane forests. On the Ethiopian highlands the species also occurs in single-dominant Afromontane forests such as *Juniperus procera* forests on Mt. Wuchada (2600 m) and *Hagenia abyssinica* forests in the Bale Mountains. On Mt. Kenya it has been recorded from the Afromontane bamboo zone. On Mt. Kenya (3200 m), Mt. Meru (3300 m), Mt. Elgon (3500 m) and the Bale Mountains (3500 m) it occurs in Afromontane bushland and thicket. Again on the Bale Mountains (3500 m) and on the rim of the caldeira round Lake Wanchi (3650 m) it occurs in Afromontane and Afroalpine shrubland. With an increase in elevation the latter vegetation type is replaced by Afromontane and Afroalpine grassland. *Polystichum wilsonii* has been recorded from this vegetation type on Mt. Kilimanjaro (3000 m) and the Ethiopian highlands (3900 m). On Mt. Cameroon *P. wilsonii* has been recorded from 1950 m to 3800 m and on the island of Grande Comore from 1000 m to 1400 m. In both cases the plants were associated with lava flows.

Growth in *Polystichum wilsonii* shows a degree of seasonality. In the Drakensberg several new fronds are produced almost simultaneously at the onset of the rainy season in November. This pattern is retained in cultivated plants. Several Afroalpine vegetation types are subject to periodic burning. Fires, however, appear to have little or no damaging effect on the rhizomes.

9. **Polystichum × saltum** J.P. Roux in *Bot. J. Linn. Soc.* **124**: 376, fig. 1 (1997). Type: South Africa, KwaZulu-Natal. 2828 (Bethlehem): Royal Natal National Park, Gudu Forest, near Gudu Waterfall, *c.* 1800 m (DB), *Roux* 2510b (NBG!-holotype).

Plants terrestrial or epilithic. *Rhizome* erect to suberect, to 20 mm in diameter, densely set with roots, closely set persistent stipe bases, and brown to ferrugineous paleae. *Fronds* caespitose, to 19 per plant, erect to arching, to 400 mm long: *stipe* proximally stramineous, greenish distally, shallowly sulcate adaxially, to 110 mm long, to 4 mm in diameter, densely paleated, the paleae of two types; larger paleae broadly attached, brown to ferrugineous, chartaceous, lanceolate to narrowly lanceolate, cordate, often slightly auriculate, the margins closely to widely set with short and long, straight or curved, often forked projections, the apex always terminating in a long acicular cell, to 11 × 3.5 mm; smaller paleae brown to ferrugineous, chartaceous, short- or long-stalked, narrowly triangular, cordate to cordate-imbricate, the proximal margins closely set with short and long, straight or angular, simple or branched projections, the number and size of the projections reduced distally, the apex usually simple, terminating in a long acicular cell, to 6 × 1 mm: *lamina* 2-pinnate, narrowly ovate, to 300 mm long, with up to 17 free pinna pairs: *rachis* greenish throughout, adaxially shallowly sulcate, densely paleated, the proximal paleae of two types; larger paleae similar to those on the stipe and reduced in size towards the middle of the lamina; smaller paleae short- or long-stalked, ferrugineous, chartaceous, narrowly lanceolate to narrowly triangular, slightly cordate to cordate-imbricate, often slightly auriculate, the margins proximally with short and long, straight or curved, often branched projections that are reduced in size and frequency distally, the apex usually simple, terminating in a long acicular cell, to 6 × 1 mm: *pinnae* 1-pinnate, long-stalked, proximally widely spaced, slightly

reduced, deflexed, with up to 10 free pinnule pairs, slightly overlapping distally, narrowly ovate to oblong-attenuate, to 75 × 24 mm: *pinna-rachis* greenish, adaxially shallowly sulcate, sparsely paleated; paleae ferrugineous, chartaceous, long-stalked, narrowly triangular to narrowly oblong, cordate to cordate-imbricate, the margins proximally with long, straight or twisted, simple or forked projections reduced in size and frequency distally, the apex usually simple, terminating in a long acicular cell, to 3.5 × 0.5 mm: *pinnules* opposite to alternate, firmly herbaceous, pale- to olive-green adaxially, slightly paler abaxially, the proximal acroscopic pinnule usually slightly longer than the next, asymmetric, ovate to ovate-rhomboid, basiscopically narrowly cuneate, acroscopically broadly cuneate and auriculate, the auricle often incised midway to costa, serrate to doubly serrate, long-aristate, to 18 mm long; adaxially sparsely set with a few twisted paleae chiefly along proximal part of costa, stramineous, chartaceous, filiform or with a few short marginal projections near the base, the apex always terminating in a long acicular cell, to 2 mm long; abaxially sparsely paleated, stramineous, chartaceous, long-stalked, narrowly deltate to filiform, the margins proximally with long, curved or angular, simple or branched projections, the apex simple, always terminating in a long acicular cell, to 3 mm long. *Venation* raised abaxially. *Sori* circular, *c.* 1.2 mm in diameter, terminal or near terminal on abbreviated vein branches, essentially uniseriate, discrete: *sporangium* with 13–(14)–17 indurated annulus cells; stalk eglandular: *indusium* brown, chartaceous, persistent, peltate, circular, frequently with long central processes, fimbriate, the maximum radius 0.8–(0.9)–1.02 mm. *Spores* aborted, the perispore closely perforated. *Chromosome number* 2n=164, meiosis yielding univalents and bivalents (Roux, 1997*a*).

DIAGNOSTIC FEATURES. *Polystichum* × *saltum* closely resembles *P. wilsonii* in size, frond and pinnule morphology, and to a certain degree in the characteristics of the paleae. The erose to fimbriate indusium, however, is more characteristic of *P. transvaalense*. The mean guard cell length, the adaxial epidermal cell length, and the mean maximum radius of the indusium are anomalous – being larger than that of either progenitor (Roux, 1997*a*). Perhaps the most distinctive diagnostic feature of the taxon is the varying number of aborted spores borne in the sporangia.

DISTRIBUTION AND ECOLOGY. *Polystichum* × *saltum* is currently known from only one forest in the foothills of the KwaZulu-Natal Drakensberg. This forest fragment forms part of the Highland Sourveld vegetation type (Acocks, 1988) and is nestled in a sheltered ravine on a steep mountain slope. Forests of this type, situated at 1500 to 1700 m, are mostly cool and moist throughout the year, even though most of the rainfall occurs during the summer (November-March). Like its putative parents, *P.* × *saltum* also occurs on moist moss-covered boulders along streams or on the forest floor in permanently moist conditions. *Polystichum wilsonii*, a taxon mostly associated with higher elevations where it occurs in more exposed habitats, frequently grows sympatrically with *P. transvaalense* in forests along the Drakensberg.

10. **Polystichum marionense** Alston & Schelpe in *J. S. African Bot.* **23**: 106, fig. 1a, t. 34 (1957). Type: Marion Island, *Moseley* s.n. (BM!-holotype).
Fig. 10.

Plants terrestrial or epilithic. *Rhizome* short, decumbent, branched, stoloniferous, to 5 mm in diameter, set with roots, closely spaced persistent stipe bases, and paleae; paleae sessile, ferrugineous to castaneous, scarious. *Fronds* crowded, to 8 per plant, erect, to 940 mm long: *stipe* proximally castaneous, distally stramineous, adaxially shallowly sulcate, to 290 mm long × 4 mm in diameter, proximally close-set with unicellular pyriform glands, also sparsely to densely paleated; paleae sessile, ferrugineous to castaneous, scarious, lanceolate to broadly ovate, cordate to cordate-imbricate, the margins with irregularly spaced, unicellular pyriform glands (which also occur superficially) and short or long flagelliform outgrowths terminating in either a long filiform cell, a long filiform thin-walled cell, or rarely in a pyriform glandular cell, the apex terminating in an acicular or small thin-walled cell, to 11 × 3 mm: *lamina* 1-pinnate-pinnatifid to 2-pinnate, with up to 16 free pinna pairs, narrowly ovate to oblong-acute, to 285 mm long, the pinnae proximally wide-spaced, imbricate towards the apex, the most proximal pinna pair slightly to strongly reduced: *rachis* stramineous, shallowly sulcate adaxially, moderately set with unicellular pyriform glands and sparsely to densely paleated; paleae sessile, ferrugineous to stramineous, scarious, lanceolate to narrowly ovate, cordate to cordate-imbricate, the margins irregularly set with unicellular pyriform glands (which also occur superficially), short cuneate-emarginate outgrowths often terminating in a unicellular glandular cell, and short or long flagelliform outgrowths (which also occur superficially) terminating in either a long filiform cell, a long filiform thin-walled cell, or rarely in a pyriform glandular cell, the apex teminating in an acicular or thin-walled cell, to 7 × 2 mm: *pinnae* pinnatifid to 1-pinnate, with up to 5 free pinnule pairs, short-stalked, triangular, ovate, deltoid or oblong, to 36 × 18 mm: *pinnules* opposite to alternate, proximally short-stalked and widely spaced, sessile and imbricate towards the apex, firmly herbaceous to coriaceous, dark green adaxially, slightly paler abaxially, broadly ovate to circular, broadly cuneate, the margins shallowly crenate to dentate, revolute in plants from exposed habitats, to 11 mm long; adaxially sparsely set with a few twisted, cartilaginous, castaneous paleae chiefly along the pinna-rachis or costa; paleae short-stalked, linear to oblong, the margins subentire, with a few short cuneate-emarginate outgrowths or rarely with a few unicellular pyriform glandular cells and/or flagelliform outgrowths, the apex terminating in an acicular cell, to 3 mm long; abaxially sparsely to moderately set with hairs and scarious, stramineous to ferrugineous paleae, the paleae sessile, narrowly lanceolate to narrowly ovate, cordate, the margins (and often superficially) with unicellular, pyriform glandular cells, short cuneate outgrowths that often terminate in a unicellular glandular cell, and often with a few flagelliform outgrowths terminating in an acicular or thin-walled cell, to 5 mm long. *Venation* raised. *Sori* circular, to 1.5 mm in diameter, medial to inframedial, uniseriate, discrete but slightly confluent in depauperate plants; exindusiate: *sporangium* with 11–(14)–20 indurated annulus cells. *Spores* castaneous, the perispore folded to form closely set low tubercles, verruculate to echinulate, the exospore 30–(37.78)–78 × 24–(28.62)–36 µm. *Chromosome number* unknown.

MATERIAL EXAMINED

MARION ISLAND (46°54′S, 37°45′E): Black Hagless River near Kildalkey Bay, *Gremmen* s.n. (WAG); Macaroni Bay en route to Stony Ridge, *Rand* 3270 (BOL, PRE); grey lava cliffs near Duikers Point, 10 m, *Huntley* 466 (NBG-2 sheets, PRE-2 sheets); Marion Island, *Mostert* 15 (NBG, PRE); valley in cliffs above Prinsloo Lake, 25 m, *Huntley* 788 (NBG-2 sheets); Nellie humps, ± 40 m, *Huntley* 137 (BOL, NBG); stream adjacent Kildalkey hut, ± 100 m, *O'Connor* 1003 (BOL, NBG); cliffs at Goodhope Bay, *Rand* 3653 (BOL); between station and Skua Ridge, *Rand* 3766 (BOL); *Rand* 3192 (BM, BOL), 3271 (BM, BOL), 3690 (BM, BOL).

PRINCE EDWARD ISLAND (46°38′S, 37°57′E): cliffs S. of cave on E. coast, ± 25 m, *Huntley* 657 (BOL, NBG).

DIAGNOSTIC FEATURES AND RELATIONSHIPS. *Polystichum marionense* differs from any other taxon in the study area in having

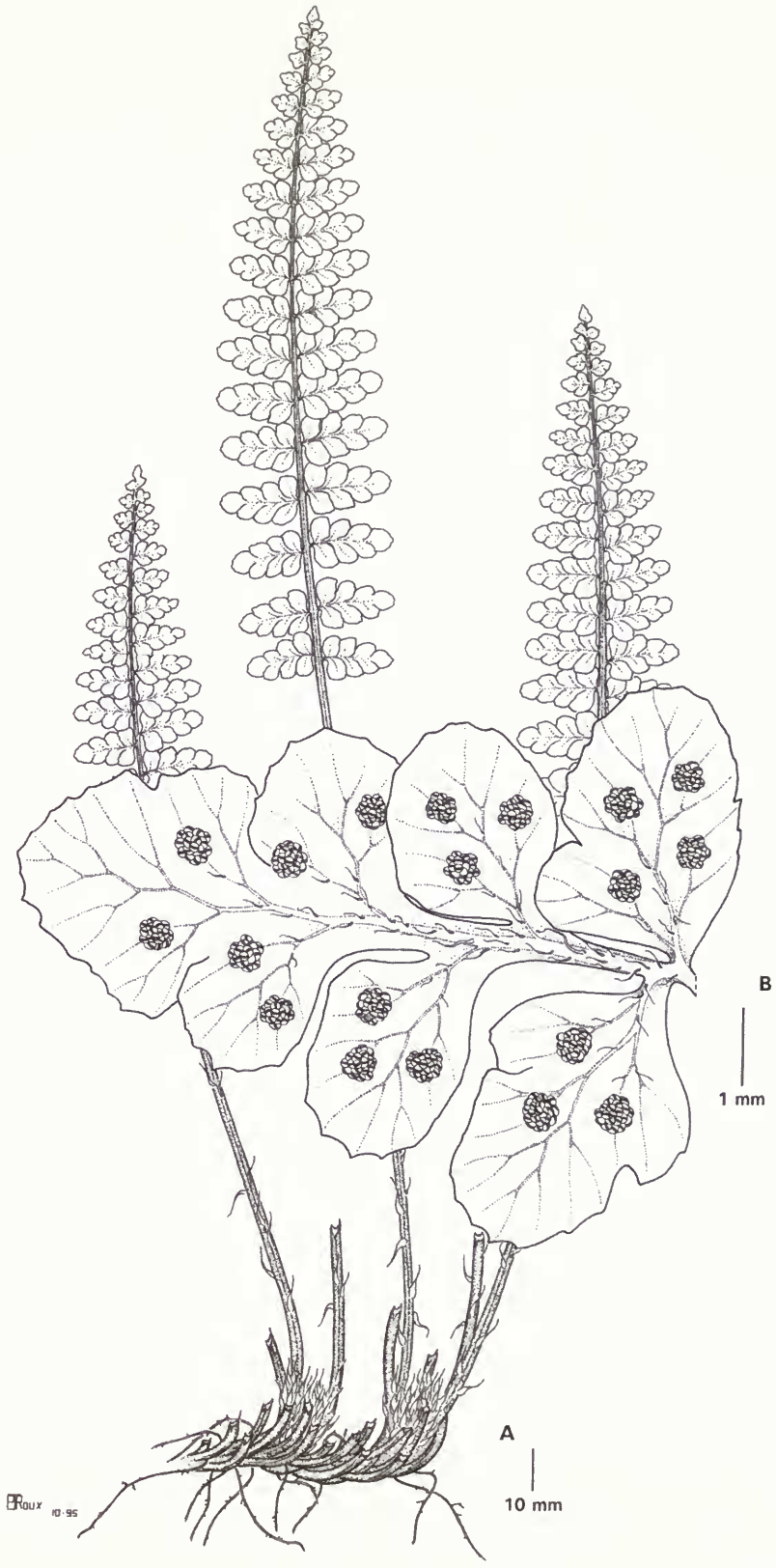

Fig. 10 *Polystichum marionense*. A, habit; B, abaxial surface of fertile pinna. All drawn from *Huntley* 466 (NBG).

a thin, decumbent and branched rhizome, pinnae that are not acroscopically developed, raised veins with few dichotomies, exindusiate sori situated along the veins and not at the vein endings, and paleae with unicellular glandular cells and flagelliform outgrowths along the margins and frequently also superficially.

Alston & Schelpe (1957) considered the species to belong to the *Polystichum mohrioides* (Bory) C. Presl group. In this group they included *P. plicatum* (Poepp.) Hicken from the Andes and South Georgia, *P. elegans* J. Rémy from the Andes, *P. scopulinum* (R.J. Eaton) Maxon and *P. lemmonii* Underw. from the western United States, and *P. cystostegia* (Hook.) J.B. Armstr. from New Zealand. *Polystichum plicatum* and *P. elegans* are sometimes considered to be varieties of *P. mohrioides*, but I found *P. mohrioides* to be extremely variable and could not on the grounds of the palea, indusium, sporangium and spore morphology distinguish between these taxa. I furthermore do not consider them related to *P. marionense,* as in this species the paleae bear long flagelliform outgrowths along the margins which often terminate in a glandular cell and are exindusiate. In *P. mohrioides* the paleae margins are subentire, but mostly bear a few short angular outgrowths. The palea apex always terminates in a short acicular cell. The indusia are large and mostly bear a variable number of pyriform cells along the margin and often also on the adaxial and abaxial surfaces. *Polystichum cystostegia* and *P. mohrioides* are clearly related as both are characterized by similar paleae and indusia. *Polystichum scopulinum* and *P. lemmonii* are related as can be judged from the paleae with short angular marginal outgrowths and apices that terminate in either an acicular cell or a small thin-walled cell. This is supported by the findings of Wagner (1979). *Polystichum scopulinum* and *P. lemmonii* are not considered to be related to either *P. marionense* or *P. mohrioides*. The affinity of *P. marionense* remains obscure.

VARIATION. Variation in *Polystichum marionense* on Marion and Prince Edward Islands can be ascribed to environmental influences. Plants from well protected sites are large, the pinnae widely spaced, and the stipe sparsely paleated. Plants from more exposed sites are generally depauperate, densely paleated, and the pinnae coriaceous and closely imbricate with the pinnule margins strongly revolute. Pinnae of depauperate forms are often arranged perpendicular to the lamina axes. Minor variations also occur in the paleae. In some collections the flagelliform marginal outgrowths are extremely long whereas in others they are short. Also the occurrence of such outgrowths from the surface of the palea varies from collection to collection. The limitation of unicellular glands to the proximal part of the palea surface seems to be fairly constant. Unicellular pyriform glandular cells on the adaxial and abaxial surfaces of the lamina have only been observed in *Huntley* 788 (NBG).

DISTRIBUTION AND ECOLOGY. *Polystichum marionense* is known only from Marion Island, Prince Edward Island and Possetion Island of the Crozet group in the Southern Ocean (Alston & Schelpe, 1957; Gremmen, 1982). Since the floras of the subantarctic islands are poorly known the species may have a wider distribution than is currently known. On Marion and Prince Edward Islands the species is only known from low-lying areas, with most collections having been made at elevations between 10 and 100 m above sea-level. The plants form large clumps in basalt rock crevices and at boulder and cliff bases. Huntley (1971) reported the plant to always occur in sites protected from the predominantly westerly and north-westerly winds.

11. **Polystichum transkeiense** W. Jacobsen in *J. S. African Bot.* **44**: 169 (1978). Type: South Africa, Transkei, Port St Johns, near road to Second Beach, deep shade in forest, 67 m, *W.B.G. Jacobsen* 4301 (PRE!-holotype).

Fig. 11.

