

## **A revision of the fern genus *Dryopteris* (Dryopteridaceae) in sub-Saharan Africa**

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### **Abstract**

The morphology of the *Dryopteris* species occurring in sub-Saharan is discussed. This is followed by a revision of the genus in this region, and the Cape Verde Islands in the Gulf of Guinea. Twenty-six species are recognised for the region.

### **Introduction**

*Dryopteris* Adans. (1763: 551) is a genus of between 225 and 230 species (Kramer 1990: 110, Fraser-Jenkins 2006: 105) with a nearly worldwide distribution. *Dryopteris* is less common in the southern hemisphere and nearly absent from Australia and New Zealand. The chief centre of diversity is the Sino-Himalayan region and Southwestern China, with minor centres of divergence in Southeast and East Asia, Pacific Islands, Africa, Europe, and the Americas. Sessa *et al.* (2012) infer that the ancestors of *Dryopteris* and its sister genus *Arachniodes* Blume (1828: 241, 242) diverged ca. 63 million years ago, and that the *Dryopteris* lineage at that point was confined to Asia.

*Dryopteris* species occur in diverse habitats, ranging from forests in coastal regions to alpine vegetations, but most taxa occur in subtropical montane environments. In Africa the distribution of *Dryopteris* forms three main centres: a North-African centre, a West-African centre and a Southeast-African centre. In the North-African centre the taxa are primarily confined to the Atlas Mountain range and its outliers extending into Macaronesia. Species occurring in this centre have a European affinity and are not discussed here. The West-African centre extends from the Congo to Guinea and includes the Cape Verde and Gulf of Guinea islands. The Eastern-Southern African centre, ranges from Eritrea in the north, southwards along the East African mountains including

the Angolan highlands, to the southern parts of South Africa. The tropical low-lying Congo River basin separates the West and Eastern-Southern African centres. No *Dryopteris* species are common to both the North African centre and/or the West and Eastern-Southern African centres (Figure 1). *Dryopteris athamantica* (Kunze) Kuntze (1891: 812), *D. kilmensis* (Kuhn) Kuntze (1891: 813), *D. manniana* (Hook.) C.Chr. (1905: 276) and *D. pentheri* (Krasser) C.Chr. (1905: 284), however, are common to both the West-African and Eastern-Southern African centres, but absent in North-Africa. Whilst some species have wide distributions within these centres, others are local endemics with restricted distributions.

INSERT FIGURE 1

In the absence of a robust phylogeny, a satisfactory classification for *Dryopteris* does not yet exist and disputes as to its circumscription continue. Molecular phylogenetic studies in the genus demonstrated that the genus as traditionally defined is polyphyletic (Geiger & Ranker 2005, Li & Lu 2006, Juslén *et al.* 2011, Sessa *et al.* 2012) and that *Nothoperanema* Holttum (1966: 25, 26) is nested in it. These studies also demonstrated that the subgeneric classification of the genus presented by Fraser-Jenkins (1986) is not supported. The study of Sessa *et al.* (2012) grouped the 97 species sequenced in five weakly to well-supported clades. *Dryopteris* species from sub-Saharan Africa are included and resolved to Clades I–III of this study. No morphological synapomorphies in support of these clades have thus far been identified. A more conservative approach is followed here whereby the taxa occurring in the region are not placed in any of the subgeneric taxa thus far described until a more robust phylogeny can be established.

*Dryopteris* is a notoriously difficult group with regard to species delimitation and identification. This may be ascribed to important morphological features often being cryptic, variation due to geographical and ecological factors, hybridization, polyploidy, and apogamy. Superficial investigation of material may therefore easily lead to incorrect identifications. Limited material is currently available for some species complicating the study of these taxa. When additional material from broader geographical area becomes available, these taxa may need to be redefined.

## **Material and methods**



The review is based on field studies carried out in various parts of the region and herbarium collections studied at various herbaria visited. Material was received on loan for study from B, BM, BOL, BONN, BR, COI, ETH, FHI, FR, H, K, LISC, LMA, LUSAKA, M, MO, NBG, NH, NDO, NU, NY, P, PO, PRE, SAM, SDNH, SRGH, US, YA, W and WAG. Material studied is alphabetically arranged by country, followed by the current political provinces, regions and/or districts that apply in these countries. Localities were established by using online gazetteers and web pages. Within the smallest regional division the collections are arranged alphabetically by collector. Coordinates, unless provided by the collector(s) are not given since most localities are imprecise and cannot be determined with any acceptable degree of confidence. For Lesotho, South Africa and Swaziland the Degree Reference System (Edwards & Leistner 1971) is used in the arrangement of the material studied.

The methodology and terminology used for studying and describing features of indumentum, indusium and sporangium follow Roux (2000). Exospore measurements were carried out on spores cleared with household bleach. During this process the perispore (perine) is removed making measurements more accurate. Treated spores were semipermanently mounted in glycerine. Spores used for scanning electron microscopy (SEM) were mounted on carbon tabs attached to microscope stubs. The spores were then coated with 24 carat gold from two sides at an angle of approximately 30° using an Edwards Auto 306 sputter coater. Scanning was done with a Nova NanoSEM 230.

## **Classification**

*Dryopteris* was first established by Adanson in 1763, but it was largely disregarded until Schott (1834) used the name in the caption to plate 9 of his *Genera filicum*. The name of the species illustrated was given as *Dryopteris filix-mas* (L.) Schott (1843: pl. 9), which has now been accepted and conserved as the type species of *Dryopteris*. The genus was not widely accepted during the 19th and early 20th century with *Dryopteris* species generally being ascribed to *Aspidium* Sw. (1801: 29), Desvaux 1811, Kunze 1836, Fée 1852, Kuhn 1868, Hieronymous 1895), *Lastrea* Bory (1824: 588), Presl 1836, 1851, Moore 1853b) or *Nephrodium* Rich ex Michx. (1803: 266, Desvaux 1827, Bory 1833, Hooker 1862, Baker 1867, 1875). These genera were all broadly

and ill-defined and are no longer in use. They included species now known to belong to various genera and families.

When Swartz described *Aspidium* in 1801 he included species that are the types of previously described genera such as *Athyrium* Roth (1799: 31, 58), *Dryopteris* Adans., *Oleandra* Cav. (1799: 115), *Polystichum* Roth (1799: 31, 69, 70), *Tectaria* Cav. (1799: 115) and *Thelypteris* Schmidel. (1763: 45). *Aspidium* is therefore illegitimate [McNeill *et al.*, Art. 52.1 (2006)] and so is the family name Aspidiaceae based on it [McNeill *et al.*, Art. 18.3 (2006)]. *Lastrea* (Bory 1826) is illegitimate too, since the species listed also included the type of *Thelypteris* Schmidel. *Nephrodium* Rich. ex Michx (1803) has priority over *Dryopteris*, but the status of this name was dubious since the 12 species listed at the time of publication belongs to nine different genera (Pichi Sermolli 1977: 87).

Molecular studies support a dryopteroid clade within the Dryopteridaceae that include *Dryopteris*, *Polystichum* Roth (1799: 69, 70), *Phanerophlebia* C.Presl (1836: 84), *Cyrtomium* C.Presl (1836: 86), and *Arachniodes* Blume (1828: 241, 242) (Schuettpelz & Pryer 2007, Lehtonen 2011).

To date four subgeneric classifications of *Dryopteris* have been published; Itô (1935, 1936a, b, c, 1939), Ching (1938), Fraser-Jenkins (1986) and Wu (2000).

The classification of Ching (1938), which is primarily based on Himalayan *Dryopteris* divides the genus into two subgenera; *D.* subgen. *Dryopteris* (as ‘*Eudryopteris*’) and *D.* subgen. *Pycnopteris* (T.Moore) Ching. Subgenus *Dryopteris* is subdivided into section *Bulligerae* (species provided with bullate scales) and section *Fibrillosae* (species with straight lanceolate or fibrillose scales). Both these section names are invalid since they are not published in accordance with the Code [McNeill *et al.* (2006), Art. 32.1].

The classification of Fraser-Jenkins (1986) considers *Dryopteris* globally and placed the species into four subgenera, most of them containing two or more sections. This highly artificial system is primarily based on macromorphological features; lamina architecture in particular. As a result of extensive variation, taxa placed by Fraser-Jenkins in different sections are now considered to be the same species, illustrating the lack of suitable and stable features that may be used in defining the subgenera and sections as set out in this work.

Wu (2000) divided *Dryopteris* into three subgenera: *D.* subgen. *Dryopteris*, *D.* subgen. *Pycnopteris* and *D.* subgen. *Erythrovariae* (H.Itô) Fraser-Jenk. on the basis of lamina and scale

morphology. He incorporated the two sections Fraser-Jenkins placed in subgenus *Nephrocystis* (H.Itô) Fraser-Jenk. in subgenus *Dryopteris*. Furthermore, a molecular study on Chinese *Dryopteris* by Li & Lu (2006) does not support support *Pycnopteris*; species with coriaceous, 1-imparipinnate laminae, as a distinct entity.

## **Morphology**

**Rhizomes:**—The rhizome of *Dryopteris* species is dictyostelic and either erect or decumbent. The erect rhizome type can be up to 150 mm long and is mostly unbranched. The structure is cylindrical in outline and sheathed by a mass of wiry roots, persistent, spirally arranged stipe bases that closely overlap and, at least in the younger parts, also with scales. Although rhizomes appear as a relatively thick structure, the central axes itself seldom exceeds 25 mm in diameter. Erect rhizomes mostly have its apex or growth point raised well above the substrate and the fronds are arranged in a caespitose manner in *Dryopteris katangaensis* J.P.Roux (2003: 237), *D. kilmensis* and *D. wallichiana* subsp. *reichsteinii* (1996: 71) are the only taxa in the region with erect rhizomes. These species are all confined to woodland or forest habitats.

The decumbent rhizome type is the most common kind in sub-Saharan African *Dryopteris* species. The structure is more or less cylindrical, or slightly dorsiventrally flattened, and is often irregularly branched. The length and diameter differs between species, but habitat and growing conditions also play a significant role in its size. In *Dryopteris pentheri* (1905: 284) the rhizome can be up to 20 mm in diameter, but the rhizome of *D. dracomontana* Schelpe & N.C.Anthony (1982: 147) may measure up to 4 mm only. In taxa with the decumbent rhizome type, fronds are borne in a spiral fashion as well, but they are generally more widely spaced exposing the ‘internodes’. Since the growing tips of the decumbent rhizome is at, or just below the substrate surface, the stipes curve strongly upwards at their base raising the fronds. Scales form a dense covering over primarily the apical region of the rhizome, becoming increasingly more abraded in the older parts. The irregular branching habit of the rhizomes in several *Dryopteris* species often results in the forming of clonal stands. Species with decumbent rhizomes often occur in habitats exposed to vegetation fires, but it appears not to affect the plants negatively because the rhizomes and its growing tips are positioned at or just below the substrate surface and is therefore protected.

Fronds:—*Dryopteris* fronds are not articulated to the rhizome. Apart from *Dryopteris dracomontana*, which demonstrates sterile/fertile frond dimorphism, the fronds are monomorphic. The species are all evergreen and the fronds remain alive for at least two or more annual cycles and are lost through decay or mechanical damage only. Frond length is greatest in the forest dwelling *D. kilmensis* where they can be up to 1.8 m long. *Dryopteris dracomontana*, has the shortest fronds. In this species the fertile fronds overtop the sterile fronds. Fertile fronds in this species may attain a length of up to 400 mm, whereas the sterile fronds, which are generally much shorter than the fertile, may reach up to 390 mm in length. The number of fronds borne by each plant appears to be determined by the rhizome type. Species with erect rhizomes always bear more fronds than those with decumbent rhizomes. *Dryopteris wallichiana* subsp. *reichsteinii* may bear up to 25 fronds on each rhizome, whereas species with decumbent rhizomes generally have 3 to 7 fronds (pers. obs.). Frond orientation is influenced by habitat with plants growing in exposed conditions generally having more erect fronds, whereas plants growing in forested or shaded habitats tend to have arching fronds. The fertile fronds of *D. dracomontana* are always erect, whereas sterile fronds on the same plant are generally spreading or held at a small angle to the substrate. In this species the number of fertile fronds borne by any plant rarely exceeds three. Frond vernation in *Dryopteris* is circinate and, when young, these organs are always covered by a dense layer of scales.

Stipes:—The value of stipe characters in fern taxonomy is discussed by Lin & De Vol (1977, 1978). They found that stipe features, especially their anatomy are more useful at the level of genus and family than at species level. The stipe in all *Dryopteris* species studied is firm and in *D. antarctica* (Baker) C.Chr. (1913: 29) the bases are incrassate to form distinct trophopods (Roux 2011). Trophopods are thickened, persistent stipe bases that serve as food storage organs (Wagner & Johnson 1983). In species with erect rhizomes the stipes are closely imbricate and directed upwards, whereas in species with decumbent rhizomes they are strongly curved upwards, raising the fronds from the substrate. Stipe lengths range from 150 mm in *D. wallichiana* subsp. *reichsteinii* to 870 mm in *D. schimperiana* (Hochst. ex A.Braun) C.Chr. (1905: 91, 291). Their diameter mostly ranges from 4 to 9 mm, but in *D. athamantica* (Kunze) Kuntze (1891: 812) it can be up to 14 mm in diameter. In *D. dracomontana* sterile frond stipes can be up to 250 mm long, whereas in fertile fronds they can measure up to 220 mm. In this species fertile fronds have thicker stipes, up to 3.5 mm in diameter, while sterile frond stipes can be up to 2.5 mm in diameter. In

most species the stipe base is flattened or variously rounded adaxially near the base, but distally they all become shallowly to deeply sulcate. In most taxa the basal part of the stipe is castaneous to black and often lustrous (nitid), becoming paler towards the apex. In live plants the distal parts of the stipe generally remains green. In most species the aerophore line is conspicuous along the entire stipe length, extending to the rachis; it generally is somewhat paler in colour than the surrounding tissue. Stipes are always scaly, but the scale density shows considerable variation among and within species and is also affected by age. In *D. cicatricata* J.P.Roux (2005: 167) the scales are borne on strongly developed enations resulting in a muricate-cicatricate surface. In most species, however, the scale scars are less conspicuous. Glands and hairs also occur on the stipe in some species.

Stipes are usually circular or transversely broadly elliptic in cross section, but distally they are variously sulcate adaxially. The aerophore structure was studied by Davies (1991) and consists of thin-walled parenchyma cells with large intercellular spaces. Stomata occurring on the stipe are confined to the aerophore line. The number of meristeles at the stipe base varies from four to five, but rarely up to seven. In *Dryopteris* the meristeles are arranged to form an open arc towards the adaxial stipe surface, with the two larger ones located adaxially at either end with the smaller ones in between.

Lamina:—Most species in the study area have narrowly to broadly ovate, 2- to 3-pinnate fronds, but in *D. kilmensis* the lamina can be up to 4-pinnate-pinnatifid. The lamina width/length ratio in these species ranges between 1.0:1.2 and 1:2. *Dryopteris wallichiana* subsp. *reichsteinii* is the only species in the region with narrowly elliptic, 1-pinnate-pinnatisect fronds and the lamina width:length ratio in this species is in the order of 1.0:3.5. Lamina length is largest in *D. fadenii* Pic.Serm. (1984: 333), measuring up to 900 mm, and smallest in *D. dracomontana*, in which the sterile fronds may only reach 175 mm.

*Dryopteris* laminae are mostly anadromous at the base, gradually becoming catadromous towards the apex. The basal pinna pair of *D. amblyodonta* J.P.Roux (2004: 207) and *D. inaequalis* (Schltdl.) Kuntze (1891: 813) often shows the anadromous development strongly. The herbaceous to thinly coriaceous pinnae and pinnules are subopposite to alternately arranged on the rachis and pinna-rachises. Proximally the pinnae and pinnules are usually short-petiolate, but distally they become sessile and later adnate. In *D. kilmensis* the pinna petioles can be up to 22 mm long. Pinnae are mostly oblong-attenuate to narrowly oblong-attenuate in outline, but in some species

they may be ovate to narrowly triangular. In most species one or more basal pinna pairs are basiscopically developed and the degree to which this feature is developed shows considerable variation between and even within a species. In *D. inaequalis* the basal pinna pairs are mostly slightly shorter than the pair above. The number of petiolated pinna pairs per lamina ranges from 11 in the sterile fronds of *D. dracomontana* to 47 in *D. wallichiana* subsp. *reichsteinii*. In most species the basal pinnae are usually widely spaced with no or little overlap with the pinnae above. Towards the lamina apex, however, the pinnae frequently overlap with the pinna pair above. Pinna length ranges between 40 mm in the fertile fronds of *D. dracomontana* to 345 mm in *D. kilmensis*. In shaded plants the pinnae are largely oriented into a single plane, but the pinnae tend to be oriented perpendicular to the rachis in plants occurring in exposed habitats, resulting in the fronds forming a 3-dimensional structure. The laminae of *D. athamantica* and fertile fronds of *D. dracomontana* in particular demonstrate this habit.

The pinnae of *D. wallichiana* subsp. *reichsteinii* are symmetric or near-symmetric, with the proximal acroscopic segment often slightly stronger developed than the basiscopical segment. With the exception of *D. schnellii* Tardieu (1948: 370) and *D. athamantica*, in which the pinnae and pinnules are acroscopically developed, the basal pinnae of all the other *Dryopteris* species in the region are all often strongly basiscopically developed.

**Stomata:**—The distribution and the arrangement of subsidiary cells are considered of taxonomic value, especially at higher taxonomic levels (Metcalfé & Chalk 1950). Frequency of stomata is often determined, but this has no taxonomic value as it is strongly influenced by prevailing external conditions (Metcalfé & Chalk 1950). In addition guard cell size has been widely used in determining or confirming ploidy levels in various plant groups (Goldblatt 1974, Barrington *et al.* 1986, Beck *et al.* 2003). Guard cell length is fairly variable within and between species with the smallest stomata of sub-Saharan Africa *Dryopteris* having been recorded in *D. kilmensis* and the largest in *D. manniana* (Hook.) C.Chr. (1905: 276). Guard cell size also appears to reflect ploidy level in *Dryopteris* (Table 1). Stomata in *Dryopteris* are confined to the abaxial surface of the lamina (hypostomatic) and positioned in the same plane as the epidermal cells, oriented with their longitudinal axis parallel or near parallel to the lateral veins. Stomata are primarily of the polocytic type (a C-shaped subsidiary cell extends  $\frac{2}{3}$  or more around the guard cells).

Epidermis:—Epidermal cells in the studied *Dryopteris* species as seen under a light microscope are polygonal, but slightly elongate in shape. The anticlinal cell walls are sinuous to curved. In *D. wallichiana* the adaxial epidermal cells appear slightly longer than those on the abaxial surface, but in *D. squamiseta* (Hook.) Kuntze (1891: 813) the cells on the abaxial surface appear to be larger than those that occur adaxially. Epidermal cell size varies in shape and size depending on its position on the lamina, but also appears to be affected by environmental influences. The cuticle is smooth in all the species.

Rachis:—In *Dryopteris* the morphology and anatomy of the rachis does not differ from that of the stipe. The rachis is mostly straight throughout its length, but distally it may become slightly flexuose in some species. Adaxially the rachis forms a V- or U-shaped sulcus along its entire length. In *D. wallichiana* subsp. *reichsteinii* and *D. oligodonta* (Desv.) Pic.Serm. (1951: 147), the rachis sulcus is not confluent with the sulcus of the pinnae. In the remaining *Dryopteris* species from the region the rachis sulcus and that of the pinna-rachises are confluent. The costae sulci are, however, not confluent with that of the pinna-rachis. The raised edges of the costae are basiscopically decurrent and join the edge of the pinnule lamina on the pinna-rachis as a lateral wing. In *D. squamiseta* the costule is slightly convex adaxially and flanked by prominent ridges on either side. In *Dryopteris* the dorsilateral aerophore line is generally visible with the naked eye, being paler than the surrounding tissue.

Proliferous buds:—Proliferous buds are outgrowths from the lamina axes capable of developing into an independent plant. Under certain conditions these organs will even produce roots when not yet touching the substrate. Proliferous buds appear to be genetically induced, but external stimuli may contribute to their formation. In *D. manniana* scaly proliferous buds are borne adaxially on the rachis mostly near the frond apex, but they may also occur along the pinna-rachis near the apices of the basal pinnae. They largely occur in or near the pinna and/or pinnule ‘axils’. One to three buds per frond appears to be the norm.

Venation:—The venation of *Dryopteris wallichiana* is of the *Pecopteridis*-type (Bower 1923: 97, Fig. 93f), whereas the venation of the other *Dryopteris* species in the region is of the *Sphenopteridis*-type (Bower 1923: 97, fig. 93c). In the *Sphenopteridis*-type a primary (central) vein extends into each segment. From this vein simple or branched secondary veins develop acroscopically and basiscopically in a pinnate fashion with the ultimate branches ending in somewhat elongated adaxial hydathodes in the teeth near the margin. In live material the venation

pattern is best visible on the abaxial lamina surface. The veins of all the *Dryopteris* species in the study area are anadromous, becoming catadromous towards the pinna and pinnule apices. In *D. antarctica* and *D. squamiseta* the venation of fertile fronds differs slightly from that in sterile fronds. In these species veins of the fertile pinnules mostly terminate in the receptacle midway between the costa and the margin. Variations, however, do occur with the fertile vein often extending for a short distance beyond the receptacle.

Indumentum:—Indumentum in *Dryopteris* occurs in the form of glands, hairs, and scales and these are found on all parts of the plant. Although indumentum, especially the scales are considered diagnostic for many fern species, no study on the morphology of African *Dryopteris* has been conducted.

Glands as here defined as unicellular structures and do not always produce an exudate. The morphology of glands and their distribution in some *Dryopteris* species are discussed by Viane (1986) and Roux (2011). Gland density is highly variable within species and this may be ascribed to environmental conditions. In the species where glands are present they were observed on the rhizome, frond axes and laminae, indusia, sporangium stalk, hairs, and scales. They are, however, not present on all these structures in all the species. Three types of these unicellular structures, capitate glands, clavate glands, and cylindrical glands, were identified. Capitate glands observed in *D. bernieri* Tardieu (1956: 161) and *D. wardii* (Baker) Kuntze (1891: 814) (Roux 2011) from the Indian Ocean region also occur on some scales in *D. oligodonta* and *D. antarctica*. Capitate glands co-occur with clavate glands on the stipe of *D. oligodonta*. Clavate glands occur along and between the veins in several *Dryopteris* species. The length of clavate glands ranges between 42  $\mu\text{m}$  in *D. oligodonta* to 170  $\mu\text{m}$  in *D. inaequalis*. Cylindrical glands are 58–260  $\mu\text{m}$  long and mostly occur along the lamina axes and veins in *D. inaequalis* (Fig. 4E & H), *D. pentheri* (Fig. 5H), *D. schimperiana* and *D. tricellularis* J.P. Roux (2002: 735). Hairs in *Dryopteris* are basifixed, pluricellular, uniseriate structures and chiefly occur along the frond axes and veins, but often also on the lamina between veins. These structures were discussed in detail by Viane (1986) and Roux (2011). Even though some species are isopiliferous, having only a single hair type within a given species, others are anisopiliferous, which have more than one hair type within a species. Four different hair types are observed in the studied *Dryopteris* species:

2-celled hairs:—Present in *D. inaequalis*, *D. pentheri*, *D. schimperiana* and *D. tricellularis*. These cylindrical hairs may be up to 260  $\mu\text{m}$  long and the cells are of equal or near equal length.



Two-celled hairs occurring in *D. inaequalis* have a basal cell that is significantly shorter than the distal cell. Cylindrical glands and 2-celled hairs are of near equal length. Two-celled hairs are confined to the lamina axes and veins. The transverse wall separating the hair cells often forms an oblique angle in *D. pentheri*.

Isocytic hairs (Viane 1986, Roux 2011):—All the cells in this hair type are somewhat elongated, never rounded, and their length is extremely variable (Figures 2M–O; 4B–D; 5I, P–R, Y, AA & BB; 6A–L, R–U, V & X). These hairs often bear one or more clavate glands, mostly near the base, and can be up to 0.8 mm long. Isocytic hairs occur abaxially along the veins and lamina.

Clavate hairs (Viane 1986, Roux 2011):—The apical and/or some subapical cells are distinctly broader than the basal cells, and often somewhat rounded (Figures 2A & B, R–U; 3F & K; 5F–G, J & L). These hairs often bear one or more glands near the base (Figures 3B & C; 4F & G; 5B & C). They may be up to 1.6 mm long.

Moniliform hairs (Viane 1986, Roux 2011):—In this type of hair all the cells, with exception of the basal cell, are rounded and the transverse walls more or less constricted (Figures 2C–E). This hair type was observed in *D. antarctica* only, where they occur along the veins on the abaxial surface of the lamina. Their lengths range between 3.0 and 3.5 mm and they can be up to 1.5 mm in diameter.

Nothoperanemoid hairs:—These hairs are mostly seven to nine cells long, with the three to four basal cells much longer than the four or more distal cells. The basal cells gradually widen towards the four more or less cupiform distal cells. The hairs are up to 290 µm long and were observed in *D. squamiseta* only (Figures DD & EE). Abnormal glands and hairs were observed in several *Dryopteris* species.

Paleasters are hair-like structures that at some point along their length, mostly towards the middle or apex, have a short section that are two or three cells wide. The basal and apical part of these structures is always uniseriate. Paleasters are essentially poorly developed scales (Figure 4P). Paleasters often occur among true hairs.

INSERT FIGURES 2, 3, 4, 5, 6

Scales are dermal appendages confined to the rhizome, frond axes and veins, but in *D. wallichiana* small fibrils or hair-like scales also occur along the lamina margin. Scales never occur

on the lamina surfaces between the veins. Fibrils [= microscales (Daigobo (1972))] are multicellular hairs or hair-like scales with sinuate joints between the cells. They often are long-stalked and bear short outgrowths near the base. Scales in *Dryopteris* are mostly one cell layer thick and flat, but in a few species some of the frond scales are often bullate. Scales in *Dryopteris* are thin-walled, non-clathrate and mostly membranous to chartaceous structures, but they may become thinly crustaceous in some species. In most species they are concolorous and depending on their age and location they can be stramineous, ferrugineous or castaneous. Young and immature scales are usually whitish.

Scale structure in *Dryopteris* shows extreme variation, but two basic types can be identified within the relevant *Dryopteris* species. The scales of *D. wallichiana* are up to 17 mm long and 2.4 mm wide. They are chartaceous and castaneous, ferrugineous or stramineous, but the larger (stipe) scales are often bicolorous. If bicolorous then they are ferrugineous to stramineous with (mostly central) castaneous streaks. The larger scales are subulate, broadly attached and cordate, while the margins are variously set with short and long, apically or basally directed, often branched outgrowths that reduce in number and size towards the scale apex. The scale apex terminates in an elliptic thin-walled cell or a subulate cell. Smaller scales are stalked, cordate to cordate-imbricate and the margins proximally variously set with outgrowths similar to those on the rhizome scales. Short- or long-stalked filiform scales occur along the costa, veins, and lobe margins. These scales proximally bear short marginal outgrowths, but distally they are entire. The scale apex terminates in a subulate cell, an elliptic thin-walled cell, or the apical cell is undifferentiated. Similar scales occur in *Polystichum* Roth sect. *Lasiopolystichum* Daigobo (1972).

Scales of the other *Dryopteris* species in the region are generally less clearly defined and they also show a greater degree of variation in overall morphology. Scales of species in this subgenus are basifixed and are generally larger than those in subgenus *Dryopteris*. They are chartaceous and stramineous to ferrugineous in colour. The scales may be filiform, lanceolate, narrowly ovate or broadly ovate in outline and in a few species bullate. Pluricellular outgrowths of variable length generally occur along the scale margins. In several species capitate, clavate or cylindrical glands occur along the scale margins and on the laminae. The scales generally terminate in a pluricellular filiform or flagelliform apex of which the terminal cell, like the marginal outgrowths, may be clavate and thin-walled or glandular. In *D. antarctica* the marginal outgrowths and scale apex terminates in a series of moniliform cells. In *D. cicatricata* the scale scars along the frond axes are

strongly developed resulting in muricate-cicatricate surfaces. The presence of bullate scales has been used by Ching (1938) and Fraser-Jenkins (1986) as a set of features defining certain sections in *Dryopteris*. Bullate scales were observed in a number of collections belonging to *D. fadenii*, *D. gorgonea*, *D. kilmensis* and *D. oligodonta*, but this is not a fixed occurrence and is therefore of little taxonomic value in the species under review.

Scales in *D. squamiseta* are castaneous and firmly chartaceous to thinly crustaceous. Structurally the scales differ from other *Dryopteris* species in that they are adnate, subulate, and patent. Few-celled uniseriate hairs terminating in a clavate gland frequently occur along the scale margin with unicellular glands regularly occurring on the scale lamina and along the margin. The scale apex terminates in a short uniseriate series of cells, the terminal cell being glandular.

Sori:—Sori of *Dryopteris* are circular and borne abaxially on the lamina. They are positioned medially, at or near the apex of ultimate vein branches. The circular or very shortly elongated receptacle is mostly devoid of paraphyses, but in *D. amblyodonta* the receptacle is set with pluricellular isocytic hairs and capitate glands. Sori in the 1-pinnate-pinnatifid *Dryopteris* species are mostly borne on the anadromous secondary vein branches, but occurrence of sori on the catadromous secondary vein branches is not uncommon. As mentioned under the venation section, the veins in *Dryopteris* generally do not show any differentiation between sterile and fertile fronds, but in *D. antarctica* and *D. squamiseta* the sori are borne at or near the apex of mostly shortened anadromous vein branches.

Indusia:—All *Dryopteris* species in the study area, with the exception of *D. filipaleata* J.P.Roux (2004a: 28), *D. manniana* and *D. ruwenzoriensis* C.Chr. ex Fraser-Jenk. (1986: 204) are indusiate. *Dryopteris fadenii* is occasionally exindusiate. Indusia are superior and near-circular, reniform, or broadly ovate in outline. Indusia are mostly one cell layer thick, but it thickens towards the point of attachment where it is several cell layers thick. The indusium margins may be entire, repand, erose, or occasionally irregularly set with pluricellular, uniseriate hairs in *D. inaequalis*, *D. amblyodonta* and *D. aurantiaca*. The anticlinal cell walls are mostly sinuate to deeply lobed, but in *D. kilmensis* and *D. squamiseta* the cells are more or less isodiametric with near-straight anticlinal walls. Collenchyma-like secondary thickenings characterise the indusium cells in *D. amblyodonta*, *D. kilmensis* and *D. squamiseta* (Figs. 7–9). Indusia are persistent, but they may be lost as a result of mechanical damage. The structure is generally uniform in colour and whitish to almost translucent in live material, becoming chartaceous and pale to dark brown when dry. Clavate

glands are observed along the indusium margin and/or on the indusium lamina of some species. Uniseriate hairs occurring on the indusium lamina, reported in *Dryopteris aquilinoides* (Desv.) C.Chr. (1905: 252) and *D. wardii* (Roux 2011), were also observed in *D. amblydonta*, *D. aurantiaca* J.P.Roux (2005: 164), *D. kilmensis* and *D. schimperiana*, but rarely so.

INSERT FIGURES 7, 8, 9

Sporangia:—*Dryopteris* sporangia are biconvex in facial view and globose to slightly obovate in lateral view. The annulus is vertical and interrupted by the stalk. The number of indurated annulus cells per sporangium is variable, ranging between 12 and 23, but mostly between 12 and 16. The mean number of indurated annulus cells per sporangium in most taxa is 13 or 14. A well-defined stomial region is present.

Cells of the stomial region are thin-walled, but the two stomium cells themselves are distinct in being larger with slightly thicker walls. The average number of hypostomial cells per sporangium is two, but as few as four and as many as nine have been observed. Similarly, the mean number of epistomial cells per sporangium is four, but as few as three and as many as eight have been counted.

The sporangium stalk is composed of three rows of cells for most of its length, but the base it may be one or two cells thick. The lengths of the stalk and stalk cells vary considerably. The stalk is generally long, consisting of slender cells, but they are often short and cupiform. The capsule generally breaks from the stalk through the tearing of the stalk cells just below the capsule. Although the stalk is mostly simple, it frequently bears one or more clavate glands, a pluricellular isocytic hair from near the base (Fig. 10), or it may bear glands and hairs.

INSERT FIGURE 10

Spores (Figures 11 & 12):—A general descriptive overview of the spore surface, spore wall structure, and spore diversity in *Dryopteris* is provided by Tryon & Lugardon (1990). Spores of the species treated here are brown, ellipsoidal, monolete, and the perispore is folded to form narrow or broad compressed reticulate ridges that form low tubercles and are densely echinulate, minutely rugulose, minutely scabrous, ruminant, or with narrow to broad reticulate ridges.

As is the case with stomata size, a correlation has been observed between spore size and ploidal level in a group of related fern taxa. It was suggested that spore size can contribute in establishing hypotheses of evolutionary relationships in polyploid complexes (Barrington *et al.* 1986). The number of spores per sporangium is mostly 64, except in *D. wallichiana* subsp. *reichsteinii*, where only 32 spores per sporangium are produced, suggesting it to be an obligate apomict.

INSERT FIGURES 11, 12

## Taxonomy

***Dryopteris* Adans.** (1763: 551), *p.p.*, *nom. cons.* Type:—*Dryopteris filix-mas* (L.) Schott [≡*Polypodium filix-mas* L.].

*Nephrodium* Rich. in Marthe (1801: 120), *nom. nud.* (McNeill *et al.* 2006: Art. 32.1).

*Nephrodium* Rich. ex Michx (19 March 1803: 266). Type:—*Nephrodium marginale* (L.) Michx. [≡*Polypodium marginale* L.] = *Dryopteris marginalis* (L.) A.Gray, designated by Pichi Sermolli (1977: 87–90). Note:—Christenhusz *et al.* (2011: 37) designated *Nephrodium filix-mas* (L.) Rich. as type, but this is superfluous.

*Arthrobotrys* Wall. (1829: no. 395, 1034), *nom. nud.* (McNeill *et al.* 2006: Art. 32.1), represented by *Arthrobotrys macrocarpa* Wall., *nom. nud.* (McNeill *et al.* 2006: Art. 32.1), = *Dryopteris cochleata* (Buch-Ham. ex D.Don) C.Chr. *Lastrea* Bory subg. *Arthrobotrys* Wall. ex Presl (1836: 77). Type:—As for *Arthrobotrys* Wall.

*Aspidium* Sw. § *Dichasium* A.Braun (1841: 710). *Dichasium* (A.Braun) Fée (1852: 302). *Dryopteris* Adans. sect. *Eudryopteris* subsect. *Dichasium* (A.Braun) Itô [1938] (1939: 6). Lectotype:—*Dichasium patentissimum* (Wall. ex Kunze) Fée [≡ *Aspidium patentissimum* Wall. ex Kunze] = *Dryopteris wallichiana* (Spreng.) Hyl.

*Lophodium* Newman (1851: 371, app. xvi). *Dryopteris* Adans. group *Lophodium* (Newman) Christensen (1905: XXI), (McNeill *et al.* (2006), Art. 35.2]. *Dryopteris* Adans. sect. *Lophodium* (Newman) C.Chr. ex Itô ([1938] (1939: 65). Type:—Christensen (1905: XXI) selected *D. spinulosum* auct. as the type, which was included within *Lophodium multiflorum* by Newman (1851: xvii, xviii). *Lophodium multiflorum* (Roth) Newman; [≡*Polypodium multiflorum* Roth] = *Dryopteris dilatata* (Hoffm.) A.Gray, designated by Christensen (1905: XXI).

*Pycnopteris* T.Moore (1855: 468). *Dryopteris* Adans. sect. *Eudryopteris* subsect. *Pycnopteris* (T.Moore) Itô ([1938] (1939: 25). Type:—*Pycnopteris sieboldii* T.Moore, = *Dryopteris sieboldii* (T.Moore) Kuntze.

*Diclisodon* Moore (1857: xcv, xcvi, pl. LXXVIIIB). Type:—*Diclisodon deparioides* T.Moore, = *Dryopteris deparioides* (T.Moore) Kuntze.

*Aspidium* Sw. group *Filix-mas* Christ (1897: 256), *nom. nud.* [McNeill *et al.* (2006), Art. 32.1]. *Dryopteris* Adans. group *Filix-mas* Christensen (1905: XXI), *nom. nud.* [McNeill *et al.* (2006), Art. 32.1]. Type:—*Dryopteris filix-mas* (L.) Schott [≡ *Polypodium filix-mas* L.].

*Aspidium* Sw. group *Spinulosum* Christ (1897: 261), *nom. nud.* [McNeill *et al.* (2006), Art. 32.1].

*Dryopteris* Adans. sect. *Nephrocystis* Itô (1935: 437). *Dryopteris* Adans. subg. *Nephrocystis* (H.Itô) Fraser-Jenkins (1986: 197). Type:—*Dryopteris hayatae* Tag., = *Dryopteris subexaltata* (Christ) C.Chr. [≡ *Aspidium subexaltatum* Christ].

*Dryopteris* Adans. subg. *Eudryopteris* sect. *Fibrillosae* Ching (1938: 366), *nom. nud.* [McNeill *et al.* (2006), Art. 32.1]. Type:—*Dryopteris fibrillosa* (C.B.Clarke) Hand.-Mazz., non (Baker) C.Chr. (1905: 264) [≡ *Nephrodium filix-mas* (L.) Rich. var. *fibrillosa* C.B.Clarke] = *D. pulcherrima* Ching, designated by Fraser-Jenkins (1986: 190).

*Dryopteris* Adans. sect. *Eudryopteris* (C.Chr.) Itô [1938] (1939: 5), *nom. inval.* (McNeill *et al.* (2006), Art. 21.3 and Art. 22.2).

*Dryopteris* Adans. subg. *Eudryopteris* sect. *Bulligerae* Ching (1938: 366), *nom. nud.* (McNeill *et al.* (2006), Art. 32.1d]. Type:—*Dryopteris bulligera* Ching.

*Dryopteris* Adans. subg. *Nothoperanema* Tagawa (1938: 199). *Nothoperanema* (Tagawa) Ching (1966: 25, 26). Type:—*Nothoperanema squamiseta* (Hook.) Ching; [≡ *Nephrodium squamisetum* Hook.] = *Dryopteris squamiseta* (Hook.) Kuntze.

*Dryopteris* Adans. sect. *Cinnamomeae* Fraser-Jenkins (1986: 193). Type:—*Dryopteris cinnamomea* (Cav.) C.Chr. [≡ *Tectaria cinnamomea* Cav.] = *Dryopteris squamiseta* (Hook.) Kuntze.

*Dryopteris* Adans. sect. *Marginatae* Fraser-Jenkins (1986: 194). Type:—*Dryopteris marginata* (Wall. ex C.B.Clarke) Christ [≡ *Aspidium marginatum* Wall. ex C.B.Clarke].

*Plants* terrestrial, epilithic, or (rarely) epiphytic. *Rhizomes* dictyostelic, suberect to erect and mostly unbranched, or short-decumbent and irregularly branched. *Fronde*s monomorphic or rarely dimorphic, approximate or crowded and caespitose; *stipes* and rachises with 3 to 7 near-circular meristeles in a broad U-shaped arrangement, the 2 dorsilateral meristeles larger, the ones in between smaller, the axes are adaxially sulcate, the sulci of the rachises and pinnae mostly confluent, but the axes sulci not confluent in some species, with a narrow, continuous aerophore line dorsilaterally, the stipe bases rarely incrassate to form persistent trophopods; *laminae* 1-pinnate-pinnatifid to 4-pinnate-pinnatifid, mostly anadromous at the base, becoming catadromous towards the apex, the basal pinna pairs mostly basiscopically developed and infrequently shorter than the next pair above. *Venation* anadromous and/or catadromous, free, forked, of the *Pecopteridis*-type, or pinnately branched and of the *Sphenopteridis*-type, often ending in elongate hydathodes adaxially near the margins, the fertile vein branches rarely abbreviate. *Stomata* of the polo- and copolocytic types, hypostomatic. *Indument* composed of capitate, clavate, or cylindrical glands occurring on the rhizomes, lamina axes, laminae, scales, hairs and sporangium stalks, 2- and 3-celled cylindrical hairs occurring on the lamina axes and veins, pluricellular, uniseriate, moniliform, isocytic or clavate hairs occurring along the veins or on the laminae, isopiliferous or anisopiliferous, and narrow and/or broad non-clathrate, chartaceous to thinly crustaceous scales occurring on the rhizomes, frond axes and abaxially along the veins on the laminae, or along the lamina margins (in *D. wallichiana*). *Sori* circular, dorsal, medial or at the ending of the ultimate vein branches; *sporangia* long-stalked, 3-seriate below the capsule, the stalks simple or bearing one or more uniseriate isocytic hairs and or clavate glands; capsules slightly globose to obovoid in lateral view, with (12–)13–14(–23) indurated annulus cells and a well-defined stomium; *indusia* superior, near-circular, reniform, broadly-ovate, or rarely unequally bilobed, entire to erose, infrequently with pluricellular uniseriate hairs along the margin (rarely also on the indusium lamina), glabrous, with unicellular clavate glands along the margins and/or indusium laminae, or exindusiate. *Spores* 32 or 64 per sporangium, ellipsoidal, monolete, with prominent folds and/or inflated tubercles, 28–68 × 18–48 μm. *Chromosome number* based on x = 41; sexual or apogamous.

**Etymology:**—*drys* (Greek), oak and *ptēris* (Greek), a fern

**Remarks:**—Fraser-Jenkins (1986) recognised 11 sections in subgenus *Dryopteris*. Species of the first four sections listed—*Hirtipedes* Fraser-Jenk., *Fibrillosae* Ching, *Pandae* Fraser-Jenk. and *Dryopteris*—are the only ones with fibrillose scales. African *Dryopteris* species with fibrillose scales include: *Dryopteris affinis* (Lowe) Fraser-Jenk., *D. filix-mas* (L.) Schott, and *D. wallichiana*

(Spreng.) Hyl. subsp. *reichsteinii* Fraser-Jenk. *Dryopteris affinis* and *D. filix-mas*, however, do not occur in sub-Saharan Africa, but they are found in North Africa where they are confined to the Atlas Mountain range.