Plants terrestrial or epilithic. *Rhizome* prostrate, widely creeping, branched, to 10 mm in diameter, set with roots, closely to widely spaced persistent stipe bases, and paleae (which are restricted to apical region); paleae broadly attached, stramineous to castaneous, chartaceous, narrowly lanceolate, cordate to cordate-imbricate, the margins repand to erose, generally without thin-walled hair-like cells, the apex often flagelliform, mostly terminating in a thin-walled cell, to 8.5 × 1.5 mm. *Fronds* usually widely spaced, 4–6 per plant, arching, to 1.34 m long: *stipe* firm, adaxially sulcate, proximally castaneous, stramineous distally, to 710 mm long × 4 mm in diameter, proximally densely paleated; paleae broadly attached, castaneous to stramineous, chartaceous, narrowly to broadly ovate, cordate to cordate-imbricate, the margins repand, erose to fimbriate, with or without thin-walled cells, the apex often flagelliform, terminating in a thin-walled cell, to 7 × 2.5 mm; distally sparsely paleated, becoming glabrous with age: *lamina* 2- or 3-pinnate, with up to 22 pairs of free pinnae, firmly herbaceous, adaxially dark green, somewhat paler abaxially, ovate to broadly ovate, to 655 mm long, the proximal pinna pair reduced in size: *rachis* stramineous to greenish, adaxially sulcate, sparsely paleated; paleae short-stalked, stramineous, chartaceous to membranous, narrowly oblong to narrowly ovate, cordate to hastate, the margins proximally repand, erose, or set with short and/or long irregular outgrowths, often with filiform outgrowths terminating in a thin-walled cell, distally repand to entire, flagelliform, terminating in a filiform cell or a thin-walled cell, to 6 × 1 mm: *pinnae* 1-pinnate or 2-pinnate, with up to 20 pairs of free pinnules, proximally widely spaced, mostly not overlapping, distally frequently overlapping; proximal pinnae narrowly ovate to narrowly oblong-attenuate, those towards the middle of the lamina ovate, narrowly oblong to oblong-attenuate, to 240 × 75 mm: *pinna-rachis* stramineous, adaxially sulcate, sparsely to densely paleated; paleae short-stalked, stramineous, chartaceous to membranous, linear, narrowly triangular to narrowly ovate, cordate to hastate, the margins proximally with short and/or long irregular outgrowths often terminating in a thin-walled cell, distally entire, twisted, the apex terminating in a filiform or thin-walled cell: *pinnules* short-stalked, opposite to alternate, widely spaced to overlapping, the proximal acroscopic pinnule the largest, the proximal basiscopic pinnule on basal pinna pair generally significantly smaller than the next basiscopic pinnule, inaequilateral, ovate, ovate-oblong to ovate-rhomboid, acuminate to obtuse, acroscopically auricled, shallowly to deeply incised, lobate-serrate, the lobes oblong, the proximal acroscopic auricle obovate, sharp-tipped to aristate, the costa adaxially proximally sulcate, sparsely paleated; paleae stramineous, membranous, twisted, simple or proximally with short or long angular outgrowths, the apex terminating in a filiform or a thin-walled cell, to 2.6 mm long, abaxially sparsely to moderately paleated; paleae stramineous, membranous, narrowly triangular to narrowly ovate, short-stalked, cordate to cordate-imbricate, the margins proximally erose or with short and/or long angular outgrowths or with long filiform outgrowths terminating in a thin-walled cell, distally entire, flagelliform, twisted, the apex terminating in a filiform or thin-walled cell, to 1.5 mm long. *Venation* raised. *Sori* circular, *c.* 1 mm in diameter, near or at the apex of abbreviated veins, discrete at maturity: *sporangium* with 10–(13)–19 indurated annulus cells; stalk eglandular: *indusium* absent. *Spores* 64 per sporangium, brown, the perispore folded to form a reticulum of inflated ridges, the ridges with a high crest, variously but mostly sparsely echinulate, minutely perforated, the exospore 32–(38.8)–46 × 22–(28.4)–36 µm. *Chromosome number* 2n=164.

MATERIAL EXAMINED

SOUTH AFRICA. 2330 (Tzaneen): Woodbush (CC), *Jenkins* 919 (PRE).

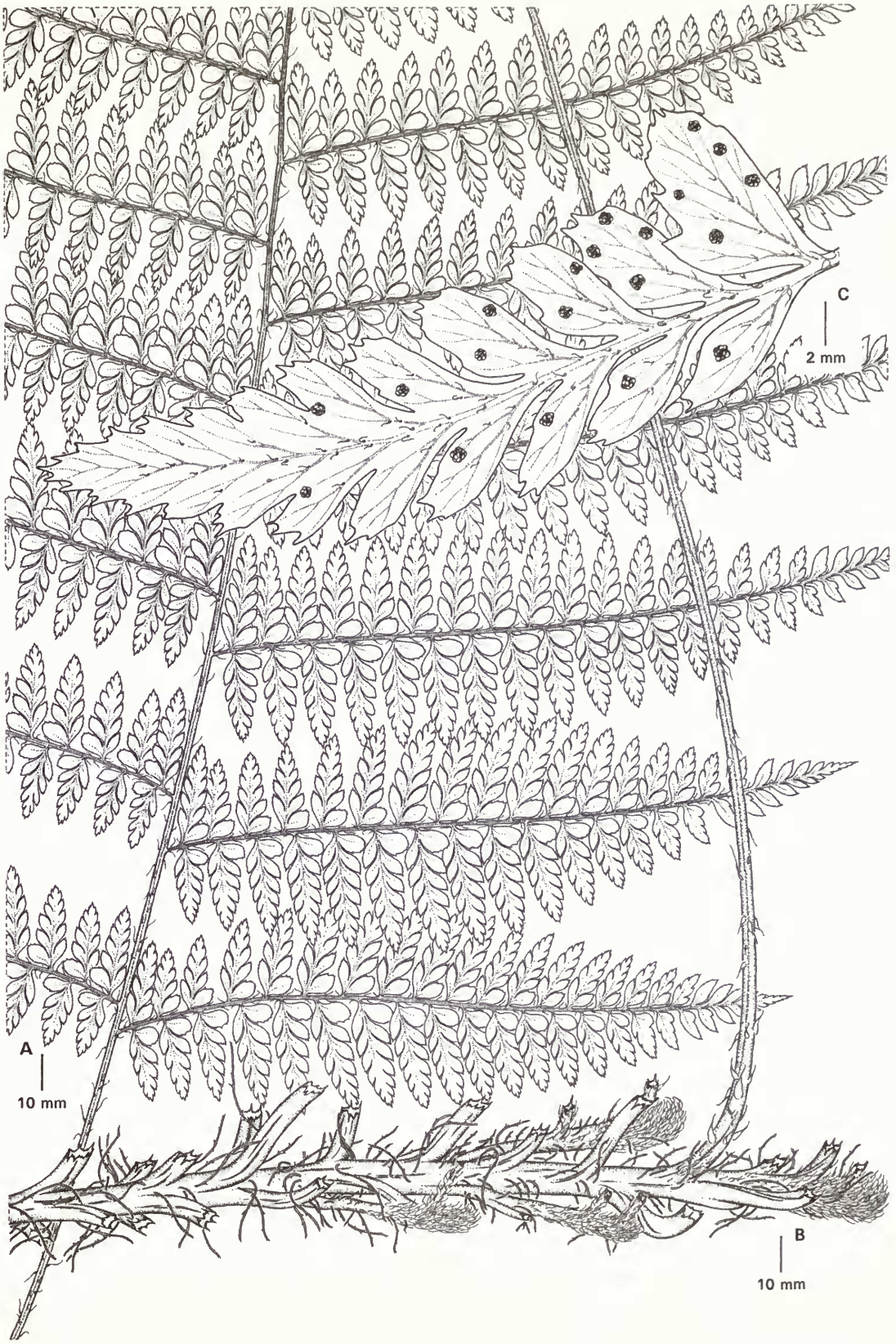

Fig. 11 *Polystichum transkeiense*. A, proximal part of lamina; B, rhizome; C, abaxial surface of fertile pinnule. A & C, drawn from *Roux* 2541 (NBG); B, drawn from *Roux* 2539 (NBG).

2430 (Pilgrim's Rest): Mariepskop (DB), *Burrows* 3150 (PRE). **2531 (Komatipoort)**: Barberton, Ida Doyer Nature Reserve, 1100 m (CC), *Muller* 2107 (PRE); Barberton, Maid of the Mist, *Thorncroft* 40 (PRE). **2730 (Vryheid)**: Pongola Bush Reserve, Stinkwood Falls, 1550 m (BC), *Glen* 2436 (PRE). **2731 (Louwsburg)**: Ngome Forest Reserve (CD), *Roux* 2535, 2536, 2537, 2538, 2539, 2540, 2541 (NBG); Ngome Forest, *Reid* 68 (PRE); Ngome Forest, 4100 ft, *Schelpe* 6223 (BOL); Ngome Forest, *Strey* 8378, 9381 (BOL, NH), 10487 (NH); Ngome Forest, *c.* 1000 ft, *Schelpe* 6244 (BOL); Ngome Forest, along waterfall path, 1000 m, *Glen* 93, 97 (PRE). **2830 (Dundee)**: Eshowe, Hospital Wood (CD), *Lawn* 63 (NH); Qudeni Forest, 5000 ft (DB), *Fisher* 802 (NH, NU, PRE), 877 (NU), Qudeni Forest, *Jordaan* 698 (NH, PRE); Qudeni Forest, 5500 ft, *Schelpe* 6267, 6268 (BOL); Qudeni Forest, 5000 ft, *Clarkson* 87 (NU), 130 (BOL, NU); Qudeni Forest, *c.* 5000 ft, *Allsopp* 743 (NU); Qudeni, 5000 ft, *Fisher* 831 (NH, NU); Qudeni, Ekombe Forest, 5000 ft, *Fisher* 817 (NU); Qudeni Forest, 1100 m, *MacDevette* 702 (PRE); Qudeni Forest Reserve, *Van Wyk* 7306 (NH); Qudeni Forest, 5000 ft, *Fisher & Schweickerdt* 109 (NH). **2831 (Nkandla)**: Nkandla Forest (CA), *Roux* 1932 (NBG); Eshowe to Nkandla, 1080 m, *Goetghebeur* 4443 (BR, PRE); Nkandla Forest, *Schelpe* 1701 (BOL); Nkandla, 3000 ft, *Meebold* 12614 (M); Nkandla, *Schelpe* 1701 (NU); Nkandla, *Nixon* s.n. (NU); Nkandla, *Lawn* 2001 (NH). **2930 (Pietermaritzburg)**: Karkloof, farm Shawswood (AC), *Roux* 1915 (NBG); Karkloof, *Van Jaarsveld* 5026 (BOL, NBG); Karkloof, farm Ehlateni, *Roux* 1006, 1007, 1008, 1009, 1010, (NBG), 1011 (NBG, PRE); Karkloof, 'Braco', 4300 ft, *Schelpe* 5115 (BOL); Balgowan, 'Boschfontein', 4000 ft, *Schelpe* 606, 610 (NU); Balgowan, 4000 ft, *Lindahl* 102 (NU); Balgowan, 'Boschfontein', 4000 ft, *Fisher* 630 (NH, NU); Karkloof, 'Elderslie', *Rycroft* s.n. (NU); Balgowan, *Graham* 107 (NU); Karkloof Forest, Ehlatine, *Rycroft* 89 (NU); Karkloof Forest, *Wirminghaus* 610 (NU); Karkloof Forest, bank of Mshwati River, *Wirminghaus* 902 (NU); Karkloof, Colsbourne farm, *Vos & McGregor* s.n. (NU); Balgowan, *Thomas* 67 (NU); Ahrens, 'Mowbray', *c.* 5000 ft (BB), *Fisher* 993 (NU); Dargle, Kilgoblin (CA), *Smook* 579 (NU), 566 (BOL, NU); Dargle, *Esterhuysen* 26200 (BOL); Lions River District, Lions Bush, *Moll* 832, 833 (NU); Dargle, Kilgoblin, *Smook* 661 (NU); Pietermaritzburg, 2500 ft, (CB), *Sanderson* s.n. (PRE); Pietermaritzburg, Winters Kloof, *Doige* s.n. (PRE); Pietermaritzburg, Worlds View, *Venter* 736 (PRE); Pietermaritzburg, Ferncliff, *Schelpe* s.n. (BOL); Zwaartkop, *Sim* s.n. (BOL); Pietermaritzburg, Ferncliff Nature Reserve, *c.* 2500 ft, *Cowan* 120 (BOL); Pietermaritzburg, Town Bush Valley, 2500 ft, *Tosh* et al. (K); Swartkop, *Hillary* 69 (NU); Pietermaritzburg, Swartkop, *Duncan-Vale* 19 (NU); Sweetwaters, *Stinger* 58 (NU); Pietermatitzburg, Swartkop, 4000 ft, *Fisher* 723 (NH, NU); Swartkop, 4500 ft, *Nixon* 36 (NU); Cascades, Town Bush, 2900 ft, *Sidly* 49 (NU); Pietermaritzburg, Claridge, *Carnegie* s.n. (NU); Hilton Road, *Devlin* 43 (NU); Town Hill, *Carnegie* 706 (NU); Sweetwaters, *Uhjati* 52 (NU); Pietermaritzburg, Town Bush Valley, *Fisher* 693 (NU); upper Town Bush Valley, 3300 ft, *Wand* 28 (NU); Town Bush Valley, *Tosh Robinson & De Villiers* 7 (NU); Town Bush Valley, *c.* 2250 m, *Doni* 72 (NU); Pietermaritzburg, Ferncliff Nature Reserve, 1000 m, *Crouch* 556, 570, 598 (NU); Swartkop, *Clarkson* 19 (NU); Town Bush Valley, *Devlin* 34 (NU); Town Bush Valley, 3000 ft, *Fisher* 667 (NU); Ferncliff Nature Reserve, 2500 ft, *Cowan* 155 (NU); Town Bush Valley, 3000 ft, *Nieuwoudt* 56 (NU); Winters Kloof, *Doidge* P54 (PRE); Cottingham, farm Keerom, 4500 ft (CC), *Strey* 8429 (BOL, NH); Richmond, Enon Forest (CD), *Van Jaarsveld* 5044 (PRE); Inanda (DB), *Wood* s.n. (B, PRE); Camperdown, Nagle Dam, 3000 ft (DD), *Wells* 1551 (NU). **2931 (Stanger)**: 10 km from Kwasizabantu towards Mapumulo (AA), *Van Jaarsveld & Lang* 5096, 5098 (BOL, NBG), *Van Jaarsveld & Jacobs* 5851 (NBG); Alexandra District, Moyeni, 750 m (BA), *Rudatis* 1100 (B, K, NBG, P); Richmond, Enon Forest (CD), *Van Jaarsveld* 5044 (BOL, NBG). **3029 (Kokstad)**: 22 miles E. of Kokstad, 4850 ft (CB), *Schelpe* 4417, 4418 (BOL); Tabankulu Forest Reserve (CD), *Wilkins* 40 (PRE); Ingeli Bush (DA), *Taylor* 5227 (NBG, PRE); Mpetsheni Forest, Weza, *Roux* 1960, 1961 (NBG); Weza Forest, *Roux* 2493, 2494, 2495, 2497, 2498 (NBG); Mpetsheni Forest, Weza, *c.* 1000 m, *Nicholas & Marais* 1675 (PRE); Weza Forest, *Roux* 623 (BOL); Weza Forest, Bangeni Forest, 1200 m, *MacDevette* 1534 (NH). **3030 (Port Shepstone)**: Burntwood, Paddock (CC), *Strey* 5994 (BR, K, NU); Umtamvuna Nature Reserve, Long Kloof, 360 m, *Abbott* 1818 (NH); Umtamvuna Nature Reserve, Gogosa Kloof, *Abbott* 2101 (NH); Umtamvuna Nature Reserve, Verassend Kloof, 360 m, *Abbott* 1821 (NH). **3128 (Umtata)**: Tsolo, Nqadu Ridge, *c.* 1100 m, (BC) *Keeler & Cloete* 449 (NH). **3129 (Port St Johns)**: Port St Johns, Egossa Forest (BC), *Strey* 8869 (BOL, NH, NU, PRE); Lusikisiki, Magwa Falls, *Strey* 6718 (NH, PRE); Egossa Forest above Magwa Falls, 1300 m, *Venter & Vorster* 72 (BR, PRE); Port St Johns, stream at S. end of airstrip (DA), *Roux* 582 (BOL, NBG); Port St Johns, *Hardcastle* s.n. (NBG); woods at Port St Johns, *Flanagan* 2973 (PRE); Port St Johns, *Hardcastle* 281/283 (PRE); Port St Johns, *McLoughlin* 788 (BOL, PRE); Port St Johns, edge of plateau, 1200 ft, *Hardcastle* 285 (PRE); Port St Johns, *McLoughlin* S36 (PRE); Port St Johns, Agate Terrace, *McLoughlin* 780 (BOL); Port St Johns, *Isaac* s.n. (BOL); Port St Johns, Moffets Glen, *Roux* 589 (BOL); Port St Johns, *Schelpe* 357, 358 (NU); Port St Johns, *Flanagan* 2473 (PRE).

SWAZILAND. 2531 (Komatipoort): Piggs Peak, Kings Forest (CD), *Compton* 27831 (NBG, PRE); Havelock, Kings Forest, 5000 ft, *Schelpe* 6163, 6169 (BOL).

WITHOUT EXACT LOCALITY: Port Natal, *Krauss* 258 (BM); loco incerto, *Hill* 36 (PRE); loco incerto BOL 57713 (BOL); Natal, *Buchanan* s.n. (BOL); Natalia, in sylvis montis humidis, *sine coll.* s.n. (P); Pondoland, *Buchanan* 30 (P); Hlokozi, Alexandra City, 2700 ft, *Rudatis* 2309 (NBG); in sylvis montanis umbrosis humidis, *Guienzius* 28 (B); Natalia, in sylvis humidis, *sine coll.* B-97066 (B); Natal, *McKen* s.n. (B); Natal, *Buchanan* 75 (B); Pondoland, *Buchanan* 30 (B); zwischen dem grossen Wasserfall und Omsamcaba, *Drége* s.n. (B); loco incerto, *Drége* s.n. B-97092 (B); Natal, *Guienzius* s.n. B-97064 (B); loco incerto, *sine coll.* s.n. NH-26388 (NH); Prom. b. spei, *Guienzius* s.n. (BR); Natal, *sine coll.* s.n. (BR); Zululand, *Haygarth* s.n. (NH); loco incerto, *sine coll.* s.n. NH-26465 & 26466 (NH); Inanda, Great Noodsberg, Town Hill, P.M.B., *sine coll.* s.n. NH-26791 (NH); loco incerto, *sine coll.* s.n. NH-26387 A-only (NH).

DIAGNOSTIC FEATURES AND RELATIONSHIPS. The thin, widely creeping rhizome, the thin-walled cells on the paleae, and the exindusiate sori are the most diagnostic features of the species. The affinity of *Polystichum transkeiense* is yet to be determined.