Ching (1938) recognised six informal species groups in section *Fibrillosae*. The section name is invalid since Ching never provided a Latin description (McNeill *et al.* 2006: Art. 36.1). Ching furthermore never provided a type for section *Fibrillosae*, but Fraser-Jenkins (1986: 190) gives *Dryopteris fibrillosa* (C.B. Clarke) Hand.-Mazz., non (Baker) C. Chr. as the type, which is in accordance with the Code (McNeill *et al.* 2006: Art. 22.6). However, one of Ching's species groups, referred to as the *D. filix-mas* group, includes both *D. filix-mas* and *D. fibrillosa*. Section *Fibrillosae* is therefore not only invalid (McNeill *et al.* 2006: Art. 22.2), but it is also a superfluous name for the autonym *Dryopteris* subgenus *Dryopteris* section *Dryopteris* (McNeill *et al.* 2006: Art. 22.1). The valid publication of section *Fibrillosae* was never questioned by Fraser-Jenkins (1986) and he placed *D. wallichiana* (Spreng.) Hyl. in it.

Non-fibrillose scaled *Dryopteris* species forms part of *D.* subgenus *Dryopteris* and subgenus *Nephrocystis* as defined by Fraser-Jenkins (1986). The relevant species were placed in various sections within these subgenera. Due to the lack of robust characters defining these subgenera and sections, and the results obtained from molecular studies (Geiger & Ranker 2005, Li & Lu 2006, Liu *et al.* 2007, Juslén *et al.* 2011, Sessa *et al.* 2012) they are not maintained here.

### Key to the *Dryopteris* species in sub-Saharan Africa

1. Rhizomes mostly erect and unbranched; laminae 1-pinnate-pinnatifid; scales of the fibrillose-type, uniseriate hairs absent; venation of the *Pecopteridis*-type ... 26. **D. wallichiana** subsp. **reichsteinii**
  - Rhizomes suberect to erect and rarely branched, or decumbent and irregularly branched; laminae 2-pinnate to 4-pinnate-pinnatifid; scales variable, of the non-fibrillose type, uniseriate hairs present; venation of the *Sphenopteridis*-type ... 2
2. Laminae adaxially and abaxially with patent, broadly attached subulate scales up to 1.2 mm long along the veins ... 24. **D. squamiseta**
  - Laminae adaxially and abaxially without patent scales along the veins ... 3



3. Scales abaxially along the costae and costules bullate. ... 4
- Scales abaxially along the costae and costules not bullate ... 5
4. Laminae to 4-pinnate-pinnatifid; pinna-rachises not winged; indusia present, reniform, the margins entire or glandular, often also with glands on the indusium laminae ... 14. **D. kilmensis**
- Laminae to 2-pinnate-pinnatifid; pinna-rachises winged; indusia absent or present, if present then cordate to reniform, the margins repand, often with glands, but never on the indusium laminae ... 8. **D. fadenii**
5. Laminae proliferous, buds mostly adaxially on the rachises near the lamina apices; sori exindusiate ... 16. **D. manniana**
- Laminae never proliferous; sori indusiate or exindusiate ... 6
6. Stipe bases modified to form persistent trophopods; stipe and rachis scales entire, glandular, or with short filiform outgrowths consisting of a short series of moniliform cells; segments with pronounced acute to acute-falcate teeth; fertile vein branches shortened; spore surface short echinulate ... 2. **D. antarctica**
- Stipe bases not forming trophopods; stipe and rachis scales generally with short or long, filiform marginal outgrowths, the terminal cells never moniliform; segment teeth not pronounced, mostly denticulate, or crenate; fertile vein branches not shortened; spore surface forming short or reticulate ridges and bulges ... 7
7. Sterile and fertile fronds dimorphic, the fertile overtopping the sterile ... 7. **D. dracomontana**
- Sterile and fertile fronds monomorphic ... 8
8. Pinnae and pinnules conspicuously acroscopically developed ... 9
- Pinnae and pinnules not acroscopically developed ... 10
9. Laminae 1-pinnate to 1-pinnate-pinnatifid; pinnules glandular adaxially ... 23. **D. schnellii**
- Laminae to 3-pinnate; pinnules glabrous adaxially ... 3. **D. athamantica**
10. Lamina axes and veins abaxially eglandular, or sparsely set with glands and sparsely to moderately set with isocytic or moniliform hairs and scales ... 11
- Lamina axes and veins abaxially sparsely to densely set with glands, and/or 2- and/or 3-celled hairs, isocytic hairs, and scales ... 15
11. Rhizomes erect to suberect ... 13. **D. katangaensis**
- Rhizomes short-decumbent ... 12
12. Sori exindusiate ... 13

- Sori indusiate ... 14
- 13. Stipe scales irregularly denticulate and irregularly set with scattered capitate glands and long pluricellular, denticulate outgrowths; spores with low reticulate ridges and bulges ... 9. **D. filipaleata**
- Stipe scales denticulate, often with a few scattered glands along the margin; spores echinulate ... 21. **D. ruwenzoriensis**
- 14. Stipes not muricate-cicatricate; spores regularly tuberculate; endospore (42–)48(–56) × (24–)32(–38) μm; stomata (44–)59.5(–80) μm long ... 20. **D. rodolfii**
- Stipes closely muricate-cicatricate; spores with broad or narrow, short or reticulate ridges, endospore (36–)38(–40) × (24–)27(–30) μm; stomata (40–)46(–52) μm long ... 6. **D. cicatricata**
- 15. Sori exindusiate or indusia small and flabellate, repand to erose; veins abaxially closely set with predominantly 3-celled cylindrical hairs ... 25. **D. tricellularis**
- Sori indusiate, indusia well-developed, entire, repand, or infrequently with filiform outgrowths; veins abaxially sparsely to moderately set with clavate glands, and/or 2-, and/or 3-celled hairs ... 16
- 16. Veins abaxially glabrous or glandular, rarely with 2-celled hairs, if present then the basal cell much shortened, never with 3-celled hairs; lamina thinly herbaceous to herbaceous; basal pinna pair often reduced ... 17
- Veins abaxially mostly with glands, and 2- and/or 3-celled hairs; lamina firmly herbaceous to subcoriaceous; basal pinna pairs never reduced. ... 23
- 17. Laminae adaxially irregularly glandular along and between the veins ... 18
- Laminae adaxially without glands between the veins ... 20
- 18. Stipes densely scaled proximally, sparsely scaled higher up; confined to Sierra Leone ... 1. **D. amblyodonta**
- Stipes densely to moderately scaly along its entire length ... 19
- 19. Laminae adaxially and abaxially with clavate glands (50–)68(–98) μm long along and between veins; indusia glandular along margins and on surfaces, confined to the Cape Verde Islands ... 11. **D. gorgonea**

- Laminae adaxially and abaxially glabrous, or variously set with clavate glands (46–)95(–166)  $\mu\text{m}$  long along and between the veins; indusia glabrous; confined to eastern and southern Africa ... 15. **D. lewalleana**
- 20. Frond axes and veins variably set with capitate glands (36–)51(–60)  $\mu\text{m}$  long ..... 18. **D. oligodonta**
  - Frond axes and veins without capitate glands, if glandular then with clavate glands that are longer ... 21
- 21. Basal pinna pairs mostly reduced; glands (56–)77(–92)  $\mu\text{m}$  long; confined to South Africa ... 12. **D. inaequalis**
  - Basal pinna pairs not reduced; glands longer ... 22
- 22. Scales and indusia eglandular ... 17. **D. occidentalis**
  - Scales and indusia glandular ... 10. **D. glandulosopaleata**
- 23. Rhizome scales orange to ferruginous, with glands along the margin and on the scales; indusium margins with uniseriate filiform outgrowths and glands on the indusium laminae ... 4. **D. aurantiaca**
  - Rhizome scales various but never orange; indusium margins without uniseriate filiform outgrowths ... 24
- 24. Veins abaxially with glands (82–)89(–96)  $\mu\text{m}$  long, often also with 2–3-celled hairs; indusia to 2 mm in diameter, mostly strongly revolute, entire or rarely glandular along the margins ... 22. **D. schimperiana**
  - Veins abaxially with glands (60–)137(–260)  $\mu\text{m}$  long, and with 2-celled hairs; indusia to 1.8 mm in diameter, rarely strongly revolute, entire to repand ... 19. **D. pentheri**

1. *Dryopteris amblyodonta* Roux (2004b: 207, figs. 1A, B, 2A–H). Figs. 2A & B; 7A, Aa & Ab; 13.

Type:—SIERRA LEONE. Sugar Loaf Mountain, on ground amongst rocks, 730 m, 15 October 1951, *T.S. Jones* 339 (holotype BM000605481!).

*Plants* terrestrial, epilithic or rarely epiphytic. *Rhizomes* suberect to short-decumbent, to 10 mm in diameter, closely set with roots, persistent stipe bases and scales, the scales ferruginous, matt,

chartaceous, subulate to linear-acuminate, to  $18 \times 2$  mm, truncate to cordate, mostly with several pluricellular, pluri- or uniseriate marginal outgrowths on the lower part, proximally often also with a few scattered capitate glands along the scale margin, entire to irregularly denticulate towards the apex, the scale apex flagelliform, terminating in a uniseriate series of thin-walled cells. *Fronde* crowded, suberect, to 640 mm long; *stipes* proximally castaneous, brown higher up, proximally adaxially flattened, shallowly sulcate higher up, to 395 mm long, to 5 mm in diameter, proximally densely scaled, sparsely scaled higher up, the scales similar to those on the rhizome, but slightly smaller and mostly with more marginal outgrowths; *laminae* lanceolate to ovate, to  $445 \times 255$  mm, to 2-pinnate-pinnatifid, with up to 11 petiolated pinna pairs, the distal pinnae become sessile and eventually adnate and increasingly basiscopically decurrent; *rachises* brown to stramineous, adaxially shallowly sulcate, narrowly winged near the apex, sparsely to moderately scaled, the scales ferruginous, chartaceous, sessile, filiform to lanceolate, to  $3.5 \times 0.5$  mm, cuneate, entire to irregularly set with capitate glands and pluricellular hairs which mostly occur along the basal margin of the scales, capitate glands may also occur on the marginal hairs, the scale apex terminates in a short series of thin-walled cells; *pinnae* petiolate, the petioles to 10 mm long, proximally spaced to slightly overlapping, near opposite to alternate, the basal pinna pair longest or slightly shorter than the pinna pair above, to 1-pinnate-pinnatifid, the basal pinnae to  $172 \times 76$  mm, basiscopically developed, inaequilaterally narrowly triangular, pinnae higher up symmetric or not conspicuously basiscopically developed, narrowly triangular to oblong-acuminate, with up to 6 petiolated pinnule pairs; *pinna-rachises* brown to stramineous, adaxially shallowly sulcate, narrowly winged towards the apex, sparsely to moderately set with clavate glands, adaxially sparsely set with filiform scales, abaxially moderately scaled, the scales similar to those on the rachis but smaller; *pinnules* petiolate, the petioles to 2 mm long, proximally widely spaced, more closely spaced distally, firmly herbaceous, proximally pinnatifid, lobed towards the apex, the basiscopic pinnule on the basal pinnae to  $58 \times 17$  mm, the acroscopic pinnule on the basal pinnae to  $35 \times 14$  mm, narrowly triangular, ovate, or oblong-acute; *costae* shallowly sulcate adaxially, sparsely set with clavate glands and filiform scales, abaxially variously set with clavate glands and filiform scales; *segments* sessile, to  $8 \times 5$  mm, broadly ovate-obtuse, denticulate, adaxially glabrous or sparsely set with clavate glands along and between the veins, abaxially sparsely set with clavate glands (60–)88(–130)  $\mu\text{m}$  long along veins, and with isocytic hairs to 236  $\mu\text{m}$  long along and near the veins. *Venation* anadromous, catadromous towards the apex, adaxially

immersed, the lateral veins in the pinnule lobes once or twice forked, evident abaxially, ending in the teeth near the margin. *Stomata* mostly of the polocytic type, (42–)53(–66)  $\mu\text{m}$  long. *Sori* essentially 2-seriate on each pinnule, medial to inframedial, more or less restricted to the anadromous vein branch of each segment or lobe, to 1.2 mm in diameter; *receptacles* set with pluricellular isocytic hairs and capitate glands. *Indusia* castaneous, firmly herbaceous, to 1 mm in diameter, reniform, repand, glabrous or glandular along the margin, rarely also haired, often glandular on the indusium lamina. *Sporangia* with one or more large capitate glands and/or hairs along the stalk, the capsules with (11–)13(–18) indurated annulus cells, epistomium (3–)4(–6)-celled, hypostomium (4–)5(–7)-celled. *Spores* brown, 64 per sporangium, monolete, plano-convex, perispore smooth, with short and low wings and bulges, exospore to (34–)38(–46)  $\times$  (24–)28(–34)  $\mu\text{m}$ .

**Distribution and habitat:**—*Dryopteris amblyodonta* appears to be restricted to Loma Mansa and Tingi Mountains in eastern Sierra Leone. On the Loma Mountains, the species occurs from 600 to 1700 m. On the Sugar Loaf Mountain, it occurs between 600 and 800 m growing among doloritic rocks and on cliff faces, but it has also been recorded as an epiphyte in dense shade along streams. In the Tingi Mountains southeast of Loma Mansa it has been recorded from among rocks at 1824 m.

**Etymology:**—*ambly* (Greek), blunt, and *donta* (Greek), teeth, with reference to the obtuse teeth of the species.

**Additional material studied:**—SIERRA LEONE. Northern Province: Koinadugu Distr., Bintumani Mountain (Loma Mansa), in dense shade along stream, 1702 m, 18 July 1960, *T.S. Bakshi 250* (K); Loma [Mansa] Mountains, summit of Bintumani, on doloritic cliff faces, 23 November 1965, *J.K. Morton SL 2793* (K); Tingi Mountains, among rocks in gully on upper slopes of (Sankanirewa) Sankanbinwa, 1824 m, 12 April 1965, *J.K. Morton & D. Gledhill SL 1901* (K). Western Area: Sugar Loaf Mountain, on rocks, 608 m, 15 October 1951, *T.S. Jones 333* (BM); Sugar Loaf Mountain, on ground among rocks, 729 m, 15 October 1951, *T.S. Jones 338 & 339* (BM); Sugar Loaf Mountain, among rocks, 608 m, 15 October 1951, *T.S. Jones 341* (BM).

**Remarks:**—*Dryopteris amblyodonta* has in the past been confused with *D. pentheri*, but their morphology does not support such an affinity. Diagnostic features of *D. amblyodonta* include clavate glands (60–130  $\mu\text{m}$  long) occurring adaxially along and between the veins whereas in *D. pentheri* glands are confined to the frond axes and veins. Two-celled cylindrical hairs occurring on

the frond axes and veins of *D. pentheri* does not occur in *D. amblyodonta*. The indusia of *D. amblyodonta* often bear glands along the margins and surface and they rarely also have pluricellular uniseriate hairs along the margins. The sporangium stalks bears several large capitate glands and hairs. The relatively similar stomata size of this species and *D. pentheri* suggests *D. amblyodonta* to be tetraploid too. Receptacular hairs and glands, not found in many African *Dryopteris* species, are characteristic of *D. amblyodonta*.

INSERT FIGURE 13

**2. *Dryopteris antarctica* (Baker) C.Chr** (1913: 29). Figs. 2C–E; B & Bb; 7B & Ba; 13.

*Nephrodium antarcticum* Baker (1875: 479, 480). Type: —FRENCH ANTARCTIC TERRITORIES. ‘Island of ‘Amsterdam’. (St Paul), *G. Staunton s.n.* (holotype BM000605582!).

*Dryopteris callolepis* C.Chr. (1924: 177). Type: KENYA. ‘Mt. Aberdare: regio bambusina superior, ± 2800 m, 31 March 1922, *R.E. Fries & T.C.E. Fries 2554* (holotype BM000605550!).

*Aspidium spinulosum* sensu Pappe & Rawson (1858: 38), non *Aspidium spinulosum* Sw. (1801: 38).

*Aspidium spinulosum* Sw. var. *dilatatum* sensu Kuhn (1868: 142), non *A. dilatatum* (Hoffm.) Sm. (1804: 1125).

*Dryopteris spinulosa* (O.F.Müll. ex Roth) Kuntze subsp. *dilatata* sensu Bonaparte (1924: 16), non *D. dilatata* (Hoffm.) Gray (1848: 631).

*Nephrodium spinulosum* sensu Peter (1929: 56).

*Dryopteris austriaca* (Jacq.) Woyn. subsp. *dilatatum* sensu Chiovenda (1935: 140), non *Dryopteris dilatata* (Hoffm.) Gray (1848: 631).

*Dryopteris dilatata* sensu Tardieu (1958: 316), non *Dryopteris dilatata* (Hoffm.) Gray (1848: 631).

*Plants* terrestrial or epilithic. *Rhizomes* short, decumbent to suberect, closely branched, to 5 mm in diameter, set with roots, crowded persistent trophopods and scales, the scales ferruginous to castaneous, often bicolorous, chartaceous, sessile, lanceolate to narrowly ovate, to 9 mm long, to 3 mm wide, cordate to cordate-imbricate, the margins entire or with scattered clavate glands, the scale apex filiform, terminating in a uniseriate series of moniliform cells. *Fronde*s 4–6 per plant,

caespitose, suberect to arching, to 1.03 m long; *stipes* base incrassate, castaneous, stramineous higher up, proximally adaxially flattened, shallowly sulcate distally, to 460 mm long, to 4.5 mm in diameter at the base, moderately set with glands and spreading scales, the scales ferruginous, often slightly darker centrally, chartaceous, sessile, ovate to broadly ovate, to 11 x 4.5 mm, truncate to cordate-imbricate, the base often significantly enlarged, entire to repand, or with scattered glands and/or short marginal outgrowths ending in a short series of moniliform cells, the scale apex terminates in a short uniseriate series of moniliform cells; *laminae* anadromous, catadromous towards the apex, herbaceous to thinly herbaceous, ovate, to 3-pinnate, to 600 mm long, with up to 17 petiolated pinna pairs, the pinnae sub-opposite to alternate, remote at the base, more closely spaced to imbricate towards the apex; *rachises* greenish, sulcate adaxially, becoming narrowly winged towards the apex, often glandular, moderately to sparsely scaly, the scales ferruginous to stramineous, chartaceous, sessile or short-stalked, lanceolate to subulate, to 4 mm long, to 2 mm wide, cuneate to cordate-imbricate, entire or with scattered glands and/or short outgrowths terminating in a short series of moniliform cells, the scale apex terminates in a short uniseriate series of cells, the cells oblong or moniliform, the scales adaxially on the rachis linear to filiform, to 5.0 × 0.4 mm; *pinnae* petiolate, the petiole to 20 mm long, the basal pinna pair mostly longest, basiscopically developed, inaequilaterally ovate, to 170 × 90 mm, to 2-pinnate, with up to 8 petiolated pinnule pairs, the pinnae higher up near symmetric, narrowly ovate to oblong-acuminate; *pinna-rachises* adaxially shallowly sulcate, the sulcus confluent with that of the rachis, narrowly winged for most of its length, glandular, also sparsely scaled, the scales stramineous, chartaceous, sessile or short-stalked, narrowly ovate to subulate, to 3.0 × 0.6 mm, cuneate to cordate, entire to closely set with glands and globose to subglobose non-glandular cells along the margin and often also on the scale laminae, or with short moniliform hairs along the margin, the scale apex filiform, terminating in a short moniliform series of cells; *pinnules* petiolate, the petiole to 2 mm long, the pinnules symmetric or inaequilaterally narrowly ovate to oblong-obtuse, 1-pinnate, often acroscopically developed, the acroscopic pinnule on the basal pinnae to 28 mm long, to 12 mm wide, the basiscopic pinnule on the basal pinnae to 65 mm long, to 25 mm wide, not or slightly imbricate, with up to 4 petiolated segment pairs; *costae* adaxially shallowly sulcate; *segments* basiscopically decurrent along the costa, spaced, never imbricate, broadly ovate to oblong-obtuse, to 18 mm long, to 9 mm wide, lobed; *lobes* strongly dentate, the teeth acute to acute-falcate, glabrous adaxially, or sparsely set with glands (52–)116(–156) µm long along the

veins and often along the lamina margin, often also with hairs and filiform scales near the base, abaxially sparsely to moderately set with glands similar to those on the adaxial surface, often also with hairs and scaled, the scales stramineous, chartaceous, sessile or short-stalked, ovate to subulate, to 1.8 mm long, to 0.7 mm wide, cuneate to truncate, entire or variously set with clavate glands and globose to subglobose non-glandular hairs along the margin, also with a few scattered moniliform hairs, with scattered glands, the scale apex filiform, terminating in a short or long moniliform series of cells. *Venation* anadromous becoming catadromous towards lamina and pinna apex, pinnately branched in the segments, the vein branches forked or simple, evident, ending in the teeth near the margin, the endings often slightly enlarged. *Stomata* mostly of polocytic type, (40–)50(–64)  $\mu\text{m}$  long. *Sori* circular, at or near the apex of a mostly shortened anadromous vein branch, discrete at maturity, to 1.2 mm in diameter; *sporangia* stalks simple, the capsules with (11–)16(–21) indurated annulus cells, epistomium (4–)5-celled, hypostomium (4–)5(–6)-celled. *Indusia* brown, firmly herbaceous, reniform, entire to erose, often glandular along the margins, to 1.2 mm in diameter. *Spores* ellipsoidal, monolete, the perispore with compressed reticulate folds, densely echinulate, (44–)50(–58)  $\times$  (32–)35(–42)  $\mu\text{m}$ . *Chromosome number*:  $2n = 164 \pm 4$  (Vida in Widén *et al.* 1973: 2129).

**Distribution and habitat:**—*Dryopteris antarctica* is remarkably disjunct in its distribution, occurring on the isolated island of St Paul (37°52'S, 77°35'E) in the south Indian Ocean, and in southern Africa where it occurs in Western Cape and the south-western corner of the Eastern Cape, occurring at elevations ranging from 600 to 2130 m. Surprisingly, the species is absent from the Drakensberg range where one would expect this high elevation species to occur. To the north of South Africa it is known from the source of the Pungwe River (1980 m) in eastern Zimbabwe, and Mt Mulanje in southern Malawi. In tropical East Africa it occurs on Mt Kenya (ca. 2530 m) and the Aberdare Mountains (2920 m) in Kenya, Mt Kilimanjaro (2900 m) in Tanzania, Mt Mgahinga (3192 m) in western Uganda, and the Virunga Mountains in the Southern Kivu province of the Democratic Republic of the Congo. It has also been reported from Volcan Sabyinyo in the neighbouring Rwanda (Pichi Sermolli 1985). The species also occurs at 1850 m on Réunion, and at 2000 m on Massif d'Andingitra in northern Madagascar (Roux 2011).

In the Western and Eastern Cape mountains, which are dominated by mountain fynbos, the plants generally occur under rock overhangs, on rock ledges, and at boulder bases. During the dry summer (November–March) exposed plants in this region may become dormant. On the Central



and East African mountains the species is mostly associated with *Helichrysum-Breutelia*, *Erica* (*Philippia*)-*Lobelia*, *Carduus-Mariscus*, *Hagenia-Hypericum*, bamboo (*Arundinaria*), and montane grassland communities, but rarely also occur in small montane forest patches.

**Etymology:**—*antarctica*, with reference to the Antarctic region, the type being from St Paul Island (85 km south of Amsterdam Island) which is part of the French Antarctic Territories, situated in the southern Indian Ocean.

**Additional specimens examined:**—DEMOCRATIC REPUBLIC OF THE CONGO. South Kivu Province: Kivu, Mt. Kahuzi, 3300 m, 2 July 1993, *M. Becker 254* (BONN); montagnes a l'Ouest du Lac Kivu (Congo Belge), forêt, 2000–2400 m, February–March 1929, *H. Humbert 7430* (BM); upper Ruamhi Valley, 3 August 1952, *R. Ross 776* (BM).

KENYA. Central Province: Kiambu Distr., Mt. Aberdare, regio bambusina superior ca. 2800 m, 31 March 1922, *Th. C.E. Fries & Rob. E. Fries 2554* (BM); Nyeri Distr., Mt Kinangop prairies alpines, 3100 m, 20 February 1912, *Ch. Alluaud 283* (BM); Aberdares National Park, observation point above Gura Falls, 3040 m, 9 February 1969, *R.B. Faden 69/156* (K); Aberdare Mts, Kiandongoro, track above Tusha, 28 February 1970, *R.B. Faden & A.J. 71/883* (K). Eastern Province: Meru Distr., Volcanic cone Kirui on the slopes of Ithanguni, NE side of Mt Kenya, ca. 2530 m, 28 February 1970, *R.B. Faden 70/105* (K); Mt Kenya, Naro Moru Track, *Hagenia-Hypericum* zone, 2950 m, 10 October 1970, *R.B. Faden & A.J. Evans 70/694* (US); Mt Kenya, West, Naro Moru Track, ca. 0°10'S, 37°11'E, *R.B. Faden, A.J. Faden & E.J. Evans 71/877* (US); forest Station to summit (Mt Kenya) at ca. 3630 m, 21–27 September 1909, *E.A. Mearns, 1499* (US631556 & US631557); W-slope of Mt Kenya along the trail from West Kenya, W-slope of Mt Kenya, along the trail from West Kenya forest station to summit, ca. 3000 m, September–October 1909, *E.A. Mearns 1701* (US631653); Sagana Valley, Mt Kenya (SW sector) on deeply shaded earth-bank in *Podocarpus-Hypericum* forest, 3192 m, 21 August 1949, *E.A.C.L.E. Schelpe 2715* (BM, US).

RWANDA. Mutara District: Volcan Karisimbi (au NE du Lac Kivu), 3600 m, June 1929, *H. Humbert 8565* (BM).

SOUTH AFRICA. Western Cape: —3318 (Cape Town): Tulbagh, W side of Swartgat Peak, Witzenberg, 1520 m (–AA), 8 April 1950, *E. Esterhuysen, 16911* (PRE); Tulbagh, Great Winterhoek, at foot of cliffs in gully, 1520 m (–BB), 31 December 1951, *E. Esterhuysen 19786* (PRE); Jonkershoek, Victoria Peak, in gullies and cliffs and in shelter of rocks, on S slope, 1460 m

(–DD), 3 January 1983, *E. Esterhuysen* 35871 (NBG). —3319 (Worcester): Little Winterhoek, ravine, 1216 m (–AC), 16 February 1947, *E. Esterhuysen* 13777 (NBG); N slope of Milner Peak, 1915 m (–AD), 6 December 1947, *E. Esterhuysen* 14253 (NBG); Hex River Mts, Milner Peak, S base of headwall, 1320 m, 4 January 2004, *N.A. Helme* 2869 (NBG); Hex River Mts, some on shale band below Buffels Dome and Milner Ridge Peak, 1520 m, 1 January 1961, *E. Esterhuysen*, 28709a (BOL); Milner Peak, Hex River Mts, 2006 m, 11 November 1960, *E. Esterhuysen* 28588 (BOL); Waaihoek Peak, recess in rocks on S slopes, 23 January 1954, *E. Esterhuysen* 22656 (PRE); Ceres, Roodeberg, Hex River Mts, 1976 m (–BC), 27 December 1952, *E. Esterhuysen* 20908 (NBG); Sonklip, N of Matroosberg, in recess at base of cliff, ca. 2040 m, 28 May 1960, *E. Esterhuysen* 28488 (K, US2595676); Ceres, Roodeberg, Hex River Mts., in shade amongst boulders in scree on S slope, 1976 m, 27 December 1952, *E. Esterhuysen* 20908 (BM, NBG); Ceres, Matroosberg, large sandstone boulder NE of summit, 2200 m, 24 November 2009, *J.P. Roux* 4477 (NBG); Upper Kromrivier kloof, off Du Toit’s Kloof, 608 m (–CA), 22 March 1980, *J.E. Burrows* 1536 (NBG); Kloof on S slopes of Du Toit’s Peak, 1064 m, 27 December 1949, *E. Esterhuysen* 16642 (BM, PRE); Paarl, kloof between Kromrivier Peak and Kromrivier Dome, 1064 m, 9 March 1958, *E. Esterhuysen* 27613 (BM); Sheltered moist shady banks in Jan du Toit Kloof between Waaihoek and Hex River Mts, 910–1220 m (–CB), 21 January 1949, *E. Esterhuysen* 15070 (PRE); Hex River Mts, Sentinel Peak, 1520–1825 m, 15 December 1957, *E. Esterhuysen* 27418 (BOL); Du Toits Kloof between Waaihoek and Hex River Mts, 910–1220 m, 21 January 1949, *E. Esterhuysen* 15074 (K); Krom Rivier Kloof, off Du Toits Kloof, deep wet gully, 4 March 1956, *E. Esterhuysen* 25431 (K, US2293808); Du Toit berge, Deception Peak area, near lakelet, 1630 m, 9 November 2008, *N.A. Helme* 5758 (NBG); Stettynsberg, in shaded recess beneath rock at summit, 1800 m (–CD), 31 July 1949, *E. Esterhuysen* 15606 (PRE). —3321 (Ladismith): Seweweekspoort Mts, S side of Ridge Peak, 2128 m (–AD), 26 December 1928 *H.K.C. Andreae* 1229 (NBG); Swartberg, Toverkop, S side, 16 December 1956, *E. Esterhuysen* 26795 (BM, PRE); Ladismith, Swartberge, in shelter of cliffs at base of Toverkop, 1980 m, 22 April 1951, *E. Esterhuysen* 18514 (BM, K, PRE); Klein Swartbergen W of Klein Swartberg Peak, cave on S side, 2000 m, 28 December 1928, *H.K.C. Andreae* 1229a (NBG); Seweweekspoort Mts., cave on S side of 2nd Peak, 1976 m, 29 December 1928, *H.K.C. Andreae* 1229 (NBG); Klein Swartberg, ridge W of Seweweekspoort, 2080 m, 3 February 1992, *E.G.H. Oliver* 9995 (NBG); Seweweekspoort Mts, S aspect, 1976 m, 29 December 1928, *T.P. Stokoe* 1905 (NBG);

Langeberge, summit above Riversdale, in shade and sheltered rocks (–DC), 19 May 1950, *E. Esterhuysen 17019* (BM, K, PRE); Ladismith, Klein Swartberg, ridge W of Seweweekspoort Mts, S-facing cliffs, 2080 m, 3 February 1992, *E.H.G. Oliver 9995* (NBG); Seven Weeks Poort Mts, S aspect, in shade, 2130 m (–AD), December 1928, *R. Primos 118* (PRE); Seweweekspoort Mts, S aspect, 1976 m, 29 December 1928, *T.P. Stokoe 1905* (NBG, PRE). —3322 (Oudtshoorn): Swartberg Pass, Boegoekloof (–AC), 13 February 1993, *J.P. Roux 2632* (NBG); Swartberg, Blesberg, summit ridge just E of the peak, 2000 m (–BC), 13 July 2000, *E.G.H. Oliver 11540* (NBG); moist montane forest near summit of Swartberg Pass, 1200 m (–AC), 10 November 1987, *C.J. Geldenhuys 1336* (PRE); Swartberg Pass, Boegoekloof, on seasonally moist moss covered rocks in streambed, 13 February 1993, *J.P. Roux 2632* (NBG). —3418 (Simonstown): Hottentots Holland Mts, Moordenaarskop, S slope, 1220 m (–BB), 12 January 1980, *J.E. Burrows 1521* (NBG); Hottentots Holland Mts, Moordenaarskop, in shelter of overhanging rock on S side, 6 August 1950, *E. Esterhuysen 17395* (BM, K, NBG); Hottentots Holland Mts, S slope, 6 August 1950, *E. Esterhuysen 17395* (NBG). —3419 (Caledon): Jonkershoek Forest Reserve, Victoria Peak, 1459 m (–AA), 15 February 1976, *E. Esterhuysen 34191* (NBG); Victoria Peak, Jonkershoek Forest Reserve, in gullies in cliffs, S slopes, 1459 m, 15 February 1976, *E. Esterhuysen 34191* (NBG); SE side near summit of Milner Peak, shady ledges by overhanging rock, 1980 m (–AD), 16 December 1948, *E. Esterhuysen 14899* (K, PRE); Hex River Mts, Waaihoek Peak, among rocks, 1825 m, 17 December 1982, *E. Esterhuysen 35855* (NBG); Riviersonderend Mts, S slope at summit of Middelberg (–BB), 11 November 1997, *J.E. Manning 2141* (NBG); Gardin Peak (SW side), amongst rocks at foot of cliffs in shade, 1220 m, 13 January 1955, *E. Esterhuysen 24104* (US2293795). Province unknown:—Cap de Bonne Espérance, *Drège, s.n.* (P).

TANZANIA. Kilimanjaro Region: Kilimanjaro, ca. 2900 m, *H.J. Schlieben 4898* (BM, K, MO).

UGANDA. Western Region: Kasese Distr., Virunga Mts, Mt Mgahinga, 3192 m, 4 December 1930, *B.D. Burt 2833* (K); Bujuku Valley, Ruwenzori, 3040 m, 27 January 1956, *E. Esterhuysen 25274* (BM); Mt Mgahinga, at summit, 3192 m, 24 August 1938, *A.S. Thomas 2460* (K), Ruwenzori, Namwamba valley, in heath zone, 3192 m, 11 January 1935, *G. Taylor 3076* (BM).

ZIMBABWE. Manicaland Province: Mutasa District, Rhodes Estate, source of Pungwe River, in shade, 1976 m, 25 May 1954, *N.C. Chase 5262* (BM); source of Pungwe River, slopes of

Inyangani Mt, Rhodes Inyanga Estate, frequent on forest floor, 1980 m, 1 May 1960, *N.C. Chase* 7336 (BM, K).

**Remarks:**—In South Africa Drège first collected the species during the 1830's at Du Toits Kloof and at Swellendam. The identity of these collections was variously interpreted by various authors. Pappe & Rawson (1858) ascribed them to *Lastrea spinulosa* C.Presl (= *Dryopteris carthusiana* (Vill.) H.P.Fuchs), a European species. This view was followed by Kuhn (1868), Baker (1867) and Peter (1929). Sim (1915), however, considered them as forms of *D. inaequalis* and Alston & Schelpe (1952) omitted the species from their checklist of southern African Pteridophyta altogether. It was only in 1970 that Schelpe mentioned the species (as *D. callolepis* C.Chr.) as occurring in South Africa. Fraser-Jenkins (1986: 208) noted that *D. callolepis* is synonymous with *D. antarctica*. It was, however, again tentatively separated from *D. callolepis* for 'geographical convenience and because of their distinct chemistry' (Widén *et al.* 1999). The type of *D. antarctica* forms part of the Banks Herbarium at the British Museum of Natural History (BM) and was studied by the author. Apart from some minor differences in scale morphology material ascribed to *D. antarctica* and *D. callolepis* cannot be separated. Phenolic compounds appear not to be of significant taxonomic value because of their variation within species and their similar distribution in species not considered related (cite source). Widén *et al.* (1999) demonstrated that these compounds differ among plants from St Paul, Kenya and Réunion. *Dryopteris antarctica* is confined to high elevations. The short, closely branched, erect to suberect rhizomes are generally enveloped by persistent trophopods, the firmly chartaceous, often bicolorous, rhizome and stipe scales, which appear entire, but often bearing glands along the margins, the scale apices terminating in a short moniliform series of cells are characteristic. The apical part of the lamina hairs also terminates in a moniliform series of cells. The strongly dentate segments, and the mostly shortened, fertile vein branches, are further diagnostic features of the species.

Fraser-Jenkins (1986) placed *D. antarctica* in subgenus *Dryopteris* section *Lophodium*, together with several taxa from the temperate parts of the northern hemisphere and Macaronesia. Widén *et al.* (1999) found *D. antarctica* to be very similar to *D. dilatata* (Hoffm.) A.Gray in both morphology and chemistry. My observations on the scale morphology of the species support this likely affinity.

**Variation:**—Considering the wide and disjunct distribution of *Dryopteris antarctica*, the species shows little variation in overall morphology. Micromorphological variations include the sporadic occurrence of glands along the indusium margin and the often significant variation in gland length (52–156 µm) occurring on the laminae. Stomata length (40–64 µm) does not suggest different ploidy levels in the species. Variation has also been observed in the degree to which glands occur on lamina scales. In collections from St Paul studied, but not cited above, the scale margins and surfaces are densely set with clavate glands whilst African collections are never as densely glandular. Non-glandular globose to subglobose cells occur on scales of plants from both St Paul and Africa.

**3. *Dryopteris athamantica* (Kunze) Kuntze** (1891: 812). Figs. 2I–K; 7C & Ca; 14.

*Aspidium athamanticum* Kunze (1844: 123). *Lastrea athamantica* (Kunze) Moore (1853b: 311). *Nephrodium athamanticum* (Kunze) Hooker (1862: 125). Type: —SOUTH AFRICA. “Ad portum Natalensem in collibus graminosis et locis paludosis”, February–April and June 1842 *W*.

*Gueinzium s.n.* (holotype LZ, destroyed, lectotype K [000675781]!, designated by Roux 2001: 127).

*Lastrea plantii* Moore (1853a: 226, 227). Type:—SOUTH AFRICA. 'Mooi River; in deserted holes of the jackal', *R. W. Plant 31* (holotype BM 000605499!, isotype BM 000605505!).

*Nephrodium eurylepium* Peter (1929: 57, Anhang: 3). Syntypes:—TANZANIA. Buha (Uha) District, February 1926, *A. Peter 37743* (lectotype BM000605522!, isolectotype, K000675770!), here designated; Kigoma District, Ujiji, February 1926, *A. Peter 37290* (syntype K000675769!).

*Plants* terrestrial or epilithic. *Rhizomes* to 200 mm long, decumbent to suberect, mostly closely branched, to 13 mm in diameter, set with roots, crowded stipe bases, and scales, the scales ferruginous, chartaceous, broadly attached, oblong-acuminate to narrowly lanceolate, to 18 x 2 mm, the margins entire or irregularly set with filiform marginal outgrowths, the scale apex filiform, terminating in an oblong thin-walled cell. *Fronde*s crowded, erect, to 1.31 m long, up to 6 at each rhizome apex; *stipes* stout, proximally castaneous, stramineous higher up, adaxially shallowly sulcate, to 540 mm long, to 14 mm in diameter, moderately to densely scaled, often subglabrous later, the scales ferruginous, chartaceous, broadly attached, linear-acuminate to

oblong-acuminate, to 24 x 2.5 mm, cuneate, entire, with long twisted, pluricellular filiform outgrowths, or with a few scattered glands along the margins, the scale apex filiform, terminating in an oblong thin-walled cell; *laminae* firmly herbaceous, anadromous, iso-, or catadromous towards the apex, narrowly ovate, to 780 mm long, to 3-pinnate, with up to 23 opposite to alternate pinna pairs; *rachises* stramineous to greenish, adaxially sulcate, narrowly winged towards the lamina apex, moderately to sparsely set with scales and hairs, the scales twisted, ferruginous to stramineous, chartaceous, sessile, linear to filiform, to 6 mm long, to 0.6 mm wide, cuneate, entire, the scale apex terminates in an oblong thin-walled cell; *pinnae* petiolate, the petiole to 12 mm long, widely spaced at the base, the pinnae mostly somewhat imbricate towards the lamina apex, the basal pinna pair mostly longest, inaequilaterally broadly ovate, to 185 mm long, to 123 mm wide, mostly basiscopically developed, to 2-pinnate, those higher up symmetrically lanceolate, with up to 8 petiolated pinna pairs; *pinna-rachises* set at an angle of 45° or less to the rachis, adaxially shallowly sulcate, the sulcus confluent with that of the rachis, narrowly winged for most of its length, sparsely scaled, the scales ferruginous to stramineous, chartaceous, sessile, linear to filiform, to 4 mm long, to 0.4 mm wide, entire, the scale apex terminates in an oblong thin-walled cell; *pinnules* petiolate, the petiole to 2 mm long, mostly somewhat imbricate, the pinnules to 1-pinnate, inaequilaterally lanceolate, acroscopically developed, the acroscopic pinnule on the basal pinna pair to 48 mm long, to 28 mm wide, the basiscopic pinnule on the basal pinna pair to 72 mm long, to 30 mm wide; *costae* adaxially shallowly sulcate, narrowly winged; *segments* spaced, inaequilaterally narrowly trullate, narrowly triangular, narrowly rhomboid or oblong-obtuse, cuneate, to 20 mm long, to 7 mm wide, basiscopically decurrent, often shallowly lobed; *lobes* denticulate to crenate, adaxially glabrous or with a few filiform scales along the costae, abaxially sparsely set with filiform scales, uniseriate hairs bearing one or more glandular cells near base, isocytic hairs, and often also with clavate glands (54–)73(–112) µm long. *Venation* anadromous, becoming catadromous towards the lamina and pinna apex, pinnately branched in the segments, the vein branches pinnately branched, forked or simple, evident, ending in the teeth near the margin, the endings often slightly thickened. *Stomata* mostly of the polocytic type, (36–)49(–68) µm long. *Sori* circular, to 1.6 mm in diameter at maturity, inframedial on predominantly anadromous vein branches, discrete or touching at maturity; *sporangia* stalks simple or haired, the capsule with (11–)14(–22) indurated annulus cells. *Indusia* brown, firmly herbaceous, reniform, entire to erose, to 1.7 mm in diameter. *Spores* ellipsoidal, monolete, the perispore with narrow to

broad reticulate ridges, granulate, (40–)45(–50) x (30–)33(–36)  $\mu\text{m}$ . *Chromosome number*:  $n = 41$  (Manton 1959: 80),  $2n = 80 \pm 2$  (see Widén *et al.* 1973).

**Distribution and habitat:**—*Dryopteris athamantica* is the most widespread *Dryopteris* species in Africa occurring in Angola, Burundi, Cameroon, Central African Republic, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Ethiopia, Ghana, Guinea, Kenya, Lesotho, Liberia, Malawi, Mozambique, Nigeria, Rwanda, Sierra Leone, South Africa, South Sudan, Sudan, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe. Within this region, the species occurs in a wide range of vegetation types, but it is largely associated with montane grasslands and seasonally moist tree savanna with *Brachystegia*, *Jubernardia*, *Uapaca*, *Erythrina*, *Schrebera*, *Strychnos*, *Combretum*, *Loudetia* etc. Although it rarely enters forest margins, it never occurs in deeply shaded moist evergreen forests. In grasslands it frequently occurs in partial shade or in full sun, in sinkholes along drainage lines, in uninhabited antbear holes, at boulder bases, in rock crevices, and on termite mounds. Vegetation fires are frequent throughout its distribution but it appears to have no or little deleterious effect on the subterranean rhizomes. The closely branched rhizomes results in the plants usually forming small clonal stands.