VARIATION. *Polystichum transkeiense* shows extreme variation in frond morphology, even within a population. Lamina dissection varies between 2-pinnate and 3-pinnate with the pinnules showing various degrees of dissection. Pinnule lobes may vary between broadly elliptic to obovate and narrowly obovate to narrowly oblong. Palea variation is not as significant as that of the lamina. Paleae do, however, vary in outline, the degree to which the margins are sculptured, the absence or presence of thin-walled cells along the margins, and in the apex terminating in a thin-walled cell or a filiform cell. Both conditions are usually present in the same plant.

DISTRIBUTION AND ECOLOGY. *Polystichum transkeiense* is confined to the eastern parts of South Africa and northern Swaziland. This region receives its rain largely during the summer months (September–March). It is an exclusively forest-dwelling species, often growing in very wet conditions. In the southern limits of its distribution at Port St Johns, *P. transkeiense* grows in Typical Coast Belt Forest that occurs from near sea-level to approximately the 450 m contour. This region receives 900–1500 mm of rain per annum. To the north and somewhat inland it occurs in forests of the Pondoland Coastal Plateau Sourveld where it occupies a plateau to 450 m above the sea. The forests are mainly found in protected places along the escarpment such as gorges and valleys below cliffs. Rainfall in this region is high; 1150–1300 mm of precipitation is measured per annum. In the KwaZulu-Natal midlands *P. transkeiense* occurs in forests of the 'Ngongoni Veld, extending between 450 and 900 m above the sea and receives on average 750–1300 mm of rainfall per annum. Nkandla, Qudeni and Weza are among the most notable forests occurring in this vegetation type. In northern KwaZulu-Natal Afromontane forests with slightly more tropical affinity occur on the inland mountains. The extensive Ngome Forest, where *P. transkeiense* is common, is an example of this forest type. Forests of this type occur northwards to the mountains south and west of Barberton.

Rainfall in this region is high, ranging between 900–1950 mm per annum (Acocks, 1988).

Jacobsen (1978) considered 'its tendency to grow isolated in deep shade and not in large clusters. . .' as a diagnostic feature of *Polystichum transkeiense*. My observations, however, do not conform with this statement. *Polystichum transkeiense* does grow as isolated plants, but generally forms continuous, dominant stands, especially in the Weza, Karkloof, Nkandla and Ngoye forests.

12. **Polystichum magnificum** F. Ballard in *Kew Bull.* **12**: 48, f. 1 (1957). Type: Uganda, Mount Elgon, in the crater (alpine region) in a small sheltered cleft on the ridge north of Maji ya moto, 3750 m, *Hedberg* 965 (K!-holotype; K!-isotype).

Fig. 12.

Plants terrestrial. *Rhizome* short-decumbent, branched, to 12 mm in diameter, set with roots, closely spaced persistent stipe bases, and paleae; paleae broadly attached, ferrugineous, chartaceous, linear, cordate, the margins subentire or with small, widely spaced, straight or curved outgrowths, the apex terminating in an acicular cell, to 30 × 2 mm long. *Fronds* 8–12 per plant, erect to suberect, to 1.13 m long: *stipe* proximally castaneous, stramineous distally, adaxially sulcate, to 470 mm long × 9 mm in diameter, densely paleated; paleae broadly attached, ferrugineous, chartaceous, those on the proximal part of stipe narrowly ovate, cordate, the margin with small widely spaced projections, the apex terminating in an acicular cell, to 40 × 2 mm, those on the distal part of stipe more variable in size; the larger broadly attached, narrowly ovate, ovate to narrowly oblong, cordate, with the margins variously set with short and/or long, simple or forked recurved outgrowths, the apex terminating in an acicular cell, to 28 × 8 mm; the smaller short-stalked, narrowly triangular, cordate, often somewhat auricled, the margins proximally with short and/or long angular or curved outgrowths, distally entire or with small projections, the apex terminating in an acicular cell: *lamina* 2-pinnate to 2-pinnate-pinnatifid, coriaceous, adaxially dark green, abaxially slightly paler, narrowly ovate to narrowly oblong, to 660 mm long, reduced towards the base, often with a single proliferous bud near the apex, the bud paleae ferrugineous: *rachis* stramineous, adaxially sulcate, densely paleated; paleae stramineous to ferrugineous, the larger broadly attached, ovate to narrowly ovate, cordate, the margins proximally with long and/or short, straight and/or curved outgrowths, distally entire, the apex terminating in an acicular cell, the smaller short-stalked, narrowly triangular, the margins proximally with curved or angular outgrowths, distally entire, the apex terminating in an acicular cell: *pinnae* mostly somewhat overlapping, narrowly ovate to oblong, not significantly developed acroscopically, to 130 mm long: *pinna-rachis* stramineous, adaxially sulcate, densely set with paleae similar to but smaller than those on the rachis; *pinnules* proximally closely spaced, distally alternate, mostly somewhat imbricate, inaequilateral, ovate, lobate, crenate, the proximal pinnules acroscopically incised to or near to the adaxially sulcate costa, the segments unequally rhomboid to obovate, adaxially densely paleated; paleae short-stalked, ferrugineous, chartaceous, subulate, simple or proximally with short marginal outgrowths, often twisted, the apex always terminating in an acicular cell, to 5 mm long, abaxially densely paleated; paleae short-stalked, ferrugineous, subulate, straight or twisted, proximally with short marginal outgrowths, the apex terminating in an acicular cell, to 4 mm long. *Venation* raised. *Sori* circular, to 2.2 mm in diameter, uniseriate, discrete at maturity, terminal or near-terminal on abbreviated vein branches: *sporangium* with 11–(13)–17 indurated annulus cells; stalk eglandular: *indusium* peltate, circular, erose, the maximum radius 0.63–(0.94)–1.14 mm, persistent, brown. *Spores* dark brown, 64 per sporangium, the perispore relatively smooth, echinulate, closely perforated, the exospore 36–(47.78)–58 × 26–(33.37)–40 µm. *Chromosome number* unknown.

MATERIAL EXAMINED

ETHIOPIA: Bale Region, Dello Awraja, in Harrena Forest *c.* 3.3 km N. of Rira, 3040 m, *Mesfin* 5077 (ETH); Bale Mountains, E. of Kara Deema, 4140 m, *Miehe* 1497 (ETH); Bale Mountains, E. of Kara Deema, 4200 m, *Miehe* 1541 (ETH); Bale Mountains, Mendoyn Anraja, in Harrena Forest, *c.* 1–2 km S. of Riva village, 2780–2850 m, *Mesfin* 5355 (ETH); Bale Region, Dello Awraja, *c.* 3.4 km N. of Rira village, 3120 m, *Mesfin* 5332 (ETH); Arussi, Juniper forest, 9000 ft, *Thomerson* 550 (ETH, K); Darra, bamboo forest, 9000 ft, *Mulvany* 48 (K); Bale Province, Rira, 20 miles SW of Goba, 10 800 ft, *Mooney* 7192 (K); Mount Tola, Gamu Highlands, 13 000 ft, *Mulvany* 1 (K); Bale Province, *c.* 30 miles S. of Goba, Saneti Plateau, 2720 m, *Ash* 3567 (BR).

KENYA: Mount Elgon, 12 500 ft, *Tweedie* s.n. (K).

DIAGNOSTIC FEATURES AND RELATIONSHIPS. Most striking is the large stature of the plants occurring at these high elevations. Also diagnostic are the densely paleated fronds, rounded lobes, and the proliferous bud borne on the rachis near the frond apex.

The affinity of *Polystichum magnificum* is uncertain. Superficially it appears to belong to section *Lasiopolystichum* but the palea structure and the short, branched decumbent rhizome does not support such an affinity.

DISTRIBUTION AND ECOLOGY. *Polystichum magnificum* is only known from Mount Elgon, on the border between Uganda and Kenya, and the Bale, Arussi, and Gamu Gofa regions in southern Ethiopia.

On Mount Elgon *Polystichum magnificum* occurs at elevations ranging from 3700 to 3800 m. In Ethiopia it occurs from 2700 to 4200 m and grows in a wide range of afromontane vegetation communities. These include afromontane forests of the *Hagenia abyssinica* (Bruce) J.F. Gmel. and *Juniperus procera* Hochst. ex Endl. types, afromontane bamboo zone, afromontane scrubland and afromontane grassland types as defined by White (1983).

The species has been reported to form compact patches up to 1.8 m in diameter at 3000 m on Mount Tola and Mount Gughé in Ethiopia. At higher elevations *Polystichum magnificum* tends to be restricted to rock crevices where it is protected from wind and fire.

13. **Polystichum zambesiacum** Schelpe in *Bol. Soc. Brot.* sér. 2, **41**: 215 (1967). Type: Rhodesia (Zimbabwe), Umtali District, Henkels Nek, Stapleford, *Schelpe* 5751 (BOL!-holotype; BOL!-isotype).

Fig. 13.

Plants terrestrial or epilithic. *Rhizome* short-decumbent to suberect, short-branched, to 25 mm in diameter, set with roots and closely spaced persistent stipe bases, the older parts nude, the apical part densely paleated; paleae broadly attached, rugose, ferrugineous, linear, truncate to cordate, the margins variously fimbriate, often also with a few long, straight, recurved, filiform outgrowths, to 30 × 2 mm. *Fronds* caespitose, 5–8 per plant, arching, to 1.8 m long: *stipe* proximally castaneous, stramineous distally, adaxially sulcate, to 840 mm long × 9 mm in diameter, proximally densely paleated; larger paleae more widely spaced and becoming smaller distally, membranous, ferrugineous throughout or with a narrow membranous margin and a dark, nitid centre, ovate, cordate, the margins fimbriate, the apex cuspidate or flagelliform, terminating in a thin-walled cell or a filiform cell, to 16 × 10 mm; smaller paleae short-stalked, narrowly ovate to narrowly triangular, cordate to cordate-imbricate, the margins proximally with irregular angular outgrowths, often also with long, twisted, filiform outgrowths often terminating in a small thin-walled cell, sparsely fimbriate distally,

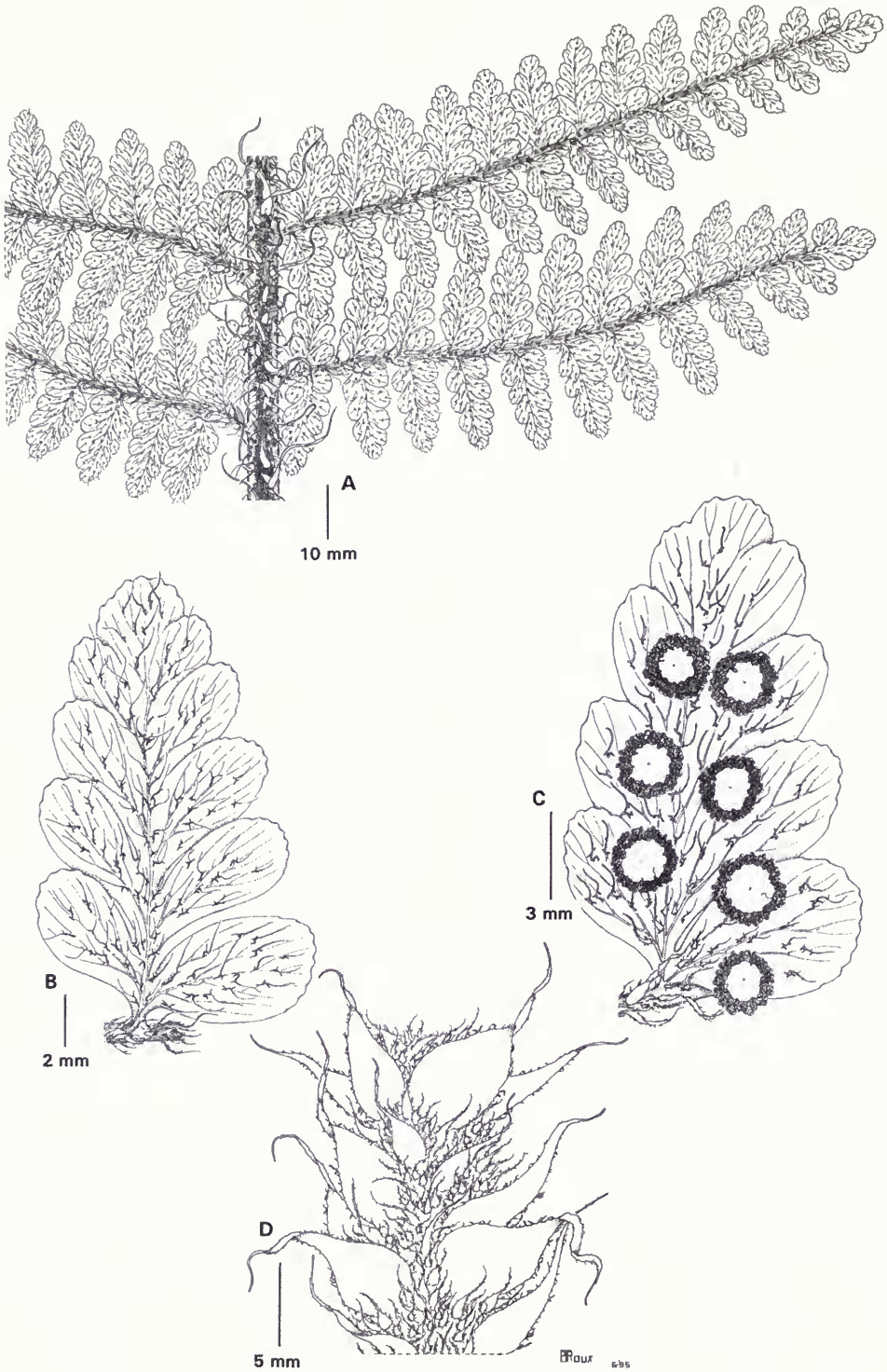

Fig. 12 *Polystichum magnificum.* A, middle pinnae of lamina; B, adaxial surface of pinnule; C, abaxial surface of fertile pinnule; D, section of abaxial surface of rachis. All drawn from *Hedberg* 965 (K).

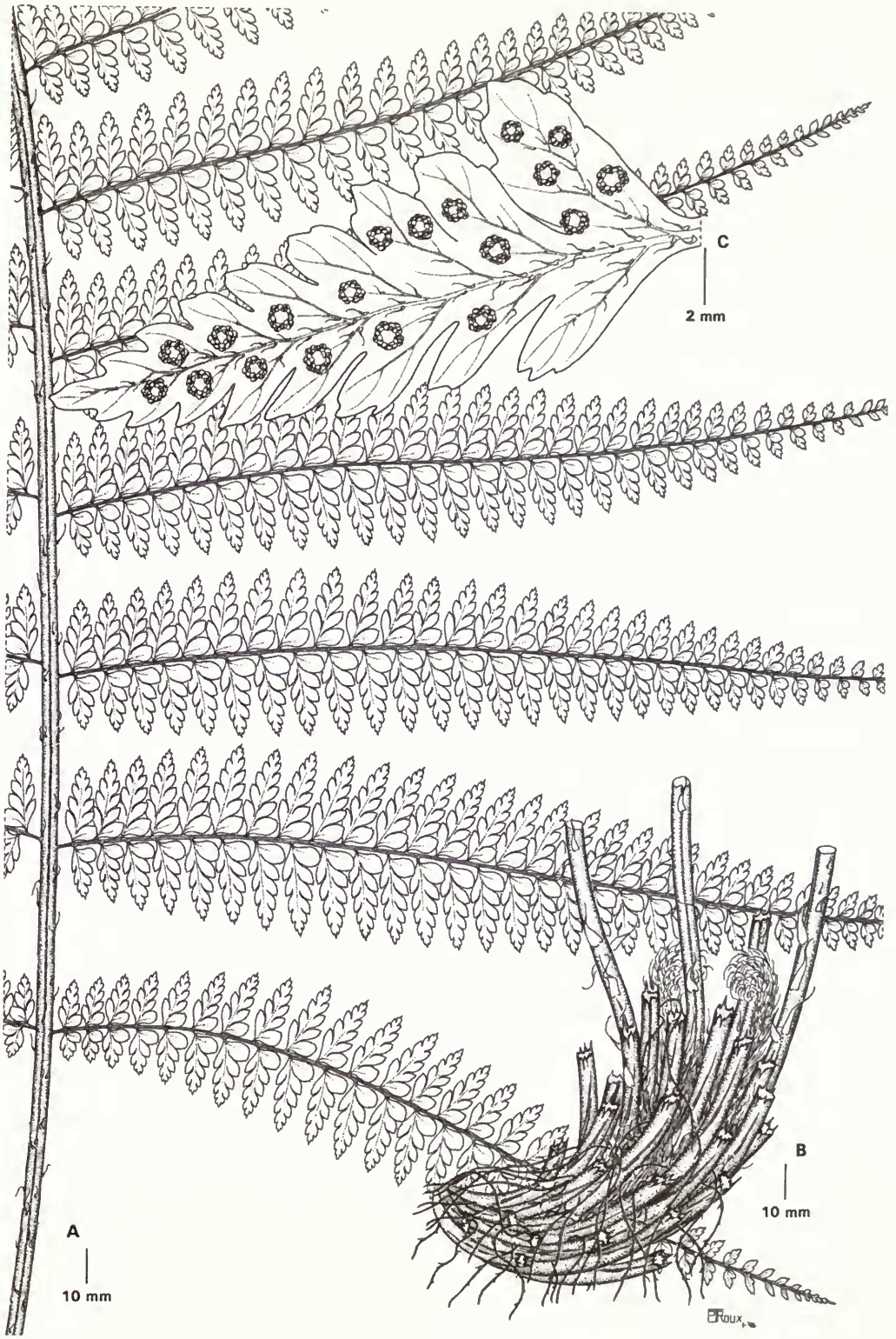

Fig. 13 *Polystichum zambesiacum*. A, proximal part of lamina; B, rhizome; C, abaxial surface of fertile pinnule. A & C, drawn from *Schelpe* 5751 (BOL); B, drawn from *Burrows* 2935 (PRE).

the apex flagelliform, terminating in a small thin-walled cell or a filiform cell; *lamina* 2-pinnate to 3-pinnate, with up to 30 free pinna pairs, firmly herbaceous, narrowly ovate to ovate, up to 890 mm long, the proximal pinna pair often slightly reduced and often somewhat deflexed: *rachis* stramineous, adaxially sulcate, often somewhat flexuous towards the apex, sparsely paleated; paleae short-stalked, chartaceous, stramineous to ferrugineous, narrowly linear, narrowly ovate to narrowly triangular, cordate to cordate-imbricate, the margins proximally with straight or angular outgrowths or with long, twisted, filiform outgrowths, distally entire or sparsely fimbriate, the apex terminating in a small thin-walled cell or a filiform cell, to 1.8 mm long: *pinnae* 1-pinnate to 2-pinnate, with up to 27 free pinnule pairs, generally widely spaced but often imbricate, lanceolate, narrowly ovate to oblong-attenuate, the proximal pinnae to 268 mm long: *pinna-rachis* stramineous, adaxially sulcate, set with paleae similar to but smaller than those on the rachis: *pinnules* opposite to alternate, widely spaced or imbricate, asymmetric, ovate-oblong, narrowly ovate to narrowly triangular, acroscopically auricled, usually somewhat reclinate, lobate-serrate, obtuse, the proximal acroscopic pinnules on basal pinnae often reduced, becoming larger towards middle of lamina, the proximal pinnules simple or incised to or near to costa, to 45 mm long; costa proximally adaxially sulcate, glabrous or with a few short-stalked, stramineous, twisted paleae; paleae filiform, simple or proximally with a few twisted outgrowths, the apex terminating in a small thin-walled cell or a filiform cell, to 1.2 mm long, adaxially sparsely paleated; paleae short-stalked, narrowly triangular to narrowly ovate, cordate, the margins proximally with short or long angular, often filiform outgrowths, the apex entire or sparsely fimbriate, terminating in a small thin-walled cell or a filiform cell, to 0.8 mm long. *Venation* raised or obscure. *Sori* circular, terminal, medial or inframedial on unabbreviated or abbreviated vein branches, discrete at maturity, *c.* 1 mm in diameter: *sporangium* with 9–(14)–20 indurated annulus cells; stalk eglandular; *indusium* peltate, circular to reniform, repand to erose, the maximum radius 0.19–(0.33)–0.5 mm, persistent, brown. *Spores* 64 per sporangium, brown, the perispore folded to form inflated reticulate ridges and tubercles, the ridges and areas between variously perforated, echinate to echinulate, the exospore 30–(37.77)–54 × 22–(27.49)–36 µm. *Chromosome number* unknown.