In southern Africa the species occurs from near sea-level to 1824 m in Lesotho, well above the snow-line. To the north it occurs at elevations ranging from 1200 in Zambia to 2400 m on the Nyika Plateau in Malawi and to 1884 m in Ethiopia.

**Etymology:**—*athamantica*, the derivation of the epithet is unknown. However, it most likely refers to the Apiaceae *Meum athamanticum*, which has highly dissected and aromatic leaves. The plant is used to relieve fever and as a diuretic. It is also said to increase lactation. The epithet stems from Greek mythology: King Athamas of Bootia was tricked by his second wife into believing that sacrificing his first son Phrixos was the only way of pleasing the gods and saving his people from starvation by putting an end to continuing bad harvests. As purgative punishment, he was made raving mad temporarily by the goddess Hera. In his rage he killed his second son and his scheming second wife fell into the sea to her untimely demise while fleeing from him.

**Additional specimens examined:**—ANGOLA. Benguela Province: Alto Catumbela, Gauda, 1370 m, January 1941, *H.G. Faulkner*, 206 (PRE); Chicala-Calengue, 1900 m, 19 June 1940, *J. Gossweiler* 12486 (BM, K); Hochland von Durjuella, zwischen Ganda und Caconda; ca. 1700 m, 10 April 1934, *O. Hund*, 924 (B20 0052706, B20 0052707, BM); Bailundo Distr., 1520 m, *F.C. Wellman* 1906 (K). Bié Province: Chinguar, among rocks on S side of Chimbandu Hill, 13 August

1967, *L.C. Leach & I.C. Cannell 13870* (BOL). Huambo Province: Centro de Estudos da Chianga, a ca. de 1750 m, 12 December 1969, *M. da Silva 2693* (K, M, PRE); Nova Lisboa, Pedra do Alemão, 9 May 1937, *A.W. Exell & F.A. Mendonça 1707* (BM); Benguela high plateau, Cuima-Lepi, Calai, 1500 m, 2 January 1933, *J. Gossweiler 9748* (BM, K, US1579385). Huíla Province: entre Sá da Bandeira a e Humpata, 2000 m, 5 June 1937, *A.W. Exell & F.A. Mendonça 2614* (BM); Humpata, Estação Agronomica, rio Vene, 5 June 1937, *A.W. Exell & F.A. Mendonça 2632* (BM); Humpata, Estação Agronomica, rio Vene, 5 June 1937, *A.W. Exell & F.A. Mendonça 2640* (BM); Serra da Chela, aux environs de Humpata, 2000–2200 m, August 1937, *H. Humbert 16662* (BM); late caespitosum justa ripas fluminis prope Humpata, 1672 m, iter 14 et 16° lat austr., April 1860, *F. Welwitsch 194* (B20 0052708, BM, K). Lunda Sul Province: Xá-Sengue, 1200 m, 7 April 1937, *A.W. Exell & F.A. Mendonça 439* (BM). Moxico Province: Alto Zambeze, Macondo, November 1955, *A.B. Machado 361* (BOL, M). Uíge Province: near Fort Uíge, 4 February 1918, *J. Gossweiler 7407* (BM). Sine loco:—Xongorola, Otchinjini, 1700 m, 20 December 1932, *O. Hundt 377* (B20 0052705).

BURUNDI. Bubanza Province: Musigati River, Mpanda, 1450 m, 24 January 1972, *J. Lewalle 6483* (BR). Bujumbura Rural Province: Kisozi, 26 November 1980, *J. Bouharmont 14213* (BR); Kisozi, 5 March 1935, *J.-B. Lejeune 214* (BR); Bujumbura, mission de Buhanga, 1300 m, 19 November 1972, *M. Reekmans 2046* (BR). Bururi Province: Bikingi (Mosso) Prov., Bururi sous-bois forêt à *Isobertinia*, 1350 m, 12 December 1977, *M. Reekmans, 6792* (BR). Kirundo Province: Nyakisozi, 27 December 1965, *J. Lewalle 151* (BR, K). Ngozi Province: Nyakisozi, 1600 m, 6 February 1974, *M. Reekmans 3059* (BR). Ruyigi Province: Canguzo, 1450 m, 30 October 1966, *J. Lewalle 1196* (BR, K); Kinyinya, 1300 m, *J. Lewalle 5411* (BR); Kigamba, 1500 m, 1 October 1974, *M. Reekmans 3730* (BR); Kigamba, 1500 m, 1 January 1975, *M. Reekmans 4161* (BR, K, PRE); Mosso Gihofi, 1300 m, 31 January 1976, *M. Reekmans 4754* (BR); pont de la Nyakijanda, Gitega et Ruyigi route Gitega-Ruyigi km 37 bord route, 1550 m, 2 January 1979, *M. Reekmans 7428* (BR, K); Gitwenge, Colline Gatuntu, 1700 m, 2 May 1980, *M. Reekmans 9003* (K, US3435157); Kitega, Bweru, environs Karuzi, colline Ruvumu, ca. 1550 m, *D. van der Ben 1936* (BR); Kitega, Kitega, Bweru, environs Karuzi, Karuri, ca. 1550 m, *D. van der Ben 2017* (BR).

CAMEROON. East Province: Douala et Mts. Bamboutes, Djuttitsa, 1800 m, 5 June 1967, *A. Meurillon CNAD 814* (K, P); Mt Bamboutos, 1900 m, August 1939, *L.P. Villiers 582* (P). l' Adamaoua Province: at Minim, 62 km N of Tibati, 9 October 1982, *J.N. Asonganyi 550* (P, YA);



plateau of the Adamaoua, 11 km S of Ngaoundere, along road to Meiganga, 29 September 1960, *F.J. Breteler* 352 (K, LISC, M, P, YA); ca. 17 km S of Meiganga, 23 November 1964, *W.J.J.O. de Wilde & J.J.F.E. & B.E.E. de Wilde-Duyfies* 3990 (K); Nghanha Mts, near Ndigou, ca. 60 km E of Gaoundéré, ca. 1800 m, 3 December 1964, *W.J.J.O. & J.J.F.E. de Wilde & B.E.E. de Wilde-Duyfies* 4522 (K); Aro vers Likop, 50 km W Ngaoundere, 25 June 1977, *G. Fotius* 2724 (YA); Ngaou Ndéré, mares de Bini, 11 October 1967, *H. Jacques-Felix* 8607 (P, YA); Tibati-Mabouka road, ca. 1000 m, *A.J.M. Leeuwenberg* 10033 (YA); Dzerkoka (13 km NW Bélel, Cameroon), 1540 m, 8 December 1964, *J. & A. Raynal* 12354 (P, YA). Far-North (l' Extreme-Nord) Province: Mala, 40 km au N de Tibati, 21 September 1963, *R. Letouzey*, 5878 (P, YA). North-West Province: Sagbo, near Ndop, Bamenda, 1672 m, 20 December 1952, *C.D. Adams* 1543a (BM); on Bamenda-Ndop road, 1428 m, 22 December 1952, *C.D. Adams* 1564 (BM); zwischen Bambili und Bamessing (nahe einer Wasserfall), ca. 1750 m, 2 January 1971, *G. & U. Benl Ka* 70-71/141 (M); Bambui, 1971, *Botté* 351 & *Botté* 352 (P); Jakiri, low lava near 'Journey's End house, 1520 m, 18 June 1962, *M. Brunt* 538 (K); Bamenda Distr., along the ridge of the hill, 11 May 1959, *B.O. Daramola s.n.* FHI41164 (K); Bamenda Distr., Bum, 1216 m, May 1931, *T.D. Maitland* 1736 (K); Savannengebiet des Baja-Hochlandes in östlichen Mittel-Kamerun (Neukamerun seit 1911) unter etwa 6° N zwischen. Kongola (Kongoros)-Kunde-Buar-Bosum a Uham, 14°E, 16°22'E, Mbussa, 800–900 m, April 1914, *J. Mildbraed* 9135 (B20 0052704, K); Kongola, 19 August 1917, *G. Tessmann* 2701 (B20 0052703). Bouba, 11 March 1961, *R. Letouzey* 3636 (K); Mbussa, 800–900 m, April 1914, *Merhwer* 9135 (K); Mbussa, 800–900 m, 29 April 1914, *J. Mildbraed* 9085 (K). South-West Province: Mt Cameroon, 2736–3040 m, 21 December 1934, *E.D. Plumtree* 234 (K).

CÔTE D'IVOIRE. Dix-Huit Montagnes Region: in grassland on Nimba Mts, 1520 m, 10 August 1954, *A.S. Boughey* 18099 (K).

DEMOCRATIC REPUBLIC OF THE CONGO. Katanga Province: a 12 km au NW Lubumbashi (d'Elizabethville), 1300 m, 9 April 1958, *A.L. Gathy* 611 (BOL); Lubumbashi (Elizabethville), Kissenga Valley, 10 January 1926, *C.W. Hirschberg s.n.* (PRE); a 3 km de Sakania (Katanga), 'Muhulu', 1230 m, 7 February 1971, *M. Lukuesa* 928 (BOL); a 60 km au NNW du Poste de Katshupa (Plateau des Kundelungu), 1690 m, 26 January 1967, *F. Malaisse* 4897 (BOL, K, US2595650); a 60 km au NNW du Poste de Katshupa (Plateau des Kundelungu), 1690 m, 26 January 1967, *F. Malaisse* 4899 (BOL); Plateau des Kundelunga, a 6.2 km au N du Poste de Katohufa, 7 May 1967, *F. Malaisse* 5234 (BOL); Plateau de Maniamba, 1200 m, January 1932, *G.*

*Sousa 1219* (K, US1702480); a env. 2 km de Kitendwe, a l'E de la route Baudouinville-Pepa, 1930 m, 19 June 1957, *J.-J. Symoens 4121* (BOL); steppe au sommet du mont Lusale, a env. 12 km au N-NE de Kasiki, env. 2400 m, 24 June 1957, *J.-J. Symoens 4443* (BOL); prairie, a l'E de la Kalule-Nord, Shisinkwa (plateau des Bianco), 1600 m, 24 December 1957, *J.-J. Symoens 5053* (BOL); a env. 10 km au S-SW de Kifinga (Katanga), le long de la route Kifinga-Kasongo Mwana, 1420 m, 30 December 1958, *J.-J. Symoens 6356* (BOL); a 11 km Lubumbashi (d'Elizabethville), 1240 m, 16 December 1965, *J.-J. Symoens 11710* (BOL, K); Lubumbashi (Elizabethville), 1250 m, 15 January 1960, *J.-J. Symoens 12075* (BOL); a 2 km de Katentania (Plateau des Bianco), talus sableux rive Jauke de la rivière Katentania, 1520 m, 6 May 1966, *J.-J. Symoens 12553* (K). Southern Kivu Province: Kisozi, 5 March 1935, *T. Pefeune 214* (PRE); regione del Lago Kivu. Presso Bukavu, lungo la costa della penisola de Cofonya nella baia de Nguba, 1500 m circa, 22 October 1953, *R.E.G. Pichi Sermoll 4423* (K). Without localiy: Environs Mission Nkingandu, 1225 m, 5 January 1985, *A. Bodenghien & F. Malaisse 29* (K).

ETHIOPIA. Oromia Region: 11 kms S of Abalti near Kombie on Addis-Ababa to Jimma road, 1050 m, 20 June 1971, *J. Ash 970* (K, MO); 21 km E of Sire (Wollega), 71 kms E of Lekempti on Addis-Ababa road, 1700 m, 1 July 1973, *J. Ash 1986* (K); 2 km N of Adoula, 20 July 1962, *W. Burger 1864* (K); ca. 6 km along the road Jimma to Bonga, ca. 1 650 m, 9 July 1969, *J.J.F.E. de Wilde 5413* (MO); S of Ghibe River, ca. 12 km S of Jimma, ca. 2000m, *I. Friis, A. Hounde, & K. Jacobsen 185* (ETH); Jimma, 1884 m, 7 October 1954, *H.F. Mooney 5888* (K, US2360698); Wofasha Forest, 2900 m, 25 March 1957, *H.F. Mooney 7015* (K); Welega Region, 8 km NW of Nejo, Welega, N-facing slope, 1880 m, 19 November 1980, *D. Sebsebe & Erich 540* (ETH). Southern Nations, Nationalities and Peoples Region: 12 km S of Soddu, 1990 m, 5 September 1975, *M.G. Gilbert & M. Thulin 551* (K, MO); Wolamo, 20 km SW v. Soddu, an Strasse nach Gofa, 7 June 1955, *W. Kuls 613* (FR); Soddu (Walamo Prov.), at edge of field near Nission Station, November 1948, *H. Scott 59* (K, US2200546).

GUINEA. Labé Region: Fouta-Djallon, à Dalaba, 1200 m, à terre en bordure de la forêt, à *Parinari excelsa*, 5 October 1948, *H. des Abbayes 657* (BM); Fouta-Djallon, region de Mali, 1500 m, September 1954, *R. Schnell 7048* (K). Nzérékoré Region: Mt. Nimba, côte, 1600 m, 20 April 1949, *R. Portois s.n.* (P); Monts Nimba, dans creux de rochers, 1400–1500 m, February 1942, *R. Schnell 443* (P); Monts Nimba, escarpment rocheux, April 1954, *R. Schnell 6237* (K).

KENYA. Coast Province: Magunda, 1894, *J.F. Darling 468* (PRE); Milimani suburb, SW of Kitale, ca. 1850 m, 24 November 1970, *R.B. Faden, A. Evans & E.M. Tweedie 70/898* (US). Rift Valley Province: Kiptorok (Elgon Masai), Kitale, Mlimani area, 1825 m, 14 June 1971, *R.B. Faden 71/476* (BOL, K). Western Province: Kakamega Forest, along Kakamega-Kapsabet road, crossing of Ikuywa River, 1610 m, 27 November 1969, *R.B. Faden & A. Evans 69/2054* (BOL, K). Sine loco, Trans Nzoia, 1824 m, July 1964, *D.R. Tweedie, 2855* (K).

LESOTHO. Leribe Distr. —2828 (Bethlehem) Leribe, 1520–1824 m (–CC), *A. Dieterlen 167* (K, NBG, NH, PRE, SAM). —2827 (Senekal) Thaba Phatsoa, Collett Dam, 1583 m (–DD), 22 February 2006, *J.P. Roux 3920* (NGB).

MALAWI. Central Region: Dedza Distr., Chongoni Forestry School, base of Chiwao Hill, 1650 m, 4 February 1959, *N.K.B. Robson 1442* (BM, K, PRE); Ntchisi Distr., Ntchisi Mtn, grassland on S side below main peak, 1300 m, 5 April 1980, *S. Blackmore, R.K. Brummit & E.A.K. Banda 1410* (K). Northern Region: Karonga Distr., Nyika grassland, 2128–2432 m, January 1953, *E.G. Chapman 81* (BM); Nyika Plateau, Juniper forest stream, 2100 m, 25 July 1981, *F. Dowsett-Lemaire 218* (K); Nyika Plateau, Chelinda camp, 2 November 1978, *J. Pawek 13728* (K); Nyika Plateau, Rufiri stream, 35 mls SE from rest house, 2400 m, 28 October 1958, *N.K.B. Robson 442* (BM, K); Nyika Plateau, falls ca. 4 miles downstream from Lake Kaulime, 2126 m, 11 February 1968, *B.K. Simon, G. Williamson & J. Ball 1756* (K); Nyassa Hochland, Station Kyimbila, 1450 m, 9 January 1911, *A. Stolz 550* (M); South Nyika Mts, June 1896, *A. Whyte s.n.* (K); Nyika National Park, Chelinda, Chelinda Bridge area, 2227 m, 30 March 2000, *C.K. Willis 53* (PRE); Mzimba Distr., Vipya Champoyo forest, 1824 m, 2 February 1962, *J.P. Chapman 1571* (BOL); Bimbya Hill, 1820 m, 12 February 1986, *I.F. la Croix 3645* (PRE); near Nkhalapya, in semi-montane grassland, 1700 m, 21 February 1987, *I.F. la Croix, 4335* (PRE); Mzuzu, Marymount towards Tung estate, 1368 m, 11 May 1969, *J. Pawek 2375* (K); Vipya, 12 miles SW of Mzuzu, 1520 m, 10 May 1970, *J. Pawek 3465* (K); Mzuzu, Marymount, 1368 m, 10 March 1071; *J. Pawek 4489* (K); Mzuzu, Marymount, 1368 m, 22 January 1975, *J. Pawek 8982* (PRE, SRGH); Mzuzu, Marymount, 1368 m, 5 February 1975, *J. Pawek 9046* (K, PRE); Mzuzu, far road to Mzuzu Govt., 1368 m, 5 March 1975, *J. Pawek 9120* (K, PRE). Northern Region (loco incerto): March 1954, *E.G. Chapman 268* (BM). Southern Region: Blantyre Distr., Blantyre, January 1888, *L. Scott s.n.* (K); Mulanje Distr., Mt Mulanje, Ruo Gorge, 28 November 1998, *J.P. Roux 2897* (NGB); Mwaza

Distr., near Nsambi, Ntcheu Distr., Kirk Mtn, Hill 29, road N of Mwanza, 1520 m, 2 July 1967, *A. Berrie 171* (K).

MOZAMBIQUE. Manica Province: de Vila Manica para Vumba, 19 June 1949, *Pedro & Pedrógão 6757* (LMA); Manica, 19 que ao N de Madqueu, 28 June 1949, *Pedro & Pedrógão 7044* (BM); Manica, Mavita (Posto Antigo), Serra Mocuta, 1225 m, 24 January 1966, *A. Pereira et al. 1279* (BOL); Mossurize (Espungabera), ao km 3.5 da picada Espungabera-Serra de Espungabera, 17 November 1966, *A. Pereira, A. Sarmentosa & A. Marques 1448* (BM, MO, PRE). Niassa Province: in the forest between Lake Shirwa and Lake Chiuta, and to the W of lake Chiuta, October 1898, *J.F. Cunningham 13* (K); Maniamba, January 1933, *Gomes & Sousa 1219* (BOL); Vila Cabral, November 1933, *A.R. Torre 7* (K); Vila Cabral, planalto da Lichinga, 1935, *A.R. Torre 15* (BM, MO). Tete Province: entre o Furancungo and Vila Gameto, 6.6 km do Furancungo, 10 July 1949, *G. Barbosa & M. Carvalho 3538* (BOL); entre Vila Mouzimho do Zóbuè: a 50 km de Vila Mouzimho, 19 July 1949, *G. Barbosa & M. Carvalho 3688* (BOL); Angónia, Metengo Balane, estrada de Vila Mousinho, 11 May 1948, *F.A. Mendonça 4160* (BM). Zambezia Province: Namuli, Makua Country, 1887, *J.T. Last s.n.* (K, B-only); Serra de Mavita, 28 April 1948, *F.A. Mendonça 1542* (BM); Namuli Mtn (SW sector), 760 m, 25 July 1962, *E.A.C.L.E. Schelpe, & L. Leach 7000* (BOL, K); Gúruè, no cimo da serra do Gúruè, ao km 5 da cascata, ca. 1300 m, 21 February 1966, *A.R. Torre & Correia 14740* (MO).

NIGERIA. Adamawa State: Dimlang (Vogel) Peak, 1650 m, 29 November 1958, *F.N. Hepper 1505* (K). Plateau State, William Camp, 23 August 1968, *J.B. Hall 626* (K); near farm Rua between William Camp and Marhai, 24 August 1968, *J.B. Hall 644* (K); Naraguta Forest Reserve, Jos Plateau, 1216 m, 26 July 1962, *D.W. Lawlor & J.B. Hall 102* (K); William Camp, Jos Plateau, 1216 m, 6 September 1962, *D.W. Lawlor & J.B. Hall 710* (K); Naraguta, 15 January 1921, *H.V. Lely 306* (K). Taraba State, Kumbo road, Bamenda-Cameroon, grassland, 2 May 1965, *R.H. Brown 191* (FHI); Mayo Ndaga, 20 November 1975, *P.O. Ekwuno 245* (FHI); Mambilla Plateau, 10 May 1972, *Gbile, Wit & Daramola 1318* (K); valley about 3 miles from Mayo Ndaga, near Ngiroje road, 3 April 1970, *J.B. Hall 1734* (K); Tibba Plateau, above Gangoro, 19 April 1962, *J. Horsman FHI 44780* (FHI); Wum road, mile 42, old farms, *H.J. Savory 342* (BM); Mambilla Plateau, rocky hill near Njawai, 16 November 1969, *P. Tuley 1912* (K).

RWANDA. Southern Province: Butare, 1800 m, *L. van Puyvelde 110* (BR); Butare, 1800 m, *L. van Puyvelde 111* (BR); Butare, 1000 m, *L. van Puyvelde 112* (BR). Mwisare. Presso Rushubi, 1400 m, 21 December 1966, *R.E.G. Pichi Sermolli 7030* (BOL, NY).

SIERRA LEONE. Northern Province: Koinadugo Distr., Loma Mansa (Bintumani Mtn), 1700 m, 18 July 1960, *T.S. Bakshi 247* (K); Loma Mansa Mts, on slopes of Bintumani, 27 March 1964, *D. Gledhill SL1102* (K); Tingi Mts, N. Kono, amongst boulders below summit of E. ridge, 13 December 1965, *D. Gledhill SL3061* (K); Loma Mansa Mts, camp 2, 16 June 1966, *D. Gledhill SL3583* (FHI, K); Loma Mansa (Bintumane Mtn), 1520 m, 4 January 1951, *T.S. Jones FB7* (BM); Loma Mansa (Bintunane Mtn), 1641 m, 8 January 1951, *T.S. Jones FB20* (BM); Loma Mansa (Bintumane Mtn), NE face, 1641 m, 8 January 1951, *T.S. Jones FB21* (BM).

SOUTH AFRICA. Eastern Cape: —3028 (Matatiele), Zwischen Passtrasse Maclear und Naude's Nek (–CA), 19 November 1958, *E. Werdermann & H.-D. Oberdieck 1136* (K). —3128 (Umtata), Encobo, Ku-Ngele (–CA), 15 February 1984, *S. Cawe 767* (BOL); Bazija (–CB), *R. Baur s.n.* (SAM 24773); slopes of Baziya mountain, 910 m, *R. Baur 180* (K); in editoribus montis Bazija, 1216 m, *R. Baur 493* (SAM). —3129 (Port St Johns), near St Johns River (–DA), 1863, *B.H. Holland s.n.* (NBG); near the Umzimhlava River, 1500 m, 31 January 1895, *R. Schlechter 6556* (BM, COI, K). Free State: —2828 (Bethlehem): Clarens (–CB), November 1917, *T.M. van Hoepen 18231* (PRE). —2829 (Harrismith): Harrismith, Drakensberg Botanic Garden (–AC), 23 March 1979, *M.J. Lumley 179* (NBG); Harrismith, farm Metz, lower E-facing slope of Seheletwane (–CA), 19 December 1983, *J.P. Roux 1644* (NBG). Gauteng: —2528 (Pretoria), Kaalfontein (–CC), 13 November 1916, *I.B. Pole-Evans s.n.* (PRE); Pretoria, Rietvlei Reserve, 1368 m (–CD), *J.E. Repton 3451* (PRE); Pretoria Distr., Kaalfontein, *A.O.D. Mogg s.n.* (PRE). —2627 (Potchefstroom), Roodepoort, Stuben's Valley (–BB) 29 December 1978, *J.P. Roux 348* (BOL, NBG); ca. 9 miles W of Krugersdorp, farm Gladysvale (–CA), 22 February 1948, *R.J. Rodin 3824* (K, PRE, US2017006). —2628 (Johannesburg), 43 km SE of Johannesburg, 10 mls SE of Nigel, farm Uitkyk, portion of Rietpoort, 1672–1840 m (–AD), 8 March 1950, *A.O.D. Mogg s.n.* (PRE); 43 mls SE of Johannesburg, 10 mls SE of Nigel, farm Uitkyk (portion of Rietpoort), 8 March 1950, *A.O.D. Mogg 18959* (K); Heidelberg, kloof (–CB), 11 October 1925, *C.E. Moss s.n.* (NU); Suikerbosrand Nature Reserve, Heidelberg Distr., 1656 m (–CD), 14 April 1970, *A. Lambrechts 292* (PRE). KwaZulu-Natal: —2828 (Bethlehem), Royal Natal National Park (–DB), November 1927, *G.E. Oliver 481* (NH); Royal Natal National Park, Tugela Valley, 8 March 1945,

*E.A.C.L.E. Schelpe 245* (NU). —2829 (Harrismith), Bergville, Oliviershoek Pass, 1641 m (–CA), 13 February 1955, *E.A.C.L.E. Schelpe 5261* (BOL); Cathedral Peak area, 1460 m (–CC), February 1943, *E.A.C.L.E. Schelpe P15* (NU); Cathedral Peak area, 1520 m, 4 February 1946, *G.F. Cross 56* (NU); Cathedral Peak Forest Research Station, 1915 m, 31 January 1951, *D.J.B. Killick 1356* (NU); Cathedral Peak, 1976 m, 23 December 1954, *J. Fiddes 32* (NU); Cathedral Peak, nKlanhla Valley, November 1945, *E.A.C.L.E. Schelpe 1089* (NU); near Cathedral Peak, 1520 m, 8 March 1942, *H.E. Box 3357* (BM); Umlambonja Valley, 1489 m, 19 December 1951, *E.A.C.L.E. Schelpe 3129* (BM); Qudeni, 1520 m (–DC), 16 February 1945, *B.S. Fisher 850* (NH, NU). —2831 (Nkandla), Hlobane, near Mklangeni River (–DD), 21 January 1950, *D. Johnstone s.n.* (NU). —2832 (Mtubatuba) Alexandra Distr., Dumisa, Mayeni, an Wasserlöchern, 750 m (–AA), 3 December 1910, *H. Rudatis 1254* (BM, K); Hlokozi, Alexandra City, 760 m, 10 September 1916, *H. Rudatis s.n.* (NBG); Moyeni, Dumisa Distr. (Alexandra City), 150 m, 3 December 1910, *H. Rudatis 958* (NBG). —2929 (Underberg), Champagne Castle, 1500 m (–AB), 2 January 1950, *J.S. Beard 682* (US2019399); Champagne Castle, 1500 m, 2 January 1950, *J.S. Beard 683* (US2109400); Champagne Castle, ravine, 6 January 1968, *R.G. Strey 7811* (BOL, PRE); Nottingham Road, Mkhomazi State Forest (–AD), 19 January 1991, *M.K.P. Meyer 7995* (PRE); York, Blinkwater Bush, 11 February 1945, *D.S. Graham 79* (NU); Mooi River (–BB), 1853, *R.W. Plant 313* (BM); between Sturt's Hill and Kamberg Nature Reserve, ca. 1500 m (–BC), 18 August 1979, *B.S. Parris & J.P. Croxall 7290* (K); Kamberg, 'Game Pass', 1885 m, December 1947, *C. Gordon-Gray 74* (NU); Mpendhle Distr., Mulangane Ridge, above Carter's Nek, 2130–2220 m, 2 December 1983, *O.M. Hilliard & B.L. Burt 17009* (NU); Mpendhle Distr., Mulangane Ridge, above Carter's Nek, 2130–2220 m, 3 February 1984, *O.M. Hilliard & B.L. Burt 17531* (NU, PRE); Bulwer, Mahuaqa Mtn, 1975 m (–CB), 11 April 1992, *N. Feltham 272* (NU); Cobham Forest Reserve, Polela River Valley, at Whale Rock, 1700 m, 6 December 1978, *L. Cowan 154* (NU); Injasuti area, N aspect in river valley, 1520 m, July 1956, *E. Esterhuysen 26043* (BOL); Sani Pass road, near 20 km mark, 1815 m, 11 April 1975, *W.B.G. Jacobsen 4623* (FR) Underberg Distr., Bamboo Mtn, S side above Restmount, 1824 m, 20 November 1982, *O.M. Hilliard & B.L. Burt 15578* (BOL, NU); Underberg Distr., Cobham Forest Reserve, Sipongweni, 2006 m, 23 February 1980, *O.M. Hilliard & B.L. Burt 14155* (BOL, NU); Underberg Distr., Cobham Forest Reserve, Sipongweni, 1976 m, 22 February 1980, *O.H. Hilliard & B.L. Burt 14137* (NU); Garden Castle Nature Reserve, en route to The Gorge (–CD), 13 February 1977, *O.H. Hilliard 8115* (NU);

Garden Castle, 1736 m, January 1946, *J.B. Crookes* 59 (NU); Boston, Impendhle, 1370 m (–DB), January 1947, *E.J. Beattie* 80 (NU); Boston, Impendhle, 1520 m, January 1948, *J. Runales* 125 (NU); Impendhle, 1580 m, 1 April 1945, *D.J. Clarkson* 162 (NU); Lions River Distr., Dargle, Kilgobbin, 4 May 1974, *L. Smook* 575 (BOL, NU); Underberg, Bulwer, Marwaqu (–DC), 18 January 1992, *M.A. Rennie* 1898 (NU); Polela Distr., 'Glengariff', farm Prosperity face, 1672 m, 27 January 1982, *M.A. Rennie* 1311 (NU); Bulwer (–DD), 14 April 1945, *R.J. Allsopp* 861 (NU); Donnybrook, 760 m, December 1947, *M. Bromhead* 36 (NU); Donnybrook, Qunu Falls, March 1947, *P. Williams* 83 (NU). —2930 (Pietermaritzburg), Lidgetton (–AC), April 1917, *A.O.D. Mogg s.n.* (PRE); Nottingham Road, March 1939, *A.P.D. McClean* 890 (K, NH); Ahrens, 'Mowbray' (–BB), 8 February 1946, *B.S. Fisher* 940 (NH, NU); Nottingham Road Distr., 1641 m, January 1944, *D.L. Smith* 66 (NU); Howick, among rocks beside Umgeni River (–CA), 3 November 1941, *H.B. Rycroft* 404 (NU); Howick, near Umgeni, 20 November 1941, *H.B. Rycroft* 511 (NU); Pietermaritzburg, Town Hill (–CB), November 1944, *B.S. Fisher* 739 (NH, NU); bei Pietermaritzburg, October 1883, *F. Wilms* 2408 (BM); Town Hill, November 1943, *B.S. Fisher* 547 (NU); Inanda (–DB), *T.M. Wood s.n.* (M, SAM); Hillcrest, 547 m (–DD), 15 February 1949, *J. Kalf* 40 (NU). —3029 (Kokstad), Kokstad, Mt Currie Nature Reserve (–AD), 16 November 1991, *N. Crouch* 517 (NU); Ngeli, E of Kwa-Shwili, (–DA), 9 December 1989, *A. Abbott* 4640 (NH); Ngele, on path from Belfast Tower and Bangeni Forest 27 January 1990, *A. Abbott* 5051 (NH); Ngele, Umsilo cutout, 1400 m, 11 October 1990, *A. Abbott* 5362 (NH). Limpopo: —2329 (Pietersburg), Ebenezer Dam, 1340 m (–DD), 7 May 1976, *W.B.G. Jacobsen* 4664 (FR); Haenertsburg, 21 October 1938, *Hafstrom & Acocks* 1965 (PRE); Haenertsburg, November 1913, *Pott-Leendertz* 4665 (PRE); 7 km from Ebenezer Dam to Tzaneen-Pietersburg road, 2 December 1975, *C.H. Stirton* 5721 (K, PRE). —2330 (Tzaneen), Woodbush (–CC), *H.A. Wager s.n.* (PRE, CH 7416); Tzaneen, De Hoek, *H.G.W.J. Schweickerdt s.n.* (NBG); Tzaneen, top of Magoebas Kloof, 11 June 1946, *E.A.C.L.E. Schelpe* 1620 (NU). —2430 (Pilgrim's Rest), Zoutpansberg, Downs, 1216 m (–AA), February 1919, *M.H.A. Junod* 4067 (K, PRE). Mpumalanga: —2430 (Pilgrim's Rest), Graskop area, Erasmus Kop (–DB), January 1946, *W.N.B. Hardcastle* 37 (PRE); Ohrigstad Dam Nature Reserve, 1672 m (–DC), 9 November 1971, *N. Jacobsen* 1774 (PRE); Pilgrim's Rest, Graskop, ca. 1 km past turnoff to God's Window (–DD), 1 March 2002, *J.P. Roux* 3271 (NBG). —2528 (Pretoria), Rietvlei P.R. Stn., Rietvlei 221, northern portion, 1520 m (–CD), 10 March 1945, *J.P.H. Acocks* 11293 (PRE). —2530 (Lydenburg), Rooiwal, (–AB), 17 July 1934,

*M. Bosman s.n.* (PRE); Ludenburg, farm Boschfontein, 2000 m, 25 April 1988, *P.M. Burgoyne* 325 (PRE); Lydenburg, Coromandel farm, 5 January 1979, *J.E. Burrows* 1455 (NBG); farm Zwagershoek near Lydenburg, January 1930, *A.A. Obermeyer* 277 (PRE); Lydenburg Distr., Spitzkop, February 1888, *F. Wilms* 1774 (BM, K); Dullstroom, ca. 4 km from crossing just S of Dullstroom on Kruisfontein road, 1911 m, (–AC), 25 March 2011, *J.P. Roux* 5341 (NBG); Dullstroom, 2000–2100 m, 30 January 1959, *E. Werdermann & H.-D. Oberdieck* 2042 (K, PRE); Dullstroom, 2000–2100 m, 30 January 1959, *E. Werdermann & H.-D. Oberdieck* 2056 (K, PRE, US2538307); top of falls just by the town of Sabie (–BB), February 1932, *V.A. Wager* 38 (PRE); Tweefontein Exp. Station, Sabie, February 1932, *V.A. Wager* B197 (PRE); Witklip, 1155 m, 10 January 1975, *J.P. Kluge* 655 (NBG); near Nelspruit (–BD), 31 March 1938, *A.O.D. Mogg s.n.* (PRE CH 5151); Belfast (–CA), 9 December 1909, *R. Leendertz* 2777 (PRE); Waterval Boven Distr., farm Wachteenbietjieshoek, 980 m (–CB), 22 January 1994, *P.M. Burgoyne* 2196 (PRE); Waterval Boven, 19 June 1912, *F.A. Rogers* 988 (PRE); Carolina Distr., near Bossies, 1824 m (–CD), January 1905, *J. Burt-Davy* 2952 (BM, PRE); farm Beerzynbosch, between Machadodorp and Badplaas, just past Skurweberg Pass, 20 January 1986, *B.S. Steel* 220 (PRE); farm Middleham, NE slope, ca. 1216 m, (–DB), 16 October 1973, *R.V. Bickerton* 4 (NBG); Barberton Distr., Rest-and-be-thankful farm, 24 April 1986, *B.S. Steel* 303 (PRE); Nelsberg (–DD), 26 February 1936, *L.E. Taylor* 1840 (NY). —2531 (Komatipoort), White River, Mpumalanga, farm Embizeni, 15 km N of White River on the Skukuza road, 1130 m (–AA), 28 October 1984, *W.B.G. Jacobsen* 5616 (FR); Barberton, 608 m (–CC), November 1911, *G. Thorncroft* 26 (PRE). —2629 (Bethal), Nooitgedacht, Ermelo (–DB), 15 December 1926, *Henrici s.n.* (PRE). —2630 (Carolina), Ermelo Distr., Spioenkop (–AB), February 1910, *J. Burt-Davy* 9336 (PRE); Mavrieriëstad (–CA), November 1915, *R. Pott* 4846 (BOL). —2729 (Volksrust), Volksrust, Highlands (–BD), 7 May 1920, *A.O.D. Mogg* 7491 (PRE). —2830 (Dundee), New Agatha, on banks of small rivers, 1307 m (–BB), 1 February 1919, *I. McCallum* 137 (PRE). *Sine loco. Barkly s.n.* (SAM24771); South Africa, Caplands, March 1888, *Bewsher s.n.* (US); *J. Buchanan* 99 (NY); South Africa, KwaZulu-Natal, June 1870, *J. Buchanan* 106 (K); Natal, *J. Buchanan* 503 (US816541); *J. Buchanan* 504 (US816542); *J. Buchanan* 505 (US816543); *J. Buchanan s.n.* (BOL23532); Mpumalanga, 1945 m, *J. Burt-Davy* 1287 (PRE); *R.J. Garden s.n.* (K); South Africa, Port Natalens, *Gueinzius s.n.* (K); *Gueinzius s.n.* (K); South Africa, Natal, *J. Guthrie s.n.*, (SAM24772); *sine loco.*, April 1916, *T. Hill s.n.* (PRE); South Africa, August 1913, *H. Jacottet & L. Jacottet* 447 (BM); South Africa, *M.H.A.*



*Junod 219* (PRE); South Africa, Shilouvane, prairie du Sanatorium, *M.H.A. Junod 896* (BM, K); *Father Mayr 77* (NU); sine loc., *Nelson s.n.* (PRE, CH 2307); South Africa, in collibus umbrosis ad Dogallam flum. (Port Natal), *C.W.L. Pappe s.n.* (K); South Africa, Prope Port Natal, 1851, *R.W. Plant 90* (K); South Africa, Gauteng, Macalisberg, *J. Sanderson* (K); sine loc., *T.R. Sim s.n.* (PRE CH 4178); South Africa, Gauteng, Magaliesberg (Macalisberg), sine coll. s.n. (K); sine loc., sine coll. s.n., (NH26455); sine loc., roadside, 12 November 1943, *A. Thienel 50* (NU); South Africa, Western Cape, Knysna, George, 1858 (locality dubious), *R. Trimen s.n.* (BM); *Van der Schijff 4802* (PRE); South Africa, Cap b. sp., *C. Wahlberg s.n.* (BM); Adams Mission Station, 182 m, 15 January 1947, *W. Wilker, 55* (NU).

SOUTH SUDAN. Central Equatoria County: on top of Mt Loka, 1763 m, 4 May 1939, *F.W. Andrews s.n.* (BM); Lado, Yei River, 10 November 1919, *F. Sillitoe 104, 105* (K).

SWAZILAND. Hhohho District:—2631 (Mbabane) Malolotja Nature Reserve, Majolomba block, 1448 m (–AA), 26 January 1990, *K.P. Braun 905* (PRE); near Black Umbeluzi River and Ngwenya Dam, off Pigg's Peak road, 1368 m, 29 December 1978, *R.D. I'Ons 78/15* (K). Manzini District:—2630 (Carolina), waterfall N of Enrich Dam, Mhlambanyatsi River (–BD), 9 May 2002, *J.P. Roux 3483* (NBG). —2631 (Mbabane), hill NE of Mbabane, 1368 m (–AA), 7 November 1957, *R.H. Compton 27208* (NBG, NH, PRE); Pine Valley, below Sibebe Rock, 12 January 1983, *G.M. Dlamini s.n.* (SDNH); Mbabane, Sibebe, 1322 m, 6 May 2002, *J.P. Roux 3384* (NBG); Malandzela area, Enkaba (–AB), 14 May 2002, *J.P. Roux 3606* (NBG); Ukutula (–AC), 10 November 1954, *R.H. Compton 24689* (NBG); Evelyn Baring Bridge, 760 m, 13 December 1960, *R.H. Compton 30374* (NBG, NH); Ngwenya Mtn, 1520 m, 27 March 1962, *R.H. Compton 31409* (NBG); Black Mbluzi Valley, 1064 m, 5 July 1962, *R.H. Compton 31539* (NBG, NH); Ukutula, 1216 m, 3 February 1966, *R.H. Compton 32506* (NBG); Siphocosini, 14 December 1983, *G.M. Dlamini s.n.* (SDNH); falls 10 mls from Manzini (Bremersdorp) (–AD), 3 July 1953, *K. Schütte 43* (BOL); Ntondozi summit, 1274 m (–CA), 13 May 2002, *J.P. Roux 3585* (NBG); Sibovo area, Lapands Mtn, 1382 m (–CC), 16 May 2002, *J.P. Roux 3667* (NBG). Shiselweni District —2631 (Mbabane) Hlatikulu Rocks, 1064 m (–CD), 13 November 1956, *R.H. Compton 26235* (NBG, SDNH); Kaphunga area, road between Kaphunga area and Njokane area, 920 m (–DC), 17 May 2002, *J.P. Roux 3701* (NBG). —2731 (Louwsburg), Ridge E of Grandis Mts, near Galile school, road between Nhlangano and Hlathikhulu (–AA), 17 May 2002, *J.P. Roux 3710* (NBG).