MATERIAL EXAMINED

MALAWI: Nyika Plateau, 2250 m, *Brass* 17255 (K, PRE, SRGH); Mount Mulanje, Lichenya Plateau, Nessa Path Forest, 1800 m, *Chapman* 8262 (MAL, PRE); Zomba Plateau, W.-facing cliff edge below Malumbe Peak, 1900 m, *Berrie* 602 (MAL); Zomba Plateau, Malumbe Peak, *Roux* 2928 (NBG); Mulanje Mountains, Lichenya Plateau, *Pawek* 3815 (K); Mount Mulanje, Lichenya Plateau, 1820 m, *Brass* 16566 (K, SRGH); Nyika Plateau, Kasaramba Peak, 8400 ft, *Simon* et al. 1730 (K, SRGH); Mount Mulanje, Lichenya Plateau, 1890 m, *Brass* 16820 (K, SRGH); Mount Mulanje, Lichenya Plateau, 1950 m, *Richards* 16556 (K); Mount Mulanje, Nayawani Forest, 6400 ft, *Newman & Whitmore* 547 (BR, SRGH); Mt. Mulanje, L. Ruo Plateau, 6400 ft, *Newman & Whitmore* 399 (BR).

MOZAMBIQUE: Manica & Sofala, Penhalonga, 4500 ft, *Schelpe* 5325 (BOL); Manica & Sofala, Gorongosa Mountains, Gogogo Peak, 5000 ft, *Schelpe* 5518 (BOL); Manica & Sofala, Gorongosa, Serra da Gorongosa, vertente do monte Nhandare, 1750 m, *Torre & Pereira* 12515 (BOL, BR, SRGH); Namuli, Makua country, *Last* s.n. (K).

TANZANIA: Uluguru Mountains, S. of Bunduki, NE edge of Lukwangule Plateau, on rocky outcrops of Muisile Hill, 2400–2450 m, *Pócs* et al. 86141/A (WAG); W. Usambaras, towards Mount Kwashenhambu, 1850 m, *Schippers* T1578A (WAG); W. Usambara Mountains, N. slopes of Mount Shegein, Shasayo Forest, 1850 m, *Schippers* T1604A (WAG); Morogoro, Ukaguru Mountains in Kilosa District, W. Mamiwa Ridge, 2100–2200 m, *Pócs* et al. 86100/B (WAG); Tanga Region, Lushoto District, W. Usambara Mountains, Shagayu Forest Reserve, NW slope of the summit 2.5 km ENE of Shagayu sawmill, 1850–1950 m, *Borhidi* et al. 84847 (ETH); Morogoro District, Uluguru Mountains, W. part of Lukwangule Plateau, 2400–2500 m, *Harris* et al. 3726 (K); Usagara: Itumba, *Wood* s.n. (K); Uluguru Mountains, above Morogoro, NE ridge of Bondwa between Morningside and Mwere Valley, 1050 m, *Pócs* 6537/C (PlC.SERM.); Uluguru Mountains, NW slope of Bondwa, along road to Morningside, *Faden* et al. 70/654 (BM, BOL); Uluguru Mountains, Morningside to Bondwa, *Faden* 70/316 (BOL, K); mainland W. of Zanzibar, *Last* s.n. (K); N. Uluguru Forest Reserve, Lupunga Peak, W. side, 2000 m, *Hall* s.n. (K); Morogoro: Uluguru gebirge, Lupanga, 2100 m, *Schlieben* 2977 (B, BR).

ZIMBABWE: Inyanga, Pungwe Gorge, 6000 ft, *Schelpe* 5699 (BOL); Inyanga, circular drive on N. rim of Pungwe Gorge, 7000 ft, *Mitchell* 148 (BOL); Umtali, Stapleford Forest Reserve, W. of Rupere Peak, 5500 ft, *Chase* 7429 (BOL, K); Inyanga, *Mitchell* 1082 (BOL, K, NU, SRGH); Umtali, 'Cloudlands', Vumba, 5200 ft, *Schelpe* 5365 (BOL); Inyanga, ad dejectum fluminis Pungwe, *c.* 1700 m, *Fries* et al. 3795 (BOL, K); Umtali District, Vumba Mountains, 'Cloudlands', forest E. of Cripps Grid, *Chase* 8345 (BOL, K); Umtali District, on Lords Head property, Vumba Mountains, 5300 ft, *Chase* 8343, 8344 (BOL, K, SRGH); Melsetter, forest in gully on W. side of N. end of Bundi Valley, *Mitchell* 514 (BOL, K, SRGH); Umtali District, Stapleford Forest Reserve, 5600 ft, *Chase* 8373 (BOL, K, SRGH); Stapleford Forest Reserve, lower part of road to Henkels Nek, 5600 ft, *Chase* 8371 (BOL, SRGH); Umtali District, Vumba Mountains, *Williams* VUM18 (BOL); Vumba Mountains, *Williams* VUM1, VUM10, VUM11, VUM12, VUM13 (BOL); Chimanimani Mountains, Gwasha, *Williams* STP1, STP2 (BOL); Inyanga, 6500 ft, *Chase* 5100 (BOL); Inyanga, Pungwe Gorge, Inyangani Mountains, 6500 ft, *Chase* 5240 (BOL); Umtali, Vumba Mountains below Castle Beacon, 5600 ft, *Chase* 7489 (BOL); Inyanga, circular drive below Inyangani Mountain, 7500 ft, *Mitchell* 135A (BOL); Umtali, Imbeza Forest Estate, Zuwanne indigenous forest, 5150 ft, *Jacobsen* 3838 (BOL, SRGH); Stapleford Forest Station, 6000 ft, *Taylor* 3234 (BOL, SRGH); Vumba Mountains, SE slope of Castle Beacon, 1675 m, *Burrows* 2944, 2945 (PRE); Inyanga, S. tip of Mount Inyangani, 2040 m, *Burrows* 2935 (PRE); Pungwe Gorge, in drier part of ravine, *Schweikerdt* 2412 (M, PRE); Umtali, Vumba, Castle Beacon, 6000 ft, *Fisher* 1638 (NU, PRE); Vumba Mountains, *Chase* 1102 (PRE); W. slope of S. tip of Mount Inyangani, 2000 m, *Burrows* 2940 (PRE); Inyanga, new beacon on Mount Inyangani, 2540 m, *Burrows* 2828 (PRE); Inyanga, montane forest, 6000 ft, *Chase* 4024 (PRE); Vumba Mountains, 5400 ft, *Chase* 8347 (K); Vumba Mountains, Bunga Forest, *Jacobsen* 3037 (SRGH); Inyanga, lower E. slope of Inyangani, *c.* 1480 m, *Müller* 3214 (SRGH); lower SE slope of Mt. Pene, 1350 m, *Müller* 2798 (SRGH); Inyanga, top of escarpment 2 km N. of Honde View, *c.* 1840 m, *Müller* 3243 (SRGH); Melsetter, Chimanimani, Bundi River, 5500 ft, *Whellan* 2184 (SRGH); Vumba Mountains, forest on E. slope of Castle Mountain, *Jacobsen* 3033 (SRGH); Stapleford Forest Reserve, Ruperi Peak, 6100 ft, *Chase* 4656 (SRGH); Stapleford Estate, montane forest, *Roux* 2828 (NBG); SE edge of Vumba Hotel forest, *Chase* 4022 (SRGH); Stapleford Forest Reserve, *Chase* 8372 (SRGH); Melsetter District, Orange Grove, *Chase* 3088 (BR, NU, S, SRGH); Inyanga District, source of Inyahupina River, Romneydale, 6100 ft, *Chase* 2089 (NU, SRGH); 30 miles S. of Umtali, 6000 ft, *Grout* 33 (NU); Umtali, Pioneer farm, *Fisher & Schweickerdt* 306 (NU); Umtali District, Vumba Mountains, Natseland, *Chase* 3428 (NU); Umtali District, Nyagari farm, N. of Zwitembo, *Chase* 3156 (NU); Inyanga District, *Chase* 3206 (NU); Inyanga District, Pungwe Falls, 6000 ft, *Chase* 3197 (NU); Umtali District, Stapleford Forest Reserve, *Chase* 4520 (NU); Umtali District, Penhalonga, *Chase* 3132 (NU); Inyanga, Pungwe view point, *Chase* 3206 (NU); Umtali, *Chase* s.n. (NU); a 15 km à l'E. d'Inyanga, sommet du mont Mimunzi, 18°14'S, 32°53'E, 1950 m, *Bamps* et al. 272 (BR); Vumba Mountains, Umtali District, Cloudlands, *Jackson* 8 (GRA).

DIAGNOSTIC FEATURES AND RELATIONSHIPS. *Polystichum zambesiacum* can be easily recognized among African members of the genus by its long and narrow rugose rhizome paleae, long-attenuate pinnae and (although variable) obtuse pinnule lobes, conspicuously small indusia, and the palea morphology.

Polystichum zambesiacum is not considered to be related to any other taxon in the study area.

VARIATION. Schippers (1993) suggested that the Tanzanian plants may be a different but related species to *Polystichum zambesiacum*. He noted the Usambara Mountain plant to differ from that of the southern highlands in the more shiny fronds, the more deeply divided pinnae, and the segment margins having more clearly aristate teeth. *Polystichum zambesiacum* is clearly a very variable taxon with lamina division ranging between 2-pinnate and 3-pinnate. Most apparent is the degree to which the size, shape and incision of the pinnules vary. This, however, cannot be linked to distribution as 3-pinnate plants have been recorded from the Pungwe Gorge in Zimbabwe [*Chase* 5240 (BOL)] and the Ukagura Mountains in Tanzania [*Pócs* et al. 86100/B (WAG)]. In the Uluguru Mountains, like in the rest of its distribution, the pinnules are mostly variously incised and lobate-dentate to ovate-serrate. One collection from this region [*Faden* et al. 70/316 (BOL, K)] shows hardly any incision of the pinnules which are poorly lobate. Lamina division can thus not be considered in subdividing the taxon. In some plants the proximal pinnule of the basal pinnae is reduced in size and thus not auriculate as the distal pinnae. The basiscopic pinnules of these pinnae are often more significantly reduced than the acroscopic pinnules. In others, however, the pinnules show no reduction of size on the lower pinnae.

Stipe paleae also show variation. In some plants the larger paleae are variously impregnated with the central part of the paleae often dark brown to black and nitid with a narrow membranous margin. These paleae are generally persistent for a long time, resulting in the non-impregnated margin being worn away. In others the paleae are reddish brown and remain membranous.

DISTRIBUTION AND ECOLOGY. *Polystichum zambesiacum* ranges from the eastern highlands of Zimbabwe and adjacent Mozambique to Mount Mulanje and the Nyika Plateau in Malawi and the Uluguru, Usambara and Pare Mountains in Tanzania.

Polystichum zambesiacum is a terrestrial or epilithic species occurring in high-altitude, evergreen, montane mist forests, along forest margins and streambanks in forests. It has been reported on Mount Inyangani, Zimbabwe, from open montane grassland, and in the Uluguru Mountains from rock outcrops.

Being a high altitude species, *Polystichum zambesiacum* is restricted to the often isolated high mountains of east Africa. In Zimbabwe and Mozambique it is confined to the Chimanimani and Nyanga Mountain ranges occurring between 1370 and 2540 m. In Malawi the fern is only known from Mount Mulanje in the south (1800–1950 m) and the Nyika Plateau in the north where it occurs between 1800 and 2550 m. In the Uluguru Mountains, Tanzania, it occurs at elevations ranging between 1050 and 2500 m. Further north, in the Usambara and Pare Mountains it occurs at 1850 to 1950 m, but is reported to be rare (Schippers, 1993).

14. **Polystichum monticola** N.C. Anthony & Schelpe in *Bothalia* **15**: 554 (1985); *Fl. Sthn. Afr., Pterid.*: 257 (1986); Burrows, *Sthn. Afr. ferns and fern allies*: 314, f. 75, t. 320a-c (1990). Type: Cape Peninsula, Table Mountain, Dark Gorge, below saddle SE side, sheltered gully, dry in summer, on steep rocky slopes, *Esterhuysen* 26685 (BOL!-holotype; B, C, CHR, G, GH, K, M, MO, NBG!, NU, P, PR, PRE!-isotypes).

Fig. 14.

Plants terrestrial or epilithic. *Rhizome* short-decumbent, closely branched, to 14 mm in diameter, set with roots, crowded persistent stipe bases, and paleae; paleae broadly attached, ferrugineous, membranous, narrowly oblong to narrowly linear, cordate, the margins entire or with widely spaced, short, apically or basally directed outgrowths, the apex acicular or with a thin-walled apical cell, to 26 × 1.8 mm. *Fronds* closely spaced, 5–8 per plant, suberect to arching, to 840 mm long: *stipe* proximally castaneous, stramineous distally, adaxially sulcate, to 385 mm long, to 5 mm in diameter, densely paleated; larger paleae broadly attached, concolorous or bicolorous, stramineous or with a castaneous central section, these occurring on the proximal third of the stipe, lanceolate to broadly ovate, cordate to cordate-imbricate, the margins with closely to widely spaced, short, straight or curved, often branched fimbriae, the apex acicular or with a thin-walled apical cell, to 20 × 7 mm; smaller paleae short-stalked, narrowly lanceolate to narrowly triangular, cordate to cordate-imbricate, the margins proximally with closely spaced, short and long, often branched fimbriae, the apex entire or with short, firm, widely spaced fimbriae terminating in an acicular cell or with a thin-walled cell: *lamina* 2-pinnate to 2-pinnate-pinnatifid, firmly herbaceous, dark green adaxially, paler abaxially, narrowly ovate to elliptic, to 510 mm long, proximally somewhat reduced, the proximal pinnae usually somewhat deflexed: *rachis* stramineous, adaxially sulcate, densely paleated; paleae short-stalked, ferrugineous, chartaceous, narrowly lanceolate, narrowly ovate or narrowly triangular, cordate to cordate-imbricate, the margins proximally with long and short, straight or twisted marginal outgrowths becoming simple towards the apex, the apex usually acicular, rarely terminating in a thin-walled apical cell, to 11.5 × 2.5 mm: *pinnae* often widely spaced proximally, somewhat overlapping distally, oblong-attenuate to narrowly oblong-attenuate, to 170 × 30 mm: *pinna-rachis* stramineous, adaxially sulcate, densely set with paleae similar to but smaller than those on the rachis, to 7 × 1.5 mm: *pinnules* opposite to alternate, closely spaced, often imbricate, asymmetric, narrowly ovate to ovate, acroscopically auricled, serrate to lobate-serrate, sharp-tipped to aristate, the proximal acroscopic pinnule the largest, the proximal pinnules often acroscopically incised to or near to costa, to 22 mm long; adaxially with a few simple and filiform or proximally hastate paleae along the proximal part of the costa, the apical cell always acicular, to 4.5 mm long; abaxially sparsely set with ferrugineous, short-stalked, narrowly triangular to subulate paleae, proximally usually with a few short or long, straight or curved outgrowths, the apical cell always acicular, to 4 × 0.9 mm long. *Venation* immersed. *Sori* circular, *c.* 1.5 mm in diameter, essentially uniseriate, terminal or near terminal on abbreviated vein branches: *sporangium* with 7–(12)–21 indurated annulus cells; stalk eglandular: *indusium* stramineous to castaneous, often black-centred, peltate, circular, entire to repand, the maximum radius 0.31–(0.61)–1.04 mm, persistent. *Spores* brown, 32 per sporangium, the perispore variable, folded to form a reticulum of inflated or compressed ridges and/or tubercles, the crests and areas between echinulate to spiculate, the areas between ridges perforated, the exospore 38–(59.07)–74 × 22–(43.76)–60 µm. *Chromosome number* 2n=246, apogamous.

MATERIAL EXAMINED

LESOTHO. 2828 (Bethlehem): Leribe (CC), *Dieterlen* 167, in part (B); Mafeteng, Mont Ka-majapela, *Dieterlen* s.n. (BR); Leribe, 5000–6000 ft, *Dieterlen* 695 (NBG, PRE, SAM). **2927 (Maseru)**: Mamathes District, 5850 ft (BB), *Guillarmod* 835 (PRE); Roma, 5550 ft (BC), *Ruch* 1909 B-only (PRE); Roma, W. ravine, *Schmitz* 399 (PRE); Roma, SE-facing slope, *Schmitz* 402 (PRE), Roma, *Schmitz* 6888 (PRE); Morija (DA), *Dieterlen* 1309 A-only (PRE). **2929 (Underberg)**: Sehlabathebe National Park, Mofoqoi, 2350 m, *Hoener* 1479 (BOL).