TANZANIA. Iringa Region: Makete Distr., Poroto Mts, 2128 m, June 1957, *Watermeyer 38* (K); Mbinga Distr., E flank of Livingstone Mts, 8.6 km N of village offices in Mbwila where Luepele River (small tributary of Luana River) crosses road from Mlangali to Ludewa, 1500 m, 20 March 1991, *R.E. Gereau & C.J. Kayombo 4415* (K, MO); Mbwila Village, Nyamlunga Peak in Livingstone Mts, 2080–2140 m, 13 March 1991, *H. Suleiman & M.J. Fundi 144* (K, MO, PRE); Mufindi Distr., 30 km from Sao Hill on Mbeya road, 1700 m, *S. Bidgood, L. Mwasumbi & K. Vollesen 827* (K); Sao Hill, 1800 m, *Klotzli et al. 334* (K); Lake Kihanga, 1830 m, *J. Lovett 1500* (MO, PRE); Idetero House, 1900 m, 11 March 1987, *J. Lovett 1728* (MO); escarpment below Fox's view point in Kigogo Forest, 1700 m, 27 December 1986, *J. Lovett & C. Congdon 1199* (K); Dabaga Highlands, Kilolo, 24 miles SE of Iringa, 1884 m, 9 February 1962, *R. Polhill & S. Paulo 1404* (K, MO, PRE); Sao Hill, ca. 2100 m, 8 January 1975, *R.K. Brummit & R.M. Polhill 13627* (K); Sao Hill, 1884 m, January 1958, *Watermeyer 17* (K); Njombe Distr., Stromgebiet des oberen Ruhudjje, landschaft Lupembe, April 1931, *H.J. Schlieben 589* (BM, M). Kagera Region, Bukoba Distr., Bunazi, 9 October 1935, *H. Gillman 582* (K); Katerero, 13.5 miles S of Bukoba, 10 October 1966, *J. Humbles 4997* (MO); Minziro Forest Reserve, Bulembe Hill, 1175 m, 21 November 1999, *C.J. Kayombo et al. 3131* (MO); 14 miles S of Rubungo (Bukoba-Biharamulo road), 1216 m, 20 February 1952, *J.R. Welch 139* (K, MO, PRE); Karegwe Distr., near Kitwe, 1210 m, October 1931, *A.E. Haarer 2201* (K); Ngara Distr., Ngara Distr., Keza, Bushubi, West Lake Prov., 1672 m, 20 March 1961, *R.E.S. Tanner 5901* (K). Kigoma Region: Kibondo Distr., 20 km NE of Kibondo, Keza Mission, 1300 m, 4 May 1994, *S. Bidgood & K. Vollesen 3263* (K); Buha (Uha), February 1926, *A. Peter 37743* (BM, K); Kasye Forest, 1000 m, 26 March 1994, *S. Bidgood et al. 2993* (K). Kilimanjaro Region: Moshi Distr., Kilimanjaro-Süs, ca. 2900 m, 3 July 1934, *H.J. Schlieben 4898* (PRE). Mbeya Region, Mbeya Distr., Mbeya-Chunya road, 25–30 km from Mbeya, 2000–2500 m, 23 May 1990, *Carter, Abdallah & Newton 2387* (K); Kambole, SW of Lake Tanganyika, 1520 m, 1896, *W.H. Nutt s.n.* (K). Rukwa Region: Kigoma Distr., Ujiji, February 1926, *A. Peter 37290* (K); Sumbawanga Distr., near Mmemya Mtn, 2006 m, 15 February 1951, *A.A. Bullock 3693* (K); Mbizi Mts, Fuzu Hill, 2270 m, *R.B. Faden, S.M. Phillips, A.M. Muasya & E.S. Macha 96/292* (K, US3350665); Malonji Plateau, 2128 m, 4 February 1957, *H.M. Richards 8423* (BM); just outside Mbizi Forest, 2128 m, 9 July 1957, *J.A. Whellan 1353* (BM). Ruvuma Region: Mbinga Distr., Matengo Hills, Miyau in secondary bushland, 1620 m, 6 March 1956, *E. Milne-Redhead & P.*

*Taylor 9040* (K). Sine loco, East Africa, Kwenesa, Nemo, 1670 m, 3 July 1944, *F.M. Benson 872* (PRE); British East Africa, December 1906, *MacDonald 3695* (PRE).

UGANDA. Central Region: Rakai Distr., Masaka Distr. Sango Bay, *E. Godman & C. Godman s.n.* (BM). Eastern Region: Mbale Distr., Elgon Distr., 1905, *E. James s.n.* (K); Mt Elgon, 1700 m, May 1920, *C.G. Lind s.n.* (BM, BOL); Mount Elgon, 1824 m, *J.D. Snowden 776* (K). Northern Region: Moyo Distr., Mt Otze, 1520 m, 7 June 1936, *A.S. Thomas 1964* (K); Mt Otze, 4 October 1957, *H.D. van Someren 816* (K); Nebbi Distr., West Nile Distr., Kango, April 1941, *W.J. Eggeling 4264* (K). Western Region: Bushenyi Distr., Buhweju County, Ibogora, 1840 m, 20 December 1969, *P.K. Rwaburindore 266* (MO); Nyagoma-Rugongo, Buhweju, 1 August 1986, 1550 m, *P.K. Rwaburindore 2285* (MO, PRE); Buhweju, Ntanzigurwa-Rugongo, 1550 m, 12 June 1987, *P.K. Rwaburindore 2430* (BR, K, MO, NY, PRE, US3423265); Buhweju, Nyagoma River, Rugongo, 1550 m, 6 August 1990, *P.K. Rwaburindore 3069* (MO); Kasese Distr., Nilangira Hill, 14 July 1951, *H.A. Osmaston 1038* (BM); Kyenjojo Distr., Butiti, May 1941, *W.J. Eggeling 4342* (K).

ZAMBIA. Central Province: Lusaka Distr., Leopard Hill road, 24 km from Lusaka, 1250 m, *J. Kornaś 1329* (LUSAKA, MO); Serenje Distr., Kundalila Falls, on the margin of riverside forest under the waterfall, 1400 m, 17 January 1973, *J. Kornaś 867* (K, MO); Lusili River, 5 km W of Serenje, 1450 m, *J. Kornaś 3141* (K, LUSAKA). Copperbelt Province: Kitwe Distr., Chati, *Fanshawe 7792* (NDO); Kitwe, *Fanshawe 8191* (K, NDO); Kitwe, *Mutumushi 122 & 2447* (NDO); Ndola Distr., Misaka Forest Reserve, 1290 m, 9 March 1973, *J. Kornaś & A. Medwecka-Kornaś 3448* (K, MO). Northern Province: Chinsali Distr., Shiwa Ng'andu, drier edge of Mushitu, 1520 m, 5 June 1956, *E.A. Robinson 1605* (K); Isoka Distr., Nyika Plateau, Chowo, 2150 m, 28 January 1982, *F. Dowsett-Lemaire 208* (K); Kasama Distr., Chishimba Falls, 20 May 1962, *E.A. Robinson 5188* (K, NY); Luwingu Distr., Luwingu, *Fanshawe 8655* (NDO); Ndola Distr., Ndola Forest Reserve, 1270 m, *J. Kornaś 1468* (LUSAKA, MO); Mbala Distr., Chalonkande River on Mbala-Mporooso rd., 39 km of Senga Hill junction, 1430 m, 8 April 1973, *J. Kornaś & A. Medwecka-Kornaś 3668* (MO); Lake Chila, ca. 100 yds from shore of lake, 1672 m, 16 March 1957, *D. Vesey-Fitzgerald 1116* (BM); Mpulungu Distr. (Abercorn Distr.), Chilongowelo stream above farm, 1460 m, 12 December 1951, *H.M. Richards 112* (K); Jembele Forest, near Chinakila, 1200 m, 13 January 1965, *H.M. Richards 19518* (K). Northwestern Province: Mwinilunga Distr., 85 miles E of Mwinilunga, 30 May 1063, *J.P. Loveridge 694* (BOL); just NE of Dobeka Bridge,

11 December 1936, *E. Milne-Redhead* 3605 (BM, PRE); S of Dobeka Bridge, 23 December 1938, *E. Milne-Redhead* 3793 (K, PRE); 12 km W of Mutanda, 1300 m, 19 January 1975, *R.K. Brummit & R.M. Polhill & S.M. Chisumpa* 13854 (K); Solwezi road, 79 km from Mwinilunga, 10 km NW of Lumwana Mission, on a small tributry of the Lumwana River, 2 May 1972, *J. Kornaś* 1726 (K, MO); Solwezi Distr., Mwinilunga road, 32 km from Solwezi, Mutanda River, 1205 m, *J. Kornaś*, 1714-A (K, LUSAKA); Solwezi Protected Forest, 1390 m, 14 May 1972, *J. Kornaś* 1793 (K); Mnibanda Bridge, 24 June 1930, *Milne-Redhead, E.* 591 (K, PRE); 78 km W of Solwezi along Solwezi-Mwinilnga road, ca. 5.5 km from main road going NW along the Lumwana East River, 1410 m, 14 February 1995, *M.M. Nawa et al.* 34 (MO, PRE). Western Province: Kalabo Distr., Ndundu, *Uapaca* open bush, 1520 m, 12 February 1952, *H.M. Richards* 958 (K); Ndundu, Abercorn, in Ndundu woodland, 1740 m, 6 April 1963, *H.M. Richards* 18061 (K).

ZIMBABWE. Harare: Maranzi rd., above Umwindsi River, 20 February 1976, *G. Pope* 1542 (PRE). Manicaland Province: Chimanimani Distr., farm 'Iona', 1370m, 15 March 1953, *N.C. Chase* 4856 (NU); Digglefold, 18 May 1948, *H.D.L. Corby* 118 (BM); N slopes of hill S of Mt Peza, 1672 m, 3 February 1958, *D.S. Mitchell* 301 (BM, BOL, NU, PRE); Melsetter, 'Stonehenge' plateau, 1670 m, 1 February 1957, *J.B. Phipps* 379 (BM, BOL, NU, PRE); Chipinge Distr., Chipinga, Gungunyana Forest Reserve, 1064 m, May 1967, *B. Goldsmith* 54/67 (BOL, K, M, PRE); Melsetter, farm Yungunyana, Mt Selinda, December 1937, *A.A. Obermeyer* 2296 (PRE); Chipinga, Mt Selinda Mission, 18 October 1947, *J.M. Rattany* 1093 (BM); between Cashel and Melsetter, 1824 m, 10 July 1953, *E.A.C.L.E. Schelpe* 4029 (BM, BOL); near Chirinda, 1124 m, 27 May 1906, *C.F.M. Swynnerton* 457 (BM, K); near Chirinda, 1155 m, 27 July 1906, *C.F.M. Swynnerton* 875 (BM, K); near Chirinda, 1155 m, 18 January 1907, *C.F.M. Swynnerton* 876 (BM, NBG); Mutare Distr., Mutare, *N.C. Chase* 1048 (BM, PRE); Mutare, from below water supply intake about 200 yards above junction with Park River Station, 19 August 1948, *N.C. Chase* 2017 (BM, PRE); upper Park River, 1094 m, 12 April 1950, *N.C. Chase* 3144 (BM, NU); Mutare, Matikas Mtn, 1576 m, 8 January 1950, *N.C. Chase* 3333 (BM); Mutare, Upper Park River, East Commonage, 1094 m, 1 March 1950, *N.C. Chase* 3466 (BM); Vumba, 1460 m, 1 July 1951, *N.C. Chase* 3991 (PRE); Mutare, Rowa Township, Zimunya's Reserve, 1033 m, 5 February 1957, *N.C. Chase* 6318 (BM, PRE, US2595656); Engwa, 1600 m, 1 February 1955, *A.W. Exell, F.A. Mendonça & H. Wild* 38 (BM); Mutasa Distr., source of Busi River, W of Chipungu, 10 October 1949, *N.C. Chase* 3340 (NU, NY); HonDI River source, Summerfield, 23 February 1949, *N.C.*

*Chase 3387* (NY); Mutare, Vumba Mts, 1670 m, 29 December 1946, *B.S. Fisher 1118* (NU); Mutare (Umtali), June 1904, *B.H. Holland s.n.* (NBG); Sheba Forest Estate, 1800 m, 23 January 1967, *W.B.G. Jacobsen 3053* (FR); Nyanga Distr., Juliasdale, ca. 2.5 km W of Punch Rock, ca. 1950 m, 23 January 1973, *H.M. Biegel 4158* (BM, BOL, M, PRE); Nyanga (Inyanga), SE of Inyangani, from Pungwe river watershed, 17 July 1948, *N.C. Chase 2019* (BM); grassland near SW boundary corner of Nyangani, 31 March 1949, *N.C. Chase 2060* (BM, NU); at Fort Rhodes, Inyanga Hotel, 10 August 1950, *N.C. Chase 3983* (PRE); Inyanga, in silva ad rivulum, ca. 1700 m, 19 November 1930, *C.E. Fries, T. Norlindh & H. Weimarck 3015* (BOL); Inyangani, ca. 3 km occidentem versus a monte, ca. 2000 m, 6 December 1930, *C.E. Fries, T. Norlindh & H. Weimarck 3502* (BOL, K, M0065924, NY); Inyangani, ca. 3 km occidentem versus a monte ad rivulum, ca. 2000 m, 8 December 1930, *C.E. Fries, T. Norlindh & H. Weimarck 3661* (BOL); Pungwe supra dejectum fluminis in campo graminoso, ca. 1700 m, 18 December 1930, *C.E. Fries, T. Norlindh & H. Weimarck 3822* (BOL, COI, K); NW side of Mare Dam, 1920 m, 9 March 1969, *W.B.G. Jacobsen 3809* (FR); forest near Mtarazi Falls, on escarpment over Honde Valley, 1520 m, 27 February 1964, *D.S. Mitchell 841* (K); ad pagum Inyanga, ca. 1750 m, 22 January 1931, *T. Norlindh & H. Weimarck 4546* (M0065888); Honde Valley, below Mtarazi Falls, 930 m, 19 April 1958, *J.B. Phipps 1143* (BOL); near Odzani River Bridge, 1428 m, 14 July 1955, *E.A.C.L.E. Schelpe 5653* (BM, BOL, NBG); valley below Troutbeck, 14 April 1960, *J.A. Whellan 1635* (BOL); valley below Troutbeck, 1520 m, 16 April 1960, *J.A. Whellan 1636* (BOL); Makoni Distr., Makamba, 6 miles W of Rusape, 1520 m, January 1956, *D.S. Mitchell 36* (BOL); Tumaru, 25 miles from Rusape on Inyanga road, 1672 m, January 1956, *D.S. Mitchell 45* (BOL). Mashonaland Central Province: Mazowe Distr., near the Jumbo Mine, May 1904, *B.H. Holland s.n.* (NBG); Iron Mask range, 7 April 1962, *I.B. Pole-Evans F.41* (M, PRE); Mazowe, Umvukwe Ridge, Mtoroshanga Parsage, 1520 m, 5 March 1961, *D. Vesey-Fitzgerald 3089* (BOL). Mashonaland East Province: Goromonzi Distr., Chishawesha, 1428 m, 20 January 1960, *D.S. Mitchell 572* (BM, BOL). Masvingo Province: Bikita Distr., Bikita Denga (Old Bikita), 1368 m, 22 February 1964, *D.S. Mitchell 802* (K). Sine loco. Zimbabwe, 1489 m, February 1918, *F. Eyles 918* (PRE); iNyumquarara valley, 1064 m, February 1935, *H.B. Gilliland 1645* (BM).

**Remarks:**—Authentic material of *Dryopteris athamantica* in the Leipzig herbarium has been destroyed during World War II. When describing *D. athamantica*, a single Gueinzus collection from KwaZulu-Natal, South Africa was cited. The sheet lodged at Kew (K000675781) with a label

in an unknown hand was designated by Roux (2001) as the lectotype of *Aspidium athamanticum*. The label reads: ‘*Aspidium (Nephrodium) athamanticum* mihi Linnaea 1844. Port Natalens. Gueinzus’, and in the bottom right hand corner ‘Kze’, and is most likely a duplicate of the original specimen cited. A sheet of this species in the Paris herbarium (P301378) bears a pink label ‘*Aspidium athamanticum* Kze n. sp.’ This sheet originally formed part of the Luerssen Herbarium. Even though it is a possible duplicate, there is no evidence that the material formed part of the original Gueinzus gathering, and thus it cannot be considered authentic.

*Dryopteris athamantica* is characterised by erect fronds and pinnae which, in exposed plants forms a three dimensional structure. The pinna-rachises are mostly set at an angle of 45° or less to the main rachis. Where plants grow in the shade these features are less pronounced or even lost. The acroscopically developed pinnules and the narrowly trullate to narrowly oblong-obtuse segments with their denticulate to crenate lobe margins, the closely spaced vein branches, which may be as little as 0.4 mm apart, are characteristic of the species.

Fraser-Jenkins (1986: 194) placed *Dryopteris athamantica* in subgenus *Dryopteris* section *Cinnamomea* Fraser-Jenk.

**Variation:**—*Dryopteris athamantica* shows little macromorphological variation. Jacobsen (1983) noted geographical variation in pinnule size. The presence of glands on the lamina axes and the occurrence of indument on the sporangium stalks show some variation. Although the sporangium stalks are mostly simple, they often bear a single long uniseriate hair from near the base. In some collections, however, [*Loveridge* 694 (BOL)] both a uniseriate hair and a gland is borne on the sporangium stalk, while in *Lewalle* 6483 (BR) only glands were observed. These variations could not be associated with external factors.

**Uses:**—The species has been used by the IsiZulu, Sotho and Xhosa as an anthelmintic, especially treating tapeworms. Powdered rhizomes [roots] are taken in half a cup of milk or water early in the morning. It was also reported that the South Sotho use a decoction of the rhizomes where it is known as *inkomankoma* to hasten the birth of the placenta in cows when this is delayed (Watt & Breyer-Brandwijk 1962).

INSERT FIGURE 14

4. *Dryopteris aurantiaca* Roux ([2004] 2005: 164, figs. 1A, 2A, Aa, B, C, D, Dd). Figs. 2L–O; 7D & Da; 13.

Type:—EQUATORIAL GUINEA. Annobón: Pico del Centro, mist forest floor, 1 August 1959, T.C. Wrigley & F.A. Melville 215 (holotype K!).

*Plants* terrestrial. *Rhizomes* to 17 mm in diameter, short-decumbent to suberect, set with roots, persistent stipe bases and scales, the scales deep orange to ferruginous, firmly chartaceous, nitid, adnate, subulate, to 27 x 7 mm, the margin and surface irregularly set with pyriform glands, the scale apex terminates in a short series of thin-walled cells. *Fronde*s to 1.2 m long, crowded, arching; *stipes* stramineous with irregular dark brown stripes and blotches, firm, to 540 mm long, to 5 mm in diameter, proximally adaxially flattened and densely scaled, distally sulcate and sparsely scaled, the scales ferruginous, dull, chartaceous, broadly attached, subulate-caudate, to 22 x 3.5 mm, cordate, the margins entire, denticulate, or irregularly set with pluricellular basally and apically directed outgrowths, the margins and scale laminae irregularly set with pyriform glands, the scale apex terminates in a short series of oblong thin-walled cells; *laminae* anadromous, catadromous towards the apex, ovate, to 660 x 340 mm, to 2-pinnate, with up to 10 petiolated pinna pairs; *rachises* adaxially shallowly sulcate, narrowly winged near the apex, moderately scaled, the scales ferruginous, chartaceous, sessile or short-stalked, filiform to narrowly lanceolate, to 5 x 1 mm, entire, denticulate or irregularly set with pluricellular outgrowths, often with several pluricellular, uniseriate outgrowths from near the base, the scale margins and surfaces irregularly set with pyriform glands, the scale apex terminates in a short uniseriate series of thin-walled cells; *pinnae* petiolate, the petiole to 16 mm long, near opposite to alternate, the basal pinna pair not conspicuously basiscopically developed, the basal pinna pair narrowly triangular to oblong-acuminate, to 240 mm long, to 70 mm wide, with up to 4 petiolated pinnule pairs; *pinna-rachises* sulcate adaxially, narrowly winged for most of the length, sparsely scaled, the scales similar to, but smaller than those on the rachis; *pinnules* petiolate, the petiole to 1 mm long, the pinnules herbaceous, near opposite to alternate, the proximal acroscopic pinnule to 32 mm long, to 12 mm wide, the proximal basiscopical pinnule to 40 mm long, to 12 mm wide, deeply lobed; *lobes* oblong-obtuse, to 7 mm long, to 3 mm wide, denticulate, adaxially with glands along the costae and veins, abaxially glandular along the veins, the glands clavate, (50–)56(–64) µm long, also with 7–13-celled isocytic hairs, to 0.7 mm long along the costae and veins, often

glandular near the base. *Venation* mostly catadromous, evident, pinnately branched, the branches terminate in the teeth near the margin. *Stomata* mostly of the polocytic type, (32–)36(–44)  $\mu\text{m}$  long. *Sori* essentially 2-seriate on the pinnules, or 2-seriate on the larger lobes, discrete at maturity, medial to inframedial on predominantly anadromous vein branches, to 1 mm in diameter; *sporangia* stalk with large pyriform glands and pluricellular hairs, the capsule broadly elliptic in lateral view, with (12–)13(–15) indurated annulus cells, the epistomium (3–)4-celled, the hypostomium 4(–6)-celled; *indusia* persistent, to 1.2 mm in diameter, brown, chartaceous, irregularly set with pluricellular hairs and large pyriform glands along the margin and surface. *Spores* 64 per sporangium, brown, ellipsoidal, monolete, perispore tuberculate or with short wings, (28–)31(–34)  $\times$  (22–)23(–24)  $\mu\text{m}$ .

**Distribution and habitat:**—*Dryopteris aurantiaca* appears to be endemic to Annobón Island, occurring in mist forest on Pico del Centro and is the only *Dryopteris* species known to occur on the island. Because *D. aurantiaca* is known from a single collection only, little is known about its distribution and conservation status.

**Etymology:**—Latin, *aurantiaca*, meaning orange, with reference to the deep orange rhizome scales.

**Remarks:**—*Dryopteris aurantiaca* is characterized by its large deep orange to reddish-brown rhizome scales with no or few marginal outgrowths, and the small pyriform glands occurring along the margins and on the scale surfaces. The indusia bear pluricellular, uniseriate hairs and large pyriform glands along the margins that differentiate it from any other African *Dryopteris* species. Stomata and spore size suggests it is a diploid species.

**5. *Dryopteris caperata* Roux** ([2004] 2005: 164, figs. 1B, 2E, F). Figs. 2R–U; 7E; 13.

Type:—SÃO TOMÉ & PRÍNCIPE. São Tomé: entre Ribeira Moça e Água Telha, na terra, 4 November 1957, *A. Rozeira 2105* (holotype PO!, isotype PO!).

*Plants* terrestrial. *Rhizomes* to 90 mm long, to 15 mm in diameter, decumbent, closely set with roots, persistent stipe bases and scales, the scales rugose, ferruginous, chartaceous, adnate, linear-caudate, to 32  $\times$  2 mm, lacerate, the margins proximally irregularly set with short bifid outgrowths, the distal outgrowths filiform and much twisted, irregularly set with clavate glands, the scale apex



twisted, terminating in one or more thin-walled filiform cells. *Fronde*s 3–6 per plant, crowded, arching to 1.2 m long; *stipes* to 615 mm long, to 7 mm in diameter, proximally castaneous, adaxially flattened and densely scaled, distally stramineous, sulcate and sparsely scaled, the scales rugose, ferruginous to brown, chartaceous, broadly attached, subulate-caudate to narrowly lanceolate-caudate, to 25 x 3 mm, lacerate, the margins irregularly set with twisted filiform outgrowths and clavate glands, the scale apex twisted, filiform, terminating in a filiform thin-walled cell; *laminae* anadromous, catadromous towards the apex, narrowly to broadly ovate, to 670 mm long, to 560 mm wide, 2-pinnate to 2-pinnate-pinnatifid, with up to 11 petiolated pinna pairs; *rachises* adaxially sulcate, narrowly winged near the apex, sparsely scaled, the scales stramineous, chartaceous, sessile, filiform to narrowly lanceolate-caudate, to 3.5 x 0.4 mm, often with a few clavate glands and filiform outgrowths along the margin, the scale apex flagelliform; *pinnae* petiolate, the petiole to 15 mm long, near opposite to alternate, the basal pinna pair not conspicuously basiscopically developed, longer or shorter than pinna pair above, the basal pinnae to 290 mm long, to 135 mm wide, inaequilaterally narrowly triangular, with up to 6 petiolated pinnule pairs, symmetrically oblong-acuminate higher up; *pinna-rachises* sulcate adaxially, narrowly winged most of the length, sparsely scaled, the scales stramineous, thinly chartaceous, sessile, filiform to narrowly lanceolate-caudate, to 4 x 0.2 mm, with a few filiform outgrowths and/or scattered glands along the margin, the scale apex flagelliform; *pinnules* petiolate, the petiole to 1 mm long, near opposite to alternate, herbaceous, the proximal acroscopic pinnule lanceolate, narrowly ovate to oblong-obtuse, to 62 mm long, to 18 mm wide, the proximal basiscopic pinnule lanceolate, narrowly ovate to oblong-obtuse, to 65 mm long, to 22 mm wide, pinnatifid to deeply lobed; *lobes* trapezoid to oblong-obtuse, to 8 mm long, to 4.5 mm wide, denticulate, glabrous adaxially, abaxially sparsely set with filiform scales to 1.5 mm long along the costae, sparsely set with 6–12-celled isocytic hairs along the veins. *Venation* mostly catadromous, evident, pinnately branched, lateral veins forked once or twice, the ultimate branches terminate in the teeth near the margin. *Stomata* mostly of the polocytic type, (32–)42(–52) µm long. *Sori* essentially 2-seriate on the pinnules, or 2-seriate on the larger lobes, discrete at maturity, medial to inframedial on the vein branches, to 1.2 mm in diameter; *sporangia* stalk simple, glandular and/or haired, the capsule obovate in lateral view, the annulus (11–)13(–17)-celled, the epistomium (2–)4(–6)-celled, the hypostomium (2–)4(–6)-celled; *indusia* persistent, brown, firmly chartaceous, reniform, to 1.2 mm in diameter, entire, shallowly repand, or erose, often strongly incurved, eglandular. *Spores* 64 per

sporangium, brown, ellipsoidal, monolete, perispore with short reticulate ridges, (28–)34(–38) x 22(–24)  $\mu\text{m}$ .

**Distribution and habitat:**—*Dryopteris caperata* appears to be restricted to the island of São Tomé, occurring in what Exell (1944) described as lower rain forest (0–800 m), mountain rain forest (800–1400 m) and mist forest (above 1400 m). The species is apparently broadly distributed in the island, having been recorded from Santa Catarina and Lembá near the coast, to 1824 m on Pico de São Tomé.

**Etymology:**—From Latin *caperatus* meaning ‘wrinkled’, with reference to the wrinkled rhizomes and stipe base scales.

**Additional specimens examined:**—SÃO TOMÉ. Água Grande Distr., Lagoa Amélia-Morro Provaz (Zona Ecológica), 1400 m, 0°17'N, 6°34'E, floresta primária, 1 April 1998, *F. de Oliveira* 626 (LISC); Lagoa Amélia, 1300 m, June 1888, *F. Quintas* 1291 (COI); Monte Café, caminho para São Pedro, 3 December 1958, *A. Rozeira* 4974 (PO). Lembá Distr., entre Pico de São Tomé et Monté Castro, 6 km au Sud de Ponta Figo, 1200–1800 m, forêt dense humide de montagne, 0°17'N, 6°33'E, 1 January 1995, *Lejoly* 95/9 (LISC); Nova Moka, São Nicolau, ad Pico de São Tomé, 1824 m, 1885, *A. Moller* 39 (K); Nova Moka, 900 m, June 1885, *H. Moller s.n.* (COI); encosta do Pico, 1950 m, August 1885, *H. Moller s.n.* (COI); Santa Catarina, Lembá, 12 October 1954, *A. Rozeira* 856 (K, PO); entre Ribeira Moça & Água Tellia na terra, 4 November 1957, *A. Rozeira* 2105 (PO); base do Pico Formoso, dependência Formoso, 17 December 1957, *A. Rozeira* 3488 (PO). Lobata Distr., Macambrará, 1064–1216 m, 29 October 1932, *A.W. Exell* 135 (BM). Mé-Zóchi Distr., Milagrosa-Bombaim, estrada para Zampalma, ca. 690 m, 27 July 1999, *E. Figueiredo, P. Arriegas & S. Chozas* 180 (LISC); Milagrosa-Bombaim, estrada para Zampalma, ca. 690 m, 27 July 1999, *E. Figueiredo, P. Arriegas & S. Chozas* 190 (LISC); Estrada Milagrosa-Bombaim, passando a bifurcação para Roça Nova, junto à cascata, 490 m, 28 July 1999, *E. Figueiredo et al.* 193 (LISC); cami del Lagoa Amélia, 1400 m, bosc humit, 61/Ne, 10 August 1986, *N. Gabaldá & N. Garcia s.n.* (COI); Trás-os-Montes, 1913, *A. Gama s.n.* (COI); Trás-os-Montes, valle do Pintão, 800 m, June 1888, *F. Quintas* 1286 (COI); próximo Cascata de São Nicolau, 7 November 1954, *A. Rozeira* 182 (K, PO); Trás-os-Montes, 10 October 1954, *A. Rozeira* 554 (K, PO); Milagrosa, 4 December 1957, *A. Rozeira* 3046 (PO); feto de Trás-os-Montes, 6 December 1958, *A. Rozeira* 5071 (PO); São Nicolau, erva vivaz nas encostas húmidas, 870 m, 13

February 1973, *J. Santo 5052* (COI, LISC). São Tomé (St Thomas), 800 m, June 1888, *F. Quintas 10* (K); entre Pouso Alto & Monte Carnio, 6 December 1957, *A. Rozeira 3107* (PO).

**Remarks:**—Diagnostic of *Dryopteris caperata* is the rugose lacerate scales. The species is also smaller in stature and the fronds not as densely scaled as that of *D. cicatricata*. The smaller spores and the short reticulate perispore ridges also separate it from that species. From *D. pentheri* it differs in the narrow rugose rhizome scales, the absence of glands and 2-celled hairs from the laminae, and the smaller stomata and spores. The stomata and spore size suggests it being a diploid species.

**6. *Dryopteris cicatricata* Roux** ([2004] 2005: 167, figs. 1C, 2G, H, Hh). Figs. 7F & Fa; 13.

Type:—SÃO TOMÉ & PRÍNCIPE. São Tomé: Casa do Pico, 10 December 1958', *A. Rozeira 5136* (holotype PO!).

*Plants* terrestrial. *Rhizomes* unknown. *Fronde*s to 1.15 m long; *stipes* brown, rigid, sulcate adaxially, closely muricate-cicatricate, to 400 mm long, to 8 mm in diameter, densely scaled, the scales stramineous, thinly chartaceous, broadly attached, lanceolate to narrowly lanceolate, to 10 x 2 mm, cordate, generally with several long and twisted pluriseriate outgrowths from near the point of attachment, also with long twisted pluricellular outgrowths terminating in a long filiform cell scattered along margin, the scale apex flagelliform, terminating in a filiform thin-walled cell; *laminae* anadromous, catadromous towards apex, oblong-triangular, to 750 mm long, to 450 mm wide, to 3-pinnate, with up to 17 petiolated pinna pairs; *rachises* adaxially sulcate, proximally closely muricate-cicatricate, less so towards the lamina apex, densely scaled, the scales stramineous, thinly chartaceous, broadly attached, filiform to narrowly lanceolate, to 10 x 2.2 mm, narrowly cuneate, cordate to cordate-imbricate, the margins often irregularly set with long and twisted pluricellular outgrowths terminating in a filiform cell, the scale apex terminates in a filiform thin-walled cell; *pinnae* petiolate, the petiole to 10 mm long, near opposite to alternate, to 2-pinnate, the basal pinna pair basiscopically developed, inaequilaterally narrowly triangular, narrowly triangular to oblong-acuminate higher up, to 290 mm long, to 137 mm wide, with up to 12 petiolated pinnule pairs; *pinna-rachises* sulcate adaxially, narrowly winged towards the pinna apex, minutely muricate-cicatricate, densely scaled, the scales stramineous, thinly chartaceous,

subulate-caudate to narrowly lanceolate-caudate, to 9 x 2 mm, generally with several long and twisted pluriseriate outgrowths from near the point of attachment, also with long twisted pluricellular outgrowths terminating in a long filiform cell scattered along the margin, the scale apex flagelliform, terminating in a filiform cell, the scales adaxially along the pinna-rachises narrower; *pinnules* petiolate, the petiole to 3 mm long, near opposite to alternate, firmly herbaceous to thinly coriaceous, to 1-pinnate, the proximal acroscopic pinnule narrowly triangular to oblong-acuminate, to 60 mm long, to 15 mm wide, the proximal basiscopic pinnule narrowly triangular to oblong-acuminate to 85 mm long, to 20 mm wide; *costae* sulcate adaxially, narrowly winged, variously set with stramineous filiform scales in the sulci, abaxially variously scaled, the scales sessile to short-stalked, narrowly lanceolate to filiform, narrowly to broadly cuneate, to 4 x 0.3 mm, entire, with one or more pluricellular, uniseriate filiform outgrowths mostly from near base, or with scattered oblong gland-like cells along the margin, the scale apex flagelliform, terminating in a filiform cell; *segments* sessile, ovate to oblong-acute, to 21 x 6 mm, shallowly lobed; *lobes* denticulate, glabrous adaxially, abaxially densely set with scales similar to, but narrower than those on the costae. *Venation* anadromous, pinnately branched, immersed adaxially and abaxially, ending in the teeth near the margin, the vein endings enlarged. *Stomata* mostly of the polocytic type, (40–)46(–52)  $\mu\text{m}$  long. *Sori* circular, to 1.2 mm in diameter, 2-seriate on the segments, inframedial on the anadromous vein branches, confluent at maturity; *sporangia* stalk simple or haired, the capsule obovate in lateral view, the annulus with (12–) 14 (–15) indurated annulus cells, epistomium (3–)4(–6)-celled, hypostomium (3–)6-celled; *indusia* persistent, to 1.2 mm in diameter, brown, firmly chartaceous, entire to shallowly repand. *Spores* 64 per sporangium, brown, ellipsoidal, monolete, perispore without ridges, echinulate, (36–)38(–40) x (24–)27(–30)  $\mu\text{m}$ .

**Distribution and habitat:**—The species is known from the island of São Tomé only, having been collected at Casa do Pico. The frond is mounted on three sheets. Complete and more recent collections are required to document variation in the species and to determine its distribution, ecological requirements and conservation status. The firmly herbaceous texture of the type suggests it having been collected from a somewhat exposed habitat.

**Etymology:** Latin, *cicatricata*, meaning ‘scarred’, referring to the muricate-cicatricate scars on the frond axes left by the scales.

**Remarks:**—The type collection is incomplete lacking a rhizome and the basal part of the stipe. *Dryopteris cicatricata* differs from *D. pentheri* in the muricate-cicatricate stipe and rachis, the absence of oblong glands and 2-celled hairs, and in the echinulate spores. The only other *Dryopteris* species from Africa with echinulate spores are *D. ruwenzoriensis* C.Chr. ex Fraser-Jenk. and *D. rodolfii* J.P.Roux. From *D. ruwenzoriensis* it differs in the sori being exindusiate and from *D. rodolfii* in the stomata and spores being significantly smaller. An additional feature of *D. cicatricata* is the conspicuously long and narrow cells of the scales. Scale and perispore morphology suggests that *D. cicatricata* belongs to the *D. ruwenzoriensis* group.

**7. *Dryopteris dracomontana* Schelpe & Anthony (1982: 147), *nom. nov.* for *Aspidium inaequale* Schldtl. var. *montanum* Kunze (1836: 549). Figs. 2V & W; 3A–C; 7G & Ga; 11B; 13.**

Type:—As for *Aspidium inaequale* var. *montanum* (McNeill *et al.* (2006), Art. 7.3).

*Aspidium inaequale* Schldtl. var. *montanum* Kunze (1836: 549). Type:—SOUTH AFRICA.

'Wittebergen, in rupestribus, 2500 m', *J.F. Drège s.n.* (lectotype BM), designated by Roux (1986: 376); 'Sneeuwbergen, locis rupestribus umbrosis, 200 m', *J.F. Drège s.n.* (isosytype BM!).

*Dryopteris pentheri* (Krasser) C.Chr. var. *montana* (Kunze) Alston (1956: 14).

*Dryopteris esterhuyseniae* Schelpe & Anthony (1982: 148, 149). Type:—SOUTH AFRICA. Natal, Drakensberg, MnWeni area, steep rocky bank above kloof below Rockies, S-aspect, 2300–2700 m, July 1953, *E. Esterhuysen 21663* (holotype BOL!, isotypes BM, NBG0081280-0!).

*Plants* terrestrial or epilithic. *Rhizomes* short-decumbent, closely branched, to 4 mm in diameter, set with roots, crowded stipe bases, and scales, the scales ferruginous to stramineous, chartaceous, broadly attached, lanceolate to subulate, to 7 x 2 mm, truncate to cordate, entire, glandular along the margins and often also on the scale lamina, or with a few short scattered uniseriate outgrowths, the scale apex filiform, terminating in a short uniseriate series of oblong cells. *Fronde*s crowded, caespitose, dimorphic, the fertile overtop the sterile, the sterile appressed to the ground or held at a small angle to it, to 390 mm long, the fertile erect, to 405 mm long; *stipe* bases castaneous, stramineous higher up, basally adaxially flattened or with a shallow and narrow sulcus, shallowly sulcate higher up, the sterile to 250 mm long, to 2.5 mm in diameter, the fertile to 220 mm long, to 3.5 mm in diameter, eglandular, or sparsely to densely glandular, sparsely to

moderately scaled, the scales ferruginous to stramineous, broadly attached to short-stalked, ovate to filiform, to 11 x 3 mm, cordate to cuneate, the margins entire or with a few scattered short or long uniseriate outgrowths, often also glandular, glands may also occur on the scale laminae, the scale apex filiform, terminating in a short uniseriate series of oblong cells; *laminae* anadromous, becoming catadromous towards the apex, firmly herbaceous to coriaceous, to 2-pinnate-pinnatifid, ovate to oblong-acute, the sterile to 175 mm long, with up to 11 petiolated pinna pairs, the fertile to 215 mm long, with up to 13 petiolated pinna pairs; *rachises* pale green, drying stramineous, adaxially shallowly sulcate, becoming narrowly winged towards the lamina apex, glandular and sparsely to moderately scaled, the scales ferruginous to stramineous, chartaceous, broadly attached or short-stalked, lanceolate to filiform, to 6 x 1.2 mm, entire or with scattered glands along the margin (often also on the scale lamina), the larger scales generally with a few short uniseriate filiform outgrowths, the scale apex filiform, terminating in a short uniseriate series of cells; *pinnae* petiolate, the petiole to 5 mm long in the sterile frond, generally slightly longer in the fertile frond, subopposite to alternate, widely or closely spaced at the base, mostly somewhat imbricate towards the lamina apex, the basal pinna pair symmetric or poorly basiscopically developed, ovate to oblong-obtuse, to 47 mm long, to 19 mm wide, those higher up oblong-obtuse to oblong-acute, to 1-pinnate-pinnatifid, the basal pinnae of the sterile frond with up to 3 petiolated pinnule pairs, the basal pinnae of the fertile frond to 40 mm long, to 14 mm wide, with up to 4 petiolated pinnule pairs, the basal pair longest or slightly reduced; *pinna-rachises* adaxially flattened or shallowly sulcate, narrowly winged, set with glands and scales, the scales ferruginous to stramineous, chartaceous, short-stalked, subulate to filiform, to 4 x 0.4 mm, entire or with a few glands near the base, the scale apex filiform, terminating in a short uniseriate series of cells; *pinnules* lobed to pinnatifid, spaced or imbricate, slightly oblique, ovate to oblong-obtuse, dentate, the basiscopic pinnule on the basal pinnae to 13 mm long, to 8 mm wide, the acroscopic pinnule on the basal pinnae up to 9 mm long, to 7 mm wide, adaxially glabrous or sparsely glandular, abaxially sparsely to closely glandular, the glands clavate, (66–)93(–124)  $\mu\text{m}$  long, also with isocytic or moniliform hairs, the hairs often with a glandular cell near the base. *Venation* anadromous to catadromous, obscure, ending in the teeth near the margin. *Stomata* mostly of the polocytic type, (40–)52(–66)  $\mu\text{m}$  long. *Sori* circular, to 1.2 mm in diameter, medial on unmodified anadromous vein branches, the sporangia often confluent at maturity; *sporangia* stalks simple or glandular, the capsule with (11–)14(–17) indurated annulus cells, the epistomium 5(–6)-celled, the

hypostomium 5(–7)-celled. *Indusia* brown, firmly herbaceous, reniform, to 1.6 mm in diameter, entire to erose, often with a few scattered glands along margin. *Spores* ellipsoidal, monolete, the perispore forming tubercles and short ridges, ruminant, (38–)43(–48) × (26–)31(–36) μm.

*Chromosome number*: unknown.

**Distribution and habitat**:—*Dryopteris dracomontana* is restricted to high elevations, ranging from the NE Free State, throughout the eastern parts of Lesotho and the KwaZulu-Natal escarpment, to the Sneeuwberg in the Eastern Cape and north-eastern corner of the Western Cape. It occurs at elevations ranging from 1850 m on Platberg near Harrismith to 3050 m near Mponjwane Cave in Lesotho, which is well above the snowline. The species is more or less restricted to basalt and dolerite, but at Sehlabathebe it also occurs on Clarens Sandstone. The plants generally grow in moist or seasonally moist conditions in shaded rock crevices, at boulder bases and at the base of cliffs. In this region the species is confined to Drakensberg grassland types forming part of the grassland biome in southern Africa (Mucina *et al.* 2006).

**Etymology**:—*dracomontana*, with reference to the Drakensberg Mountain range in South Africa to which the species is restricted.

**Additional specimens studied**:—LESOTHO. Butha-Buthe Distr.: —2828 (Bethlehem), Montaux-Sources, 2432 m (–CB), April 1913, *E. Dyke 5486* (NBG); Thaba Putsoa, mountain road, 2634 m, 19 July 1984, *B. Halliwell 5016* (K); Maluti Mts, 8 km from Oxbow Lodge to Butha Buthe, S-aspect, 2500 m (–DC), 4 February 1987, *M.D. Panagos 24* (PRE, NH); basalt ridge N of Oxbow Lodge, 11 January 1983, *J.P. Roux 1312* (NBG); basalt ridge N of Oxbow Lodge, 11 January 1983, *J.P. Roux 1312* (NBG). Maseru Distr.: —2927 (Maseru), mountain road, 52 miles from Maseru, N aspect, 2300 m, (–BC), 24 December 1954, *A.P. Bowmaker 18* (BOL). —2928 (Marakabei): Mamalapi, 2736 m (–AC), 28 December 1948, *R.H. Compton 21354* (NBG); Blue Mountain Pass, crevice of rock on S-facing slope, 24 February 1984, *O.M. Hilliard & B.L. Burt 17704* (BOL, K, NU); below Thaba Putsoa, Blue Mountain Pass, 20 January 1983, *J.P. Roux 1487* (NBG); near Blue Mountain, 2130 m, 12 December 1957, *J.A. Whellan 1454* (BOL); summit of Blue Mountain Pass, 28 February 1990, *J.P. Roux 2226* (NBG). Mokhotlong Distr.: —2929 (Underberg), Summit of Drakensberg between Indumeni Dome and Cleft Peak, 2950 m (–AA), 19 April 1953, *D.J.B. Killick 1961* (PRE); between Mokhotlong and Sani top, ca. 15 km from Mokhotlong, 2200 m (–AC), 12 January 1983, *G. Matthews 889* (NBG). Quacha's Nek Distr.: —2929 (Underberg), Sehlabathebe area, on way up to Devil's Knuckles, 2890 m (–CC), 8 December

1979, *R.S. Davis 178* (NU); on way to summit of Devil's Knuckles, Sehlabathebe area, S-aspect, 2735 m, 8 December 1979, *R.S. Davis 216* (NU); Sehlabathebe National Park, S-facing slope between Musong and Maal Cof ponds, 2300 m, 15 March 1976, *F.K. Hoener 1426* (BOL); Sehlabathebe National Park, N side of the Tsoelikana within 0.5 km upstream from the pond where the river leaves the park, 2225 m, 4 December 1976, *F.K. Hoener 1694* (BOL); Sehlabathebe National Park, 2300–2500 m, *A. Jacot Guillarmod, F. Getliffe & Mzamane 83* (PRE); Sehlabathebe National Park, rocks near river, December 1976, *Schmitz, 7123* (PRE).