SOUTH AFRICA. 2730 (Vryheid): Hlobane, *Johnstone* 295 (NH). **2828 (Bethlehem)**: Clarens, mountain N. of Leibrandt Kloof (CB), *Roux* 937 (NBG); Golden Gate National Park, NE of Glen Reenen Camp, 6200 ft (DA), *Liebenberg* 7498 (PRE); Golden Gate National Park, Wonderhoek, *Gertenbach & Groenewald* 9167 (PRE); Golden Gate National Park, *Roberts* 3235 (PRE); Golden Gate National Park, *Rossouw* 406 (BOL); N. of Montaux-Sources, Witsieshoek area, 1800 m (DB), *Junod* 14 (P); Royal Natal

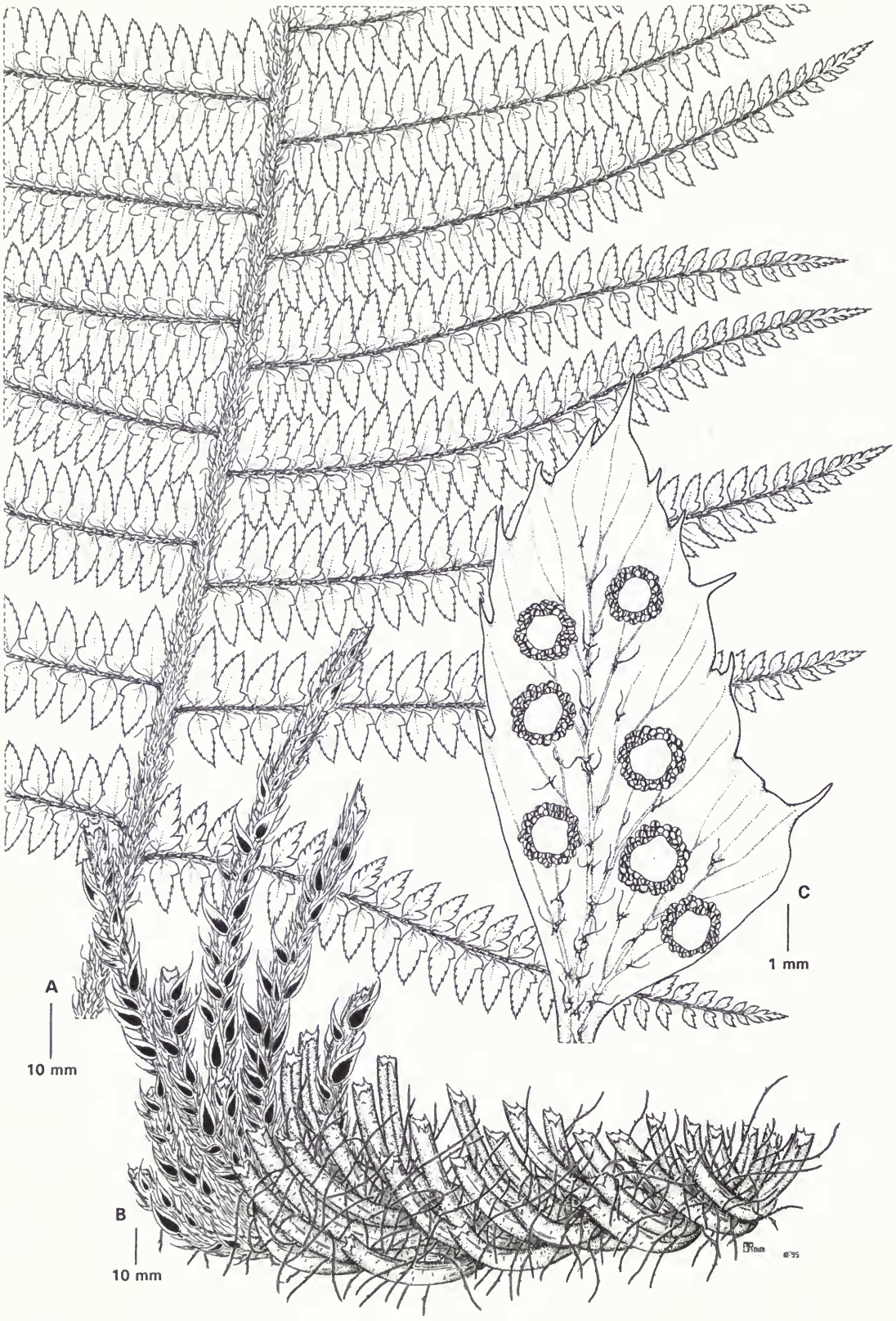

Fig. 14 *Polystichum monticola*. A, proximal part of lamina; B, rhizome; C, abaxial surface of fertile pinnule. A, B, drawn from *Roux* 2581 (NBG); C, drawn from *Van Jaarsveld* 6494 (NBG).

National Park, Gudu Forest, *Edwards* 325 (NU, PRE); Royal Natal National Park, Gudu Forest, *Roux* 2513 (NBG); shady gully on the Lion facing the Tugelana Valley, *c.* 6300 ft, *Esterhuysen* 35645 (B, BOL, NBG, NU, PRE); Witsieshoek, 6000–7000 ft, *Thode* s.n. (NBG); Royal Natal National Park, Gudu Forest, 5000 ft, *Schelpe* 1455 (NU); Mont-aux-Sources, *Bottomley* s.n. (PRE); Mont-aux-Sources, Tugela River, near gorge, *Hutchinson* 41 (PRE); Mont-aux-Sources, *Schweickerdt* 760B (PRE); Royal Natal National Park, *West* 1284 (PRE); Quaqua mountains, Lefika, *Rustenberg* s.n. (P); versant N. du Mont-aux-Sources, region de Witsies Hoek, *c.* 1800 m, *Junod* 14 (P). **2829 (Harrismith)**: Swinburne, Boschhoek, E. slope of Manyenyeza (AC), *Jacobsz* 4711 (PRE); Harrismith, Platberg, valley below Monkey Point, *Roux* 2520 (NBG); Platberg, 1600 m, *NBG Exped.* s.n. (BOL); Harrismith, Platberg, 1600 m, sine coll. 151191 (NBG); Harrismith, Platberg, dolerite cliffs left of summit of Donkey's Pass, *Roux* 2528 (NBG); Platberg, in shade of concrete furrow leading to Hawkins Dam, 2220 m, *Roux* 2527 (NBG); Harrismith, Platberg, *Roux* 2523 (NBG); Harrismith, Kerkenberg, *Schelpe* 7278 (BOL); Cathedral Peak area, nKdhlanhla Forest, *Schelpe* p.47 (NU); Cathedral Peak area, 5000 ft, *Brass* 76 (NU); Cathedral Peak area, Indumeni Forest, 5100 ft, *Schelpe* 737 (NU); Van Reenen, 6800 ft (AD), *Schlechter* 6932 (B, NBG, PRE); Oliviershoek Pass, forests S. of Seheletwane (CA), *Roux* 2518 (NBG); Oliviershoek, 6000–7000 ft, *Thode* s.n. (NBG); Cathedral Peak Hotel, along Cathedral Peak path, 1500 m (CC), *Goetghebeur* 4563 (BR, PRE); Cathedral Peak area, *Brass* 67, 79, 82, 96, 98 (NU); Cathedral Peak Forest Station, 6050 ft, *Killick* 1134 (NU); Cathedral Peak area, 2000–3000 ft, *Wilker* 69 (NU); Drakensberg, MnWeni Pass, *c.* 8500–9000 ft, *Esterhuysen* 27830 (PRE). **2831 (Nkanhla)**: Ngoye, 2–3000 ft (DC), *Medley-Wood* 10886 (PRE). **2926 (Bloemfontein)**: Thaba 'Nchu Mountain, 6500 ft (BB), *Roberts* 2998 (PRE). **2929 (Underberg)**: Giants Castle Nature Reserve, forests above Hillside campsite, c. 1600 m (AB), *Roux* 2499, 2501, 2506, 2507 (NBG); Injasuti area, 5000 ft, *Esterhuysen* 26041 (BOL); Kamberg area, Storms Heights, *c.* 7000 ft (BC), *Hilliard & Burtt* 11795 (NU, PRE); Mpendhle District, Mulangane Ridge, above Carter's Nek, 7000–7300 ft, *Hilliard & Burtt* 16951 (BOL); 18406 (NBG, PRE); Kamberg, 'Game Pass', 6100 ft, *Gordon-Gray* 85 (NU); Drakensberg Garden State Forest Reserve, near Mlambonja River (CA), *Van Jaarsveld* 6492, 6494 (NBG); Drakensberg Gardens, 6000 ft, *Bronhead* 59 (NU); Drakensberg Gardens, *Dyer* 73 (NU); Drakensberg Garden area, 6000 ft, *Schelpe* p54 (NU); Drakensberg Garden Hotel, up to Rhino Peak, along Mlambonja River, 2000 m, *Goetghebeur* 4519 (BR, PRE); Gxalingenwa Valley between Sani Pass and Polela Valley, *c.* 6700 ft (CB), *Hilliard & Burtt* 17076 (NU, PRE); Cobham Forest Station, Ndlovini, Troutbeck, *c.* 6000 ft, *Hilliard & Burtt* 13311 (NU), 13329 (BOL, NU); Cobham Forest Reserve, Sipongweni, 6500 ft, *Hilliard & Burtt* 14135 (BOL, NU, PRE); Cobham Forest Reserve, 'Lakes' Cave area, *c.* 7800 ft, *Manning* et al. 15918 (BOL, NU); Garden Castle area, 9000 ft (CD), *Crooked* 62 (NU); Garden Castle area, *Elliott* 31 (NH), 37 (NU); Boston, Impendhle, 5000 ft (DB), *Randles* 185 (NU); Impendhle, 5200 ft, *Clarkson* 133 (NU); Impendhle, *c.* 5000 ft, *Huntley* 167 (NU); Bulwer, Marwaga Mountain, farm Sunset, 1810 m (DC), *Roux* 2309 (NBG); Farm Sunset, 5800 ft, *Rennie* 1441 (NU, PRE); Himeville District, 5000 ft, *Webb* 101 (NU); Farm Sunset, gully above dams, 6000 ft, *Rennie* 1055 (NU); Polela District, near Bulwer (DD), *Henkel* s.n. (NU); Bulwer, 5100 ft, *Clarkson* 182 (NH, NU, PRE); Bulwer, *Allsopp* 843 (NU). **2930 (Pietermaritzburg)**: Zwaartkop (CB), *Sim* s.n. (NU, PRE). **3018 (Kamiesberg)**: Kamiesberg, Rooiberg, 5500 ft (AC), *Rourke* 1684 (BOL, NBG, PRE); Rooiberg, farm Damsland, *Roux* 2453 (NBG). **3027 (Lady Grey)**: Herschel District, Majuba Nek, *Hepburn* 262, B-only (GRA). **3028 (Matatiele)**: Ongeluks Nek, *c.* 4 km from Lesotho border post, 2250 m (AB), *Matthews* 916 (NBG). **3029 (Kokstad)**: Mt. Currie, farm Highland Home (AB), *Roux* 2488, 2490 (NBG); Mt. Currie, *Edwards* 214a (NU); Mt. Currie, 5200 ft, *Edwards* 44 (NU); Kokstad (CB), *Mogg* 1927 (PRE). **3030 (Port Shepstone)**: Ixopo (AA), *Hancock* s.n. (NU). **3124 (Hanover)**: Compassberg, near top, *c.* 2440 m. (DC), *Trollip* s.n. (PRE); top of Compassberg, *Coetzee* s.n. (PRE); Compassberg, farm Grootkop, 6300 ft, *Acocks* 23447 (PRE). **3126 (Queenstown)**: Broughton, near Molteno (AD), *Flanagan* s.n. (SAM); Broughton near Molteno, *Flanagan* 1681 (PRE); Broughton, Molteno, 6300 ft, *Flanagan* 527 (PRE); Queenstown, Hangklip Mountain, 6600 ft (DD), *Roberts* 2012 (PRE). **3128 (Umtata)**: Maclear, farm Woodcliffs (AB), *Roux* 2481, 2484, 2485 (NBG). **3218 (Clanwilliam)**: Clanwilliam Division, between Tafelberg and Spout, 6000 ft (BB), *Schelpe* 1960 (BOL, K). **3219 (Wuppertal)**: Gideon's Kop, 1500 m (CB), *Burrows* 1235 (BOL). **3224 (Graaff-Reinet)**: Mount Oudeberg near Graaff-Reinet (DD), *sine coll.* 96897 (B); in fissuris rupium in monte Oudeberg prope Graaff-Reinet, 4800 ft, *Bolus* 1736 (BOL, K). **3225 (Somerset East)**: Montis Boschberg (DA), *MacOwen* 870 (BR). **3226 (Fort Beaufort)**: Katberg, 3500–4000 ft (BC), *Baur* 865 (B, GRA); Katberg Pass summit, farm Pleasant View, *Roux* 2697 (NBG); Hogsback, Elandsberg summit (DB); *Roux* 2688 (NBG); Hogsback, Zincucha Forest, *Roux* 2683 (NBG). **3318 (Cape Town)**: in numerosis umbrosis montis Tafelberg, Paradys (CD), *MacOwen* s.n. (P); Table Mountain, Dark Gorge, below Saddle, SE side, *Esterhuysen* 26563 (B, BOL, PRE); Stellenbosch, Jonkershoek, Langrivierkloof (DD), *Roux* 2580, 2581, 2582, 2583 (NBG); Stellenbosch, Simonsberg, 3000 ft, *Esterhuysen* 25453 (BOL); Stellenbosch, Helderberg, Disa Gorge, *Esterhuysen* 28475 (BOL). **3319 (Worcester)**: Great Winterhoek Mountains, 4000–5000 ft (AA), *Esterhuysen* 26982 (B, BOL, NBG, PRE); Tulbagh, W. slopes of Swartgat Peak, Witzenberge, 4000 ft (AC), *Esterhuysen* 16914 (BOL, NBG); Tulbagh, Great Winterhoek Mountains, 5500 ft, *Esterhuysen* 19787 (BOL, NBG); Ceres, Baviaansberg (BA), *Stokoe* s.n. (NBG, SAM); shale band below Milner Peak, Hex River Mountains, 5000 ft (AD), *Esterhuysen* 14264 (BOL), 14885 (BOL, NBG); Milner Ridge Peak and Buffels Dome, 5000 ft, *Esterhuysen* 28708B (BOL); Ceres, Slab Peak, 1310 m, *Winter* 431 (NBG); Hex River Mountains, Moraine Kloof, *c.* 4000 ft, *Ashton* 352 (BOL); Goudini, Waaihoek Mountains, 4000 ft (CB), *Barnard* s.n. (SAM). **3320 (Montagu)**: Boesmansbos (DD), *Adamson* s.n. (BOL). **3321 (Ladismith)**: Swartberg, near Ladismith, Toverkop, 6500 ft (AC), *Esterhuysen* 26698 (B, BOL, NBG, NU, PRE); below Toverkop on S. slope of Swartberg, 5000–6000 ft, *Esterhuysen* 14013 (BOL, PRE); cliffs at base of Toverkop, 6500 ft, *Esterhuysen* 18511 (BOL). **3322 (Oudtshoorn)**: Prince Albert Division, Swartberg Mountains (AC), *Stokoe* 9410 (NBG, SAM); Prince Albert, *Popta* s.n. (L); Blesberg, 6000 ft (BC), *Esterhuysen* 24920 (BOL); Montagu Pass (CD), *Schweickerdt* 4705 (PRE); Kammanassie Mountains, Mannetjiesberg, 4200 ft (DB), *Matthews* 1023 (NBG); S. slope of Mannetjiesberg, Kammanassie Mts, 5000 ft, *Esterhuysen* 18396 (BOL). **3323 (Willowmore)**: Hoopsberg, S. slope, 5000 ft (CB), *Esterhuysen* 6557 (BOL). **3324 (Steytlerville)**: S. slopes of Kouga Peak near Joubertina (CA), *Esterhuysen* 16280 (BOL, NBG); Uitenhage, Cockscomb, Great Winterhoek mountains, 4800 ft (DB), *Esterhuysen* 27090 (BOL, PRE).

ZIMBABWE: Victoria Falls, *Sim* s.n. (PRE).

WITHOUT EXACT LOCALITY: Orange Free State, Wittebergen, ad Caledonrivier, *Rehmann* 3938, 3978 (B); Natal, *sine coll.* s.n. (NBG); Blinkwater Bush, *Graham* 84 (NU); Transvaal, *Repton* 5B (PRE); in summo monte Koudveld, 6500 ft, *Tyson* 140 (PRE); in sylvis umbrosis faecium montium Hott. Holland., *sine coll.* 341 (S); Malappa's Place, *Rustenberg* s.n. (P); Natal, *sine coll.* s.n. (BR); Basotholand, *Koopowitz* s.n. (GRA); Bushmans Cave, *Lubke* s.n. (GRA).

DIAGNOSTIC FEATURES AND RELATIONSHIPS. *Polystichum monticola* is characterized by its largely montane habitat, the usually large stands it forms, the short decumbent rhizome clothed by long, narrowly linear to cuspidate paleae, the closely spaced, firmly herbaceous fronds, smallish pinnules, bicolorous larger paleae on the proximal part of the stipe, short-stalked paleae with proximal margins that bear stiff, often branched outgrowths, and with an apical cell that is not thin-walled, the relatively large repand to entire, persistent indusia, the 32 spores borne by each sporangium, and the somatic chromosome number of 2n=246.

In palea morphology *Polystichum monticola* exhibits features of sections *Lasiopolystichum* and *Metapolystichum*. Both of these sections are characterized by short, unbranched, suberect to erect rhizomes resulting in the plants growing as individuals. In *P. monticola*, however, the rhizome is decumbent and mostly repeatedly branched: as a result plants form large clonal stands. In spore morphology it is closer to section *Metapolystichum* than to section *Lasiopolystichum*.

VARIATION. Depending on habitat, *Polystichum monticola* shows considerable variation in frond size, lamina texture, pinnae arrangement and pinnule size. Plants from xeric habitats have short fronds with closely spaced pinnae and small imbricate pinnules that are

firm-herbaceous in texture. Some collections proved to have unusually large indusia, with a maximum radius up to 1.04 mm having been measured on a plant from Milner Peak in the Hex River Mountains [*Esterhuysen* 14885 (NBG, BOL)]. Indusia of the type collection are unusually small with the mean radius being merely 0.36 mm (n=6). Collections with these unusually large indusia occur at random throughout the distribution of the species and cannot be ascribed to any environmental condition. The same pattern applies to the often black-centred indusia. Although the number of indurated annulus cells per sporangium is relatively uniform in the species, unusually low and high numbers have been recorded. A plant from Leribe, Lesotho [*Dieterlen* 695 (SAM)] has sporangia with the number of indurated annulus cells varying between 7 and 13 (x=10.66; n=50), whereas a plant from Platberg, Harrismith [*Roux* 2523 (NBG)] has sporangia with the number of indurated annulus cells varying between 13 and 17 (x=14.7; n=50). Plants from forest habitats generally have larger fronds that are softer in texture to those occurring in more exposed habitats where the fronds are smaller and firm-herbaceous to subcoriaceous.

DISTRIBUTION AND ECOLOGY. *Polystichum monticola* is confined to southern Africa where it has been recorded from the Northern Cape, Western Cape, Eastern Cape, KwaZulu-Natal and Free State, as well as in Lesotho, with one isolated record from the Victoria Falls in Zimbabwe that needs to be confirmed. The species is largely confined to the mountains ranging from the Cape Peninsula, along the southern Cape mountains to the Drakensberg Escarpment as far north as Platberg in the northeastern Free State. Plants have also been recorded from outlying locations such as the Kamiesberg in the Northern Cape Province and from Thaba 'Nchu Mountain in the eastern Free State. This apomictic taxon occurs at elevations ranging from 600 to 2740 m in often xeric environments. The habitat includes rock crevices in screes, cliff bases, streambanks, forest margins and forest floors. Often growing in exposed habitats where it forms large masses, the species is frequently exposed to veld fires, from which it soon recovers.

15. **Polystichum dracomontanum** Schelpe & N.C. Anthony in *Contr. Bolus Herb.* **10**: 145 (1982). Type: Natal, Bergville Division, on banks above stream in side kloof west of main kloof, shortly above the Singati Cave (E. of Mont-aux-Sources), in unburnt sparse bush or small trees or in the open, *c.* 6000 ft, *Esterhuysen* 35646 (BOL!-holotype; B!, BOL!, C, GH, K, M, MO, NU!, P, PRE!, S-isotypes).

Fig. 15.