SOUTH AFRICA. Eastern Cape: —3027 (Lady Grey) Lady Grey, farm Ossa, bank of Karrinmelkspruit (–CA), 17 January 1982, *J.P. Roux 1142* (NBG); lower S slopes of Ben McDhui (–DB), 19 January 1982, *J.P. Roux 1166* (NBG); Ben McDhui, 2900 m, 11 March 1904, *E.E. Galpin 6936*, A-only, (PRE); Ben McDhui (Wittebergen), 2900 m, 11 March 1904, *E.E. Galpin 6937* (BOL, K, PRE); Ben McDhui (Wittebergen), 2900 m, 11 March 1904, *E.E. Galpin 6938* (BOL, K); Ben McDhui, 2735 m, 4 February 1983, *O.M. Hilliard & B.L. Burt 16405* (BOL, K, NU). —3123 (Victoria West) in summo monte Koudveld prope Murraysberg, 1980 m (–DD), January 1879, *W. Tyson 102* (PRE, SAM). —3124 (Hanover), In rupium fissuris, Compassberg, 2584 m (–DC), *H. Bolus 1973* (BOL, K). —3127 (Lady Frere), Otto du Plessis Pass, 500 m E of pass, steep S-facing cliff, ca. 2060 m (–BC), 20 January 1989, *K. Steiner 1901* (NBG). —3225 (Somerset East), Cradock, Winterberge (–BA), 5 July 1943, *Cilliè s.n.* (NBG). —3226 (Fort Beaufort), Hogsback, Elandsberg summit, headwaters of E flowing stream (–DB), 24 November 1994, *J.P. Roux 2689* (NBG). Free State: —2829 (Harrismith), Harrismith, Platberg, ridge W of Gibson Dam (–AC), 30 November 1981, *J.P. Roux 1040* (NBG); Witsieshoek, on road to the Sentinel (–DB), 15 January 1981, *J.P. Roux 904* (NBG); Witsieshoek, on road to the Sentinel, 15 January 1981, *J.P. Roux 904* (NBG). KwaZulu-Natal: —2828 (Bethlehem), Mont-aux-Sources, 2432 m (–CB), April 1913, *E. Dyke 5486* (NBG); Mont-aux-Sources (–DD), *E. Dyke 5704* (PRE). —2829 (Harrismith), Injasuti area, 2130–2430 m (–AB), June 1956, *E. Esterhuysen 26040* (K, PRE, US2293837); Cathedral Peak region, S-slope, 3000 m (–CC), 5 July 1993, *N. Crouch 659* (NU); at boulder base near Mponjwane cave, near source of Orange River, 3050 m, 4 July 1993, *N. Crouch 660* (NU); MnWeni area, S-side between Rockies and in Ponjwan, 2735 m, July 1949, *E. Esterhuysen 15548* (K); Bergville, MnWeni area, Drakensberg, on E-slopes below Rockies, 2130–2430 m, July 1953, *E. Esterhuysen 21663* (NBG); Bergville, Cathedral Peak, steep SE slopes, 2585 m, July 1954, *E. Esterhuysen 22997* (BOL, NBG); summit of escarpment E of



MnWeni Pass, 2890–3040 m, July 1958, *E. Esterhuysen s.n.* (BOL). —2929 (Underberg), Cathkin area, 2430–2735 m (–AB), July 1952, *E. Esterhuysen 20284* (BOL); between Mokhotlong and Sani top, ca 15 km from Mokhotlong, 2200 m (–AC), 12 January 1983, *G. Matthews 889* (NBG); Giant's Castle, Langalibalele Pass. On damp E-facing slope (–AD), 25 April 1977, *J. Winter 4* (BOL); Drakensberg Garden State Forest, near Mlambonja River (–CA), 3 February 1982, *E. van Jaarsveld & Mackellar 6484* (NBG); near Mlambonja River, SE slope, 3 February 1982, *E. van Jaarsveld & MacKellar 6541* (NBG); Drakensberg Gardens State Forest, kloof in shade near Mlambinja River, 3 February 1982, *E. van Jaarsveld & MacKellar 6484* (NBG); Drakensberg Gardens State Forest, near Mlambinja River, SE slope, 3 February 1982, *E. van Jaarsveld & MacKellar 6541* (NBG); Sani Pass, just below top border post (–CB), 13 January 1983, *J.P. Roux 1367* (NBG); Sani Pass, 2130 m, 26 January 1966, *D.J.B. Killick & J. Vahrmeyer 3820* (PRE); Sani Pass, just below top border post, 13 January 1983, *J.P. Roux 1367* (NBG). —3028 (Matatiele), near summit of Ongeluk's Nek (–AD), 14 January 1983, *J.P. Roux 1376* (NBG).

**Remarks:**—*Dryopteris dracomontana* was initially described as *Aspidium inaequale* var. *montanum* by Kunze in 1836, but was placed in synonymy under *D. inaequalis* by various authors (Kuhn 1868, Sim 1892, 1915, Alston 1956, Schelpe 1970). Jacobsen's (1978, 1983) interpretation of Kunze's *A. inaequale* var. *montanum* was completely flawed. He ascribed material with a small stature, typical of plants growing in the Cape forests to it. Schelpe in an unpublished checklist of South African pteridophytes intended raising the variety to species level as he refers to Kunze's taxon as *D. montanum* (Kunze) Schelpe ined. Realising that this combination would be an illegitimate later homonym for *D. montana* (Aschers.) Kuntze (= *Thelypteris limbosperma* (All.) H.P.Fuchs), Schelpe & Anthony (1982) named it *D. dracomontana*, based on a new type. Article 7.3 (McNeill *et al.*, 2006), however, state that the new name is typified by the type of the older name, the Drège collections and not *Winter 4*, as cited by Schelpe & Anthony (1982).

Schelpe & Anthony (1982) based *D. esterhuyseniae* on two collections from the high Drakensberg. The types consist of incomplete plants, which may have led to it being described as distinct from *D. dracomontana*. No definitive characters separating these taxa were identified and I have no hesitation in placing *D. esterhuyseniae* as a synonym of *D. dracomontana*. The material on which *D. esterhuyseniae* is based are shade forms of *D. dracomontana*.

*Dryopteris dracomontana* can readably be separated from other *Dryopteris* species in the region by its habitat, its small stature and sterile/fertile frond dimorphism. Fraser-Jenkins (1986) places *D. dracomontana* in section *Marginatae* Fraser-Jenk.

**Variation:**—Variation within the species appears to be environmentally induced. Scale size, and the density of glands on the scales varies significantly. Shade plants tend to be larger, the scales narrower, and more sparsely set.

**8. *Dryopteris fadenii* Pichi Sermolli** (1984: 333, 336, figs. 3, 4). Figs. 3D – G; 8A & Aa; 11C; 15.

Type:—KENYA. Nyandarua District: Sasumua Dam, just below outlet, steep slope, common, 2460 m; *Juniperus procera*–*Arundinaria alpina* mixed bamboo forest with some other trees and shrubs being *Rhamnus prinoides*, *Halleria lucida*, *Myrsine africana*, *Ilex mitis*, *Rubus* spp., 24 January 1971, R.B. Faden, A. Evans & V.L. Cameron 71/68 (holotype FI-PS 26171 & FI-PS 26172, isotypes BOL!, K!, Herb. Reichstein, Basel).

*Plants* terrestrial. *Rhizomes* short-decumbent, unbranched, to 16 mm in diameter, set with roots, crowded stipe bases, and scales, the scales brown to dull ferruginous, the larger scales chartaceous to crustaceous, the smaller scales chartaceous, broadly attached, linear-acuminate to ovate, to 31 x 5 mm, truncate to cordate, the margins irregularly set with short bifid teeth, clavate glands (often also on scale lamina), and irregularly often also with short and/or long, somewhat gnarled multicellular outgrowths, the scale apex terminates in a short uniseriate series of oblong cells. *Fronde*s 5–7 per plant, caespitose, erect to arching, to 1.5 m long; *stipes* base castaneous, stramineous higher up, shallowly sulcate adaxially, to 605 mm long, to 10 mm in diameter, proximally densely scaled, the larger scales higher up fugacious, dull ferruginous to stramineous, membranous to chartaceous, the larger scales broadly attached, the smaller scales short-stalked, linear-acute to broadly ovate, to 24 x 10 mm, cordate to cuneate, the margins irregularly set with short bifid teeth, occasionally with glands, and/or often also with short and long, multicellular outgrowths, the scale apex filiform, terminating in a short uniseriate series of oblong cells, the smaller scales sessile, oblong to ovate, to 2.5 x 0.5 mm, cordate, the margins subentire to irregularly set with filiform outgrowths, the scale apex filiform, terminating in a short uniseriate

series of oblong cells; *laminae* anadromous, catadromous towards the apex, firmly herbaceous, ovate to broadly ovate, to 920 mm long, to 620 mm wide, 2-pinnate to 2-pinnate-pinnatifid, with up to 8 petiolated pinna pair; *rachises* greenish to stramineous, adaxially shallowly sulcate, becoming narrowly winged towards the lamina apex, initially sparsely to moderately scaled, the scales stramineous to ferrugineous, chartaceous, the larger scales broadly attached, the smaller scales short-stalked, the stalk simple, glandular, or haired, linear-acute to ovate-acuminate, to 6 x 1.5 mm, narrowly cuneate to cordate, the margins subentire, often with scattered unicellular glands, or with short bifid teeth, often also with a few short pluricellular outgrowths, the scale apex filiform, terminating in a short uniseriate series of oblong cells; *pinnae* petiolate, the petiole to 18 mm long, subsessile and adnate towards the apex, the basal pinnae triangular, lanceolate, or oblong-acuminate towards lamina apex, to 320 mm long, to 140 mm wide, 1-pinnate to 1-pinnate-pinnatifid, the basal pinna pair the longest, basiscopically developed, alternate, widely spaced at the base, often somewhat imbricate, the basal pinnae with up to 5 petiolated pinnule pairs; *pinna-rachises* adaxially sulcate, the sulcus confluent with that of the rachis, narrowly winged for most of its length, subglabrous adaxially, initially moderately set with scales on the abaxial surface, the scales often bullate, stramineous to ferrugineous, membranous to chartaceous, the larger scales sessile, the smaller scales short-stalked, linear-acuminate to ovate-caudate, to 5 x 2.5 mm, cuneate to cordate, the margins entire, with short bifid teeth, or with a few filiform outgrowths, mostly from near base, the scale apex filiform, terminating in a short uniseriate series of oblong cells; *pinnules* petiolate, the petiole to 4.5 mm long, symmetric to slightly inaequilaterally narrowly lanceolate to oblong-acuminate, pinnatifid, often slightly basiscopically developed, the acroscopic pinnule on the basal pinnae to 86 mm long, to 25 mm wide, the basiscopic pinnule on the basal pinnae to 106 mm long, to 38 mm wide, opposite to alternate, basally mostly widely spaced, often slightly imbricate; *costae* shallowly sulcate adaxially, pronounced abaxially, narrowly winged throughout, abaxially variously set with hairs and scaled, the scales similar to, but smaller than those on the pinna-rachis; *segments* sessile, symmetric to inaequilaterally lanceolate-acute to oblong-obtuse, to 18 mm long, to 8 mm wide, basiscopically decurrent, crenulate, or denticulate, adaxially glabrous or with a few scattered hairs along the costules, abaxially sparsely to moderately set with hairs and scales, the hairs of the moniliform or isocytic types, the isocytic hairs to 14 cells long, mostly occurring on or near the costules and veins, the scales stalked, the stalk uniseriate, often with a glandular hair, filiform to subulate, often bullate, to 1.6 x 0.4 mm,

entire to repand, the scale apex filiform, terminating in a short uniseriate series of oblong cells. *Venation* anadromous becoming isodromous to catadromous at the lamina apex, pinnately branched in the segments, the vein branches pinnately branched, forked or simple, evident, ending in the teeth near the margin, the endings slightly enlarged. *Stomata* mostly of polocytic types, (30–)44(–80)  $\mu\text{m}$  long. *Sori* circular, to 2 mm in diameter, medial to inframedial on the anadromous vein branches, discrete or touching at maturity; *sporangia* stalks simple, glandular, or with a short, few-celled hair, the capsule with (12–)14(–20) indurated annulus cells, the epistomium (3–)5(–7)-celled, hypostomium (4–)6(–8)-celled; *indusia* absent or present, if present then brown, firmly herbaceous, cordate to reniform, to 1 mm in diameter, repand to erose, with or without glands along the margin. *Spores* ellipsoidal, monolete, variously set with prominent tubercles and/or ridges, ruminant, (36–)42(–52) x (24–)27(–34)  $\mu\text{m}$ . *Chromosome number*:  $2n = 82 \pm 2$  (Vida in Widén *et al.* 1973).

**Distribution and habitat:**—*Dryopteris fadenii* appears to be confined to East Africa, occurring in the highlands of Kenya, Mt Meru and Kilimanjaro in Tanzania, Mount Ruwenzori in Uganda and the Bale Mountains in Ethiopia. In Kenya, the species mostly occurs in moist conditions along streams, near waterfalls, and in *Podocarpus* forests. At higher elevations the species occurs in *Juniperus procera* – *Thamnocalamus (Arundinaria) alpina* forests and bamboo forests mixed with *Podocarpus milanjanus*. On Mt Meru the species occurs from 1824 to 2560 m, while on Mt Kenya the distribution extends to 2980 m. On Mt Kilimanjaro in Tanzania the species grows in similar conditions at 1800 to 2800 m. On Mt Ruwenzori in western Uganda *D. fadenii* grows in the ericaceous belt at elevations ranging from 1824 to 3500 m, and in Ethiopia it occurs in *Erica (Philippia)-Hagenia* forests ranging from 3250 to 3500 m.

**Etymology:**—Named after Robert (Bob) Bruce Faden (1942–), botanist at the Smithsonian Institute, United States of America, who has contributed to the pteridological knowledge of Tropical East Africa.

**Additional specimens studied:**—BURUNDI. Muramvya Province: Bugarama, jachère à *Lobelia giberroa*, 27 December 1969, *J. Lewalle* 4273 (BR).

ETHIOPIA. Addis Ababa Region: ca. 10 km W of Lekemti, montane rainforest, ca. 2000 m, 18 May 1965, *W.J.J.O. de Wilde & B.E.E. de Wilde-Duyffes* 6745 (K).

KENYA. Central Province: Kiambu Distr., Sasumua Dam, just below outlet, 2460 m, 24 January 1971, *R.B. Faden, A. Evans & J.B.C. & S. Cameron* 71/68 (FI-PS. 26171 & 26172; BOL,

K, MO, NY!); Sasumua Dam, ca. 1.5 km downstream along river, 2450 m, 24 January 1971, *R.B. Faden 71/75* (K, US2650901, US2650902); Kikuyu escarpment forest (S Aberdare Forest), Ndiara waterfall on Ndiara River along Sasumua pipeline road, 0°48'S, 36°42'E, 2370–2400 m, 18 August 1974, *R.B. Faden 74/1348* (K, MO); Nyeri Distr., Nyandarua South, South Kinangop, 2432 m, 8 January 1962, *Isaac 3008* (BOL); Aberdare, S. Kinangop, 25 November 1957, *B.C.G. Molesworth-Allen 3621* (US2420521, US2420522); Aberdare Forest, S. Kinangop, 2610 m, 24 November 1957, *B.C.G. Molesworth-Allen 3639* (US2420531); South Kinangop, 24 November 1957, *B.C.G. Molesworth-Allen 3658* (K); South Nyeri Distr., Aberdare National Park, Nyeri Chania River falls, 2980 m, 29 June 1969, *R.B. Faden & A. Evans 69/802* (BOL, K); Thika East Distr., Kimakia Forest Station, 3rd stream crossing after station headquarters towards South Kinangop (Njabini) from Thika, 2525 m, 13 July 1969, *R.B. Faden & A. Evans 69/907* (K, NY); Kimakia Forest Station, Thika, South Kinangop (Njabini) road, 6 miles from forest station headquarters towards Njabini, 2520 m, 13 July 1969, *R.B. Faden & A. Evans 69/900* (BOL, K); Kimakia Forest Station, Gatare road, crossing of Kimakia River, 0°46'S, 36°45'E, 2470 m, 14 February 1970, *R.B. Faden & A. Evans 70/66* (K). Eastern Province: Meru Distr., Marimba, Ithangune Forest at the base of volcanic cone Kirue, road along base of Kirue, 2200 m, 22 June 1969, *R.B. Faden, A. Evans, Maara & Mwirigi 69/757B* (BOL); Mt Kenya, Naro Moru track, *Hagenia-Hypericum* zone, 2950 m, 10 October 1970, *R.B. Faden 70/686* (US); Mt Kenya, S side, Kamweti track, crossing of Thiba River, 1875 m, 28 December 1970, *R.B. Faden, 70/924* (US). Mt Kenya, Kathita River, *E.A.C.L.E. Schelpe 2587* (US2082506, US2082507); NW Mt Kenya, Marimba Forest, 2188 m, 14 October 1960, *B. Verdcourt 2999* (K); Igembe South Distr., Nyambeni Tea Estate, 1976 m, 8 October 1960, *B. Verdcourt & R.M. Polhill 2929* (K). Nairobi Province: Nairobi Distr., Ngong near Nairobi. 1°22'S, 36°40'E, July 1942, *McLoughlin 720* (BOL). Rift Valley Province: Kericho Distr., Kimugung River, ca. 5 km NW of Kericho, 2060 m, 10 June 1972, 0°20'S, 35°20'30"E, *R.B. Faden, A.J. Faden & J.B.C. Cameron 72/285* (K); Norak North Distr., Endabarra, Mau Forest, 2219 m, 15 January 1946, *P.R.O. Bally 4813* (K); South Western Mau Forest Reserve, camp 8, riparian woodland along the river Itare, 1920 m, 12 August 1949, 0°36'30"S, 35°18'20"E, *R.A.M. Geesteranus 5745* (K).

RWANDA. Ruhengeri Province: Kinigi Distr., Parc des Volcans, beside tarn on E side of Mt Visoke, 2700 m, 15 February 1975, *W.G. d'Arcy, 7786* (MO); Parc des Volcans, in *Eucalyptus* grove between Mt Visoke and Ruhengeri, 2400 m, 2 March 1975, *W.G. d'Arcy, 8178* (MO).

TANZANIA. Arusha Region: Arusha Distr., Mt Meru, W slopes above Olkakola estate, 3250 m, 31 October 1948, *O. Hedberg* 2402 (K); Engare Nanyuki River, 2055 m, *M. Richards* 20850 (K); Ngare Nanyuki forest, 2560 m, *M. Richards* 24073 (K); Arusha National Park, Mt Meru crater, 2644 m, 9 March 1971, *M. Richards* 26745 (K); Arusha National Park, Mt Meru, 2644 m, 9 March 1971, *M. Richards* 26841 (K); Meru, upper forest, 1824 m, *H.D. van Someren* 436 (K). Iringa Region: Makete Distr., Ngozi, Mbeya Poroto Mtn, 2130 m, 16 October 1956, *M. Richards* 6533 (BM000787477); Mufindi Distr., on S side of and near the main road, opposite the entrance to Lugodo factory, 14 August 1971, *R.E. Perdue & S.P. Kibuwa* 11111 (K). Kilimanjaro Region: Moshi Rural Distr., S-E Kilimanjaro, 2800 m, 5 October 1908, *Ch. Alluaud* 52 (BM); Kilimanjaro, Kibosho in locis humidis apertis (... in sylvis), 1906, *T. Daubenberger* 38 (M); Kilimanjaro, between Maundi crater and Mandare hut, ca. 2750 m, 15 October 1993, *J.M. Grimshaw* 93951 (K); Kilimanjaro, Korongo, forest above Kilimanjaro Timbers, 2300 m, on low cliffs at base of Korongo, 7 February 1994, *J.M. Grimshaw* 94208 (K); Kilimanjaro, forest above Kilimanjaro Timbers, 2500 m, 25 June 1994, *J.M. Grimshaw* 94591 (K); Kilimanjaro, ca. 1900 m, 21 January 1934, *H.J. Schlieben* 4598 (K, MO, PRE); Kilimandjaro S, ca. 1800 m ü. M., 6 February 1937, *H.J. Schlieben* 4722 (BOL, K, MO); Kilimanjaro-S; Umbwe Route, 1930 m, 7 October 1973, *E. Zogg & H. Gassner* 114/24 (NY). Mbeya Region: Mbeya Distr., NW slope of Rungwe Mtn on N slope of Mwashitu hill above Sinihi stream, ca. 4 km SE of Isongole and 2 km WSW of Shiwaga Crater, 2200–2350 m, 9°04'S, 33°37'E, 10 June 1992, *L.B. Mwasubi* 16228 (MO). Morogoro Region: Morogoro Distr., W-slopes of Nguru Mts, above Maskati, 6°05'S, 37°25'E, 1700–1800 m, *S. Bidgood, L. Mwasumbi, T. Pocs & K. Vollesen* 500 (K). Tanga Region: Lushoto Distr., Shume-Magamba Forest Reserve, 2 May 1987, *C. Kisena* 462 (K). Sine loco, Ost-Afrika, *sine coll. s.n.* (M65901).

UGANDA. Western Region: Kasese Distr., Bigo, Bujuku River, 3450 m, 23 July 1952, *H.A. Osmaston* 1687 (BR).

**Remarks:**—The small bullate scales occurring along the lamina axes and the small cordate to reniform indusia, which often become hidden in developed sori are diagnostic of *Dryopteris fadenii*. The laminae are mostly devoid of glands, but a few scattered glands often occur along the indusium margins. Fraser-Jenkins (1986) places *D. fadenii* in section *Marginatae* Fraser-Jenk. Roux (2004c) discussed the affinity of the taxon.

**Variation:**—The stipe base scales of *Dryopteris fadenii* show considerable variation. Linear-acute scales with long pluricellular outgrowths along the margins, especially near the apices, are more frequent. In some collections, however, the scales are broadly ovate, devoid of filiform marginal outgrowths, but bear scattered glands that often also occur on scale laminae. Intermediate forms between these extremes do occur. Indusium form and size also varies significantly. In some collections the indusia are small and completely hidden by the sporangia, when in others the indusia are always visible, but never very large. When visible they are mostly cordate ranging to reniform and the margins irregularly crenate to repand. The margins are rarely set with a few scattered glands. The sporangium stalks mostly bear a long uniseriate hair, but less frequently only a simple gland is borne on the stalks, whereas in others the stalk is eglandular. A combination of these characters often occurs in a single sorus.

INSERT FIGURE 15

**9. *Dryopteris filipaleata* Roux** (2004a: 28, figs 1, 2). Figs. 3H – K; 16.

Type:—TANZANIA. Eastern Province: Morogoro District (T6), Uluguru Mountains, Mwere valley, wet evergreen forest along stream with abundant *Cyathea manniana* and epiphytes, 1400–1450 m, 26 September 1970, *R.B. Faden, T. Pócs, B.J. Harris & P. & K. Csontos 70/596* (holotype BOL!, isotype K!).

*Plants* terrestrial. *Rhizomes* short-decumbent, to 12 mm in diameter, set with roots, closely set persistent stipe bases and scales, the scales ferruginous to castaneous, chartaceous, broadly attached, linear acuminate to narrowly lanceolate, to 15 x 5 mm, the margins irregularly denticulate, irregularly set with scattered capitate glands, and long pluricellular, denticulate outgrowths of which the apex terminates in a short uniseriate series of cells, in larger scales the number of outgrowths increase towards the scale apex, the scale apex irregularly denticulate, terminating in a short uniseriate series of cells. *Fronde*s closely spaced, suberect to arching, to 1.13 m long; *stipes* proximally castaneous and adaxially flattened, stramineous and shallowly sulcate higher up, to 610 mm long, to 7 mm in diameter, proximally densely scaled, sparsely scaled higher up, the scales ferruginous, chartaceous, similar to those on the rhizome, to 18 x 6 mm; *laminae* 2-pinnate-pinnatifid to 3-pinnate, ovate to broadly ovate in outline, to 590 mm long, to 430 mm

wide, with up to 13 petiolated pinna pairs; *rachises* stramineous, sulcate adaxially, initially closely scaled, sparsely scaled later, the scales ferruginous to castaneous, firmly herbaceous to thinly crustaceous, short-stalked, linear-acuminate to filiform, to 4 x 0.5 mm, cuneate to narrowly cuneate, the margins irregularly denticulate, the scale apex terminates in a short series of oblong cells; *pinnae* the basal pinnae petiolate, the petiole to 13 mm long, increasingly more broadly attached and basiscopically decurrent along the rachis towards the lamina apex, 1-pinnate-pinnatifid to 2-pinnate, near opposite to alternate, proximally more widely spaced, overlapping or not, the basal pinnae longest, the basal pair mostly conspicuously basiscopically developed, inaequilaterally triangular, to 270 mm long, to 135 mm wide, those higher up mostly near symmetrical, ovate, oblong-acuminate to lanceolate, with up to 7 petiolated pinnule pairs; *pinna-rachises* sulcate adaxially, narrowly winged towards the apex, moderately scaled, the scales ferruginous to castaneous, firmly herbaceous to thinly crustaceous, short-stalked, linear to filiform, to 3 x 0.3 mm, irregularly denticulate, the scale apex terminates in a short series of oblong cells; *pinnules* the basal pinnules petiolate, the petiole to 3 mm long, increasingly more broadly attached and basiscopically decurrent along pinna-rachis towards the pinna apex, firmly herbaceous, pinnatifid to 1-pinnate, near opposite to alternate, spaced to slightly overlapping, proximal basiscopic pinnules slightly basiscopically developed, narrowly lanceolate to oblong-acuminate, to 78 mm long, to 26 mm wide; *costae* sulcate adaxially, pronounced abaxially, flexuose towards the apex, narrowly winged, sparsely scaled, the scales filiform, to 2.2 x 0.1 mm, irregularly denticulate, the scale apex terminates in a short series of oblong cells; *segments* and lobes ovate-obtuse to oblong-obtuse, to 15 mm long, to 7 mm wide, basiscopically decurrent, crenulate to denticulate, adaxially glabrous or with few hairs and filiform scales along the costae, abaxially sparsely set with scattered (4–)6(–18)-celled moniliform hairs, hairs to (78–)219(–615)  $\mu\text{m}$  long on and between the veins. *Venation* evident, pinnately branched, mostly ending in the teeth near the margin. *Stomata* mostly of polocytic types, to (40–)50(–62)  $\mu\text{m}$  long. *Sori* predominantly 2-seriate along the pinnules, 2-seriate on the lobes in larger plants, medial to inframedial on predominantly anadromous vein branches. Exindusiate. *Sporangia* stalk simple, glandular or haired, the capsule with (13–)14(–19) indurated annulus cells, the epistomium 4(–6)-celled, the hypostomium (3–)6(–7)-celled. *Spores* monolete, ellipsoid, with low reticulate ridged and bulges, to (32–)41(–54) x (18–)26(–34)  $\mu\text{m}$ .



**Distribution and habitat:**—*Dryopteris filipaleata* appears to be restricted to the mountainous areas of Kenya and Tanzania. The species occurs in forests of the Lake Victoria Basin, the Eastern Arc Mountains and Mount Meru. *Dryopteris filipaleata* mostly occurs at elevations ranging between 1350 and 2000 m. It either grows on the forest floor or along streambanks in moist to wet evergreen forests with *Cyathea manniana*, *Piper capense*, *Ensete ventricosa*, *Symphonia*, *Balthasaria* and *Allanblackia ulugurensis*.

**Etymology:**—With reference to the narrow lamina scales and the long pluricellular marginal outgrowths of the larger rhizome and stipe base scales.

**Additional specimens studied:**—KENYA. Eastern Province: Embu Distr., Thiba Fishing Camp, 31 July 1977, *M.G. Gilbert & D. Rankin 4821* (K); Meru Distr., Jombeni range, 1520 m, *H.D. van Someren 438* (K); Meru, upper forest, August 1949, *H.D. van Someren 493* (K). Nyanza Province: Kisumu Distr., Kisumu, bushland, 2128 m, February 1915, *R.A. Dümmer 1524 & 1727* (K).

TANZANIA. Morogoro Region: Morogoro Rural Distr., Uluguru Mts, Morningside to Bondwa, 1350–1900 m, 3–4 July 1970, *R.B. Evans et al. 70/351* (K); Uluguru Mts, Mwere Valley, 1400–1450 m, 26 September 1970, *R.B. Faden et al. 70/596* (BOL, K); Uluguru Forest Reserve, Lupanga Peak, 2000 m, 1981, *J.B. Hall s.n.* (K); Kanga Mtn, Northern Nguru, 1800 m, 2 December 1987, *J. Lovett & D.W. Thomas 2800, 2802 & 2802A* (MO). Pwani Region: Bagamoyo Distr., mainland west of Zanzibar, March 1885, *J.T. Last s.n.* (K).

**Remarks:**—*Dryopteris filipaleata* forms part of a small group of probably unrelated African species that are exindusiate. From *D. manniana* (Hook.) C.Chr. it differs in it being a larger plant not bearing proliferous buds along the rachis. The narrow lamina scales and the long pluricellular marginal outgrowths of the larger rhizomes and stipe base scales also separate it from *D. manniana*. From *D. tricellularis* J.P.Roux, which is indusiate or exindusiate (Roux 2002), it differs in the absence of mostly 3-celled isocytic hairs occurring on the lamina axes and veins. The broader denticulate scales that do not bear marginal outgrowths, the long isocytic lamina hairs, the prominent segment teeth, and the echinate spores of *D. ruwenzoriensis* C.Chr. ex Fraser-Jenk. separate it from *D. filipaleata*. From *D. pentheri* it differs in scale morphology, the absence of cylindrical glands and 2-celled hairs. The spore and stomata size of *D. filipaleata* is very similar to that of *D. pentheri*, which suggests that it is also a tetraploid.

INSERT FIGURE 16

**10. *Dryopteris glandulosopaleata* Roux** (2004b: 211, figs. 3A, B, 4A–G). Figs. 3L–R; 8B & Ba; 15.

Type:—CAMEROON. Mt Cameroon, Tongo Camp, (6700 ft) 2036 m, *T.D. Maitland 1046* (holotype K!).

*Plants* terrestrial. *Rhizomes* short-decumbent, to 8 mm in diameter, closely set with roots, persistent stipe bases and scales, the scales dull ferruginous, thinly chartaceous, sessile, narrowly lanceolate to subulate, to 24 x 3 mm, broadly cuneate, dentate, regularly set with capitate glands along the margin and on the scale lamina, often also with one or more pluricellular outgrowths which distally terminates in a short series of thin-walled oblong cells, the scale apex terminates in a short series of oblong thin-walled cells. *Fronde*s crowded, suberect to arching, to 900 mm long; *stipes* proximally castaneous, stramineous higher up, proximally adaxially flattened, shallowly sulcate higher up, to 390 mm long, to 6 mm in diameter, closely set with clavate glands, proximally densely set with spreading scaled, moderately scaled higher up, the scales to 24 x 3.5 mm, similar to those on the rhizome, but paler and reducing in size distally; *laminae* lanceolate to ovate, to 455 mm long, to 300 mm wide, to 2-pinnate-pinnatifid, with up to 14 petiolated pinna pairs, the distal pinnae sessile and eventually adnate and increasingly basiscopically decurrent; *rachises* stramineous, adaxially shallowly sulcate, narrowly winged near the apex, closely set with clavate glands and initially moderately scaled, the scales fugacious, ferruginous, thinly chartaceous, sessile, narrowly lanceolate to subulate, to 5 x 1 mm, cuneate, entire to dentate, irregularly set with capitate glands along the margin and on the scale laminae, or with one or more pluricellular marginal outgrowths mostly from near the base, the scale apex terminates in a short series of oblong thin-walled cells; *pinnae* petiolate, the petiole to 8 mm long, proximally spaced to slightly overlapping, near opposite to alternate, the basal pinna pair longest, to 215 mm long, to 95 mm wide, to 1-pinnate-pinnatifid, mostly not conspicuously basiscopically developed, narrowly ovate, lanceolate or oblong-acuminate towards the apex, with up to 10 petiolated pinnule pairs; *pinna-rachises* stramineous, narrowly winged towards the apex, adaxially shallowly sulcate, sparsely set with clavate glands and filiform scales, abaxially moderately to closely set with clavate glands, moderately set with scales, the scales stramineous, thinly chartaceous, similar to,

but smaller than those on the rachis; *pinnules* petiolate, the petiole to 1 mm long, the pinnules alternate, proximally widely spaced, more closely spaced distally, firmly herbaceous, proximally pinnatifid, progressively more shallowly lobed distally, narrowly triangular to oblong-acute, the basiscopic pinnule on the basal pinnae to 50 mm long, to 12 mm wide, the acroscopic pinnule on the basal pinnae to 50 mm long, to 12 mm wide; *costae* shallowly sulcate adaxially, glabrous adaxially, abaxially closely set with clavate glands and scales, the scales stramineous, chartaceous, sessile, subulate, to 2.5 x 0.3 mm, the scale margins and laminae regularly set with clavate glands, the scale apex terminates in a short uniseriate series of thin-walled cells; *segments* sessile, broadly ovate-obtuse, to 7 mm long, to 4.5 mm wide, lobed; *lobes* oblong, truncate to obtuse, to 6 mm long, to 3 mm wide, denticulate, adaxially with a few clavate hairs and isocytic hairs along and between the veins, abaxially closely set with clavate glands (62–)111(–146)  $\mu\text{m}$  long along and between the veins, and isocytic hairs to 340  $\mu\text{m}$  long mostly near the veins. *Venation* anadromous, catadromous towards the apex, immersed adaxially, evident abaxially, ending in the teeth near the margin. *Stomata* mostly of the polocytic type, (44–)54(–70)  $\mu\text{m}$  long. *Sori* circular, to 1.5 mm in diameter, 2-seriate on the segments and lobes, inframedial, confluent at maturity. *Indusia* ferruginous, firmly herbaceous, reniform, to 2 mm in diameter, strongly incurved, entire to shallowly repand, glabrous or (rarely) with a few clavate glands along the margin and laminae. *Sporangia* stalk simple, glandular or haired, the capsule with (13–)14(–23) indurated annulus cells, the epistomium (4–)6(–8)-celled, the hypostomium (5–)6(–9)-celled. *Spores* 64 per sporangium, brown, monolete, plano-convex, perispore asperous, with low and narrow reticulate ridges, exospore (48–)56(–68) x (34–)37(–48)  $\mu\text{m}$ .

**Distribution and habitat:**—*Dryopteris glandulosopaleata* appears to be restricted to mountainous regions of Cameroon and Nigeria, where it grows among rocks in riverbeds. In Cameroon the species is restricted to Mount Cameroon, occurring at elevations ranging between 1520 and 2740 m in light shade, and in Nigeria the species is known from Naraguta.

**Etymology:**— With reference to the scales which are regularly set with glands along the margin and on the scale laminae, and which often also occur on the indusia.

**Additional specimens studied:**—CAMEROON. South-West Province: Cameroon Mtn, under lava rock in mountain grassland, 2740 m, 1 April 1952, *C.D. Adams 1269*, (BM000787476); Mt Cameroon, 2250 m, 3 February 1962, *F.J. Breteler et al. MC163* (K); Buxa, 1905, *Deistal 635*

(K); Mt Cameroon, 1520 m, 17 January 1926, *Dunlap* 225 (K); Mt Cameroon, Tongo camp, 2036 m, *T.D. Maitland* 1046 (K).

NIGERIA. Plateau State: Northern Nigeria, Naraguta, 25 June 1921, *H.V. Lely* 308 (K).

**Remarks:**—Diagnostic of the species are scales that are regularly set with glands along the margins and on the scale laminae, clavate glands occurring along the lamina axes, the absence of 2-celled hairs, and clavate glands. Similar stomata and spore size suggest that *D. glandulosopaleata* is a tetraploid. An affinity with *D. aurantiaca* that appears to be diploid should be investigated.

**11. *Dryopteris gorgonea* Roux** (2004d: 33, fig. 5). Figs. 3S–U; 4A–D; 8C; 17.

Type:—CAPE VERDE ISLANDS. Fogo: Espia, Mosteiros, 1 August 1934, *A. Chevalier* 45113 (holotype P!, isotype COI!, K!).

*Plants* terrestrial. *Rhizomes* suberect to erect, to 50 mm long, to 5 mm in diameter, closely set with roots, crowded stipe bases and scales. *Fronde*s to 1.02 m long, suberect to arching; *stipes* proximally castaneous, to 640 mm long, to 9 mm in diameter, adaxially flattened and densely set with glands and pluricellular dendroid hairs and scales, the larger scales concolorous or bicolorous, if bicolorous then centrally castaneous to ferruginous with a narrow stramineous margin, firmly herbaceous, broadly attached, linear-attenuate, to 23 x 3 mm, the margin variously set with long reflexed pluricellular, mostly uniseriate hairs and capitate glands, the capitate glands also occur on the scale laminae, the scale apex flagelliform, the stipe higher up stramineous, shallowly sulcate and sparsely scaled, the larger scales fugacious, concolorous, ferruginous to stramineous, chartaceous, broadly attached, lanceolate to broadly ovate, to 5 x 4 mm, variously set with few short or long marginal outgrowths and glands, the scale laminae variously set with capitate glands, the scale apex flagelliform; *laminae* anadromous, catadromous towards the apex, herbaceous, ovate to broadly ovate, to 650 mm long, to 31 mm wide, to 2-pinnate-pinnatifid, with up to 13 petiolated pinna pairs; *rachises* adaxially shallowly sulcate, narrowly winged towards the apex, variously set with clavate glands and scales, the scales fugaceous, stramineous to ferruginous, chartaceous, broadly attached, ovate-caudate to lanceolate-caudate, to 5 x 4 mm, the margins variously set with a few short and/or long outgrowths and glands, the laminae variously set with

capitate glands, the scale apex flagelliform; *pinnae* petiolate, the petiole to 8 mm long, near opposite to alternate, slightly imbricate or not, to 1-pinnate-pinnatifid, the basal pair mostly longest, not conspicuously basiscopically developed, ovate, lanceolate, or oblong-acute distally, to 193 mm long, to 85 mm wide, with up to 6 petiolated pinnule pairs; *pinna-rachises* shallowly sulcate adaxially, the sulcus not confluent with that of the rachis, narrowly winged for most of the length, closely set with clavate glands, sparsely scaled, the scales ferruginous to stramineous, chartaceous, sessile, often somewhat bullate, lanceolate to broadly ovate, to 3.5 x 1 mm, variously set with short or long mostly uniseriate hairs and capitate glands, a few capitate glands also occur on scale laminae, the scale apex terminates in a short or long uniseriate series of oblong cells; *pinnules* petiolate, the petiole to 2 mm long, the pinnules near opposite to alternate, slightly imbricate or not, pinnatifid, ovate to oblong-obtuse, to 48 mm long, to 24 mm wide, adaxially glandular along and between the veins, also with scattered isocytic hairs along the costae, abaxially closely set with clavate glands (50–)68(–98)  $\mu\text{m}$  long, and isocytic hairs along the veins, the hairs often glandular near the base; *costae* adaxially shallowly sulcate, glandular, abaxially variously scaled, the scales ferruginous to stramineous, chartaceous, sessile to short-stalked, often somewhat bullate, similar to those on the pinna-rachis, to 3 x 1 mm; *segments* oblong-obtuse, to 13 mm long, to 6 mm wide, lobed; *lobes* dentate, the teeth cuneate. *Venation* anadromous, catadromous towards lamina apex, pinnately branched in the lobes, the lateral veins forked or simple, the branches end in the teeth near the margin. *Stomata* mostly of the polocytic type, (42–)53(–64)  $\mu\text{m}$  long. *Sori* circular, up to 1.2 mm in diameter, medial on predominantly anadromous vein branches, 2-seriate on the segments, discrete or touching at maturity; *sporangia* stalk simple, glandular, or haired, the capsule with (10–)13(–16) indurated annulus cells, the epistomium 4(–5)-celled, the hypostomium 4(–5)-celled. *Indusia* brown firmly herbaceous, flabellate, to 0.5 mm in diameter, entire to repand, glandular along margin and lamina. *Spores* brown, ellipsoidal, monolete, perispore folded to form narrow reticulate ridges, (38–)42(–46) x (24–)28(–32)  $\mu\text{m}$ .

**Distribution and habitat:**—*Dryopteris gorgonea* appears to be endemic to the Cape Verde Islands having been recorded from São Antão, São Vicente and the summit of Monte Gordo on São Nicolau. Unfortunately no ecological information has been recorded. No recent collections of the species appear to have been made from any of the islands and it has been suggested to be extinct (Lobin *et al.* 1998). Since the species closely resembles *D. oligodonta* a careful survey on the islands may reveal extant populations.

**Etymology:**—Named after Gorgades, the former name of the Cape Verde Islands.

**Additional specimens studied:**—CAPE VERDE ISLANDS. Fogo: Espia, Mosteiros, 1 August 1934, *A. Chevalier 45113* (COI, K, P). São Antão: Covão, 23–24 July 1934, *A. Chevalier 45532* (COI, K, P). São Nicolau: in summo monte Gurdo, 1851, *Bolle, C. s.n.* (COI, K); Monte Gordo, 24 February, 1864, *R.T. Lowe s.n.* (K); *Forbes s.n.* (K). Province unknown, Cape Verdes, *Cardosa 169* (K); Cap du Vert, *Forbes s.n.* (K).