Plants terrestrial or epilithic. *Rhizome* decumbent, stoloniferous, to 10 mm in diameter, densely set with roots, persistent stipe bases, and paleae; paleae ferrugineous, broadly attached, chartaceous, linear-attenuate, entire, the apex terminating in a small thin-walled cell, to 28 × 2 mm. *Fronds* closely spaced, 5–7 per plant, erect or arching, to 1.15 m long: *stipe* proximally castaneous, stramineous distally, adaxially sulcate, to 540 mm long × 6 mm in diameter, initially densely paleated, becoming glabrous with age, proximally with paleae similar to those on the rhizome, the paleae distally of two types; larger paleae broadly attached, ferrugineous to castaneous throughout or stramineous to ferrugineous with a castaneous central region or apex, chartaceous, narrowly ovate to ovate, cordate, the margins with short, straight or curved projections, the apex often flagelliform, terminating in a thin-walled cell, to 25 × 6 mm; smaller paleae ferrugineous to stramineous, membranous, narrowly ovate to lanceolate, cordate to cordate-imbricate, the margins closely set with short and/or long, straight or curved, often branched outgrowths, the apex flagelliform, acicular or terminating in an oblong to clavate thin-walled cell, to 11.5 × 1.8 mm: *lamina* 2-pinnate to 2-pinnate-pinnatifid, with up to 24 free pinna pairs, ovate, to 610 mm long: *rachis* stramineous to greenish, adaxialy sulcate, initially densely paleated; paleae short-stalked, membranous, narrowly lanceolate to narrowly ovate, cordate to cordate-imbricate, the margins proximally with long and/or short, straight or curved, often branched outgrowths, the apex acicular or flagelliform and terminating in a thin-walled cell, to 7.3 × 1.6 mm: *pinnae* proximally short-stalked, 1-pinnate to 1-pinnate-pinnatifid, with up to 18 free pinnule pairs, proximally widely spaced, often slightly reduced, distally often overlapping, ovate to narrowly ovate, to 105 mm long: *pinna-rachis* stramineous, adaxially sulcate, initially densely paleated; paleae stramineous, membranous, narrowly oblong to narrowly triangular, cordate to cordate-imbricate, the margins proximally with long and/or short, curved, often branched outgrowths, the apex acicular, to 9.75 × 2 mm: *pinnules* opposite to alternate, firmly herbaceous to coriaceous, dark green adaxially, paler abaxially, proximally widely spaced to imbricate, asymmetric, ovate to ovate-rhomboid, often somewhat falcate, acroscopically auricled, serrate to doubly-serrate, sharp-tipped to strongly aristate, the margins somewhat revolute, the proximal acroscopic pinnule usually slightly longer than the next, to 22 mm long; adaxially glabrous or with a few stramineous, membranous, filiform, acicular paleae along proximal part of the costa, to 9.5 mm long, abaxially sparsely paleated; paleae short-stalked, stramineous, membranous, filiform, narrowly oblong to narrowly triangular, cordate, the margins proximally with short and/or long, straight or curved outgrowths, the apex terminating in an acicular cell or with a thin-walled cell, to 8 mm long. *Venation* immersed or raised. *Sori* circular, *c.* 2 mm in diameter, terminal or near-terminal on abbreviated vein branches, uniseriate, discrete to confluent at maturity: *sporangium* with 10–(13)–21 indurated annulus cells; stalk eglandular: *indusium* ferrugineous to stramineous, chartaceous, persistent, peltate, circular, with or without central processes, repand to weakly erose, the maximum radius 0.63–(0.81)–1.09 mm. *Spores* 64 per sporangium, brown, the perispore globose or folded to form inflated or narrow reticulate ridges, minutely and sparsely perforated, the ridges and areas between echinate to echinulate, the exospore 25–(54.24)–70 × 28–(41.04)–58 µm. *Chromosome number* unknown.

MATERIAL EXAMINED

LESOTHO. 2927 (Maseru): pente de la montagne de Mathatha district de Mafeteng (CC), *Dieterlen* s.n. (P).

SOUTH AFRICA. 2828 (Bethlehem): Tugela Gorge above chain ladder, 6200 ft (DB), *Hilliard & Burtt* 15445 (BOL, NU); Royal Natal National Park, Tugela Gorge, scrub above chain ladder, *Roux* 2715 (NBG); tributary flowing into the Singati, E. of Mont-aux-Sources (DD), *Esterhuysen* 35644 (B, BOL, NBG, PRE); Bergville, Mont-aux-Sources, *Schweickerdt* 760 (PRE); Mbunduni (MnWeni area), 9000 ft, *Esterhuysen* 27811 (BOL); MnWeni Pass, 8000 ft, *Esterhuysen* 27839 (BOL, PRE). **2829 (Harrismith)**: Farm Bosch Hoek (AD), *Roux* 896, 897, 898 (NBG); MnWeni area, foot of Rockies Pass, 5500 ft, (CB), *Esterhuysen* 21656 (BOL); Rockies Pass, 8000 ft, *Edwards* 2145 (NU); Cathedral Peak area, shady side of kloof (CC), *Esterhuysen* 15486 (BOL, NBG); Cathedral Peak, sheltered slopes below Cleft Peak, 8000 ft, *Esterhuysen* 10199a (BOL, PRE); between Cathedral Peak and Royal Natal National Park, MnWeni Pass, 9000 ft, *Edwards* 851 (NU, PRE); SE slope of The Camel, 8700 ft, *Everson* 73, 74 (BOL); NE facing slope of The Camel, 8700 ft, *Everson* 75, 76 (BOL); Bergville, Orange Peel Gap, 7200 ft, *Everson* 71, 72 (BOL); NE slope of The Camel, 7000 ft, *Schelpe* 756 (NU); Orange Peel Gap, 2420 m, *Crouch* 647 (NU); Cathedral Peak, *Nixon* s.n. (NU); Cathedral Peak area, Umbonbonja River, 6000 ft, *Schelpe* 1096 (NU). **2929 (Underberg)**: Injasuti Valley, Solitude (AB), *Malan* 7 (BOL, NBG); Injasuti Nature Reserve, *Leucosidea* scrub at campsite, *Roux* 2721 (NBG); Ndedema Valley, 6000 ft, *Noel* 1281 (GRA); Injasuti

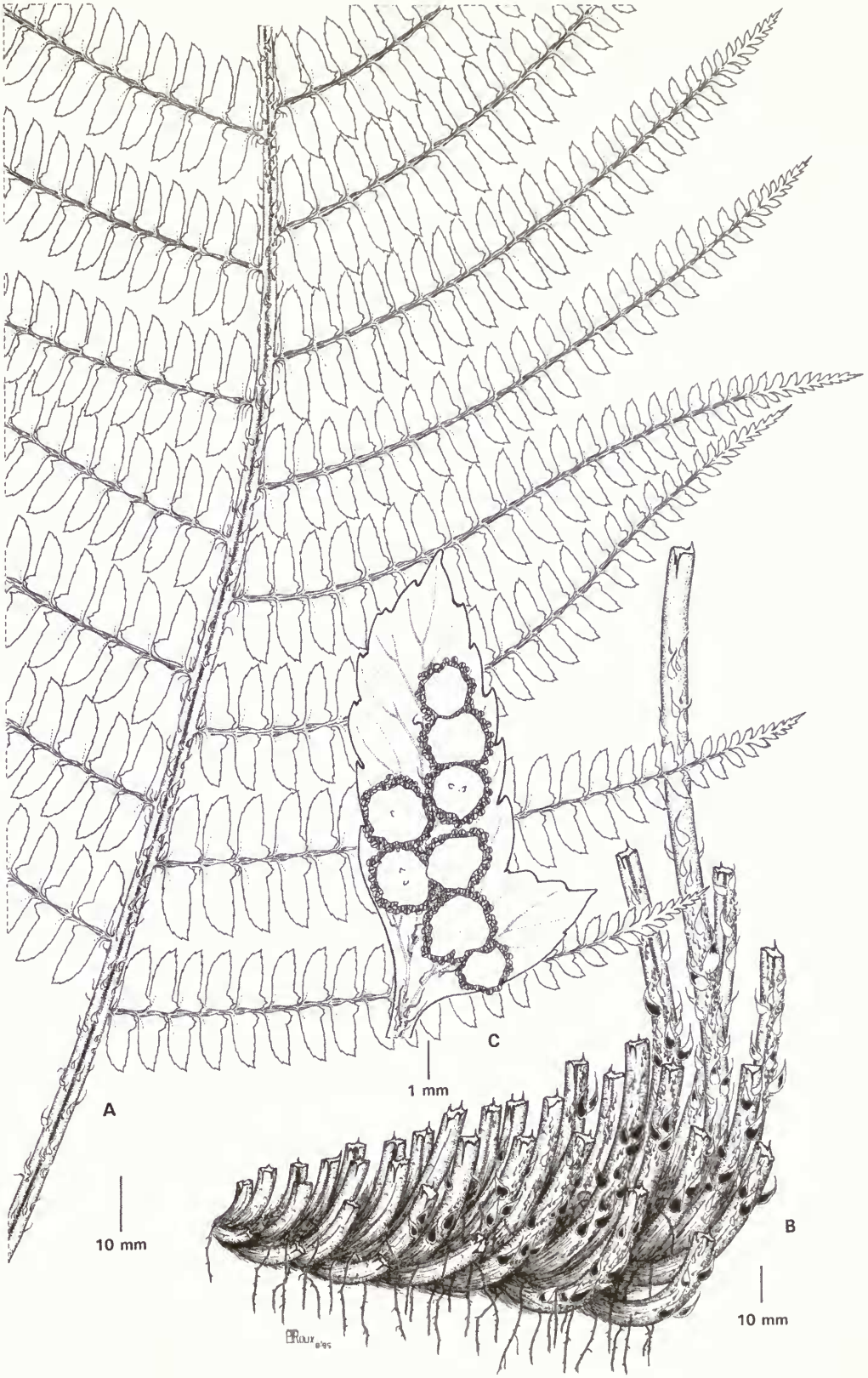

Fig. 15 *Polystichum dracomontanum.* A, proximal part of lamina; B, rhizome; C, fertile pinnule. All drawn from *Esterhuysen* 35646 (BOL).

area, 6500 ft, *Esterhuysen* 35219 (BOL); Injasuti area, 6500–8000 ft, *Esterhuysen* 26039 (BOL); Injasuti area, 7000 ft, *Esterhuysen* 26050 (K); Tabamhlope Mountain, 6000 ft (BA), *West* 184 (PRE); Mulangane Ridge, above Carter's Nek, 7000–7300 ft (BC), *Hilliard & Burtt* 17032, 17529 (BOL, NU, PRE); 5–7 miles NNW of farm Castle View, headwaters of Mlahlangubo River, 6700 ft (CB), *Hilliard & Burtt* 15188 (BOL, K, NU); Cathedral Peak, Ndumeni Valley, 1950 m (CC), *Farrell* 21 (NH).

DIAGNOSTIC FEATURES AND RELATIONSHIPS. *Polystichum dracomontanum* may be confused with *P. monticola*, which occurs in the same region and often in similar habitats. It can, however, be separated from it in the decumbent rhizome that produces slender stoloniferous branches, in the stipe that becomes near glabrous with age, and in the ovate lamina. Other diagnostic features are the entire rhizome paleae that evidently always terminate in a short thin-walled cell, in contrast to the often acicular apical cell in *P. monticola.* Paleae from the stipe, rachis, pinna-rachis and abaxial lamina surface appear to terminate more often in a thin-walled cell in contrast to those of *P. monticola*, where the apical cell appears to be largely acicular. The adaxial surface of the pinnules is largely glabrous but a few filiform paleae may occur proximally along the costa. These paleae always terminate in an acicular apical cell. Paleae from the abaxial surface of the pinnules largely terminate in an acicular apex, but paleae terminating in a short thin-walled cell are not unknown. The smaller paleae in *P. dracomontanum* are stramineous and membranous. The coriaceous lamina and somewhat revolute pinnule margins are also diagnostic. Micromorphological characters separating *P. dracomontanum* from other taxa are the small, almost square, adaxial epidermal cells with almost straight anticlinal walls and the almost circular stomata that are visible at a ×12 magnification. Considering the rhizome and palea morphology, *P. dracomontanum* is allied to the *P. pungens* group of species.

VARIATION. Relatively little variation occurs within the species. Variation was observed in the colour of the larger stipe paleae. In most cases they are stramineous to ferrugineous throughout, but in a few collections they are centrally castaneous with a narrow stramineous margin. The paleae also show some variation in that some terminate in a long acicular cell whereas others may terminate in a short, thin-walled cell. Pinnules vary in size and in the margins that may be sharp-tipped to aristate.

DISTRIBUTION AND ECOLOGY. *Polystichum dracomontanum* is largely confined to the northern Drakensberg Escarpment between Lesotho and KwaZulu-Natal where it occurs on both the lower Clarens Sandstone and the upper basalt formations. The species also occurs further northwards along the escarpment between the Free State and KwaZulu-Natal. Isolated populations have also been reported from the Mafeteng District in southeastern Lesotho. It occurs at elevations ranging from 1675 to 2745 m. Within this distribution the species is restricted to two vegetation types as defined by Acocks (1988). Along the high Drakensberg escarpment it occurs in *Themeda-Festuca* Alpine Veld that receives an annual precipitation of 600–1900 mm. *Polystichum dracomontanum* occurs in grasslands and scrub forests associated with this vegetation type. To the north, along the escarpment between the Free State and KwaZulu-Natal, dominated by the Clarens Sandstone formation, the species occurs in sheltered forests of the Highland Sourveld type. Precipitation in this region measures between 750 and 1500 mm. The habitat includes streambanks, boulder bases, screes and scrub, and rarely also forests. *Polystichum dracomontanum* prefers moist cool slopes in shaded gullies and kloofs where it often forms large stands. At certain sites the species is subjected to regular veld fires, but this appears to have no adverse effect on plants.

16. **Polystichum incongruum** J.P. Roux in *Bot. J. Linn. Soc.* **125**: 36 (1997). Type: South Africa, 3320 (Montagu): Swellendam, Marloth Nature Reserve, Koloniesbos, in scree on dry E.-facing slope (CD), *Roux* 2377 (NBG!-holotype).

Fig. 16.

Plants terrestrial. *Rhizome* decumbent, stout, to 16 mm in diameter, sparsely branched, set with roots, crowded stipe bases, and castaneous to ferrugineous, chartaceous paleae. *Fronds* crowded, to 8 per plant, suberect to arching, to 1.8 m long: *stipe* proximally castaneous, stramineous for most of its length, adaxially sulcate, to 930 mm long × 7 mm in diameter, moderately to densely paleated; paleae at stipe base of two types, the larger broadly attached, ferrugineous to stramineous, membranous, narrowly to broadly ovate-acuminate, rarely with unicellular clavate cells on the paleae surface, cordate to cordate-imbricate, the margins with short close-set outgrowths, the apex often flagelliform, terminating in an acicular cell or an oblong thin-walled cell, to 20 × 6 mm, the smaller sessile to short-stalked, stramineous, membranous, narrowly ovate-acuminate to narrowly triangular, truncate to cordate-imbricate, with short and/or long, straight or curved, somewhat lacerate outgrowths proximally, the apex flagelliform, entire and twisted, mostly terminating in an acicular cell but often also in a thin-walled cell: *lamina* 2-pinnate to 3-pinnate, with up to 27 free pinna pairs, ovate to broadly ovate, to 870 mm long, the pinnae more widely spaced proximally, the distal pinnae often imbricate, the proximal pinnae not to strongly reduced, not or slightly deflexed: *rachis* stramineous, adaxially sulcate, moderately to densely paleated; paleae sessile to short-stalked, ferrugineous to stramineous, membranous, narrowly ovate-acuminate to narrowly triangular-acuminate, truncate, cordate or cordate-imbricate, the margins proximally with short and/or long, curved, often branched outgrowths reduced in size and number towards the apex, the apex often flagelliform, twisted, terminating in an acicular cell or an oblong thin-walled cell, to 12 × 3 mm: *pinnae* 1-pinnate to 2-pinnate, with up to 21 free pinnule pairs, narrowly oblong-attenuate to narrowly ovate-attenuate, themiddle pinnae to 265 mm long, to 95 mm wide: *pinna-rachis* stramineous, adaxially sulcate, moderately to densely paleated; paleae sessile to short-stalked, ferrugineous to stramineous, membranous, narrowly ovate-acuminate, narrowly triangular-acuminate to subulate, cordate to cordate-imbricate, the proximal margins with short and/or long, often branched outgrowths reduced in size and number towards the apex, the apex often flagelliform, twisted, largely terminating in an acicular cell but often also in an oblong thin-walled cell, to 7 × 2 mm: *pinnules* opposite to alternate, closely to widely spaced, often slightly imbricate, firmly herbaceous to coriaceous, dark green adaxially, slightly paler abaxially, inaequilateral, ovate to narrowly trullate, often somewhat falcate, basiscopically cuneate, acroscopically cuneate to truncate and auriculate, the larger pinnules commonly deeply incised to form free or nearly free, narrowly ovate, narrowly elliptic to narrowly obovate ultimate segments, the margins serrate to doubly serrate, rarely aristate, the proximal acroscopic pinnule to 60 mm long, to 13 mm wide, often overlapping the pinna-rachis above; adaxially sparsely set with stramineous, membranous, twisted paleae chiefly along the costa, these filiform, narrowly linear to narrowly linear-hastate, simple or with few short marginal outgrowths proximally, the apex usually terminating in an acicular cell but often also in an oblong thin-walled cell, to 4.5 mm long, abaxially moderately paleated; paleae stramineous, membranous, subulate to narrowly triangular, twisted, short-stalked, truncate to cordate, proximally with short and/or long, often branched, somewhat lacerate marginal outgrowths, the apex usually terminating in an acicular cell, up to 3.5 mm long. *Venation* adaxially

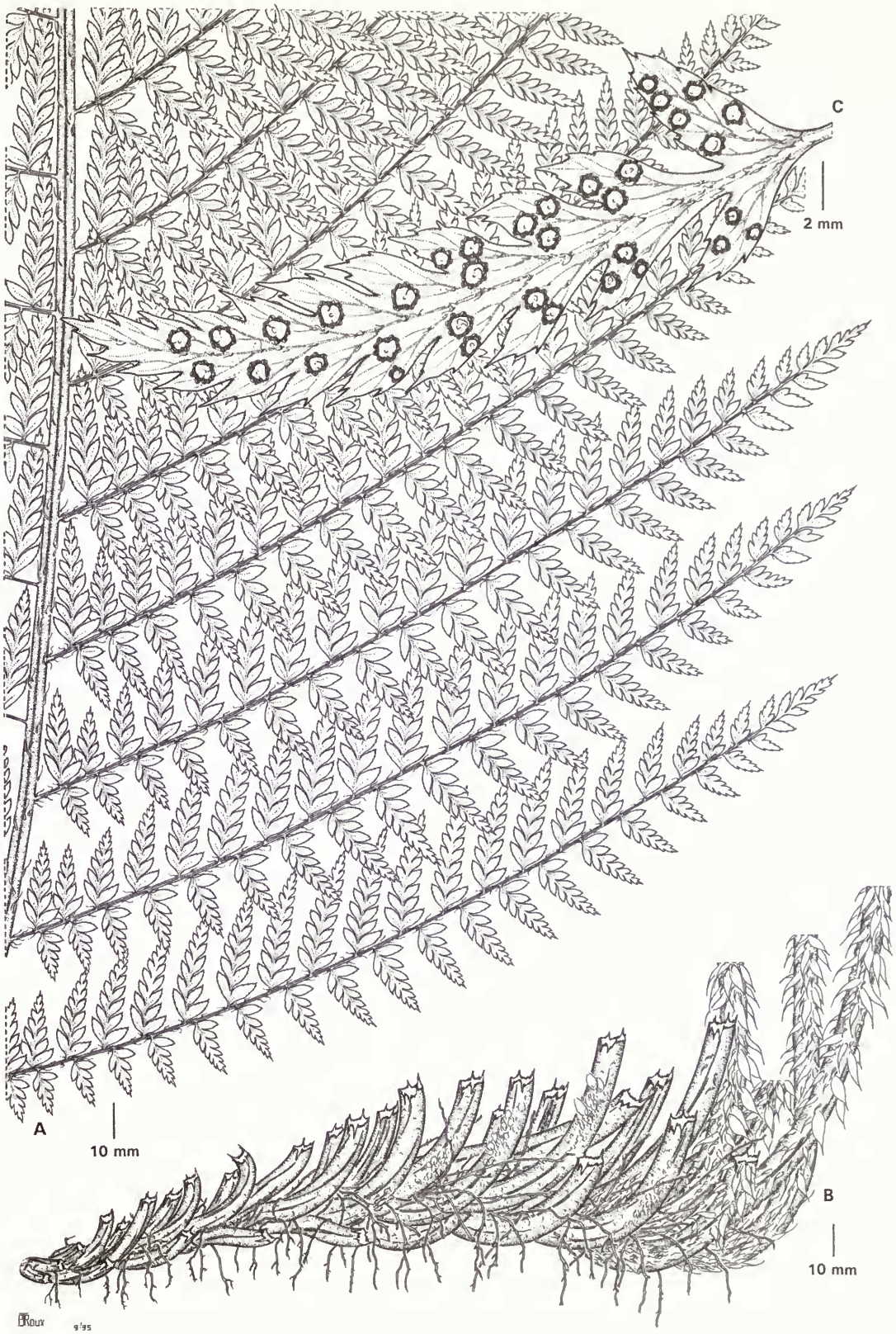

Fig. 16 *Polystichum incongruum*. A, middle pinnae of lamina; B, rhizome; C, abaxial surface of fertile pinnule. All drawn from *Roux* 2377 (NBG).

obscure, raised abaxially. *Sori* circular, up to 1.5 mm in diameter, terminal or near terminal on abbreviated vein branches, essentially uniseriate, discrete: *sporangium* with 11–(13)–21 indurated annulus cells; stalk glandular or eglandular: *indusium* stramineous or stramineous and black-centred, persistent, circular, simple or with central processes, the margins entire, minutely undulate to erose, often bearing clavate unicellular glands, the maximum radius 0.22–(0.46)–0.82 mm. *Spores* stramineous, the perispore folded to form narrow and broad reticulate ridges, the ridges crested, the crests and areas between minutely echinulate, porate, the exospore 30–(43.84)–72 × 22–(33.22)–52 µm. *Chromosome number* 2n=164, n=82.

MATERIAL EXAMINED

SOUTH AFRICA. 3226 (Fort Beaufort): summit of Katberg Pass (BC), *Roux* 2426 (NBG); Katberg forests, 3000 ft, *Adams* 113, 118, 134, 147 (NU); Hogsback, Zingcuka Forest (DB), *Roux* 2409, 2412 (NBG); Hogsback, Elandsberg, SE slope above scree, 4900 ft, *Furness & Phillipson* 49 (PRE); Hogsback, Auckland Forest Station, *Roux* 2418, 2419, 2420, 2421 (NBG); Hogsback Forest Reserve, 750 m, *Dahlstrand* 2926 (NBG); Hogsback Forest Reserve 'Fern Walk', 800 m, *Dahlstrand* 1550 (PRE); Auckland Forest, Hogsback, 750 m, *Dahlstrand* 2819 (NBG); Hogsback, 3900 ft, *Griffen* 1852 (PRE); Hogsback, *Buckner* s.n. (NU); Hogsback, *Dahlstrand* 1853 (NU); Hogsback, 4000 ft, *Hoal* 36 (NU); Middle Drift District, Hogsback, 3900 ft, *Schelpe* 6556 (B, PRE). **3227 (Stutterheim)**: Keiskamma Hoek, Gxulu Mountain, 5500 ft (BA), *Story* 3507 (PRE); Keiskammahoek, Gxulu Kop, 4500 ft (CA), *Wells* 3343 (PRE); Perie Forest (CB), *Sim* s.n. (PRE); Stutterheim, Evelyn Valley, *Taylor* 4203 (NBG); Mount Kemp, 5000 ft, *Sim* s.n. (PRE); Perie Forest, 4000 ft, *Sim* s.n. (PRE); Amabele (DA), *Hardcastle* 293 (NBG, PRE); ±1 km past Amabele station on road to Stutterheim, *Roux* 2678 (NBG). **3320 (Montagu)**: Swellendam, Koloniesbos (CD), *Roux* 2373, 2377, 2589, 2590, 2591 (NBG); Swellendam, Duiwelsbos, along trail leading to Die Plaat, *Roux* 2592, 2593, 2595 (NBG); Swellendam, Wamakersbos, *Roux* 2594 (NBG); Heidelberg, Grootvadersbos, Safraandraai (DD), *Roux* 2598 (NBG); Grootvadersbosch West, 1200 ft, *Kruger* 1322 (NBG, PRE); Grootvadersbos, *Plantkunde Dept. Univ. van Stellenbosch* s.n. (NBG); Swellendam, Strawberry Hill, *Esterhuysen* 10371 (BOL). **3322 (Oudtshoorn)**: Mossel Bay, Robinson Pass, Ruitersbos, Boesmansrivier, 1200 m (CC), *Roux* 2603, 2604, 2605, 2606 (NBG); Mossel Bay, Ruitersbos Forest Station, *Roux* 2381 (NBG); Groot Brakrivier, Jonkersberg Forest Station, Langbos, 380 m, *Roux* 2607, 2608, 2609, 2610, 2611, 2612 (NBG); Robinson Pass, 1700 ft, *Schelpe* 4989 (BOL); George, ±1 km from turnoff to Witklippen Forest on old George-Knysna road (CD), *Roux* 2391, 2392 (NBG); George, lower circular drive, 275 m, *Cameron* 90 (PIC-SERM); George, *Paterson* 1239 (BOL); George, *Schlechter* 525 (PRE); George District, 200 m, *Humbert* 9834 (PRE); George, Montagu Pass, forest at summit of pass, *Roux* 2613 (NBG); Montagu Pass, *Rehmann* 118 (B); Woodville Forest, 440 m (DA), *Roux* 2622, 2623, 2624, 2625 (NBG); George, on road to Bergplaas Forest Station, ±1 km past turnoff to Woodville hiking trail (DC), *Roux* 2395, 2396, 2397, 2398 (NBG); George, Saasveld Forest Station, Groenkop Research Area, *Roux* 2434 (NBG); George, Groenkop, Swartrivier, 300 m, *Van Daalen* 167 (BOL); old road between George and Knysna, above Touws River, Knysna side, 260 m, *Roux* 2620, 2621 (NBG); George, Groenkop Forest, *Geldenhuys* 394 (BOL); Wilderness, *Levyns* s.n. (BOL); George, Wilderness, *Mogg* 11656 (PRE); George, *Schlechter* s.n. TM525 (PRE); in silvis pr. George, 300 m, *Schlechter* 2441 (B); George, Wilderness, *Jacobsen* 2292 (PRE); George, Saasveld, forest above the reservoir, *Roux* 2384, 2385 (NBG); George, ±1.2 km from Saasveld turnoff on road to George, *Roux* 2437, 2438, 2439, 2440, 2441, 2614, 2615, 2616, 2617, 2618 (NBG); old road between George and Knysna, above Touwsriver, George side, 210 m, *Roux* 2619 (NBG); Goudveld Forest Reserve, Jubilee Creek forest walk, 340 m (DD), *Roux* 2627, 2629 (NBG); Farleigh Forest Station, forest above Platbos hut, *Roux* 2401 (NBG). **3323 (Willowmore)**: Concordia Forest Station, near Witklipdraai (CC), *Roux* 2637 (NBG); Knysna, Kom-se-Pad, Gouna Forest, Grootdraai picnic site, *Roux* 2638 (NBG); Knysna, Kom-se-Pad, 2.2 km from T-junction to Diepwalle, *Roux* 2405 (NBG); Knysna, Kleinbos, Buffelsnek, *Schelpe* 4312 (BOL); Knysna, Paardekop, *Steyn* 720 (NBG); Knysna, Deepwalls, *Schönau* 318 (BOL); Knysna, Gouna, *Schelpe* s.n. (BOL); Keurbooms River Forest Reserve, 200 m (CD), *Dahlstrand* 1355 (NBG); Bloukrans Pass, Varkrivier (DC), *Roux* 2649, 2650, 2651 (NBG); Bloukrans Forest Station, Platbos, along hiking trail, 260 m, *Roux* 2645 (NBG); Bloukrans Pass, 300 ft, *Schelpe* 4342 (BOL); Bloukrans Pass, *Acocks* 21298 (PRE); Tsitsikama Forest Reserve (DD), *Roux* 2647 (NBG); Storms River Forest Reserve, 100 m, *Dahlstrand* 1693 (PRE); Stormsriver, 250 ft, *Schlechter* 5963 (PRE); Stormsriver Gorge, 400 ft, *Jacobsen* 2331 (PRE); in umbr. pr. Storms River, 80 m, *Schlechter* 5963 (B); Tsitsikama Forest Reserve, 260 m, *Roux* 2648 (NBG). **3423 (Knysna)**: Knysna, Kaffirkop Forest, 420 m (AA), *Roux* 2640, 2641, 2642 (NBG), near Knynsna, *Mitchell* s.n. (M, PRE); Knysna, Kaffirkop Forest, *Roux* 1994, 1995, 1996 (NBG); Knysna, *Marloth* 5710, 5711 (PRE); Knysna, *Rex* s.n. (PRE); Knysna, *Mitchell* s.n. (BOL); Tzitzikamma forest, 1 mile E. of Storms River village, 850 ft (BB), *Schelpe* 4372 (BOL); Storms River mouth, *Maguire* 507 (NBG). **3424 (Humansdorp)**: Hofman's Bosch (BB), *Britten* s.n. (PRE).

WITHOUT PRECISE LOCALITY: Puspasvlei, Voormansbosch, Duivelsbosch and Keurboom, 1000–4000 m, *Zeyher* 4610 (PRE); George to Wilderness, *Moss* 6280 (PRE); Zuurberg, *Rogers* s.n. (PRE); loco incerto, *Dahlstrand* 1303 (NU); loco incerto, *Zeyher* s.n. B-97089 (B); loco incerto, *Burchell* 5200 (B); Kaffrarian forests, *sine coll.* 96893 (B); loco incerto, *sine coll.* B-96855 (B); Pr. b. sp, *Zeyher* 4610 (B); Cap. b. Sp., *Krebs* 360 (B); Prom. bon. spei, *Düring* s.n. (B); Cap. b. sp., *Drège* s.n. (B); Pr. b. sp., *Ecklon & Zeyher* 63 (B); Cap Colonie, *Breutel* s.n. (B); loco incerto, Herb. Lipzig, A & B only B-97050 (B); loco incerto, Herb. Lipzig 97051 (B); loco incerto, *Braun* s.n. (B); loco incerto, *Gueinzius* s.n. B-97069 (B); between Plettenberg Bay and Humansdorp, *Rodin* 1191 (BOL, PRE, S); loco incerto, *d'Urban* s.n. (B); loco incerto, Hort. bot. Berol. B-97049 (B); loco incerto, Hort. bot. Berol. B-97047 (B); Pr. b. spei, *sine coll.* B-97048 (B).

DIAGNOSTIC FEATURES AND RELATIONSHIPS. Differentiation in the field between this species and *Polystichum pungens* is not always easy because of their sympatric distribution, the variation within and among populations, and the absence of stable macromorphological characters. However, *P. incongruum* can be separated from *P. pungens* by its thicker, more stout rhizome. The pinnules in the former species are narrower, more slender and acuminate (often also slightly falcate), compared to the somewhat ovate to ovate-oblong, almost obtuse pinnules of *P. pungens*. A further character separating *P. incongruum* from *P. pungens* is the frequent occurrence of clavate unicellular glands along the sporangium stalk in the former species. Clavate unicellular glands occurring along the indusium margin have also been observed in some populations in the southern Cape, a feature never occurring in *P. pungens*. The former species is furthermore a sexual tetraploid (2n=164), whereas *P. pungens* is a sexual octoploid (2n=328).

VARIATION. Variation in lamina morphology is perhaps the most apparent, hence the specific epithet (*incongruens* = inconsistent). Lamina division may vary between 2-pinnate to 3-pinnate, the pinnae being narrowly oblong-attenuate and widely spaced to narrowly ovate-attenuate and imbricate, with extreme variations often occurring within populations. Proximal pinnae may be reduced or not with the length ratio between these and the middle pinnae ranging between 1:1 and 1:0.42. The most proximal pinna pair is often deflexed. Pinnules also show a large degree of variation in size and incision as illustrated by Roux (1997*b*). Proximal acroscopic pinnules also show a large degree of variation in length. In some plants these pinnules are only slightly longer than the next pinnule, but in others the pinnules may extend beyond the pinna-rachis of the pinna above. These variations do not appear to be environmentally induced, but the variation in frond size and lamina texture is clearly influenced by the environment. Plants occurring in exposed habitats in the Amatola Mountains have short erect fronds, a coriaceous lamina, and sprout from a stout rhizome, whereas plants growing in shaded habitats have long and slender arching fronds with a herbaceous lamina, and the rhizome is slender and branches freely. Palea

morphology shows minor variations between plants from the southern and eastern part of the distribution. In the southern part of the distribution the apices of the generally long marginal outgrowths of the paleae tend to split leaving a somewhat lacerated appearance, whereas in the eastern part of the distribution the outgrowths are short and tend not to split at the apices. Indusia vary in size, shape, the absence or presence of central processes, and in the occurrence of clavate unicellular glands along the margin. When glandular cells are present along the indusium margin of a specific collection not all indusia will bear them. Glandular cells along the sporangium stalk may be present or absent. Since these variations occur randomly they are not considered to be environmentally induced.

DISTRIBUTION AND ECOLOGY. *Polystichum incongruum* is confined to the Western and Eastern Cape Provinces of South Africa. The species has a somewhat disjunct distribution, with a southern centre ranging from Swellendam to Hofmans Bosch and an eastern region centred in the Amatola Mountains. In the Swellendam region the species occurs in forests of the 'Ngongoni veld type (Acocks, 1988). These forests are small, isolated, and confined to deep sheltered ravines and steep slopes below the south-facing cliffs. In the southern Cape the species is confined to the Knysna forest type, which is more extensive. This region receives a well-distributed rainfall that ranges between 460–1250 mm per annum. Soil in this region is sandy and is largely derived from weathered Table Mountain Sandstone. In the eastern part of its distribution the species occurs at elevations ranging between 600 and 1350 m where forests of the Dohne Sourveld type are predominant. In this region, however, the species is not confined to forested habitats but also occurs above the tree-line. The region receives an annual rainfall of 600–1000 mm with regular snowfalls during winter and the soil is predominantly of doleritic derivation.

In the southern part of its distribution the species is confined to forests where it forms small or large clonal stands and is especially common in light shade along streambanks, road cuttings and forest clearings. It may occur in dryish or very wet conditions. In the eastern part of its distribution the species occurs in more varied habitats ranging from natural forests to pine plantations but also occurs above the tree line forming large stands along streams, on screes and at boulder and cliff bases. Plants in the latter habitats are exposed and generally stunted with short erect fronds. In this region the plants are frequently subjected to veld fires but this appears not to adversely affect them.

17.**Polystichum pungens** (Kaulf.) C. Presl, *Tent. pterid.*: 83 (1836); Schelpe & Anthony, *Fl. Sthn. Afr., Pterid.*: 254 (1986), pro parte; Burrows, *Sthn. Afr. ferns and fern allies*: 312 (1990), pro parte. Type as for *Aspidium pungens* Kaulf.
Fig. 17.

Aspidium pungens Kaulf., *Enum. fil.*: 242 (1824). Type: Habitat in Promentorio b. spei, *Chamisso* s.n. (LE-holotype; BOL!-photograph).
Dryopteris pungens (Kaulf.) Kuntze, *Rev. gen. pl.* **2**: 813 (1891).