**Remarks:**—*Dryopteris gorgonea* differs from *D. pentheri*, to which it was formerly ascribed, in the scales often bearing capitate glands on the surface and the presence of clavate glands (50–)68(–98)  $\mu\text{m}$  long along the frond axes and on the lamina surfaces. In *D. pentheri* the glands are oblong, (60–)137(–260)  $\mu\text{m}$  long, and restricted to the frond axes and veins. Also the 2-celled hairs diagnostic of *D. pentheri*, have not been recorded for *D. gorgonea*. The similar lamina and scale morphology and gland distribution suggests *Dryopteris gorgonea* and *D. oligodonta* to be closely related. *Dryopteris gorgonea*, however, differs in the longer clavate glands [(36–)51(–60) vs. (50–)68(–98)  $\mu\text{m}$ ] and larger stomata [(30–)37(–48) vs. (42–)53(–64)  $\mu\text{m}$ ]. The larger stomata suggests it is a tetraploid, rather than a diploid as *D. oligodonta* (Fraser-Jenkins 1982). Fraser-Jenkins (1986) placed *D. oligodonta* in section *Marginatae* Fraser-Jenk.

*Dryopteris* collections from the Cape Verde Islands were ascribed to various taxa, of which a summary is provided by Lobin *et al.* (1998). Fraser-Jenkins (1982) was first to show that two *Dryopteris* species occur on the islands, ascribing them to *D. oligodonta* (Desv.) Pic.Serm. and *D. pentheri* (Krasser) C.Chr. Roux (2004d) discussed the taxonomy of *D. gorgonea*.

INSERT FIGURE 17

**12. *Dryopteris inaequalis*** (Schltdl.) Kuntze (1891: 813). Figs. 4E–J; 8D & Da; 10; 11D; 15.

*Aspidium inaequale* Schlechtendal (1825: 23, 24, pl. 12). *Nephrodium inaequale* (Schltdl.) Hooker (1862: 125), non Schrader (1824: 869). *Lastrea inaequalis* (Schltdl.) Presl (1836: 77). *Polystichum inaequale* (Schltdl.) Keyserling (1873: 44). Type:—SOUTH AFRICA. 'In Promontorio bonae spei', *J.L.L. Mund & L. Maire s.n.* (Lectotype B20 0044699!), designated by Pichi Sermolli (1984: 329); "Prom. Bon. Sp.", *C.H. Bergius s.n.* (syntype B20 0044698).

*Nephrodium filix-mas* (L.) Rich. var. *elongatum* sensu Sim (1892: 180, 181, pl. C). *Dryopteris elongata* sensu Sim (1915: 104, pl. 17), *p.p.*

*Plants* terrestrial or epilithic, mostly with 2 – 4 fronds. *Rhizomes* short-creeping, sparsely irregularly branched, to 14 mm in diameter, set with roots, closely to widely spaced persistent stipe bases and scales, the scales stramineous to ferruginous, chartaceous, broadly attached, ovate to linear-acuminate, to 20 x 3 mm, cuneate to cordate, entire, or with a few widely spaced, uniseriate, multicellular hairs and pyriform glands along the margin, the scale apex filiform, terminating in a short uniseriate series of oblong cells. *Fronde*s suberect to arching, to 1.15 m long; *stipes* proximally castaneous, stramineous to greenish higher up, proximally adaxially flattened, shallowly sulcate higher up, to 540 mm long, to 6 mm in diameter, proximally densely scaled, sparsely to moderately scaled higher up, the scales stramineous to ferruginous, chartaceous, the larger scales broadly attached, the smaller sessile or short-stalked, ovate to narrowly lanceolate, or filiform, to 24 x 4 mm, cordate to cuneate, the margins entire or denticulate, often with a few widely spaced, multicellular hairs and pyriform glands (which may also occur on the scale surface), marginal hairs on the smaller scales are mostly confined to the basal region, the scale apex filiform, terminating in a short uniseriate series of oblong cells; *laminae* anadromous, becoming catadromous towards the apex, herbaceous, 2-pinnate to 2-pinnate-pinnatifid, narrowly ovate to ovate, to 620 mm long, to 370 mm wide, with up to 14 petiolated pinna pairs; *rachises* green, drying stramineous, adaxially shallowly sulcate, becoming narrowly winged towards the lamina apex, eglandular or sparsely to densely glandular, and sparsely to moderately set with scales and branched hairs, the scales stramineous to ferruginous, chartaceous, sessile or short-stalked, narrowly lanceolate to filiform, to 6 x 1.5 mm, cuneate, entire, often with a few twisted filiform outgrowths, mostly from near the base, and glands, which may also occur on the scale surface, the scale apex filiform, terminating in a short uniseriate series of oblong cells; *pinnae* petiolate, the petiole to 14 mm long, subopposite to alternate, the pinnae to 2-pinnate, the basal pinna pair inaequilaterally triangular to broadly ovate, or deltate, to 206 mm long, to 118 mm wide, oblong-acuminate, ovate or lanceolate towards the lamina apex, the basal pinna pair shorter or longer than the next pair above, basally widely spaced, often somewhat imbricate higher up, with up to 6 petiolated pinnule pairs; *pinna-rachises* adaxially shallowly sulcate, the sulcus confluent with that of the rachis, pronounced abaxially, narrowly winged for most of the length, the wing proximally less conspicuous, sparsely to densely glandular, abaxially sparsely to moderately set with hairs and scaled, the hairs and scales stramineous to ferruginous,

membranous to chartaceous, sessile or short-stalked, narrowly lanceolate to filiform, to 4 x 1 mm, cordate to narrowly cuneate, the margins entire or denticulate, often with a few widely spaced twisted filiform outgrowths, mostly from near the scale base, and glands, the scale apex filiform, terminating in a short uniseriate series of oblong cells; *pinnules* petiolate, the petiole to 3 mm long, the pinnules to 1-pinnate, widely spaced, often somewhat imbricate, aequilaterally to inaequilaterally narrowly triangular, ovate-obtuse, or oblong-obtuse, the distal pinnules basiscopically decurrent, the acroscopic pinnule on the basal pinnae to 43 mm long, to 20 mm wide, the basiscopical pinnule on the basal pinnae to 80 mm long, to 28 mm wide, often with a single pairs of petiolated segments; *costae* adaxially shallowly sulcate, pronounced abaxially, narrowly winged along its entire length, the wing continuous with that of the pinna-rachises wing, glandular or eglandular, variously set with isocytic or moniliform hairs and scales, the hairs often bear one or more glands near the base; *segments* spaced, inaequilaterally narrowly ovate-obtuse to oblong-obtuse, to 17 mm long, to 9 mm wide, basiscopically decurrent, shallowly to deeply lobed; *lobes* serrate, adaxially glabrous or with a few filiform scales along the costae, abaxially with uniseriate hairs often bearing one or more gland-like cells near the base, and with filiform scales bearing one or more oblong glands and often a unicellular hair near the base, mostly occurring along the costae, and/or simple isocytic or moniliform hairs, occurring on the veins and lamina, and/or clavate to oblong glands (74–)109(–170)  $\mu\text{m}$  long, occurring on the costae, veins and/or lamina near the veins, or eglandular. *Venation* anadromous, becoming catadromous distally, pinnately branched in the segments, the veins branches pinnately branched, forked, or simple near the apex, evident, the branches end in the teeth near the margin, the endings slightly enlarged. *Stomata* of the anomo- and polocytic types, (30–)42(–58)  $\mu\text{m}$  long. *Sori* circular, to 1.6 mm in diameter at maturity, medial on the predominantly anadromous vein branches, discrete, essentially biseriate on the segments; *receptacles* often haired; *sporangia* stalk simple, with one or more glandular cells, or with a long uniseriate hair, the capsule with (9–)13(–20) indurated annulus cells, epistomium (3–)4(–7)-celled, hypostomium (3–)4(–8)-celled. *Indusia* persistent, brown, firmly herbaceous, reniform, to 1.6 mm in diameter, glabrous, with unicellular glands along the margin and/or surface, rarely also with a pluricellular uniseriate hair along the margin, the margin often strongly revolute. *Spores* ellipsoidal, monolete, perispore variable, folded into low tubercles or reticulate ridges, finely rugose to ruminant, (30–)38(–50) x (20–)26(–31)  $\mu\text{m}$ . *Chromosome number*:  $2n$  = unknown.



**Distribution and habitat:**—*Dryopteris inaequalis* is confined to South Africa and Swaziland. In South Africa it occurs in moist to seasonally moist coastal and montane forests, extending from the Cape Peninsula, along the southern and eastern Cape mountains, northwards along the Drakensberg range to Mpumalanga and westwards to the Waterberg and Blaauwberg in the Limpopo Province. It has been recorded at elevations ranging from 30 to 1976 m. In Swaziland it is confined to western higher lying areas and escarpment, occurring at elevations ranging between 1205 and 1900 m. *Dryopteris inaequalis* does not appear to be edaphically bound and has been recorded in soils derived from a wide range of geological formations. The species mostly occupies mixed coastal and montane forests, where plants occur on the open forest floor, among rocks, or along streams. In Swaziland it has been recorded from seasonally moist granite rock overhangs in grassland. The plants occur as individuals, but small clonal stands are often formed.

**Etymology:** *inaequalis*, unequal, probably with reference to the asymmetric basal pinnae and/or pinnules.

**Additional specimens examined:**—SOUTH AFRICA. Eastern Cape: —3124 (Hanover) Eastern Cape, Kookfontein (–CB), February 1912, *S. Burger 961* (PRE). —3126 (Queenstown) Broughton, near Molteno (–AD), 1892, *H.G. Flanagan 473* (PRE); Broughton, near Molteno, 1 915 m, December 1892, *H.G. Flanagan 1863* (BOL, PRE); Stormberg (–BC/BD), *sine coll. s.n.* (US1173349). —3129 (Port St Johns) Port St Johns, Mt Theiger (–CB), 6 September 1983, *A. Hutchings 571* (BOL); Port St Johns, 76 m (–DA), 1950, *W.R.B. Hardcastle 280* (PRE); Mlolweni Forest, 137 m, 4 June 1971 *W.B.G. Jacobsen 4285* (FR); Port St Johns, June 1944, *A.G. McLoughlin 787* (BOL); Intafufu River, *A.P. Mills 400* (K, NH, PRE); Port St Johns, Big Umngazi River, 23 April 1979, *J.P. Roux 565* (BOL, NBG); Port St Johns, Moffet’s Glen, 24 April 1979, *J.P. Roux 570* (NBG); Port St Johns, along road leading to the airstrip, 24 March 1984, *J.P. Roux 1874* (NBG); Port St Johns, in evergreen forest along road to army camp above town, 22 January 1987, *J.P. Roux 1975* (NBG); Port St Johns, 24 m, 10 January 1955, *E.A.C.L.E. Schelpe 5037* (BOL); Intafufu River (–DD), 11 October 1968, *A.P. Mills 393* (K, PRE). —3225 (Somerset East) Montis Boschberg, 912 m (–DA), *P. MacOwan 335* (NY); in depressis summi montis Boschberg, 1 368 m, *P. MacOwan 1574* (K); Somerset East, Boschberg, May 1869, *P. MacOwan s.n.* (M, NBG, PRE, SAM24770); Somerset East, *sine coll. s.n.* (NY). —3226 (Fort Beaufort) Katberg Forest, 912 m (–BC), 2 February 1945, *B.Z.M. Adams 144* (NU). —3227 (Stutterheim) Queenstown Distr., Gwatyn, Woodvale Forest, 1276 m (–AB), 15 April 1911, *E.E. Galpin 8202*

(PRE); Keiskammahoek, Amatola Mts (–CA), *W.S.M. D'Urban s.n.* (K); Evelyn Valley Forest, Pirie, 24 January 1987, *J.P. Roux 1990* (NBG); Pirie Forest (–CC), *E.A.C.L.E. Schelpe s.n.* (BOL32165); Capland, Pirie-Wald, 600 m, 2 March 1894, *sine coll. s.n.* (NY); forest at Pirie Bush, *W.S.M. d'Urban s.n.* (K); King Williamstown, Pirie forest, June 1881, *sine coll. s.n.* (PRE731472); Pirie Forest, 912 m, *T.R. Sim 647* (NH); Amabela (–DA), October 1939, *Ross Nurseries CH5477* (PRE); Komgha (–DB), 1892, *H.G. Flanagan 470* (PRE). —3228 (Butterworth) Dwessa Forest (–BD), 21 April 1979, *J.P. Roux 558* (NBG); Dwessa Forest, ca. 100 m, *E. Moll 5773* (BOL). —3322 (Oudtshoorn) Groot Rivier (–AD), 10 November 1951, *L.E. Taylor 3598* (NBG). —3325 (Port Elizabeth) Uitenhage, Van Staden's River (–CC), *Browning 1076* (MO); Van Staaden's River, *H. Bolus 1708* (BOL); Uitenhage (–CD), *W.H. Harvey s.n.* (K). —3326 (Grahamstown) Greater Addo National Park, Alexandria Forest, 103 m (–AC), *E. Pienaar & L. Seoke ALB25/05* (NBG); Grahamstown, Faraway, portion 3 of Cold Springs, 700 m (–BA) 18 March 1984, *A. Jacot-Guillarmod 9465* (MO, PRE); Coldsprings near Grahamstown (–BC), July 1909, *M. Daly 1041* (NH); Grahamstown, *J. Glass s.n.* (SAM 24765); Grahamstown, Fern Kloof, 668–760 m, 31 July 1932, *J.V.L. Rennie 337* (BOL); Grahamstown, July 1909, *M. Daly 967* (PRE); kloof near Grahamstown, 1863, *B. Holland s.n.* (NBG); Victoria East Distr., Hogsback forest, shortcut from Alice main road to Hogsback, 1033 m (–DB), 2 February 1974, *W.B.G. Jacobsen 4576* (NBG). —3327 (Peddie) Cape, East London Park (–BB), 8 July 1911, *E. Paetzold 8217* (PRE). KwaZulu-Natal: —2930 (Pietermaritzburg) Balgowan, farm Boschfontein, 1216 m (–AC) 31 May 1944, *B.S. Fisher 624 & 637* (NU) & 626 & 648 (NH); Balgowan, Boschfontein, May 1944, *E.A.C.L.E. Schelpe 409 & 609* (NU); Camperdown Distr., Nagle Dam, in Mpetu Forest (–DA), 23 June 1957, *M.J. Wells 1532* (NU). —2730 (Vryheid) Madhlangampisi Mtn, 2165 m (–AB), 26 February 1979, *N. Jacobsen 5107* (FR); Eshowe (–DB), 15 June 1951, *J.G. Lawn 2037* (NH); Hlobane, Motola Forest, 12 February 1950, *D. Johnstone 298* (NH). —2831 (Nkandla) Pembeni Forest, 5 km NE of Hlabisa Village (–BB), 2 December 1984, *E.R. Harrison s.n.* (BOL); Nkandla Forest (–CA), 19 January 1987, *J.P. Roux 1933* (NBG). —2929 (Underberg) farm Furth 2038, stream N of Umgeni River, ca. 3 km N of Everglades in streambed, 1420 m (–DB), 21 December 1985, *W.B.G. Jacobsen 5722* (FR, PRE); Hlabeni Forest (–DC), 5 March 2002, *J.P. Roux 3361* (NBG). —2930 (Pietermaritzburg) Karkloof, farm Shawswood (–AC), 15 January 1987, *J.P. Roux 1918* (NBG); Howick Distr., Karkloof forest, farm 'Elderslie', 14 March 1940, *H.B. Rycroft s.n.* (NH, NU); Howick, 1064 m, April 1947, *H.D.D. Stanton 77* (NU); Pietermaritzburg, Chase Valley (–CB), 20

May 1943, *R.F. Allrodd 86* (NU); Pietermaritzburg, Town Bush Valley, 912 m, May 1949, *M.F. Camden-Smith 43* (NU); Pietermaritzburg, Sweetwaters, March 1946, *B.J. de Villiers 80* (NU); Town Hill, June 1916, *F.G. Carnegie 720* (NU). Limpopo: —2228 (Maasstroom), Blaauwberg, 1650 m (–BB), November 1982, *N. Jacobsen 5349* (FR); Blouberg Nature Reserve, S of summit of Blouberg Mtn, 1650 m, 4 December 1990, *J.E. Burrows & S.M. Burrows 5026* (PRE). —2230 (Messina) farm Bloemfontein, ca. 1600 m (–CC), 23 January 1974, *N. Jacobsen 4588* (FR). —2427 (Thabazimbi) W extremity of Waterberg Distr., farm Groothoek 1246, steep S-facing mountain side, 1976 m (–BC), 7 April 1948, *L.E. Codd 3990* (PRE); western extremity of Waterberg Distr., farm Groothoek, 2nd farm from W end of mountain, S-slope of mountain, ca. 1650 m, 25 February 2002, *J.P. Roux 3185* (NBG). Mpumalanga: —2430 (Pilgrim's Rest) Mariepskop, Bedford trail (–DB), 14 January 1969, *P. Vorster 148* (MO); Mount Sheba Nature Reserve, entrance road to hotel, 1800 m (–DC), 30 January 1973, *W.B.G. Jacobsen 4479* (FR); Graskop, Fairyland, 6 January 1979, *J.P. Roux 387* (BOL). —2531 (Komatipoort), Hwangeni (The Bearded Man), 1420 m (–CC), 27 July 1978, *N. Jacobsen 4961* (FR). Western Cape: —3318 (Cape Town), Cape Town, Table Mountain (–CD), *H. Barkly s.n.* (K); Table Mountain, *H. Bolus 1707* (BOL); Table Mountain, Devil's Peak, *C.F. Ecklon s.n.* (BOL); Table Mountain, Dark Gorge, 547 m, 17 November 1956, *E. Esterhuysen 26566* (BOL, MO); Table Mountain, Skeleton Gorge, at Contour Path, 243 m, 27 September 1924, *R.H. Marloth s.n.* (PRE); Table Mountain, Skeleton Gorge, ca. 450 m, 5 September 1979, *B.S. Parris & J.P. Croxall 7470* (K); Table Mountain, Skeleton Gorge, 2 January 1977, *J.P. Roux 112* (NBG); Table Mountain, Skeleton Gorge, along contour path, ca. 300 m, 15 September 1999, *J.P. Roux 2941* (NBG); Table Mountain, Newlands Forest, bank of Old Mountain stream, 13 May 2003, *J.P. Roux 3816* (NBG). —3320 (Montagu), Voormansbosch (–DC), *K.L.P. Zeyher s.n.* (SAM); Swellendam, Strawberry Hill, in forest on S-slopes (–DD), 11 September 1944, *E. Esterhuysen 10369* (BOL). —3322 (Oudtshoorn) Goudveld State Forest, W of Knysna River, 100 m (–CC), 1 August 1997, *J. Baard 189* (NBG); distr. George, in sylv. Knysna (–CD), January 1839, *sine coll. s.n.* (M); George, *sine coll. s.n.* (K); George, Groenkop Forest (–CD), November 1977, *C.J. Geldenhuys 393* (BOL); George, Groenkop Forest, 24 October 1977, *C.J. Geldenhuys 395* (BOL); George, March 1893, *R. Schlechter 472* (PRE); near George, Witfontein Forest, 16 October 1935, *L.E. Taylor 1659* (NY); George, Groeneweidebos, W-slope above stream in forest, 200 m (–DB), 11 September 1981, *C.J. Geldenhuys 610* (BOL); George, near Kaaimans River, old Knysna road, 106 m, 10 January 1972,

*Cameron 82* (BOL); George Distr., Woodville, 290 m (–DC), 5 November 1981, *C.J. Geldenhuys 615* (PRE); George Distr., Bergplaas, in Beervlei, 500 m, 5 November 1981, *C.J. Geldenhuys 616* (PRE). —3323 (Willowmore) Knysna, The Crag, De Vaselot Nature Reserve, 150 m (–BD), 9 May 1978, *C.J. Geldenhuys 535* (BOL); De Vaselot Natuur Reserwaat, 150 m, 11 May 1978, *C.J. Geldenhuys 562* (BOL); Buffelsnek State Forest, Dieprivier picnic grounds. ca. 325 m (–CC), 27 August 1979, *B.S. Parris & J.P. Croxall 7411* (K); Helpmekaar River, along Otter Trail, E of Nature's Valley (–DC), 7 July 1978, *J.E. Burrows 1293* (NBG); Bloukrans State Forest, Vark River, ca. 60 m, 26 August 1979, *B.S. Parris & J.P. Croxall 7378* (K). —3423(Knysna) in the Knysna forests (–AA), *J. Bowie s.n.* (K); Wilderness, above Lakes Caravan Park, 20 February 1979, *J.E. Burrows 1438* (NBG); Wilderness, 76 m, 22 January 1943, *R.H. Compton 14296* (NBG); Wilderness, 76 m, 22 January 1943, *R.H. Compton 14309* (NBG); north above Knysna, Tsitsikamma Forest, 300 m, October 1976, *De Joncheere SAC295* (PRE); Wilderness, July 1923, *M.R.B. Levyns 810* (BOL); Knysna, *D.S. Mitchell s.n.* (BOL14490); Knysna, Deepwalls, 5 July 1960, *E.A.C.L.E. Schelpe s.n.* (BOL); Wilderness, 10 January 1958, *J.A. Whellan 1504* (BOL); Wilderness, 3 July 1943, *sine coll. s.n.*, STE 30268 (NBG); Storms River mouth, along path above Ngubu's shelter on Otter Trail, 30 m (–BB), 5 July 1978, *J.E. Burrows 1276* (NBG). —3424 (Humansdorp) Witelsbos, Jaftaskraalbos, 60 m (–AA), 12 February 1985, *C.J. Geldenhuys 966* (BOL). Without locality:—*Barkly, H. s.n.* (SAM 24761); Cape ‘Prom. bon. sp.’, *C.H. Bergius s.n.* (B20 0044698); South Africa, KwaZulu-Natal, *J. Buchanan s.n.* (K); *W.J. Burchell 5201* (K); *W.J. Burchell 5233* (K); *W.J. Burchell 3589* (K); South Africa, Cape, *W.J. Burchell 585A* (K); South Africa, ‘Afr. austr.’, *C.F. Drège s.n.* (K, left specimen); in Umgaza (Omgaziana) et Umzimvubu (Omsamwubo), *Drège, C.F. 4225* (NY); British Kaffraria, *W.S.M. d'Urban 100* (K, left only); forest at Mowbray Park, British Kaffraria, *W.S.M. d'Urban s.n.* (K); South Africa, KwaZulu-Natal, *R.J. Garden s.n.* (K); C.B.S., *W.H. Harvey s.n.* (NY); Natal, February 1867, *M.J. McKen 51* (K); Cape, ‘Prom. bon. sp.’, *J.L.L. Mund & L. Maire s.n.* (B20 0044699); South Africa, preserved 5 March 1981, *T. Reichstein 4088* (FR); Cape, ‘Cap b. sp.’, *sine coll. s.n.* (US617438); South Africa, Cape, *sine coll. s.n.* (K); South Africa, Cape, *sine coll. s.n.* (K); *sine coll. s.n.* (SAM 24763); *sine coll. s.n.*, STE 27424 (NBG); *Sine coll. s.n.*, STE 27426 (NBG); *sine coll. s.n.*, STE 27431 (NBG); *sine coll. s.n.*, (NH26453); *sine coll. s.n.* (NH26777); *sine coll. s.n.* (PRE731471); South Africa, KwaZulu-Natal, *J.M. Wood s.n.* (M, SAM); South Africa, CBS, *K.L.P. Zeyher 4611* (K); ?Natal,

*K.L.P. Zeyher s.n.* (BOL); Cape of Good Hope 1845, *K.L.P. Zeyher s.n.* (BM000787480); South Africa, ceded territory, *K.L.P. Zeyher s.n.* (K).

SWAZILAND. Manzini Distr.: —2631 (Mbabane) on hills surrounding the Black Umbeluzi Valley near Mbabane, N-facing slope (–AC), 30 December 1978, *R.D. I'Ons 78/24* (K).

Shiselweni Distr.: —2631 (Mbabane) Hlatikhulu, forest in ravine E of town, 1205 m (–CD), 15 May 2002, *J.P. Roux 3631* (NBG).

**Remarks:**—*Dryopteris inaequalis* (Schltdl.) Kuntze, originally described as *Aspidium inaequale* by Schlechtendal in 1825, is based on two collections, one by Bergius and the other by Mund and Maire. The itineraries of the expeditions of these gentlemen are not known (Gunn & Codd 1981), but they probably collected on the Cape Peninsula and surrounds, and Mund may have travelled as far as Uitenhage. Although accepted as a distinct species, either as *Aspidium* (Kunze 1836, Hooker 1862, Kuhn 1868), *Lastrea* (Presl 1836, Pappe & Rawson 1858), *Nephrodium* (Hooker & Baker 1863, Barkly 1875, McKen 1869, Buchanan 1875, Sim 1891, 1892), or as *Dryopteris* (Christensen 1905, Sim 1915, Alston & Schelpe 1952, Schelpe 1970, Jacobsen 1983, Schelpe & Anthony 1986, Burrows 1990), its circumscription caused much confusion. Hooker (1863) recognised *N. inaequale* as distinct and also listed *Nephrodium filix-mas* (L.) Rich. var. *elongatum* (Ait.) Hook. & Baker as occurring at the Cape. The latter has been renamed as *D. aitoniana* by Pichi Sermolli (1951) and is endemic to Madeira.

The Bergius and Mund & Maire collections differ greatly from each other and this may have led Sim (1891, 1892) to believe that Schlechtendal based his species on different elements, part being *N. inaequale* and part being *N. filix-mas* var. *elongatum*. Judging from Sim's descriptions he considered the Bergius collection, which is a smaller plant, as *N. inaequale* and the Mund & Maire collection as *N. filix-mas* var. *elongatum*. The Mund and Maire collection has since been selected as lectotype of *D. inaequalis* (Pichi Sermolli 1984: 172), which is in line with more recent interpretations of the species.

The occurrence of a single species in southern Africa, *D. inaequalis*, or two, *D. inaequalis* and *D. petheri* have been disputed since the latter was published. Alston & Schelpe (1952), Pichi Sermolli (1984, 1985) and Roux (2001) recognised both species. Alston (1959), Schelpe (1970), Kornaś (1979), Jacobsen (1983), Schelpe & Anthony (1986) and Burrows (1990), however, considered them to be conspecific.

*Dryopteris inaequalis* is characterised by the relatively thin and short-creeping rhizomes, the basal pinna pairs that are generally shorter than the next pair above, the isocytic to moniliform lamina hairs that often bear more than one glandular cell near the base, the scales that regularly bear pluricellular hairs from the stalk, and the indusia that frequently bear glandular hairs along the margins and surface. Fraser-Jenkins (1986) places *Dryopteris inaequalis* in section *Marginatae* Fraser-Jenk. Stomata and spore size suggests it being a diploid rather than a tetraploid as *D. pentheri*.

**Variation:**—*Dryopteris inaequalis* is a variable taxon; its variability appearing to be environmentally induced. One of the more obvious variations is the degree to which the basal pinna pair is reduced. Also the frond axes and veins are variably set with glands and plants occurring at higher elevations and in deep shade generally appear to have fewer glands and may even be eglandular. The sporangium stalks may be simple, glandular, or haired, a feature that cannot be linked to any obvious environmental factors. A similar situation exists in the glandular or eglandular indusia. The perispore also exhibits variation in the degree to which it is folded.

**13. *Dryopteris katangaensis* Roux** (2003: 237, figs. 1–4). Figs. 4K–N; E & Ea; 11E; 15.

Type:—ZAMBIA. Northwestern Province: Mwinilunga District, Lumwana East River, 19 km from turnoff to Kabompo Gorge, Solwezi–Mwinilunga road, in light or deep shade along stream, 11 October 1999, *J.P. Roux 2989* (holotype NBG0197292-1!, NBG0197292-2!, NBG0197292-3!, NBG0197292-4!, NBG0197292-5!).

*Plants* terrestrial. *Rhizomes* suberect to erect, to 100 mm tall, to 12 mm in diameter, set with roots, crowded persistent stipe bases, and scales, the scales often rugose, dull brown to ferruginous, chartaceous, linear, to 23 x 3 mm, truncate to cordate, the margins repand to erose, irregularly set with long twisted filiform outgrowths, the scale apex flagelliform, twisted. *Fronde*s caespitose, crowded, to 5 per plant, suberect to arching, to 940 mm long; *stipes* stramineous, proximally adaxially flattened, sulcate higher up, to 490 mm long, to 9 mm in diameter, proximally densely scaled, moderately scaled higher up, the scales fugaceous, often rugose, dull brown to ferruginous, chartaceous, lanceolate-caudate, to 20 x 3 mm, the margins repand to erose, also irregularly set with twisted filiform outgrowths, the scale apex flagelliform, twisted; *laminae*

anadromous, catadromous towards the apex, firmly herbaceous, to 3-pinnate, ovate to broadly ovate, to 460 mm long, to 330 mm wide, with up to 10 petiolated pinna pairs; *rachises* stramineous, adaxially shallowly sulcate, narrowly winged in the pinnatifid apex, initially moderately scaled, the scales dull brown to ferruginous, chartaceous, lanceolate-caudate, to 6 x 1.5 mm, cordate, the margin repand to erose, frequently with long filiform outgrowths especially from near the base, twisted, the scale apex flagelliform, twisted; *pinnae* petiolate, the petiole to 9 mm long, the basal pinna pair to 2-pinnate, the basal pair longer or shorter than the next pair above, irregularly narrowly ovate, to 240 mm long, to 135 mm wide, basiscopically developed, the proximal basiscopic pinnule shorter or longer than the next basiscopic pinnule, pinnae higher up lanceolate to oblong-acuminate, subopposite to alternate, spaced or imbricate, with up to 10 petiolated pinnule pairs; *pinna-rachises* adaxially sulcate, the sulcus confluent with that of the rachis, pronounced abaxially, narrowly winged in the pinnatifid apex, abaxially moderately scaled, the scales ferruginous to stramineous, chartaceous, sessile or short-stalked, narrowly ovate-caudate to lanceolate-caudate, to 4 x 0.8 mm, repand, the margins regularly set with filiform outgrowths from near the point of attachment, often also with one or more glandular cells, the scale apex short to long flagellate; *pinnules* petiolate, the petiole to 3 mm long, inaequilaterally narrowly trullate, obtuse, or oblong-obtuse, basiscopically decurrent towards the pinna apex, inaequilaterally pinnatifid to pinnatisect, the acroscopic pinnule on the basal pinna to 62 mm long, to 18 mm wide, basiscopic pinnule on the basal pinna to 78 mm long, to 18 mm wide, spaced or slightly imbricate, the proximal pinnae with up to 2 pairs of oblong-obtuse segments, the margins dentate, adaxially glabrous, abaxially sparsely set with hairs and scales, the hairs isocytic, occurring along the costae and veins, (5–)7(–14)-celled, to 640  $\mu\text{m}$  long, the scales stramineous, linear to narrowly lanceolate-caudate, to 3.5 x 0.35 mm, truncate to cuneate, the margins repand, often with uniseriate hairs on the stalk or near the point of attachment, often also glandular, the scale apex short or long flagelliform. *Venation* anadromous, catadromous towards the lamina and pinna apex, pinnately branched, forked or simple near the apex, evident, ending in the teeth near the margin. *Stomata* of the anomo- and polocytic types, (30–)39(–48)  $\mu\text{m}$ . *Sori* circular, inframedial on the anadromous vein branches, discrete or paired, the paired ones touching at maturity; *sporangia* stalk simple, glandular or haired, the capsule with (11–)15(–19) indurated annulus cells, epistomium (4–)5(–6)-celled, hypostomium (4–)6-celled. *Indusia* brown to ferruginous, persistent, firmly chartaceous, reniform, to 2 mm in diameter, the margins strongly

revolute, entire. *Spores* brown, ellipsoidal, monolete, perispore unevenly folded to form small and large bulges and ridges, scabrous, (38–)43(–52) x (26–)31(–38) µm). *Chromosome number*: unknown.

**Distribution and habitat:**—*Dryopteris katangaensis* is confined to the Katango-Zambian Centre of endemism (Roux 2003). In Zambia it ranges from the Mwinilunga District in the Northwestern Province to the adjacent higher lying areas, often referred to as the Upper Katanga (formerly Shaba) Province of the Democratic Republic of the Congo. Here it is known from the Bianco and Kundelungu plateaus. The species is confined to shaded streambanks in *Brachystegia-Jubernardia-Isobertina* ‘miombo’ woodland at elevations ranging from 1530 to 1560 m.

**Etymology:**—The epithet refers to the mineral rich Katanga region extending from Zambia to the Democratic Republic of the Congo.

**Additional material studied:**—DEMOCRATIC REPUBLIC OF THE CONGO. Katanga Province: Plateau des Kundelungu, 7.4 km au NNE du Poste de Katshupa. Frange forestière étroite de la rivière Luanza, 1560 m, 3 August 1966, *F. Malaisse 4478* (BOL, K); Plateau des Bianco. Sous-bois, galerie forestière de la Kalule-Sud, en aval du pont de la route Kansenia-Biono, 1530 m, 15 June 1958, *J.-J. Symoens 5722* (BOL).

ZAMBIA. North-Western Province: Mwinilunga Distr., Lumwana East River, 19 km from turnoff on road to Kabompo Gorge, Solwezi-Mwinilunga road. Frequent in light or deep shade along streams, 11 October 1999, *J.P. Roux 2989* (NBG); Solwezi Distr., Camp 8, W of Rivier Mumbezi. Shady damp banks of stream, 27 July 1930, *E. Milne-Redhead 787* (K, PRE); Zambia, *Mutumushi 3149* (SRGH).

**Remarks:**—Diagnostic of *D. katangaensis* are the short suberect to erect rhizomes, the absence of glands from the laminae, the long and narrow pinnules, and the sori covered by large, strongly recurved indusia. The stomata and spore size suggests it being a diploid. Based on morphological features it seems likely to be closest to *D. lewalleana* Pic.Serm.

14. *Dryopteris kilmensis* (Kuhn) Kuntze (1891: 813), as ‘*D. kilemensis*’. Figs. 4O–T; 8F; 11F; 18.



*Aspidium kilmense* Kuhn (1868: 24). Type:—TANZANIA. 'Africa orientalis tropica. In Kilma ad radices montis Kilimandjaro regionis Dschagga 3–4000 ped. 1864', *O. Kersten* 46 (holotype B20 0051628, isotype B20 0058467). *Nephrodium kilmense* (Kuhn) Baker (1874: 498).

*Nephrodium lastii* Baker (1891: 324). Type:—MOZAMBIQUE. *J.T. Last s.n.* (holotype, K!). *Aspidium lastii* (Baker) Hieronymus (1895: 85). *Dryopteris lastii* (Baker) Christensen (1905: 274).

*Dryopteris platylepis* Rosenstock (1907: 4, 5). Type:—TANZANIA. 'Africa orient. germ. Kilimanjaro, 4000 m, in humide sylvae primaevae, 1906', *P. Daubenberger* 37 (holotype M!, isotype M!).

*Dryopteris remotipinnula* Bonaparte (1925: 178, 179). Type:—MADAGASCAR. 'Région floristique du Centre. Massif de Manongarivo. Vers 1700 mètres d'altitude. Bois humide. Rocailles'. May 1909, *H. Perrier de la Bâthie* 7619 (holotype P003495031!, isotypes P00483237!, P00483238!).

*Dryopteris cordipinnula* Christensen (1932a: 27), *nom. nud.* [McNeill *et al.* (2006) Art. 32.1(d)]. *Dryopteris cordipinnula* Christensen (1932b: 55, 56, t. 11, figs. 10–12). Type:—MADAGASCAR. 'Mandraka' August 1906, *Ch. d'Alleizette* 111 (lectotype BM!), designated by Roux (2011: 53); 'Imerina: Betsitra, près Andsoforobé', October 1906, *Ch. d'Alleizette* 170 (syntype BM).

*Plants* terrestrial. *Rhizomes* short-decumbent or short and erect, to 150 mm long, to 15 mm in diameter, set with roots, crowded persistent stipe bases and scales, the scales ferruginous, chartaceous, broadly attached, subulate to narrowly lanceolate, to 30 x 4 mm, the margins entire or with a few scattered filiform outgrowths near the apex, the scale apex short-filiform, terminating in an oblong cell. *Fronde*s caespitose, arching, to 1.5 m long; *stipe* base castaneous, stramineous higher up, sulcate adaxially, to 815 mm long, to 9 mm in diameter, proximally densely scaled, subglabrous higher up, the scales ferruginous to castaneous, chartaceous and often rugate, or thinly crustaceous, broadly attached or sessile, filiform to broadly ovate, to 40 x 9 mm, truncate to cordate, entire, or with a few scattered filiform outgrowths near the base or apex, occasionally with a few scattered glands (these frequently also occur superficially on the scale lamina), and short uniseriate hairs, the scale apex filiform, terminating in a short uniseriate series of cells, the apical cell oblong or spheroidal, higher up often with glands; *laminae* anadromous, catadromous towards the apex, herbaceous, to 4-pinnate-pinnatifid, broadly ovate, to 625 mm long, with up to 14

petiolated pinna pairs; *rachises* stramineous, adaxially shallowly sulcate, becoming narrowly winged towards the apex, sparsely scaled, the scales castaneous to ferrugineous, chartaceous, to thinly crustaceous, broadly attached or sessile, filiform to broadly ovate, to 6 mm long, to 3 mm wide, truncate to cordate, the margin regularly set with glands, or with a few uniseriate hairs near the base, the scale apex filiform, terminating in a short uniseriate series of cells, the apical cell oblong or spheroidal; *pinnae* petiolate, the petiole to 22 mm long, the basal pair inaequilaterally ovate, to 345 mm long, to 230 mm wide, ovate to lanceolate towards the lamina apex, to 3-pinnate-pinnatifid, the basal pair the longest, basiscopically developed, opposite to alternate, basally widely spaced, more closely spaced apically, often imbricate, with up to 12 petiolated pinnule pairs; *pinna-rachises* adaxially shallowly sulcate, the sulcus confluent with that of the rachis, often closely set with glands and scales, abaxially sparsely scaled, the scales ferrugineous to stramineous, chartaceous, sessile, ovate to broadly ovate, to 4.5 x 2.7 mm, cordate, entire or regularly set with glands, the scale apex filiform; *pinnules* petiolate, the petiole to 9 mm long, the pinnules to 2-pinnate-pinnatifid, ovate, the acroscopic pinnule on the basal pinnae to 105 mm long, to 29 mm wide, the basisopic pinnule on the basal pinnae to 150 mm long, to 70 mm wide, subopposite to alternate, spaced or slightly imbricate, with up to 9 petiolated segment pairs; *costae* adaxially sulcate, sparsely scaled, the scales similar to, but smaller than those on the pinna-rachis; *segments* petiolate, the petiole to 1 mm long, ovate, to 1-pinnate-pinnatifid, with up to 3 pairs of petiolated ultimate segments, spaced, the basisopic segment on the basal pinnae to 44 mm long, to 20 mm wide, the acroscopic pinnule on the basal pinnae to 28 mm long, to 14 mm wide; *costules* adaxially sulcate, winged, ridged adaxially, abaxially sparsely scaled, the scales similar to, but smaller than those on the pinna-rachis; *ultimate segments* oblong-obtuse, firmly herbaceous, the basisopic ultimate segment on the basal segment to 11 mm long, to 6 mm wide, the acroscopic ultimate segment on the basal segment to 9 mm long, to 6 mm wide, deeply lobed; *lobes* serrate to crenulate, glabrous adaxially, abaxially glabrous or often with glands along the veins, the glands (46–)66(–84)  $\mu\text{m}$  long, with isocytic hairs and scales, the scales often bullate, sessile, broadly ovate, to 1.5 x 0.7 mm, truncate to cordate, entire or with a few scattered glands, the scale apex filiform, terminating in an oblong or spheroidal cell. *Venation* anadromous, becoming catadromous towards the lamina and pinna apex, pinnately branched in the segments, the vein branches pinnately branched, forked or simple near the apex, evident, ending in the teeth near the margin. *Stomata* mostly of the polocytic types, (30–)39(–50)  $\mu\text{m}$  long. *Sori* circular, to 1

mm in diameter, inframedial on the anadromous vein branches, discrete at maturity; *sporangia* stalk simple, glandular, or rarely with a pluricellular uniseriate hair, capsules with (12–)13(–16) indurated annulus cells, epistomium (4–)5(–6)-celled, hypostomium (4–)6(–7)-celled. *Indusia* brown, firmly herbaceous, reniform, to 1 mm in diameter, entire or glandular along the margins (rarely also on the laminae). *Spores* ellipsoidal, monolete, the perispore with low tubercles and/or long reticulate ridges, minutely rugulose to minutely scabrous, (32–)36(–42) x (20–)22(–26)  $\mu\text{m}$ . *Chromosome number*:  $2n = \text{ca. } 82$  (Vida in Widén *et al.* 1973).

**Distribution and habitat:**—*Dryopteris kilmensis* is confined to the central and eastern parts of tropical Africa, occurring in Burundi, Cameroon, the Kivu and Katanga Provinces of the Democratic Republic of the Congo, Ethiopia, Uganda, Kenya, Madagascar, Malawi, Mozambique, Rwanda, Sudan, Tanzania, Uganda, Zambia, Malawi and the eastern highlands of Zimbabwe. The species is restricted to Afromontane rain forests with *Podocarpus milanjanus*, *Ocotea usambarensis*, *Neoboutonia macrocalyx* etc., Afromontane bamboo (*Arundinaria*) and the Afromontane evergreen bushland and thicket communities, all forming part of the Afromontane Region as defined by White (1983). The species is mostly confined to deep shade in wetmontane or riparian forests, occurring from 1300 m on the Muhila Plateau in the Democratic Republic of Congo to 3465 m at Mgahinga in Uganda.

**Etymology:**—The epithet refers to the Kilema region (formerly Kilma) on Mt Kilimanjaro, Tanzania.

**Note:**—Pichi Sermolli (1985: 158) discusses the spelling of the specific epithet and argues for the use of ‘*kilemense*’ rather than ‘*kilmense*’, the original spelling. The Code (McNeill *et al.* (2006), Art. 60.1), however, states that the original spelling is to be retained. Even though Kuhn himself later (1879: 46) changed the spelling to ‘*kilemense*’, it cannot be upheld since it is not a typographical nor orthographical error.