Plants terrestrial or epilithic. *Rhizome* decumbent, sparsely branched, to 370 mm long, to 20 mm in diameter, set with roots and closely to widely spaced persistent stipe bases, the older parts nude, the apical part densely paleated; paleae broadly attached, castaneous to ferrugineous, chartaceous, narrowly lanceolate to narrowly ovate, truncate to cordate, the margins subentire to erose, the apex flagelliform, generally terminating in a small thin-walled cell, to 17 × 3 mm. *Fronds* 5–6 per plant, suberect to arching, to 1.4 m long: *stipe* proximally castaneous, stramineous distally, adaxially sulcate, to 685 mm long × 7 mm in diameter, sparsely to densely set with conspicuous larger and smaller paleae; larger paleae more frequent proximally, widely spaced and smaller distally, proximally castaneous, broadly attached, distally ferrugineous, chartaceous, narrowly to broadly ovate, often oblique, cordate to cordate-imbricate, the margins minutely erose to short-fimbriate, the apex flagelliform, terminating in a long acicular cell or a small oblong thin-walled cell, to 21 × 6 mm; smaller paleae short-stalked, ferrugineous to stramineous, chartaceous to membranous, narrowly triangular, narrowly lanceolate to narrowly ovate, cordate to cordate-imbricate, the margins proximally erose or with short and/or long, straight or curved outgrowths, the apex entire, flagelliform, terminating in a long acicular cell or a small oblong thin-walled cell: *lamina* 2-pinnate to 2-pinnate-pinnatifid, with up to 21 free pinna pairs, firmly herbaceous, adaxially dark green, abaxially slightly paler, ovate to broadly ovate, to 704 mm long, the pinnae often slightly imbricate distally, more widely spaced proximally, the most proximal pinna pair slightly reduced, often somewhat deflexed: *rachis* stramineous to greenish, adaxially sulcate, sparsely to densely paleated; paleae short-stalked, ferrugineous to stramineous, membranous, ovate, narrowly ovate to narrowly triangular, sessile or short-stalked, cordate to cordate-imbricate, the proximal margins erose to sparsely fimbriate or with short and/or long, curved or angular, often branched outgrowths that reduce in size and number towards the apex, the apex flagelliform, terminating in a long acicular cell or a small thin-walled cell: *pinnae* 1-pinnate to 1-pinnate-pinnatifid, with up to 24 free pinnule pairs, narrowly ovate-attenuate to narrowly oblong-attenuate, to 272 × 48 mm; *pinna-rachis* stramineous, adaxially sulcate, moderately to densely paleate; paleae ferrugineous to stramineous, membranous, narrowly triangular, short-stalked, cordate-imbricate, the proximal margins with short and/or long, often branched outgrowths reduced in size and number towards the apex, the apex flagelliform, twisted, terminating in an acicular cell or a small thin-walled cell, to 4.5 mm long, each pinna often subtended by one or more large, often bullate, broadly ovate, cordate, minutely erose to fimbriate paleae: *pinnules* opposite to alternate, widely spaced to slightly imbricate, the proximal acroscopic pinnule the largest, often significantly longer than the next, especially towards the middle of the lamina, each subtended by one or more large, often bullate, broadly ovate paleae, similar to but smaller than those on the rachis, inaequilateral, ovate, ovate-oblong to ovate-rhomboid or trullate, often somewhat falcate, basiscopically cuneate, acroscopically cuneate to truncate and auriculate, the larger pinnules commonly deeply incised near to the costa forming a nearly free auricle acroscopically, the margins serrate to lobate-serrate, sharp-tipped, rarely aristate, the costa proximally adaxially sulcate, most proximal acroscopic pinnule to 50 mm long, to 19 mm wide, often reaching beyond pinna-rachis above; adaxially sparsely set with paleae chiefly along costa, filiform to taeniform, the margins entire or proximally with a few short curved or long angular outgrowths, the apex terminating in a long acicular cell or a small thin-walled cell, to 6 mm long; abaxially sparsely to moderately paleate, the paleae stramineous, membranous, short-stalked, subulate, narrowly triangular to narrowly ovate, cordate to cordate-imbricate, the margins proximally with short and/or long, angular outgrowths, the apex entire, filiform, terminating in a long acicular cell or a small thin-walled cell, to 3.7 mm long. *Venation* adaxially obscure, raised abaxially. *Sori* circular, *c.* 1 mm in diameter, terminal or near terminal on abbreviated vein branches, essentially uniseriate, discrete at maturity: *sporangium* with 10–(12.8)–19 indurated annulus cells; stalk eglandular: *indusium* peltate, stramineous, castaneous or black, nitid, amorphous to circular, entire to repand, the maximum radius 0.26–(0.5)–0.8 mm in diameter,

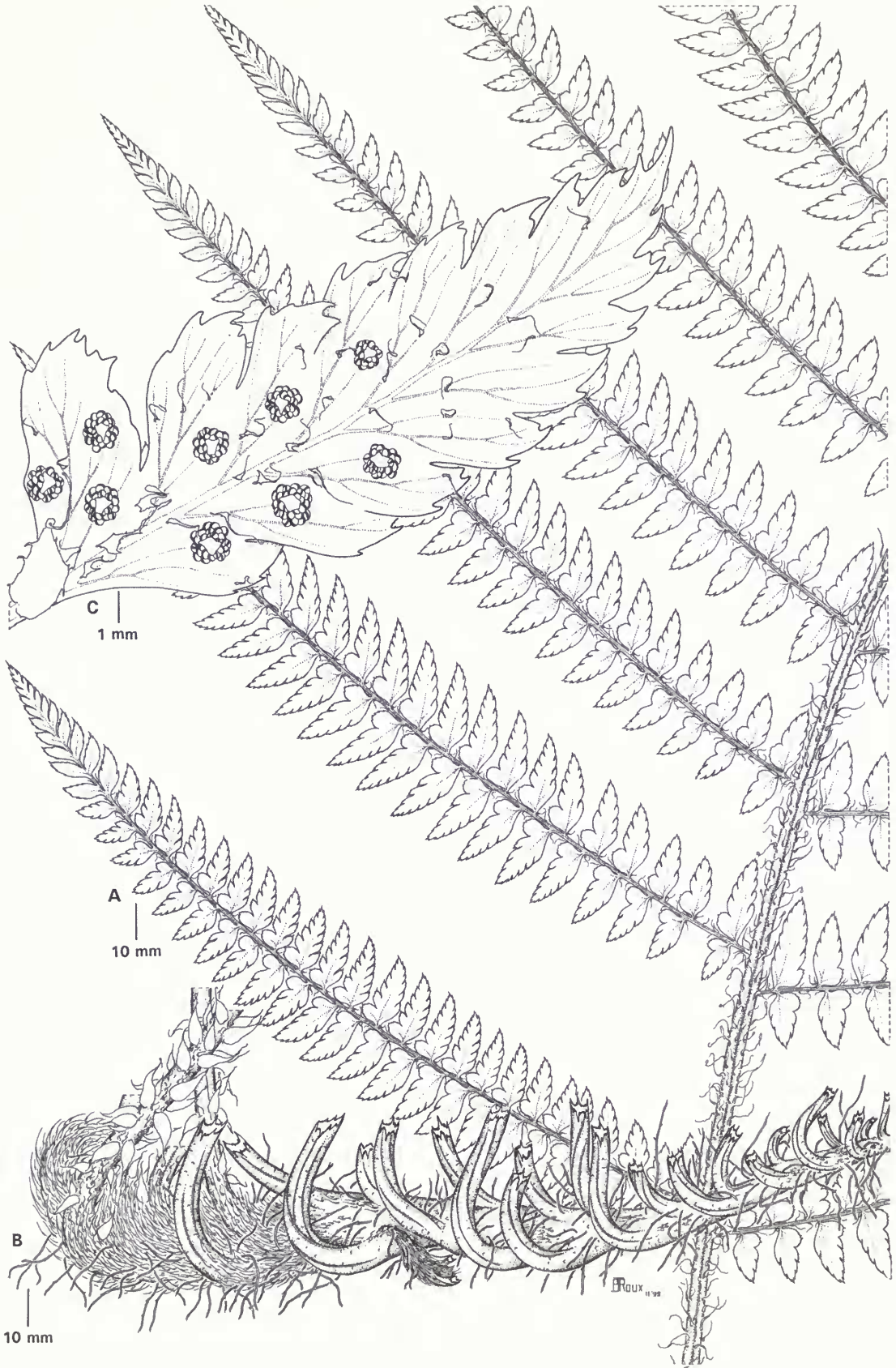

Fig. 17 *Polystichum pungens.* A, proximal part of lamina; B, rhizome; C, abaxial surface of fertile pinnule. All drawn from *Roux* 2367 (NBG).

persistent, brown. *Spores* pale brown, 64 per sporangium, the perispore folded to form inflated reticulate ridges, the ridges crested, the ridges and areas between sparsely to densely echinulate, variously porate, the exospore 30–(49.31)–62 × 28–(38.08)–56 µm. *Chromosome number* 2n=328.

MATERIAL EXAMINED

SOUTH AFRICA. 2330 (Tzaneen): Woodbush (CC), *Wager* s.n. CH7461 (PRE); De Hoek, Woodbush, *Schweickerdt* s.n. TM1852C (PRE). **2430 (Pilgrim's Rest)**: Pilgrim's Rest, Mount Sheba Nature Reserve, Waterfall trail (DC), *Roux* 2554 (NBG). **2730 (Vryheid)**: Hlobane, Mto!a forest (DB), *Johnstone* 295 (NU). **2828 (Bethlehem)**: Royal Natal National Park, Gudu forest, Gudu waterfall (DB), *Roux* 2512 (NBG); Royal Natal National Park, Gudu forest, *Schelpe* 1454 (NU). **2829 (Harrismith)**: Farm Whitestones (CA), *Roux* 1901 (NBG, PRE); Bezuidenhouts Pass, farm Whitestones, *Roux* 1684 (NBG, PRE); Oliviershoek Pass, forests S. of Seheletwane, *Roux* 2519 (NBG); Cathedral Peak area, Indumeni forest, 5100 ft (CC), *Schelpe* 781 (NU). **2831 (Nkandla)**: Eshowe (CD), *Laura* s.n. CH6421 (PRE). **2929 (Underberg)**: Giants Castle Nature Reserve, forest above Hillside camping site (AB), *Roux* 2500, 2502, 2505 (NBG); Lions River District, Lions Bush, 5000 ft (BD), *Moll* 832 (PRE). **2930 (Pietermaritzburg)**: Buccleuch (AD), *Sim* s.n. CH3641 (PRE); Hilton Road (CB), *Wager* s.n. B-only (NU); Hilton District, Cedara Dam, 3200 ft, *Churcher* s.n. (NU); Zwaartkop, *Sim* s.n. PRE-11026 (PRE); *Sim* s.n. CH387 (PRE); *Sim* s.n. TM1239C (PRE). **2931 (Stanger)**: prope Mapumulo (AA), *Abraham* s.n. (B). **3029 (Kokstad)**: Insizwa forest (CC), *Strey* 10749 (PRE). **3030 (Port Shepstone)**: Paddock, Burntwood (CC), *Strey* 5994 (PRE). **3128 (Umtata)**: Tsolo District, Ngadu, 3200 ft (BC), *Von Breitenbach* 1330 (PRE). **3129 (Port St Johns)**: Port St Johns (DA), *Wager* s.n. CH2996 (PRE). **3225 (Somerset East)**: Boschberg (DA), *MacOwen* s.n. (P); forest kloofs of the Boschberg mountain, *sine coll.* s.n. (P); in sylvis ad ped. Mont. Boschberg, 3000 ft (DA), *MacOwen* s.n. (B). **3226 (Fort Beaufort)**: Katberg forests (BC), *Adams* 168, 175 (NU); Hogsback, Auckland forest (DB), *Roux* 510 (NBG); Hogsback forest, 4250 ft, *Schirach* 280 (NBG); Hogsback, *Stirton* 6267 (PRE). **3227 (Stutterheim)**: Fort Cunninghame, 3300 ft (AD), *Galpin* 2446 (PRE); Isidenge forest (CA), *Roux* 1981 (NBG); Keiskamma Hoek, 2000 ft, *Ely* s.n. (PRE); Cathcart, Fort Cunningham forest Reserve (CB), *Roux* 2428, 2429, 2432 (NBG); Frankfort, *Sim* s.n. (PRE); Pirie, *Sim* s.n. (PRE); Dohne Hill, *Sim* s.n. (PRE); Komgha (DB), *Flanagan* s.n. (PRE). **3318 (Cape Town)**: Nursery Gorge (CD), *Schelpe* s.n. BOL-35933 (BOL); head of Nursery Gorge, *Esterhuysen* 25851 (BOL); top of Nursery Gorge, *Esterhuysen* 15355 (BOL); Devils Peak, Dark Gorge, *Esterhuysen* 26564 (BOL, NBG); Table Mountain, Hiddingh Ravine, *Esterhuysen* 25862 (BOL); Kirstenbosch, *sine coll.* BOL-55808 (BOL); Devils Peak, waterfall, *Wolley-Dod* 915 (BOL); Table Mountain, Skeleton Gorge, *Schelpe* s.n. (BOL); SE slopes of Devils Peak, *Pillans* 2694 (BOL); Skeleton Gorge, *Esterhuysen* 26674 (BOL); Skeleton Gorge, *Roux* 97 (BOL); mountain woods at back of Newlands, *sine coll.* s.n. (P); Newlands Ravine above contour path, *Roux* 2370, 2371 (NBG); Lubberts Gift, *Roux* 2372 (NBG); Kirstenbosch, contour path, *Compton* 14629 (NBG); Window Gorge, *Roux* 36 (NBG); Dark Gorge, *Roux* 2367, 2368*a*, 2369 (NBG); Window Gorge, *Wasserfall* 84, 156 (NBG); Newlands, Paradise, *Rawson* s.n. (SAM). **3320 (Montagu)**: Heidelberg, Grootvadersbosch (DD), *Roux* 2596 (NBG); Grootvadersbosch, Safraandraai, *Roux* 2597, 2599 (NBG); Grootvadersbosch, Stinkhout hiking trail, *Roux* 2378, 2379, 2380 (NBG); Grootvadersbosch, *Taylor* 1228 (BOL); Grootvadersbosch, near end of road running past redwoods, *Roux* 2600 (NBG). **3322 (Oudtshoorn)**: George, Wildernes (DC), *Compton* 14305 (NBG); Goudveld Forest Station, Krisjan se Nek picnic site (DD), *Roux* 2626 (NBG). **3325 (Port Elizabeth)**: Enon (BC), *sine coll.* B-97063 (B). **3326 (Grahamstown)**: in sylvis prope Grahamstown (BC), *MacOwan* s.n. (P); kloofs near Grahamstown, *Holland* s.n. (NBG). **3418 (Simonstown)**: Diepgat, kloof below SW Triplets (BB), *Esterhuysen* 27060 (BOL); ravines of the Helderberg, *Parker* 4311 (BOL). **3419 (Caledon)**: Riviersonderend, Oubos (BB), *Roux* 2586 (NBG). **3423 (Knysna)**: Knysna (AA), *Marloth* 1901 (L).

SWAZILAND. 2631 (Mbabane): Millers Falls, 4500 ft (AC), *Compton* 25967 (NBG); 5 km NW of Mbabane, 1200 m, *Kemp* 896 (PRE).

WITHOUT EXACT LOCALITY: loco incerto, *sine coll.* BOL-55877 (BOL); Albany District, *Cooper* 1415 (P); Africa austral, *Drège* s.n. (P); Cap. b. spei, *Bojer* s.n. (P); Cap. b. spei, Herb Musei Palat. Vindob. 126 (P); in umbrosis montium Hottentots Hollandiae, *Zeyher* s.n. (SAM); Drakensberg, *Bottomley* s.n. CH5018 (PRE); Fort Beaufort District, *Myburg* s.n. (NBG); Bedford District, *Van Rensburg* s.n. (NBG); Katberg, *Young* s.n. (PRE); Natal, Pondoland and Zululand midlands, *Watt & Brandwyk* 336 (PRE); district of Albany, *Cooper* 1415 (PRE); loco incerto, *Flanagan* s.n. (PRE); Kaffirland, St. Augustine, *Baur* 215, B-only (B); Afr. austr., *sine coll.* s.n. (B); Prom. b. spei, *Krebs* 360 (B), Natalia, *Buchanan* 85 (B); Natalia, in sylva ad fr. Tugela, *Gueinzius* s.n. (B).

Controversy as to the correct name for this taxon has existed for a long time. Sim (1892) initially labelled this species as *Aspidium aculeatum* var. *pungens*, but by 1915 he realized that two entities could be recognized, a forest dwelling species that he referred to *Polystichum aculeatum* and a montane form that he referred to *P. pungens*. Becherer (1937), however, proposed the name *P. lucidum* (Burm.f.) Becherer (= *Asplenium lucidum* Burm.f.) for the forest growing species, a name that became well entrenched (Schelpe, 1969; Roux, 1979; Jacobsen, 1983). Following a reinterpretation of the types, Anthony & Schelpe (1985) concluded that *Asplenium lucidum* Burm.f. is synonymous with *Asplenium adiantum-nigrum* L. This largely follows the view of C.V. Morton who distributed photographs of what he believed to be the type of the species. A review of these anomalous typifications has been provided by Roux (1994). Since it was concluded that *A. lucidum* is synonymous with *A. adiantum-nigrum*, a new name was required for the forest species. The next available name for the species is *P. pungens* (Kaulf.) C. Presl (= *Aspidium pungens* Kaulf.).

DIAGNOSTIC FEATURES AND RELATIONSHIPS. *Polystichum pungens* forms part of a species group characterized by decumbent rhizomes and paleae that usually terminate in a long flagelliform apex. It can, however, be separated from other taxa in the group by not having glandular cells on the sporangium stalk and by the longer, more slender rhizome. Furthermore, *P. pungens* has a somatic chromosome number of 2n=328, versus 2n=164 in *P. incongruum* with which it may be confused and to which it evidently is related.

VARIATION. Variation in pinnule size and shape may be influenced by numerous environmental factors. Smaller pinnules may be ovate in outline and shallowly lobate-dentate. As the pinnules increase in size, they become more deeply lobate in the proximal part of the pinnule, often extending to the costa, resulting in the proximal acroscopic segment being short-stalked. The proximal acroscopic pinnule is generally longer than the following pinnule. The length ratio of the proximal and the following pinnule taken from the central part of the lamina ranges between 1:0.91 [*Compton* 14629 (NBG)] and 1:0.56 [*Roux* 2368*a* (NBG)].

Paleae vary mostly in shape and in the degree to which the margin is sculptured. Although most paleae terminate in a long filiform apical cell, some do terminate in a short, thin-walled cell. In one collection [*Esterhuysen* 26564 (BOL, NBG)] unicellular glandular cells also occur along the palea margin as well as on the surface of the larger rhizome paleae.

Indusium size and outline vary considerably within the species. Although indusia are generally peltate, often some are reniform or have the flange not fully 360° developed. Both conditions are frequent within a single plant. Although the general outline of the indusium may be considered circular, it is often irregular with the margins varying from subentire to repand. Indusia appear to increase in size from the western part of the distributional range to the east. The plant with the smallest mean indusium radius was recorded from Table Mountain [*Compton* 14629 (NBG), x=0.3 mm; n=6] and the plant with the largest mean radial length is from the George region [*Roux* 2626 (NBG), x=0.71 mm; n=6]. The maximum radius of the indusia varies between 0.26 and 0.78 mm. Plants as far east as

Port Elizabeth usually have stramineous indusia, whereas plants ranging from the Boschberg farther north have dark, almost black indusia, and are uniform in outline.

DISTRIBUTION AND ECOLOGY. *Polystichum pungens* is restricted to South Africa and Swaziland. In this region the species occurs from Table Mountain on the Cape Peninsula to the Hottentots Holland Mountains, along the Riviersonderend, Langeberg, Outeniqua and Great Winterhoek Mountains to Port Elizabeth and Grahamstown. Inland it occurs from the Boschberg at Somerset East to the Amatola Mountains and along the Drakensberg foothills to the Wolkberg in the Northern Province.

In the eastern part of its distribution *P. pungens* is restricted to isolated climax forest patches largely restricted to the southern mountain aspects and sheltered ravines. This region, and the more extensive Knysna forest complex, is subject to a high, well-distributed rainfall and acidic sandy soils. At Grahamstown and on the Boschberg the species occurs in temperate scrub forest subject to more seasonal precipitation. In the Amatolas the species occurs in forests of the Dohne Sourveld type that lie between 600–1350 m above sea level. From here the distribution extends to the eastern slopes and foothills of the Drakensberg. Forests in this region are of the Highland Sourveld type, which is largely confined to the deep gorges and protected mountain slopes occurring at elevations ranging from 1350–2150 m. To the north the species occurs in forests of the Northeastern Mountain Sourveld. In the Eastern Cape and southern KwaZulu-Natal it has been reported from forests of the Pondoland Coastal Plateau Sourveld that are found at an elevation of 300–450 m. These forests are largely confined to the escarpment, gorges and valleys below krantzes. In the KwaZulu-Natal midlands it is confined to forests of the Mist Belt 'Ngongoni Veld, whereas in northern KwaZulu-Natal it occurs in 'Ngongoni Veld.

Polystichum pungens is a terrestrial or epilithic species occurring as isolated individuals or often also as large clones on dryish or moist slopes in partially to deeply shaded conditions. In Newlands Ravine on Table Mountain, however, the species forms extensive stands on exposed east-facing slopes.

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SYSTEMATIC INDEX

Accepted names are in roman and synonyms in *italics*.