**Additional specimens studied:**—BURUNDI. Bujumbura Rural Province: Bugarama, 2100 m, sous-bois de la forêt à Ficalhoa, *J. Lewalle 5220* (BR). Bururi Province: Nella foresta riparia umida della vallata del torrente Siguvyaye, vicino al ponte torrente, 1700 m, 18 December 1966, *R.E.G. Pichi Sermolli 6970* (BOL, NY). Muramvya Province: Bukeye, Mont Teza, 2650 m, ravin, petite forêt, *J. Lewalle 3829* (BR); Nyabigondo-Teza, 2500 m, fructicée à Ericaceae, *J. Lewalle 6421* (BR); Bugarama, 2200 m, forêt secondaire, 26 February 1971, *M. Reekmans 173* (BR); Teza, forêt d'altitude, 2400 m, 8 January 1972, *M. Reekmans 1382* (BR); bois sacré de Mpotsa forêt de

montagne (sous-bois), 2000 m, 9 June 1976, *M. Reekmans* 8251 (BR, K, PRE). Ruyigi Province: Kitega, N of Lake Tanganyika, virgin forest, 2188 m, 17 February 1946, *Housheidner* 39 (NU).

CAMEROON. North-West Province: Ndop Plain, 3 miles S of Baba village, 1155 m, 5 March 1962, *M. Brunt* 135 (K); Victoria, Mann's Spring, below Luivongo, in montane forest, 31 March 1948, *P.W. Richards* 4309 (K).

DEMOCRATIC REPUBLIC OF THE CONGO. North Kivu Province: Wimbi, 22 July 1937, *Jean Louis* 4634 (K.). South Kivu Province: Mt Kahuzi (02°15'S, 28°41'E), 2690 m, terrestre, 1 July 1993, *M. Becker* 232 (BONN); Kivu, Mt Kahuzi (02°15'S, 28°41'E), 3280 m, terrestre, 2 July 1993, *M. Becker* 264 (BONN); Kivu, Mt Kahuzi (02°15'S, 28°41'E), 2960 m, terrestre, 19 July 1993, *M. Becker* 325 (BONN); Kivu, Madriri (02°19'S, 28°42'E), 2260 m, terrestre, 22 July 1993, *M. Becker* 340 (BONN); Kivu, Idjwi (02°S, 29°E), 2150 m, 8 September 1993, *M. Becker* 434 (BONN); Mt Kahuzi W of Kivu, 3130 m, sheltered positions near summit, 13 September 1959, *Cambridge Congo Expedition 1959*, 477 (US2295783); Mt Kahuzi, afroalpine *Erica*-zone, 2890–3130 m, *J. Raven s.n.* (K); Kivu, Kabare, route Kabare-Walungu, embranchement vers Mulume, env. Marais Lushandja, 2300 m, 15 September 1956, *G. Troupin* 2566 (K).

ETHIOPIA. Southern Nations, Nationalities and Peoples Region: Bonga, at top of waterfall near Catholic Mission, 1900 m, on forest floor with scarce ground cover, common, 18 November 1970, *I. Friis, A. Hounde & K. Jacobsen* 332 (K); Bonga, forest and waterfall behind the Catholic Mission, *Ocotea*-forest, dominant on forest floor, 1900 m, 7 January 1973, *I. Friis et al.* 2128 (ETH, K); ca. 3 hrs walk W of Gatcheb Mission Station, N of Mizan Teferi, in shade at swamp margin, 1500 m, 15 January 1976, *M.G. Gilbert* 4223 (ETH, K); zona a sud di Bonga. Nella foresta umida montana a circa un'ora di cammino da Muti lungo il sentiero proveniente da Shappa. Ressestre lungo il sentiero in luogo umido ma luminoso al margine della foresta, ca. 2000 m, 1 January 1967, *R.E.G. Pichi Sermolli* 7109 (K); zona a sud di Bonga. In località Isheti presso Gaetà a un'ora di cammino a sud di Muti lungo il sentiero per Deckià. Nel fondo di una piccola valle nella foresta umida montana, 1900 m, 2 January 1967, *R.E.G. Pichi Sermolli* 7128 (M).

KENYA. Central Province: Nyeri Distr., Castle Forest Station, track going E from road ca. 300 m above buildings, 2050 m, river valley with montane forest with *Ocotea & Podocarpus milanjanus*, 20 October 1979, *M.G. Gilbert* 5774 (K); below Castle Forest Station, track through damp evergreen forest with some *Podocarpus & Tabernaemontana*, *Sambucus africana* frequent in openings, 1900–2070 m, 19 December 1972, *J.B. Gillett & R.E. Holttum* 20088 (K); E.

Aberdares, 2584 m, forest undergrowth, *E.R. Napier 5855* (K); Aberdare Forests, Royi Distr., 2128 m, *H.M. Gardner 1274* (K); Gatamayu (Katamayo), 2432 m, June 1938, *C. van Someren 7378* (BM); Thika East Distr., Kimakia Forest Station, Gatare Rd., crossing of Kimakia River, 2470 m, *Arundinaria* bamboo with occasional *Podocarpus milanjinus*, streambank, 14 February 1970, *R.B. Faden 70/60* (BOL, K, NY). Coast Province: Taita-Taveta Distr., Taita Hills, Vuria Peak, 2000–2200 m, black wattle plantations with a little indigenous forest on the steep slopes, August 1970, *R.B. Faden & A. Evans 70/498* (US); Vuria Hill, forest remnants, 2000–2170 m, 8 May 1985, *R.B. Faden, H.J. Beentje, J. Ndegwa Ndiang'ui, Mutangah & D.O. Nyakundi s.n.* (K). Eastern Province: Embu Distr., Kirinyanga, Mt Kenya, Kamweti Track above Kamweti forest station, at the rain gauge, 3000 m, 9 January 1972, *P.G. Archer s.n.* (EA15050, K); volcanic cone Kirui on the slopes of Ithangune, E-slope of Mt Kenya, 2300–2700 m, *Podocarpus* on the slopes and secondary forest with *Neoboutonia macrocalyx* and *Macaranga kilimandscharica* along road leading to the base of Kirui, 13 April 1969, *R.B. Faden, M. Temba & P.H. Karanja 69/521* (K.); Mt Kenya, S side, Kamweti Track above Kamweti Forest Station, 2400–2600 m, bamboo (*Arundinaria*) forest, 28 December 1970, *R.B. Faden, A. Evans & M. Githui 70/933* (US); Mt Kenya, Castle Forest Station, edge of *Ocotea usambarensis* wet montane forest, 2100 m, 17 October 1971, *R.B. Faden, A.J. Faden & P. Holland 71/871* (BOL, K, MO). Rift Valley Province: Kericho Distr., moist montane and riverine forest near the Tea Research Institute, ca. 5 km E of Kericho, along the Timbilil (Dimlitch) River and a small tributary, 2080–2140 m, 11 June 1972, *R.B. Faden, A.J. Faden & J.B.C. Cameron 72/321* (K).

MALAWI. Northern Region: Chitipa Distr., Nyika Plateau, montane forest undergrowth, 2350 m, 17 August 1946, *L.J. Brass 17285* (K, NY). Southern Region: Mulanje Distr., Mt Mlanje, Luchenyia Plateau, locally common in forest undergrowth, 1890 m, 7 July 1946, *L.J. Brass 16707* (K, NY); Mt Mlanje, Litchenya Plateau, Nessa path, forest path side in forest near enumeration plot, 1800 m, 24 November 1986, *E.G. Chapman 8249* (PRE); Mt Mlanje, near edge of clearing in evergreen ravine forest, 1945 m, 8 August 1956, *E.I. Newman & T.C. Whitmore 393* (NY); Mt Mlanje, Ruo Plateau, 1760 m, ravine *Widdringtonia*-forest, 17 August 1956, *E.I. Newman & T.C. Whitmore 478* (NY); Mlanje Distr., Luchenyia Plateau, Mt Mlanje, in damp forest, 1950 m, 6 June 1962, *Richards 16555* (K); Zomba Distr., Zomba, Mt Zomba, Mulanje Peak, montane forest, 1 December 1998, *J.P. Roux 2927* (NBG); forming clumps on forest floor, 18 July 1987, *I.F. LaCroix, 4615* (PRE).

MOZAMBIQUE. Manica Province: Manica Distr., Manica, serra Zuira, planalto Tsetserra, ca. 4 km da residência do Sr. V. Carvalho, floresta das fadas, 1900 m, *A.R. Torre & Á. Pereira 12873* (M). Sofala Province: Gorongosa Distr., Gogogo Peak, Gorongosa Mtn, occasional in forest, 1763 m, 5 July 1955, *E.A.C.L.E. Schelpe 5519* (BOL, NBG). Zambezia Province: Gúruè Distr., Gúruè, encosta da serra do Gúruè, a Oeste do Pico Namúli (médio) próx. do rio Malema, 1600 m, 5 January 196?, *A.R. Torre & M.F. Correia 16959* (MO).

RWANDA. Ruhengeri Province: Mutara Distr., upper gorge of River Sousa, S side of Mt Karisimbi, 3300 m, 20 February 1975, *W.G. d'Arcy 7972* (PRE).

SOUTH SUDAN. Central Equatoria State: Imatong Mts, near Gilo village, upland rain forest with *Albizia gummifera*, *Macaranga kilimandscharica*, *Croton macrostachys* and *Ocotea kenyensis*, 1800 m, *I. Friis & K. Vollesen 229* (K); Imatong Mts, Bushbuck Hill, 2200 m, *Podocarpus milanjanus-Olea hochstetteri* forest, edge of forest towards *Hagenia abyssinica* woodland, 16 February 1982, *I. Friis & K. Vollesen 909* (K); Imatong Mts, Gilo, marshy ground beside small stream in mountain ravine forest, 1 mile below rest house beside *Cyathea*, 1672 m, 27 June 1947, *K.N.G. MacLeay 89* (K); Imatong Mts, Gilo, wet forest floor, mountain ravine forest, 1611 m, 27 June 1947, *K.N.G. MacLeay 93* (K).

TANZANIA. Arusha Region: Arusha Distr., upper Meru Forest, 1824 m, *H.D. van Someren 432* (K); Meru Distr., Meru, upper forest, 1824 m, amongst secondary undergrowth in clearing, *H.D. van Someren 446* (K). Iringa Region: Njombe Distr., Iringa, forests around Milo village, 13 November 1987, *L. Mwasumbi et al. 13691* (MO). Kagera Region: Bukuba Rural Distr., Buyango, swamp forest, September–October 1935, *H. Gillman 431* (K). Kilimanjaro Region: Moshi Distr., Kilimanjaro, Mweka route, floor of *Podocarpus-Erica arborea* forest, 2766 m, 27 July 1968, *M. Bigger 2039* (K); Kilimanjaro, 30 January 1960, *T. Buchloh 239* (K); Kilimanjaro, 4000 m, in *locis udis sylvae*, 1906, *I. Daubenberger 37* (M); Kilimanjaro, Gürtelwald 2500 m Weg zum Kibo auf der Moorhiseite, October 1909, *R. Endlich 662* (M); Kilimanjaro, S slope between Umbwe and Weru Weru Rivers, in *Podocarpus-Ocotea* forest, 2736 m, 30 August 1932, *Greenway 3185* (K); Kilimanjaro, forest below Mandera Hut, common in damp forest, 2500–2700 m, 14 October 1993, *J.M. Grimshaw 93903* (K); Kilimanjaro, forest above Kilimanjaro Timbers, 2500 m, common in open understory, 2 July 1994, *J.M. Grimshaw 94601* (K); on slopes of Kilimanjaro, forest above 1459 m, 12 September 1929, *M.D. Glynne 258* (K, MO); Kilimanjaro, Bismarck Hut track, 24 July 1963, *M.D. Gwynne H262/63* (K); Kilimanjaro, June 1926, *A. Peter 41957* (K); Kilimanjaro,

Presso la Bismark's Hut. Terrestre, nel sottobosco rado della foresta umida montana a *Podocarpus milanjanus*, *Hagenia abyssinica* ed *Ilex mitis*, 2750 m, 8 July 1956, *R.E.G. Pichi Sermolli 5150* (K); Kilimanjaro, Maranga-Bismarck, temperate rain-forest, 2128 m, 17 December 1935, *R.G. Turrall 90* (K). Mbeya Region: Rungwe Distr., upper margins of *Hagenia-Podocarpus* etc. forest. W-slopes of Rungwe Mt, ca. 2400 m, 9 November 1966, *J.B. Gillett 17706* (PRE). Morogoro Region: Kilombero Distr., Kilombero, Mwanihana Forest Reserve above Sanje village. 1400–1700 m, 10 October 1984, *D.W. Thomas 3880* (MO); Morogoro Distr., Uluguru Mts, Mwere Valley, intermediate evergreen forest, 1450–1650 m, 26 September 1970, *R.B. Faden et al 70/625* (K); Uluguru North Forest Reserve, forest on main ridge of North Uluguru mountain close to Lupanga Peak, 2100 m, 9 December 1980, *J.B. Hall s.n.* (K); Bezirk Morogoro, Uluguru-Gebirge, Nordwestseite, Lupanga-Berg, Nebelwald, 2100 m ü. M. 12 November 1932, *H.J. Schlieben 2975* (M, P). Tanga Region: Lushoto Distr., Shume-Magamba Forest Reserve, 2 May 1987, *C. Kisena 577* (K).

UGANDA. Central Region: Mukono Distr., Buhweju County, Karingoma, near Kitega, forest, 0°20'S, 30°26'E, 1700 m, 31 March 1994, *P.K. Rwaburindore 3679* (MO). Eastern Region: Mbale Distr., Mt Elgon, bamboo zone & *Podocarpus* wood, 2736 m, January 1919, *R.A. Dümmer 3631* (BOL K, SAM). Western Region: Bushenyi Distr., W Ankole, Buhweju, Isingiro, 0°14'S, 30°31'E, 1900 m, swamp forest, 2 November 1992, *P.K. Rwaburindore 3492* (BR, MO, PRE); Kabale Distr., Kigesi Distr., near Kabale, edge of impenetrable forest, ca. 243 m, 13 December 1957, *B.S.L. Allen 3743* (K); Rutanga, forest, 1824 m, February 1963, *S.J. Leakey s.n.* (K); Impenetrable Forest, near Kabale, 2430 m, 13 December 1957, *B. Molesworth-Allen 3744* (US2420519); Rubanda, Bwindi Forest, abundant in forest, 2350 m, 13 November 1989, *P.K. Rwaburindore 2881* (K, MO); Kanaba Gap, bamboo forest, June 1950, *H.D. van Someren, 656* (K); Mt Elgon, Sasa trail, montane forest, 2500 m, 27 December 1996, *K. Wesche 565* (K); Kanungu Distr., Kinkizi county, forest understory, 2400 m, 14 December 1971, *A.B. Katende 1467* (MO); Kasese Distr., Mgahinga, 3465 m, March 1948, *I.R. Dale U533* (K); Ruwenzori Mts, Mobuku valley, rain forest, 1825–2430 m, 10 January 1956, *E. Esterhuysen 25178* (BOL); Ruwenzori, 2432 m, August 1931, *Fishlock & Hancock 158* (K); Ruwenzori, 2584 m, 21 July 1960, *D.A. Livingston, J. Richardson & R. Kendall 16* (K); Ruwenzori, Mobuku Valley, in forest, 1884 m, 7 January 1939, *M.V. Loveridge 330* (K, MO); Ruwenzori, above Mimiuba Camp, 2580 m, 22 January 1962, *J.P. Loveridge 406* (BOL, K); Ruwenzori, Nyambitaba Hut, dense woodland, 2584 m, 30 January

1964, *J. Noble 11* (K); Nyinabitaba, Mobuku River valley, 2900 m, in bamboo-*Philippia* forest, 11 July 1952, *H.A. Osmaston 1517* (BR); Ruwenzori, Bwamba Pass, 2200m, 1954, *H.A. Osmaston 3935* (K); Ruwenzori Mts., vicinity of Nyabitaba Hut, montane rain forest, 2614 m, growing on rocks in forest of *Podocarpus*, *Rapanea*, *Faurea*, 15 January 1967, 0°22'N, 29°59'E, *R.E. Perdue & S.P. Kibuwa 8437* (K, M); near Nyinabitabu, Mobuku Valley, 2675 m, montane rain forest on top of moraine ridge, 8 July 1952, *R. Ross 448* (BR); Ruwenzori, Nyamgasani valley, bamboo forest, 2740 m, January 1935, *P.M. Synge 1669* (MO).

ZAMBIA. Northern Province: Mungwi Distr., Mungwi, 18 December 1960, *E.A. Robinson 4204* (K, M). Luapala Province: Samfya Distr., Fort Rosebury Distr., near Samfya Mission, Lake Bangweulu, in *Mitragyna stipulosa-Syzygium elegans*, *Xylopia* swamp forest, 30 August 1952, *F. White 3171* (BOL, K).

ZIMBABWE. Manicaland Province: Chimanimani Distr., Melsetter, Chimanimani Mts, just below and to the W of summit of point 71, 2280 m, 11 February 1958, *D.S. Mitchell 362* (BOL); Mutare Distr., Bvumba (Vumba) Mts, stream on S slope of Bunga Forest, 1641 m, 10 July 1980, *J.E. Burrows 1675* (BOL, NBG); Bvumba (Vumba) Mts, Mutare, Elephant Forest, 17 January 1949, *N.C. Chase 1056* (PRE); Bvumba (Vumba) Mts, entrance to Col. Methuens property within forest margin, 30 October 1950; *N.C. Chase 3109* (NBG, NU); Stapleford, Henkel's Saddle, W face above foresters house, 1610 m, 28 April 1952, *N.C. Chase 4518* (NU); Stapleford Forest Reserve, 1825 m, 25 September 1952, *N.C. Chase 4657* (MO); Mutare, Pioneer farm, terrestrial in damp forest, 1825 m, 26 July 1948, *Fisher & Schweickerdt 319* (K, NU); Mutare, Bvumba (Vumba) Mts, near hotel, frequent on forest floor, 17 January 1949, *Fisher & Schweickerdt 440* (K, NU); 30 miles S of Mutare (Umtali), 1825 m, growing on forest floor in shade, August 1947, *G.E. Grout G35 & G40* (NU); Imbeza Forest Reserve, Zuwane Forest, on contour path, in deep shade, 1570 m, 13 March 1969, *W.B.G. Jacobsen 3840* (FR); Stapleford Estate, montane forest, 23 November 1998, *J.P. Roux 2829* (NBG); Mutare, Vumba Mts, Elephant forest, 1640 m, 25 June 1955, *E.A.C.L.E. Schelpe 5390* (BOL); Mutare, Stapleford, Henkel's Nek, occasional on streambank in forest, 1760 m, 16 July 1955, *E.A.C.L.E. Schelpe 5749* (BOL); Mutasa Distr., junction of Pungwe and Nyazengu Rivers, Pungwe Gorge, riverine forest, *J.E. Burrows 950* (NBG); Nyanga (Inyanga), S spur of Mt Inyangani, terrestrial in light shade of *Philippia* forest, 2060 m, 6 June 1982, *J.E. Burrows 2850* (BOL); Nyanga, S spur of Mt Inyangani, 2060 m, 6 June 1982. Terrestrial in light shade of *Philippia* mist forest floor, *J.E. Burrows 2851* (BOL); Pungwe Gorge,



Syfretts Place, in forest at ancient irrigation furrow, 1825 m, *N.C. Chase 3806* (NU); Nyanga (Inyanga), ravine S of Pungwe Falls, 2070 m, 22 October 1955, *N.C. Chase 5828* (BOL); Nyanga (Inyanga), ravine S of Pungwe Falls, 2070 m, 22 October 1955, *N.C. Chase 5829* (BOL); Sheba Forest Estate, in shady ravine, 1800 m, 23 January 1967, *W.B.G. Jacobsen 3057* (FR); Nyanga (Inyanga), circular drive above N rim of Pungwe Gorge, locally frequent in open spaces in forest, 2130 m, February 1957, *D.S. Mitchell 147* (BOL); Nyanga (Inyanga), circular drive below Mt Inyangani, February 1957, *D.S. Mitchell 135B* (BOL); Nyanga, Pungwe Gorge, 1825 m, 15 July 1955, *E.A.C.L.E. Schelpe 5694* (BOL, NBG); Nyanga (Inyanga), Pungwe/Mtendere, common in forest, 25 December 1965, *O. West 7112* (K).

**Remarks:**—*Dryopteris kilmensis* can be distinguished from other African *Dryopteris* species by its large structure, the erect rhizomes, fronds that are up to 1.5 m long, and the finely dissected laminae that may be up to 4-pinnate-pinnatifid. The sessile, broadly ovate, often bullate scales with the apices terminating in short uniseriate series of cells are also characteristic. The spore sculpture is unique in African *Dryopteris*.

**Variation:**—Macromorphologically *Dryopteris kilmensis* shows little variation, but micromorphological variation was detected in scale morphology, the presence of glands on the laminae, the presence of glands or pluricellular hairs on the sporangium stalks, and the distribution of glands on the indusia.

Scale texture appears to be influenced by environmental conditions as plants occurring in less favourable conditions have scales that are thinly crustaceous rather than chartaceous. The rhizome and frond scales of these plants are generally also broader than those of plants from moist forest habitats. Glands and pluricellular hairs along the scale margins show variation in frequency. In *Osmaston 3935* (BR) indument composed of glands and pluricellular hairs were detected on the laminae of the stipe base scales.

A direct correlation cannot be drawn between habit and the presence of glands occurring on the lamina, but some collections from higher elevations bear these structures, and others do not. Similarly, glandular collections from moist forests were also observed, a feature rarely occurring in plants from these habitats.

The sporangium stalks of *D. kilmensis* are generally simple, but collections were encountered where some sporangia bear a single gland on the stalk. In others a long simple pluricellular hair is

borne near the stalk bases. No collections were observed where both glands and pluricellular hairs occur.

Generally, the indusia of *D. kilmensis* are simple, or it may bear a number of glands along the margins. The occurrence of glands on the indusium surface is, however, less frequent and have only been observed in a few collections from Mt Ruwenzori [*Osmaston 1517* (BR) & *Osmaston 3935* (K)] and the Uluguru Mountains [*Hall s.n.* (K)].

INSERT FIGURE 18

**15. *Dryopteris lewalleana* Pichi Sermolli** (1985: 158–162, fig. 3). Figs. 4U–W; 5A–C; 8G & Ga; 19.

Type:—BURUNDI. 'Burundi, Prov. Bujumbura, route de Mwisare, 1 050 m, talus humide' 8 May 1971, *J. Lewalle*, 5482 (holotype FI-PS 26049, isotypes BR!, FI-PS).

*Lastrea pentagona* Moore (1853a: 227). *Aspidium pentagonum* (T.Moore) Kuhn (1868: 139). Type:—SOUTH AFRICA. 'Natal, Umvoti, in ravines and wet places', 1853, *A.W. Plant 325* (holotype K!).

*Dryopteris inaequalis* (Schltdl.) Kuntze var. *atropaleacea* Schelpe (1967: 213). Type:—TANZANIA. 'Tanganyika, Sumbawanga, Mbisi, Ufipa, Mbisi forest, 7500 ft' 18 January 1958, *L.D.E.F. Vesey-Fitzgerald 1390* (holotype BOL).

*Plants* terrestrial or epilithic. *Rhizome* short-decumbent, sparsely irregularly branched, to 21 mm in diameter, set with roots, closely spaced stipe bases and scales, the scales stramineous to ferruginous, rarely atrocastaneous, chartaceous to thinly crustaceous, broadly attached, ovate-caudate to linear-acuminate, to 18 x 4 mm, cuneate to cordate, the margins entire, repand, or with a few widely spaced, uniseriate, multicellular hairs, and pyriform glands, the scale apex filiform, terminating in a uniseriate series of oblong cells. *Fronde*s suberect to arching, to 1.3 m long; *stipes* proximally castaneous, stramineous to greenish higher up, proximally adaxially flattened, shallowly sulcate higher up, to 750 mm long, to 8 mm in diameter, proximally densely scaled, moderately to sparsely scaled higher up, the scales stramineous to ferruginous, chartaceous, the larger scales broadly attached, to 25 x 6 mm, the smaller scales sessile or short-stalked, ovate to narrowly lanceolate, or filiform, cordate to cuneate, the margins entire or denticulate, often with a

few widely spaced, multicellular hairs, and pyriform glands (which may also occur on the scale laminae), marginal hairs on the smaller scales are mostly confined to the basal region, the scale apex filiform, terminating in a short uniseriate series of cells; *laminae* anadromous, becoming catadromous towards the apex, herbaceous to firmly herbaceous, ovate to deltate, 2- to 3-pinnate, to 640 mm long, with up to 14 petiolated pinna pairs; *rachises* stramineous, adaxially shallowly sulcate, becoming narrowly winged towards the apex, eglandular or sparsely glandular, and moderately to sparsely set with scales and hairs, the scales stramineous to ferruginous, chartaceous, sessile or short-stalked, narrowly lanceolate to filiform, to 8 x 1.5 mm, cuneate, the margins entire or denticulate, often with a few twisted filiform outgrowths, mostly from near the base, and glands (which may also occur on the scale laminae), the scale apex filiform, terminating in a short uniseriate series of cells; *pinnae* petiolate, the petiole to 20 mm long, the basal pinna pair inaequilaterally triangular to broadly ovate, or deltate, oblong-acuminate, ovate or lanceolate towards the lamina apex, to 320 mm long, to 250 mm wide, to 2-pinnate, the basal pair shorter or longer than the next pair above, subopposite to alternate, basally widely spaced, often somewhat imbricate higher up, with up to 10 petiolated pinnule pairs; *pinna-rachises* adaxially shallowly sulcate, the sulcus confluent with that of the rachis, pronounced abaxially, narrowly winged for most of the length, the wing proximally less conspicuous, eglandular or sparsely glandular, abaxially moderately to sparsely set with hairs and scales, the hairs and scales stramineous to ferruginous, membranous to chartaceous, sessile or short-stalked, narrowly lanceolate-caudate to filiform, to 4 x 1 mm, cordate to narrowly cuneate, the margins entire, repand or denticulate, often with twisted filiform outgrowths, mostly from near the base, and glands (which often also occur on the scale laminae), the scale apex filiform, terminating in a uniseriate series of oblong cells; *pinnules* petiolate, the petiole to 5 mm long, aequilaterally to inaequilaterally narrowly triangular, to lanceolate, distally basiscopically decurrent, to 1-pinnate, the acroscopic pinnule on the basal pinnae to 94 mm long, to 34 mm wide, the basiscopic pinnule on the basal pinnae to 145 mm long, to 52 mm wide, widely spaced, often somewhat imbricate, with up to 2 pairs of petiolated segments; *costae* adaxially shallowly sulcate, often with a few glands and isocytic hairs, pronounced abaxially, narrowly winged, the wing continuous with that of the pinna-rachises, glandular or eglandular, variously set with isocytic or moniliform hairs and scales, the hairs often bear one or more glands near the base; *segments* spaced, inaequilaterally narrowly ovate-obtuse to oblong-obtuse, basiscopically decurrent, to 28 mm long, to 9 mm wide, shallowly to deeply lobed;

*lobes* serrate, adaxially glabrous, with a few glands along and between the veins, and/or with a few filiform scales along the costa, abaxially with hairs and scales, the scales ferruginous to stramineous, chartaceous, short- or long-stalked, narrowly lanceolate-caudate to filiform, to 3 x 1.2 mm, the margins entire to repand, often glandular, the scale apex terminates in a series of oblong cells, hairs uniseriate, often bearing one or more gland-like cells near the base, mostly occurring along the costa, and/or simple isocytic or moniliform hairs, occurring on the veins and lamina, and/or oblong to clavate glands (46–)95(–166)  $\mu\text{m}$  long, occurring on the costa, veins and/or lamina near the veins, or eglandular. *Venation* anadromous, becoming catadromous towards the lamina and pinna apex, pinnately branched in the segments, the veins branches pinnately branched, forked, or simple near the apex, evident, ending in the teeth near the margin, the endings slightly enlarged. *Stomata* of the anomo- and polocytic types, guard cells (30–)41(–62)  $\mu\text{m}$  long. *Sori* circular, to 1.6 mm in diameter at maturity, medial on the predominantly anadromous vein branches, discrete, essentially 2-seriate on the segments; *sporangia* stalk simple, with one or more glands, or with a long uniseriate hair, capsule with (9–)13(–21) indurated annulus cells, epistomium (3–)4(–6)-celled, hypostomium (3–)4(–8)-celled. *Indusia* persistent, brown, firmly herbaceous, reniform, to 1.6 mm in diameter, glabrous, the margin repand, rarely lacerate, often strongly revolute. *Spores* ellipsoidal, monolete, the perispore folded into low tubercles or reticulate ridges, finely rugose to ruminant, (28–)38(–50) x (20–) 25 (–31)  $\mu\text{m}$ . *Chromosome number*: unknown.

**Distribution and habitat:**—*Dryopteris lewalleana* occurs in Angola, Burundi, the Democratic Republic of the Congo, Ethiopia, Kenya, Malawi, Mozambique, South Africa, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe. The species is generally confined to the moister higher lying areas of these countries occurring from 300 m in South Africa to 2400 m in the Bale Region of Ethiopia. It is almost exclusively a forest species, but infrequently occurs in sheltered habitats in montane grasslands, in moist to seasonally moist conditions, often forming small clonal clusters as a result of the densely branched rhizomes.

**Etymology:**—The epithet honours Professor José Lewalle (6 June 1931–5 April 2004), Belgian-born botanist working at the University of Burundi (1965–1972), later at the Agronomical and Veterinary Institute of Rabat, Morocco.

**Additional specimens studied:**—ANGOLA. Huambo Province: Mt Moco, forest patch above village, montane forest, 2050 m, 17 December 1973, *B. Huntley, Roberts & Ward 28* (PRE).

BURUNDI. Bujumbura Rural Province: route de Mwisare, 1050 m, 8 April 1971, *J. Lewalle 5482* (BR). Cibitoke Province: pres de Mabaye, route Cibitoke-Mabaye, 1430 m, talus (expos. N), 1 November 1969, *Symoens 13180* (BOL). Muramvya Province: Muramvya, jachere a *Lobelia giberroa*, 2200 m, December 1969, *J. Lewalle 4273* (US3016000); Galerie forestière de ravin, 1000 m, 15 December 1967, *J. Lewalle 2521* (BR, K, MO). Ruyigi Province: Gisuru, Mollo Urundi, forêt du Bigonzi, 5 December 1951, *Michel & Reed 825* (BR); dépression l'ouest du mont Budziranaga, 12 December 1951, *Michel & Reed 889* (BR, MO).

ETHIOPIA. Amhara Region, (Gojam) Beles. Dopo Chagni verso Bahar-Dar, sulle rocce e sotto I 'panettoni' vicino al passo, *M. Bigazzi & M. Tardelli 660* (FI). Southern Nations, Nationalities and Peoples Region: Dello Awraja, in *Hareenna*-forest, Kecha, ca. 45 km on Dello Mena-Goba road, 2400 m, *Schefflera-Hagenia* forest with thickets of *Arundinaria alpina* along river banks, 2400 m, 6°42.5'N, 39°44'E, 3 August 1986, *M. Tadesse 4873* (ETH).

KENYA. Central Province: Nyeri Distr., SE Aberdares forests, Kitikuya Distr., bamboo zone, *H.M. Gardner 1269* (K). Eastern Province: Machakos Distr., Machakos, Ukambane, 1520–1824 m, December 1893, *G.F. Scott Elliot 6524* (K). Marsabit Distr., summit of Mt Kulal, in montane forest, 2128 m, on road bank, March 1972, *Tweedie 4236* (K); summit of Mt Kulal, 2280 m, 25 July 1958, *B. Verdcourt 2243* (K, PRE).

MALAWI. Central Region: Lilongwe Distr., Dzalanyama Forest Reserve, submontane forest (Kasitu Hill), 1550–1600 m, 28 June 1984, *F. Dowsett-Lemaire 1165* (K); Namasi Lomba, B.C.A., November–December 1899, *K.J. Cameron 84c* (K). Northern Region: Chitipa Distr., Nyika Plateau, 2128 m, 1896, *A. Whyte 24758* (SAM). Mchijj Distr., Mafinga Mtn, (Chisenga), 1650–1750 m, riverine forest, 8 December 1982, *F. Dowsett-Lemaire 515* (K). Mzimba Distr., Lunyangwa, forming clumps in undergrowth of riverine forest, 1330 m, 25 February 1987, *I.F. La Croix, 4336* (MO, PRE); Mzuzu, Tung Estate, 1368 m, 11 May 1969, *J. Pawek 2384* (K); Mzuzu, Marymount, rain forest patch, 1368 m, 22 January 1975, *J. Pawek 8982* (K, MO); Mzuzu, Lunyangwa River waterworks, 1368 m, 30 January 1975, *J. Pawek 9029* (K); Mzuzu, Marymount, 1368 m, *Brachystegia*-woodland, near stream, 23 June 1975, *J. Pawek 9800* (K, MO). Nkhata Distr., Mzuma Forest Reserve (W of Chinteche), 600 m, on forest edges, 24 June 1983, *F. Dowsett-Lemaire 821* (K). Rumpi Distr., Kaziwiziwe River, steep wooded slopes in narrow river valley, 1350 m, 8 January 1959, *H.M. Richards 10561* (K); Livingstonia, Kaziweziwe River, shady bank, 8 January 1959, *E.A. Robinson 3108* (K, M, PRE). Southern Region: Blantyre Distr.,

Zambesiland, Shire Highlands, *G. Adamson 19* (K); Ndirande Mtn, damp forest, 1520 m, 19 January 1967, *A. Berrie 37* (K); Ndirande Mtn, S end, in small wooded creek between conifer plantations, ca. 1459 m, 13 April 1967, *A. Berrie 135* (K); Blantyre, Soche Hill, near summit, ca. 1520 m, 30 April 1967, *A. Berrie 141* (BOL, K); Blantyre, Soche Hill (mountain forest reserve), near summit, in damp soil near rocks, in shade near summit, ca. 1520 m, 30 April 1967, *A. Berrie 151* (K); Shire Highlands, Zambazia, July 1885, *J. Buchanan 15* (K); Shire Highlands, Satchi, *G.F. Elliot S.8513* (K); Chikwawa Distr., Mang'anja (Manganja) hills, near Mbame, 912 m, 9 March 1862, *J. Kirk s.n.* (K). Mulanje Distr., Mt Mulanje, close to Madzeka Hut, along the Sombani/Chinzama path, 1800 m, 2 March 1987, *Chapman 8376* (K, MO, PRE); Mt Mulanje, Tuchila Plateau, 1824 m, mixed evergreen forest with *Widdringtonia*; deep herb layer and intense shade, 21 July 1956, *E.I. Newman & T.C. Whitmore 106* (COI); Mt Mulanje, Lichenya Plateau, evergreen forest floor, 1976 m, 15 September 1970, *J. Pawek 3786* (K). Zomba Distr., Zomba Distr., Zomba Plateau, 1400 m, 28 May 1946, *L.J. Brass 16055* (K, NY); Zomba Plateau, Chingwe's Hole Forest, near entrance to nature trail, at extreme edge of forest, ca. 1900 m, *A. Berrie 392* (K). Sine loco: Malawi (Nyasaland), 1891, *J. Buchanan 24* (K, US816551, US816552).

MOZAMBIQUE. Manica Province: Manica Distr., Macequece, Zambesi River, on river bank in shade, 28 January 1949, *Fisher & Schweickerdt 526* (BM); Manica, Mavita (Posto Antigo), Serra Mocuta, 800–600 m, in *Brachystegia*, *Uapaca*-forest, 17 January 1966, *A. Pereira, A. Sarmiento & A. Marques 1171* (BOL); Penhalonga, occasional on earth bank in forest, 1216 m, 26 June 1955, *E.A.C.L.E. Schelpe 5350* (BOL). Nampula Province: Ribáuè Distr., Ribáuè Mtn, occasional in undergrowth of *Brachystegia*-woodland, 1155 m, 19 July 1962, *E.A.C.L.E. Schelpe & L. Leach 6926* (BOL, K). Niassa Province: districto de Mozambique, 25 January 1964, *A.R. Torre & J. Paiva 10211* (MO, PRE). Zambesia Province: Gúruè Distr., Namuli Mtn, occasional on roadside earth bank on margin of gully forest, 760 m, 25 July 1962, *E.A.C.L.E. Schelpe & L. Leach 7002* (BOL, K); Serra de Gúruè, encostas dos morros Maipi, 8 November 1942, *F.A. Mendonça 1321* (BM000787478); Milange Distr., Milange, Serra Tumbine, ca. 1000 m, 18 January 1966, *M.F. Correia 468* (BOL, M).

SOUTH AFRICA. Eastern Cape:—3029 (Kokstad) Tabankulu Forest Reserve, in moist places (–CD), 2 April 1968, *F. Wilkins 34* (PRE). —3126 (Molteno) Broughton, near Molteno, 1915 m (–BC), 1892, *H.G. Flanagan 1682* (BOL). —3127 (Lady Frere) Engcobo (–DB), 25 May 1912, *A.G. McLoughlin 1044* (PRE). —3128 (Umtata) Tsolo, Nqadu, forest floor (–BC), *S. Cawe 452* (BOL);

Nqadu Forest, 24 November 1982, *A. Hutchings 121* (BOL). —3129 (Port St John's) Flagstaff, 5 mls from Flagstaff, 1064 m, occasional in kloof forest (–AB), 11 January 1955, *E.A.C.L.E. Schelpe 5063* (BOL); Agate Terrace (–DA), *A.G. McLoughlin s.n. s/16* (BOL). —3226 (Fort Beaufort) Grahamstown, Paradise kloof, 699 m (–BC), 19 December 1953, *E.A.C.L.E. Schelpe 4394* (BOL); Bedford Distr., (–CA), *Van Rensburg s.n.* (NBG); Hogsback Forest Reserve, 'Fern Walk', 800 m (–DB), 26 November 1969, *K.A. Dahlstrand 1854* (MO, PRE); Victoria East, Hogsback Forest, 1275 m, 13 March 1950, *M.H. Giffen X49* (PRE); Amatolas, November 1890, *T.R. Sim s.n.* (NH5265); Fort Beaufort Distr., in shade near water (–DC), June 1942, *D.C. Myburgh s.n.* (NBG); Isidinge Forest, Sandile's Kop, in forest, 1100 m (–DD), 22 February 1984, *C.J. Geldenhuys 792* (BOL). —3227 (Stutterheim) King Williamstown Distr., Cwencwe Forest Station, in high forest (–AD), 9 November 1955, *D.M. Comins 1326* (PRE); in Quacu Forest, near Toise River (–AD), 30 September 1906, *E.E. Galpin 7680* (PRE); Stutterheim Div., upper streams of Toise River, 2 April 1958, *M.H. Giffen s.n.* (PRE60253); Fort Cunynghame, 7 November 1953, *L.E. Taylor 4264* (NBG); Isidinge forest, on deeply shaded forest floor (–CA), 24 January 1987, *J.P. Roux 1984* (NBG); Hogsback, Middle Drift, occasional in forest clearings, 1124 m, 8 January 1955, *E.A.C.L.E. Schelpe 5012* (BOL); Stockenstroom, Hogsback forest, 1292 m, 3 May 1954, *M.C. Schirach 279* (NBG); Hogsback Forest Station, 5 May 1947, *L.E. Taylor 2527* (NBG); Stutterheim, Kababu Hills, damp places in forest, ca. 1030 m (–CB), 2 August 1942, *J. Acocks 9003* (PRE); Evelyn Valley forest, 13 June 1947, *R.H. Compton 19234* (NBG); Evelyn Valley, 13 January 1947, *F.M. Leighton 2654* (BOL); Frankfort, 608 m, 1891, *T.R. Sim 480* (PRE); Stutterheim, Kologha, 5 November 1953, *L.E. Taylor 4192* (NBG); King Williams Town, Pirie forest (–CC), 1891, *B. Holland s.n.* (NBG); Pirie, in forest, 912 m, March 1891, *T.R. Sim 482* (PRE); Pirie, 912 m, 1891, *T.R. Sim 483* (PRE); Pirie, *T.R. Sim W.I. 790* (K); Pirie forest, *E.A.C.L.E. Schelpe s.n.* (BOL32158). Free State: —2829 (Harrismith) farm Boschhoek, frequent on moist evergreen forest floor (–AD), 12 December 1980, *J.P. Roux 895* (NBG); farm Boschhoek, Manyenyeza, ca. 2000 m, 11 December 1980, *H.J.T. Venter 8537* (BOL); Oliviershoek Pass, farm Windmill, E-slope of Seheletwane, 1910 m (–CA), 22 March 2011, *J.P. Roux 5300* (NBG); Oliviershoek Pass, farm Windmill, E-slope of Seheletwane, 1838 m, 22 March 2011, *J.P. Roux 5302* (NBG). KwaZulu-Natal: —2728 (Frankfort) Newcastle, top of Normandien Pass, in montane forest, 1900 m (–DC), 23 March 2011, *J.P. Roux 5312* (NBG); Normandien Pass, Holkrans, common in montane forest, 23 March 2011, *J.P. Roux 5319* (NBG). —2730 (Vryheid)

Piet Retief–Wakkerstroom road 6 km from turnoff on road to Luneburg, deeply shaded forest floor (–AD), 7 March 1990, *J.P. Roux 2267* (NBG); Paulpietersburg Distr., Pongola Bush Nature Reserve, overlooking Uitvlugt and Lachkraal farms, forest, 1500 m (–BC), 11 October 1990, *H.F. Glen 2391* (US3419536); 40 km E. of Vryheid on road to Nongoma (–DD), 27 July 1947, *Taylor 2579* (NBG). —2731 (Louwsburg) Ngotshe, Ngome forest (–CD), 16 July 1956, *E.A.C.L.E. Schelpe 6215* (BOL). —2828 (Bethlehem) Royal Natal National Park, moist, rocky shady places in gorge (–DB), 28 August 1930, *Hutchinson et al. 49* (NH); Royal Natal National Park, near gorge, in moist rocky shady places, 28 August 1930, *J. Hutchinson 4527* (K); Royal Natal National Park, Tugela Valley, ca. 1824 m, 21 January 1980, *B. Louw s.n.* (BOL); Singati Valley, Natal Drakensberg, ca. 1824 m, 15 July 1953, *A.R.A. Noel 1457* (BOL); The Cavern, among grass in shady conditions, 1760 m, January 1957, *A.L. Pascoe 42* (NU); Royal Natal National Park, Gudu Forest, in shaded forest undergrowth, 1520 m, 2 April 1946, *E.A.C.L.E. Schelpe 1458* (NU); Oliviershoek, Robinson’s Bush, shaded forest floor, 1732 m, 23 January 1980, *E.A.C.L.E. Schelpe 7952* (BOL); Oliviershoek, Robinson’s Bush, shaded forest floor, 1732 m (–DB), 23 January 1980, *E.A.C.L.E. Schelpe 7964* (BOL); Mont-aux-Sources (–DD), July 1928, *A.M. Bottomley s.n. CH4549* (PRE). —2829 (Harrismith) Cathedral Peak area, in large forest, 1520 m (–CC), 7 February 1946, *G.F. Brass 64* (NU); Cathedral Peak area, in grass at base of rock in moist soil, 1520 m, 12 February 1946, *G.F. Brass 80* (NU); Cathedral Peak area, forest along Lambonya River, 1520 m, 13 February 1996, *G.F. Brass 100* (NU); Cathedral area, 1st waterfall, in dense shade, 1460 m, July 1943, *E.A.C.L.E. Schelpe p.34* (NU); Cathedral area, near hotel, 1490 m, July 1944, *E.A.C.L.E. Schelpe 622* (NU); Cathedral area, in forest near stream, 1370 m, 28 July 1947, *E.A. Thomas 31* (NU). —2830 (Dundee) Qudeni Forest, in forest undergrowth, 1672 m (–DB), 17 July 1956, *E.A.C.L.E. Schelpe 6260* (BOL). —2831 (Nkandla) Hlobane, Mtola Forest, common in forest margins down in lower lying areas (–DD), 23 January 1950, *D. Johnstone 297* (BM000787473). —2929 (Underberg) Cathedral area, Indumeni Forest, frequent in shaded forest undergrowth, 1550 m (–AA), July 1944, *E.A.C.L.E. Schelpe 782* (NU); Champagne Castle (–AB), July 1944, *A.W. Bayer 1449 & 1450* (NU); Cathkin area, Ndema Forest, 1340 m, 5 July 1945, *C.M. Hillary 92 & 93* (NU); Cathkin Park, 12 January 1946, *B.C. Howlett 28* (NU); Cathkin Park, forest, 21 February 1946, *B. & C. Howlett 28* (NH); Champagne Castle, 1672 m, October 1933, *A. Meebold 12272* (M); Giants Castle, on shaded rocky banks in *Podocarpus latifolius/Buddleja salviifolia* forest, ca. 1500 m (–BA), 19 September 1979, *B.S. Parris & J.P. Croxall 7306* (K);



Natal, Sweetwaters, 1914, *T.R. Sim s.n.* (BOL, PRE); Kamberg, Game Pass farm, forest margin (–BC), 12 January 1990, *R. Williams 789* (PRE); Cobham State Forest, Emerald Vale, forest floor, 1945 m (–CB), 4 March 1985, *O. Hilliard & B.L. Burt 18317* (K, NU, PRE); Impendhle, Inhluzani, kloof forest, 152–182 m (–DB), 22 July 1954, *E. Esterhuysen 23036* (BOL); Kamberg, 'Game Pass', infrequent in damp shaded area, 1825 m (–DC), December 1947, *C. Gordon-Gray 89a* (NU); Bulwer, 1550 m (–DD), 13 April 1945, *D.J. Clarkson 176* (NH, PRE). —2930 (Pietermaritzburg) Dargle, Kilgoblin (–AC), 4 May 1974, *L. Smook 571* (BOL); Greytown, De Rust, ca. 1368 m, in bush (–BA), March 1915, *J. Thode s.n.* STE4171 (NBG); Zwartkop (–CB), 1912, *T.R. Sim 1236* (PRE); Little Swartkop, Hilton Road, 1200 m, 8 May 1949, *J.S. Beard 670* (US2019380, US2019406); Pietermaritzburg, Zwartkop, terrestrial in shade on forest margin, October 1944, *B.S. Fisher 716* (NH); Cottingham, farm Keerom, between rocks in forest, 1368 m (–CC), 23 March 1969, *R.G. Strey 8428* (BOL, NH); Richmond, Enon forest, SW slopes of mountain on forest fringes (–CC), 9 April 1980, *E.J. van Jaarsveld 5046* (BOL). —2931 (Stanger) prope Mapumulo, coloniae Natalis (–AA), *S.L. Abraham 20* (US). —3029 (Kokstad) Insizwa Mts, in satus mont. Insizwa, 1884 m (–CD), 28 January 1895, *R. Schlechter 6514* (K); Insizwa, 27 January 1895, *Krook s.n. sub A. Penther 32* (M); Ngele, Umsilo cutout, grassland, 1400 m (–DA), 11 October 1990, *A. Abbott 5385A* (NH). —3030 (Port Shepstone) Enisdale, Umgayeflat, ca. 550m (–AD), 26 June 1910, *H. Rudatis 180* (NBG); Enisdale, Umgayeflat, ca. 600 m, 20 January 1910, *H. Rudatis 613* (NBG); Enisdale, Umgayeflat, ca. 550 m, 26 January 1910, *H. Rudatis 780* (NBG); Alexandra Distr., station Dumisa, Enisdale, 600 m, 20 February 1910, *H. Rudatis 839* (K, M); Dumisa, 600 m, 26 June 1910, *H. Rudatis 1047* (K); Alexandra City, Hlokozi, 820 m, moist places in forests, 15 May 1918, *H. Rudatis 2359* (NBG); Timbankulu Forest, in moist places on forest floor (–CB), 21 June 1984, *M. Jordaan 349* (NH). —3128 (Umtata) slopes of Baziya Mts, in forests (–CB), *R. Baur 3* (K). Limpopo: —2229 (Waterpoort) Soutpansberg, Shefeera Estate, on forest floor, 1064 m (–DD), 7 July 1956, *E.A.C.L.E. Schelpe 5968* (BOL); 6 km from Mountain Inn to Bluegumspoort, Soutpansberg, 7 February 1982 *C.H. Stirton 10562* (PRE). —2230 (Messina) Soutpansberg, Entabeni, occasional on forest streambanks, rhizome massive creeping, 1216 m (–CC), 7 July 1956, *E.A.C.L.E. Schelpe 6010* (BOL); Soutpansberg, Entabeni, 972 m, occasional on shaded clay banks in forest, 7 July 1956, *E.A.C.L.E. Schelpe 6016* (BOL); Entabeni, dry places, 7 August 1935, *L.E. Taylor 785* (NY). —2329 (Pietersburg) Louis Trichardt, Hanglip Forest Reserve, indigenous forest near picnic spot (–BB), 12 February 1980, *Bredenkamp & Van*

*Vuuren 438, 439 & 440* (BOL); Louis Trichardt, Hanglip Forest, 1476 m, 30 March 2011, *J.P. Roux 5391* (NBG); Louis Trichardt, Hanglip Forest, 1476 m, 30 March 2011, *J.P. Roux 5394* (NBG); Haenertsburg (–DD), November 1913, *Pott-Leendertz (4675) 1172* (PRE); Haenertsburg, 13 November 1938, *K.M. Putterill s.n.* CH5204 (PRE). —2330 (Tzaneen) Duiwelskloof, below lower waterfall, Rosendal, 1018 m (–CA), 9 February 1958, *J.C. Scheepers 101* (PRE); Westfalia Estate, kloof W of Compartment 28b, near loop in irrigation canal, ca. 1048 m, 20 January 1959, *J.C. Scheepers 555* (PRE); Woodbush Forest Reserve, Haenertsburg (–CC), *Bredenkamp & Van Vuuren 451* (BOL); Entabeni Forest Station, Section F43, 12 March 1985, *P.J. Chaplin s.n.* (PRE); Woodbush, September 1909, *T.J. Jenkins 922* (PRE); Woodbush, September 1909, *T.J. Jenkins 1731* (PRE); Marovuni, woods, *H.A. Junod 395* (PRE); New Agatha, on banks of small rivers, 1216 m, 27 February 1919, *I. McCallum 137* (PRE); New Agatha, vlei, 18 November 1918, *I. McCallum 934.35* (PRE); New Agatha Distr., vlei fern, 1215 m, 18 November 1919, *I. McCallum 943.44* (PRE); New Agatha, *I. McCallum s.n.* CH1321 (PRE); Wolkberg 634LT, New Agatha Forest Reserve, banks of creek, 1500 m, 22 April 1971, *P.J. Muller & J.C. Scheepers 107* (K, PRE); Tzaneen Distr., De Hoek, 20 July 1931, *H. Reynolds s.n.* (PRE); Tzaneen, Woodbush Forest Reserve, Grootbos, 2 March 1992, *J.P. Roux 2567* (NBG); De Hoek Forest Reserve, Debengeni Falls, common on moist forest floor, 27 February 2002, *J.P. Roux 3208* (NBG); De Hoek Forest Reserve, Debengeni Falls, frequent on road cuttings in forest, 27 February 2002, *J.P. Roux 3210* (NBG); De Hoek Forest Reserve, Debengeni Falls, frequent on moist road cutting in forest, 27 February 2002, *J.P. Roux 3213* (NBG); Woodbush Forest Reserve, common in deep shade on moist forest floor, 27 February 2002, *J.P. Roux 3225* (NBG); Woodbush Forest Reserve, frequent on moist road cuttings in forest, 27 February 2002, *J.P. Roux 3231* (NBG); Pietersburg, Woodbush, 1520 m, streambanks in forest, 10 July 1956, *E.A.C.L.E. Schelpe 6051* (BOL); Tzaneen, De Hoek, *Schweickerdt s.n.* (NBG); Magoebaskloof, near De Hoek forest station, 4 February 1981, *E.J. van Jaarsveld 6093B* (BOL); Magoebaskloof, Houtboschdorp forest, 4 February 1981, *E.J. van Jaarsveld 6116* (BOL, MO); Woodbush, *H.A. Wager s.n.* CH7419 (PRE). —2430 (Pilgrims Rest) The Downs, Soutpansberg (–AA), *H.A. Junod s.n.* CH 680 (US1625050); Lebowa, Mapulaneng Wilderness Area, closed evergreen tall forest, 1500 m (–DD), 14 May 1985, *F. Venter 10663* (PRE). Mpumalanga: —2430 (Pilgrim’s Rest) Shiluvane, bois du Marouvogne (–AB), *H.A. Junod 893* (K); Graskop area, Erasmus Kop, in exposed places among rocks (–DB), January 1946, *W.N.B. Hardcastle 12* (PRE); Mariepskop, in forest near homestead of forester, 5

December 1957, *Schweickerdt* 2433 (BOL); Pilgrim's Rest, moist places in forest margin, ca. 1520 m, 27 May 1960, *Van der Schijff* 4449 (PRE); Mt Sheba Nature Reserve (–DC), 11 November 1992, *M. Weigand* 2849 (M); Pilgrims Rest, Mount Sheba Nature Reserve, 1641 m, 31 May 1972, *W.B.G. Jacobsen* 4430 (PRE); Pilgrims Rest, Ceylon forest station, Lone Creek Falls, ca. 1368 m (–DD), 28 December 1960, *A.F. Braithwaite* 164 (BOL). —2530 (Lydenburg) Coromandel farm, Zwagershoek, S of Lydenburg on Dullstroom road (–AB), 5 January 1979, *J.P. Roux* 353 (BOL); Lydenburg Distr., bei der Stadt Lydenburg, October 1887, *F. Wilms* 1778 (K); Machadodorp-Lydenburg road, 18 km N of Bambi Hotel, Badfontein farm, opposite Braam Raubenheimer Dam (Kwena Dam), Marantan hiking trail (–AD), 17 April 1997, *C. Archer* 2157 (PRE); Maritzbos, forest floor near steam, 1307 m (–BA), 4 July 1979, *G.L. Mohle* 65 (PRE); Lydenburg, Uitsoek State Forest, Mokobulaan catchment, ca. 1350–1410 m (–BC), 21 December 1971, *H. Howe* 83 (PRE); Nelspruit, Berlin Forest Reserve, occasional on streambanks in forest (–DA) 4 July 1956, *E.A.C.L.E. Schelpe* 5949 (BOL, US2293724, US2293725, US2293726); Mariepskop, at base of Klaserie waterfall (–DB), 23 July 1983, *J.E. Burrows* 3114 (K); 7 km from Kaapsche Hoop towards Ngodwana, 23 May 1975, *E.J. van Jaarsveld* 495 (PRE). —2531 (Komatipoort) Mac-Mac (–AA), 1875, *T. Ayres s.n.* (NH); farm Holnekt, Louws Creek Timber Company, NE slope (–CB), 19 March 1980, *Buitendag* 1282 (K, MO, NBG, PRE); farm Twello 373 JU, in montane forest on SE-facing slope, 1450 m (–CC), 19 September 1981, *W.B.G. Jacobsen* 5307 (FR); 17 mls from Barberton towards Havelock, 1520 m, forest floor, 21 July 1953, *E.A.C.L.E. Schelpe* 4116 (BOL); Barberton, 1520 m, May 1911, *G. Thorncroft* 23 (PRE); Barberton, May 1911, *G. Thorncroft* 137 (US1625043); Angus Mine, Barberton, 11 March 1992, *M. Weigand* 2265 (M). *Loco incerto*, South Africa, British Kaffraria *W.S.M. d'Urban* 100 (K, b only); Natal, August 1869, *J. Buchanan* 9 (K); Natal, *J. Buchanan* 555 (US816580); Natal, *J. Buchanan s.n.* (BOL); Natal, *W. Rawson* 45 (NY); Natal, 1216 m, July 1864, *sine coll. s.n.* (K); South Africa, forests, 760 m, *R. Baur* 43 (K); Afr. austr., *Drège s.n.* (K, left specimen); *sine loco*, *Scully s.n.* (SAM24764).

SWAZILAND. Hhohho Distr.: —2531 (Komatipoort) Bulembu, King's Forest, seasonally moist forest floor, 1316 m (–CA), 7 May 2002, *J.P. Roux* 3411 (NBG); Horo Forest (–CB), 1932, *V.A. Wager* 132 (PRE); Pigg's Peak Distr., Havelock, 'King's Bush', dense high forest, 1520 m (–CC), March 1960, *O.B. Miller* 7243 (PRE); King Forest, Havelock Mine, ca. 1520 m, 13 July 1956, *E.A.C.L.E. Schelpe* 6154 (BOL). Manzini Distr.: —2630 (Carolina) waterfall above Enrich Dam, Mhlambanyatsi River (–BD), 9 May 2002, *J.P. Roux* 3480 (NBG); Mangcongo area, road

between Sandlane and Bhunya, 13 May 2002, *J.P. Roux* 3596 (NBG). —2631 (Mbabane) Ngwenya Mts, forest, ca. 1520 m (–AA), 27 March 1962, *R.H. Compton* 31409 (SDNH); Mbabane, above bus rank by roadside (–AC), 21 March 1983, *G.M. Dlamini s.n.* (SDNH); Mbabane, Ukutula, edge of forest, ca. 1216 m, 16 May 1956, *R.H. Compton* 25922 (NBG, PRE, SDNH); hill NE of Mbabane, forest, ca. 1368 m, 21 November 1957, *R.H. Compton* 27249 (NBG, PRE); hill N of Mbabane, ca. 1368 m, 30 November 1959, *R.H. Compton* 29118 (NBG); Mdzimba Mts, Longeni area, SW-facing ravine, 11 May 2002, *J.P. Roux* 3525 (NBG); Mdzimba Mts, Manzimnyana Falls (–AD), 10 May 2002, *J.P. Roux* 3505 (NBG); falls 10 mls from Bremersdorp (Manzini), *K. Schütte* 39 (BOL). Shiselweni Distr.: —2631 (Mbabane) Hlatikulu, forest in ravine to E of town, 1205 m (–CD), 15 May 2002, *J.P. Roux* 3633 (NBG).

TANZANIA. Arusha Region: Monduli Distr., Mt Meru, Engarenanyuki River, in dense forest, 2128 m, 27 December 1966, *D. Vesey-FitzGerald* 5042 (K). Iringa Region: Mbinga Distr., Southern Highlands, Livingstone Mts, steep E-facing ravine on side of Msalaba Mtn, along foot trail from mission at Luana in stand of *Oxytenanthera abyssinica*, 1920 m, 15 January 1991, *R.E. Gereau & C.J. Kayombo* 3608 (K); Njombe Distr., Nyehamutwe, Lunyanya (Hagafilo) village, 10 km SE of Njombe on road to Songea, seasonally wet swamp, 9°24'S, 34°45'E, 1950 m, 8 November 1987, *L.B. Mwasubi, D.W. Thomas & Magehema* 13532 (MO); Nyehamutwe, Lunyanya (Hagafilo) village, 10 km SE of Njombe on road to Songea, 9°24'S, 34°45'E, 1950 m, 8 November 1987, *L.B. Mwasubi, D.W. Thomas & Magehema* 13539 (MO); Kitulo, on floor of planted *Pinus patula* plantation, in grassland, 2371 m, 25 September 1968, *B.J. Harris* 2323 (K). Kigoma Region: Kigoma Rural Distr., Gombe National Park, behind office on cliff (slope) trail to Kasekela via former students' quarters, 860 m, 4°40'S, 29°37'E, 5 January 1999, *G. Gobbo & B. Alimad* 107 (NBG); Gombe National Park, lower Kahama Valley, in drier part of riverine forest near transition to vine and tangle thicket, 810 m, 5 March 1996, *R.E. Gereau et al.* 5920 (MO, PRE); Gombe National Park, Peak (above Peak Ridge), hillside between Kakombe and Kasakela Valleys, in open woodland dominated by *Terminalia* sp., 1010 m, 7 March 1996, *R.E. Gereau et al.* 5943 (MO, PRE). Mbeya Region: Mbozi Distr., Mbosi Circle, Mchembo Estate, 1400 m, in alluvial soil in bed of Mchwambo River, 1400 m, 11 January 1961, *H.M. Richards* 13850 (K). Rukwa Region: Mpanda Distr., Kungwe-Mahali Peninsula, ca. 6°S, 30°0E, by Kasala Peak, below Kungwe Mtn, 6 September 1959, *R.M. Harley* 9531 (K). Ufipa Distr., Kanda Hills, escarpment road, in gorge, wet and shady streambed, 1800 m, 10 March 1959, *H.M. Richards* 11121 (K);

Namwele, common on banks of gullies under trees, 1824 m, 24 February 1950, *A.A. Bullock* 2567 (K). Sumbawanga Distr., Rukwa Escarpment, Namwele, shady gully, ca. 1800 m, 28 December 1961, *E.A. Robinson* 4786 (K, M); Sumbawanga, Mbisi, Mbisi forest, 2280 m, 18 January 1958, *D. Vesey-FitzGerald* 1390 (BOL, NBG). Ruvuma Region: Songea Distr., by Mkurira River 32 km E of Songea in boggy grassland by streamside, 930 m, 19 January 1956, *E. Milne Redhead & P. Taylor* 8276 (K); ca. 11 km E of Songea Distr., boundary in eroded gully on gravelly soil in *Brachystegia-Uapaca* woodland, 840 m, 7 June 1956, *E. Milne-Redhead & P. Taylor* 10713 (K); Songea, in and along stream between stones, 9 September 1995, *M. de Boer* 669 (K). Tanga Region: Lushoto Distr., Mtai-Sunga road, escarpment Western Usambaras, 1750 m, rocky hillside, 25 June 1953, *R.B. Drummond & J.H. Hemsley* 2761 (K, US2292265, US2292266).

UGANDA. Western Region: Mbarra Distr., Kigezi, Rubaya, forest, 1976 m, *A.S. Thomas* 4254 (K, MO); Kigezi, Kachwekano farm, hillside thicket, 2128 m, September 1949, *J.W. Purseglove* 3112 (K).

ZAMBIA. Central Province: Serenje Distr., Kundalila Falls, margin of miombo woodland, ca. 1430 m, 24 August 1983, *B.S. Parris & J.P. Croxall* 10178 (K, MO). Eastern Province: Lundazi Distr., Nyika Plateau, upper slopes of Kangampande Mtn, forest floor, 2128 m, 6 May 1952, *F. White* 2725 (K). Northern Province: Chinsali Distr., Bwingi Mfumu hills, W of Great North road, 45 km NNE of Mpika, 1700 m, 4 April 1973, *J. Kornaś & A. Medwecka-Kornaś* 3588 (K). Mbala Distr., Chilongowelo, stream above farm, 1216 m, 24 December 1951, *H.M. Richards* 364 (K); Itembwe Gorge, in a cave, on the rocks of a steep cliff, 1500 m, 15 January 1964, *H.M. Richards* 18774 (K).

ZIMBABWE. Harare: Chinamora Reserve, Ngamamarira Pass, near stream, 1 July 1963, *J.P. Loveridge* 1011 (BOL, K); Dombashawa ca. 14 miles NE of Harare, just below Bushman's cave in crevice of rock shaded by forest, 1520 m, 16 January 1958, *D.S. Mitchell* 217 (BOL); Ngomakurira Mt, 20 miles NNE of Salisbury in Chindamora Nature Reserve, ca. 1580 m, 21 February 1959, *D.S. Mitchell* 489 (BOL). Manicaland Province: Chimanimani Distr., Chimanimani Mts, *Uapaca*-woodland on W bank of Haroni Gorge below Haroni View on Tilbury estate, occasional in shade among grass, 820 m, 16 February 1958, *D.S. Mitchell* 399 (BOL); Chimanimani, gully above upper Haroni, *Brachystegia-Faurea* woodland, 1307–1428 m, 3 February 1957, *J.B. Phipps* 459 (K, PRE). Chipinge Distr., Chirinda Forest margin, 1094 m, May 1967, *B. Goldsmith* 62/67 (K, PRE); near Chirinda, 1155 m, wooded glen, 20 June 1906, *C.F.M.*

*Swynnerton 874* (K, SAM). Makoni Distr., Silverbow, among broken rocks at base of boulders, 1672 m, 15 June 1957, *N.C. Chase 6531* (BOL, K); Forest Hill Kop, S-aspect, 1489 m, July 1917, *F. Eyles 727* (PRE). Mutare Distr., Mutare (Umtali) Distr., E-face of Mandambiri, near summit, 26 June 1949, *N.C. Chase 3261* (NBG); Mutare (Umtali) Distr, commonage, Park River, 1095 m, 9 June 1952, *N.C. Chase 4553* (NBG); Mutare, junction of Vumba and Nchowa falls roads, 1216 m, 24 August 1952, *N.C. Chase 4618* (MO); Rowa township, Zimunya Reserve, in hollow in shelter of boulders, 1033 m, 5 February 1957, *N.C. Chase 6318* (BOL, K); Nyanga (Inyanga) Distr., below waterfall of Mare River,  $\frac{1}{2}$  mile downstream of Mare Dam, 1830 m, 10 March 1969, *W.B.G. Jacobsen 3825* (FR); Mutare, 'Witchwood', Vumba Mts, 1276 m, forest floor, 27 June 1955, *E.A.C.L.E. Schelpe 5439* (BOL); Guruve (Sipolilo) Distr., Mpingi Pass, Great Dyke, forest patch, damp place, serpentine soils, 1368 m, 18 May 1962, *H. Wild 5782* (K, MO); Bvumba (Vumba) Mts, Burma Valley, *D. Williams BUR1* (BOL); Bvumba (Vumba) Mts, Burma Valley, *D. Williams BUR2* (BOL); Bvumba (Vumba) Mts, Burma Valley, *D. Williams BUR 3* (BOL). Mashonaland Central Province: Centenary Distr., Centenary, Miware Grove, Mawari farm, ca. 1064 m, in shaded area along stream, 19 June 1982, *H.H. Burrows 1985* (BOL). Mashonaland East Province: Marondera Distr., Zambesi Mission, Marondera (Moramballes), 851 m, 30 December 1858, *J. Kirk s.n.* (K); Wedza Mtn, kloof forest, 1702 m, 27 February 1964, *H. Wild 6337* (BOL, K); Murehwa Distr., Athlone farm, Mt. Bogoto, Nyandora I.C.A., 1524 m, 15 December 1964, *N. Jacobsen 2613* (FR). Mashonaland West Province: Zvimba Distr., Manyame (Hunyani) River, February 1918, *F. Eyles 920* (PRE). Masvingo Province: Bikita Distr., Bikita Bonga, Hunyana Mtn., near Bikita, between rocks 1489 m, *D.S. Mitchell 808* (BOL, K).

**Remarks:**—When Pichi Sermolli (1985) described *D. lewalleana* he noted its close affinity to the *D. inaequalis* species group, to which *D. pentheri* also belongs. I had the privilege to study an isotype of the species, and *Lewalle 2366* (BR), a paratype. The latter I found to be a specimen of *D. pentheri*, which again illustrates the difficulty to distinguish these taxa if only macromorphological characters are relied upon. Furthermore, *D. lewalleana*, as defined here, is not restricted to Burundi as suggested by Pichi Sermolli, but it is widespread in eastern and southern Africa. Most of the collections that are here ascribed to *D. lewalleana* have formerly been ascribed to either *D. pentheri* or to *D. inaequalis*.

*Lastrea pentagona* T.Moore has consistently been cited as a synonym of *D. inaequalis* by Schelpe (1970) and Schelpe & Anthony (1986). Characteristic of the type collection are the lamina

scales that are prominently denticulate with few marginal outgrowths, the long isocytic to moniliform hairs occurring abaxially on the laminae and the apparently eglandular lamina axes and veins. This and the guard cell length [(38–)42(–46)  $\mu\text{m}$ ] fall within the variation of *D. lewalleana*.

Schelpe (1970) maintained *D. inaequalis* (Schltdl.) Kuntze var. *atropaleacea* Schelpe as a distinct entity. It is known by a single collection from Tanzania. Characteristic of this collection is the pair of reduced basal pinnae and the atrocastaneous, thinly coriaceous stipe base scales. Together with several other minor features, I have no doubt that it belongs to *D. lewalleana*, and that *Vesey-Fitzgerald 1390*, on which the variety is based is a variation perhaps caused by environmental factors.

*Dryopteris lewalleana* is often confused with *D. inaequalis* and *D. pentheri*, to which it is undoubtedly closely related. From *D. inaequalis* it can be distinguished by its firmer lamina texture (herbaceous to firmly herbaceous vs. thinly herbaceous to herbaceous), the thicker, short-decumbent rhizomes, the basal pinna pairs generally not shorter than the pair above and the indusia always being eglandular. From *D. pentheri* it differs in the lamina axes and more frequently eglandular veins, and if glandular, then more sparsely so. The glands are mostly clavate and not oblong as in *D. pentheri*. Also the shorter gland length [(46–)95(–166)  $\mu\text{m}$  vs. (60–)137(–260)  $\mu\text{m}$ ], the guard cells [(30–)41(–62)  $\mu\text{m}$  vs (34–)53(–72)  $\mu\text{m}$ ], and the absence of 2-celled hairs from the lamina axes and veins separating them.

**Variation:**—*Dryopteris lewalleana* is a highly variable species and extreme variations may even occur within a population. Most notable is the degree to which the lamina is dissected, gland density on the lamina axes and veins, scale morphology, the length and hair type occurring on the lamina, and in the indusium size and margin sculpture. A few collections, *Vesey-Fitzgerald 1390* (BOL, BM), *Richards 11121* (K) and *Richards 18774* (K) have atrocastaneous, thinly crustaceous rhizome and stipe base scales, a feature that typifies *D. inaequalis* var. *atropaleacea* (Schelpe 1967). These collections originate from diverse localities in Tanzania and Zambia and are here included in the general variability of the species.

INSERT FIGURE 19

**16. *Dryopteris manniana* (Hook.) Christensen** (1905: 276). Figs. 5D–G; 20.

*Polypodium mannianum* Hooker (1863: 253). Type:—EQUATORIAL GUINEA. Bioko: 'Fernando Po, on the peak, 2000 feet', 1860, *G. Mann 351* (holotype K000675774!). *Phegopteris manniana* (Hook.) Kuhn (1868: 123).

*Dryopteris raynalii* Tardieu (1965: 500, pl. 2, figs 1–4). Type:—CAMEROON. 'Sadolkoulay, 36 km est de Ngaondéré sur blocs basaltiques, grotte derrière la chute du Tello, partie supérieure sombre et humide'. 1200 m, *J. Raynal & A. Raynal 13279* (holotype P00279997!).

*Plants* terrestrial. *Rhizome* erect to short-decumbent, mostly unbranched, to 8 mm in diameter, set with roots, closely spaced stipe bases and scales, the scales brown to ferruginous, chartaceous, broadly attached, subulate, to 22 x 3 mm, the margins closely set with short teeth, the scale apex filiform, terminating in an oblong cell. *Fronde*s 4–7 per plant, caespitose, arching, to 1 m long; *stipes* greenish to stramineous, shallowly sulcate adaxially, to 480 mm long, to 5 mm in diameter, proximally densely scaled, moderately scaled higher up, the scales stramineous to ferruginous, chartaceous, the larger scales broadly attached, to 15 x 4.5 mm, the smaller scales short-stalked, cordate to cuneate, the margins basally frequently with one or more filiform outgrowths, often with scattered glandular cells, denticulate, the scale apex filiform, terminating in an oblong cell; *laminae* anadromous, catadromous towards the apex, herbaceous, ovate, to 2-pinnate-pinnatifid, to 525 mm long, with up to 12 petiolated pinna pairs, proliferous, generally with one or more scaled buds adaxially along the rachis near the lamina apex, often also with buds adaxially on the pinna-rachis in larger fronds; *rachises* greenish to stramineous, adaxially sulcate, becoming narrowly winged towards the apex, moderately scaled, the scales ferruginous to stramineous, chartaceous, sessile or short-stalked, filiform to lanceolate, to 7 x 1.8 mm, cordate to narrowly cuneate, denticulate, basally frequently with one or more filiform outgrowths, higher up closely set with short teeth, the scale apex filiform, terminating in an oblong cell; *pinnae* petiolate, the petiole to 18 mm long, the basal pinna pair inaequilaterally ovate, narrowly ovate to oblong-acuminate towards the lamina apex, to 250 mm long, to 95 mm wide, to 1-pinnate-pinnatifid, the basal pinna pair mostly the longest, basiscopically developed, subopposite to alternate, basally widely spaced, more closely spaced towards the lamina apex and often imbricate, with up to 3 pairs of petiolated pinnules; *pinna-rachises* adaxially shallowly sulcate, the sulcus confluent with that of the rachis, pronounced abaxially, narrowly winged for most of the length, abaxially sparsely to moderately scaled, the scales stramineous to ferruginous, chartaceous, sessile or short-stalked, filiform to



narrowly oblong, to 5 x 1 mm, cordate to narrowly cuneate, the margins dentate, basally frequently with one or more filiform outgrowths, the scale apex apex filiform, terminating in an oblong cell; *pinnules* petiolate, the petiole to 2 mm long, symmetric or inaequilaterally narrowly ovate to ovate, basiscopically decurrent, pinnatifid, often basiscopically developed, the acroscopic pinnule on the basal pinnae to 50 mm long, to 17 mm wide, the basiscopical pinnule on the basal pinnae to 56 mm long, to 23 mm wide, not or slightly imbricate, lobed; *lobes* broadly oblong-obtuse, shallowly lobed, dentate, glabrous adaxially, abaxially rarely glandular, the glands (56–)62(–72)  $\mu\text{m}$  long, sparsely set with hairs and scales along the veins, the hairs moniliform, often with a unicellular gland near the base, the scales to 2 mm long, stramineous, chartaceous, short-stalked, stalk often glandular, filiform to linear, repand to dentate, the scale apex filiform, terminating in an oblong cell. *Venation* anadromous, becoming catadromous towards the lamina and pinna apex, pinnately branched in the lobes, evident, ending in the teeth near the margin, endings mostly slightly enlarged. *Stomata* mostly of the polocytic type, guard cells (40–)56(–70)  $\mu\text{m}$  long. *Sori* circular, to 1.5 mm in diameter, inframedial on unmodified fertile vein branches, discrete at maturity; *sporangia* stalk simple or haired, the capsule with (11–)14(–18) indurated annulus cells; exindusiate. *Indusia* lacking. *Spores* ellipsoidal, monolete, perispore forming short and long ridges, ruminant, (40–)44(–58) x (26–)30(–32)  $\mu\text{m}$ . *Chromosome number*:  $2n = \pm 164$  (Vida in Widén *et al.* 1973: 2130).

**Distribution and ecology:**—*Dryopteris manniana* is somewhat disjunct in its distribution, occurring in Bioko, Burundi, Cameroon, Côte d’Ivoire, Equatorial Guinea, Guinea, Kenya, Liberia, Madagascar, Malawi, Mozambique, Nigeria, Rwanda, São Tomé, Sierra Leone, Tanzania, Uganda and Zimbabwe. In East Africa it occurs from the Vumba Mountains in Zimbabwe, the Namúli Mountains in Mozambique, the Mulanje mountains and Nyika Plateau in Malawi, the western parts of Burundi, Rwanda and Uganda, the West Usambara and Pare Mountains in Tanzania and in Kenya. Here the species occurs in deep shade in moist montane forests at elevations ranging from 1400 m in Uganda to 2249 m along the Kikuyu Escarpment in Kenya. In West Africa *D. manniana* occurs in Bioko, Cameroon, Côte d’Ivoire, Guinea, Liberia, Nigeria, São Tomé and Sierra Leone. In this region the species is confined to moist montane forests. On Bioko the species mostly occurs in the undergrowth of moist montane forests such as *Cyathea*-woodland and *Schefflera*-forests, ranging from 610 to 1860 m (Benl 1991).

**Etymology:**—The epithet honours the collector of the type, Gustav Mann (1836–1916), German born gardener at Kew from 1859. Recruited by W. Hooker to replace Barter on the ill-fated Niger Expedition in West Africa. Mann collected extensively on the islands and countries around the Gulf of Guinea.

**Additional specimens studied:**—EQUATORIAL GUINEA. Bioko (Fernando Po): Bioko North, Pico, 1620 m, 2 January 1976, *G. Benl & U. Benl FP 348a* (M); Pico, 1780 m, 4 January 1976, *G. Benl & U. Benl FP 374* (M); Pico, 1750 m, 4 January 1976, *G. Benl & U. Benl FP 386* (M); Pico, 1700 m, auf kleinen Lavafeld, 6 January 1976, *G. Benl & U. Benl FP 408* (M); über Bocoricho, Weg zur Laguna Lombé, 780 m, 10 January 1976, *G. Benl & U. Benl 474* (M). Bioko South, Lake Loreto, near Moka (Moca), on steep bank in shade above lake, 912 m, 6 December 1951, *C.D. Adams 1020* (BM, K, MA); Aufstieg zum Monte Baká (Moka-Hochtal), 1460 m, 22 January 1974, *G. Benl & U. Benl FP 56* (M); 'Cyathea wald' am linken Ufer des Rio Iladyi vor dem Wasserfall, ca. 1180 m, 24 January 1974, *G. Benl & U. Benl FP 120* (M); über Ruiché (Pfad zur Caldera), 820 m, 10 January 1976, *G. Benl & U. Benl 492* (M); fuente de Mioko, 1350 m, 17 January 1976, *G. Benl & U. Benl FP 597* (M). Loco incerto, Bioko, *G. Mann s.n* (B20 0059225).

BURUNDI. Bururi Province: Nella foresta riparia umida della vallata del torrente Siguvyaye vicino al ponte sul torrente, 1700 m, 18 December 1966, *R.E. G. Pichi Sermolli 6974* (NY).

CAMEROON. Central Province: Mont Eloumden, 5 km SW of Yaoundé, ca. 1160 m, 29 December 1963, *F.J. Breteler et al. 2337* (K, LISC, P); Mont Fébé, 3 km NW of Yaoundé, ca. 960 m, 23 January 1962, *F.J. Breteler et al. 2560* (K). Littoral Province: Mamengouba Mts, 4 km WNW of Nkongsamba, forest, 1200 m, 9 September 1971, *A.J.M. Leeuwenberg 8316* (B20 0120450, LISC, M, PRE); forest on summit of Mount Koupe, 2000 m, 14 February 1984, *D. Thomas 3172* (YA). North-West Province: Bui Division, Mt Oku, N slopes, *R.L.L. Viane 2728* (GENT). South-West Province: Buea, in cave near water supply, 1000 m, 18 February 1937, *D.R. Rosevear RF/51* (BM); Buea, 1000 m, 18 February 1937, *D.R. Rosevear RF/53* (BM); Kamerunberg, Schlucht über Buea, 1150 m (an halbnasser Felsenwand neben Wasserfall, 24 December 1970, *G. Benl & U. Benl Ka 70-71/39* (M, YA); Kamerunberg, Nebelwald über Bonakanda, 1220 m (Kr. Buba, nordöstl. von Buea), 26 December 1970, *G. Benl & U. Benl Ka 70-71/82* (M); Kamerunberg: Mapanja-Mann's Spring, zwischen 1000 und 1400 m, 10 February 1975, *G. Benl Ka 75/59* (M); Buea, Mt Cameroon, on damp lava wall of ravine above forestry plantation, 970 m, 28 October 1963, *R.M. Tryon & A.F. Tryon 6473* (K).

CÔTE D'IVOIRE. Dix-Huit Montagnes Region: Mt Tonkoui (cercle de Man), à terre dans la forêt à *Parinari excelsa*, 1100 m, 24 September 1948, *H. des Abbayes 539* (BM, P); Mt Tonkoui, near Man, summit, ca. 1100 m, shady bank, 25 January 1984, *F.N. Hepper & J. Maley 7778* (NMG); Mt Tonkoui, SW of Man, montane rainforest, 1150 m, 4 March 1959, *A.J.M. Leeuwenberg 2972* (K, LISU, MO); Man, Tonkoui, 26-28 April 1959, *R. Portors s.n.* (P).

GUINEA. Nzérékoré Region: Pays des Guerzes: Entre Nzo et Sakonanta, pied de la montagne de Nzo, *A. Chevalier 21076* (P); Monts Nimba, February 1942, *R. Schnell 258* (P).

KENYA. Central Province: Kiambu Distr., Kikuyu Escarpment Forest above Mataara Tea Factory, evergreen forest, 2130 m, 1 January 1969, *R.B. Faden 69/001* (K); Kikuyu Escarpment Forest above Matuara Tea Factory, evergreen forest, 2249 m, 1 January 1969, *R.B. Faden 69/020* (K). Nyeri Distr., Aberdare Mts, 22 December 1924, *J. Ransder s.n.* (K); Nyeri Hill, wet forest with *Aningeria aldolfi-frederici* and *Casearia battiscombei* dominant with an understory of *Teclea nobilis*, *Allophyllus abyssinicus* etc., 2128–2210 m, 8–9 March 1969, *R.B. Faden & A. Evans 69/289* (K). Taita-Taveta Distr., Taita Hills, Mbololo Hill (Mraru Ridge) 1450–1525 m, lower part of main mist forest, 9 April 1971, *R.B. Faden, A. Evans, M. Githui, R. Osborn & C. Smeenk 71/219* (US); Taita Hills, Mbololo Hill (Mraru Ridge), intermediate wet evergreen forest with dominant trees, 17-18 October 1970, *R.B. Faden & M. Githui 70/701* (US); Taita Hills, Mt Kasigau, pipeline route from Rukanga, from edge of plateau on E side along ridge to the lower slopes of the final peak, 1400–1600 m, mist forest with *Syzygium sclerophyllum*, *R.B. Faden, A. Evans, B. Kariuki & C. Smeenk 71/165* (US); Taita Hills, Ngangao Forest, base of Ngangao, 1800–1900 m, wet evergreen forest with *Albizia*, *R.B. Faden, A. Evans, M. Githui & C. Smeenk 71/252* (US); Sagala Hills near Voi, eastern slope near the highest point, mist forest with dominant trees being *Newtonia buchananii* etc., 1400–1500 m, 1 January 1971, *R.B. Faden 71/12* (K); Taita Hills, Mbololo Hill, Mraru Ridge, mist forest with *Newtonia*, *Macaranga*, *Dicranolepis*, 1500–1600 m, 5 July 1969, *R.B. Faden, A. Evans & T. Wolf, 69/824* (BOL, K); Taita Hills, Bura Bluff, forest, path sides and streams, 1825 m, February 1955, *H.D. van Someren, 840* (K); Ngangao, Taita Hills, February 1955, *H.D. van Someren, 870* (K). Eastern Province: Embu Distr., Mt Kenya, Thuchi River, occasional in deep forest shade, 1489 m, 24 July 1949, *E.A.C.L.E. Schelpe 2394* (BM, US2082473); Embu, Forest, August 1949, *H.D. van Someren 439* (K); Meru Distr., Jombeni Range, in undergrowth near water, 1520 m, *H.D. van Someren 438* (K); Nyambeni (Jombeni) range, forest floor by rivers, 1520 m, August 1949, *H.D. van Someren 489* (K);

Nyambeni Hills, 1 mile N of Maua on Maua-Kangeta road, roadside forest edge, 1550 m, 31 May 1969, *R.B. Faden, A. Evans & J. Worth 69/650* (BOL, K, MO); Nyambeni Tea Estate, 8 October 1960, *B. Verdcourt & Polhill 2929* (K); Mt Kenya, S-side, Kamweti Track, crossing of Thiba River, 1875 m, stream in wet evergreen montane forest, 28 December 1970, *R.B. Faden, A. Evans & M. Githui 70/923* (US); Mt Kenya, SE, Irang (Irengi) Distr. Forest Office area, 2000 m, 9 August 1978, *E. Zogg, K.U. Kramer & H. Gassner 276/10* (US2903071). Nyanza Province: Kisumu Distr., Kisumu, bushland slopes, 2130 m, February 1915, *R.A. Dümmer 1727* (K). Rift Valley Province: Kericho Distr., Itari River, riparian forest, September 1949, *H.D. van Someren 291* (K).

LIBERIA. Nimba County: Nimba, 18 March 1965, *J.G. Adam 21180* (K); Mt Nimba, dry places in montane forest, 1100 m, 12 February 1962, *G. Kunkel 718* (B20 0057572, B20 0057573); Mt Nimba, 1000 m, in high forest, 16 August 1961, *G. Kunkel 719* (B20 0057582); Mt Nimba, 1250 m, in high forest, 16 August 1961, *G. Kunkel 720* (B20 0059266, B20 0059267, B20 0057571); Mt Nimba, 850 m, wet places, in forest, 25 August 1961, *G. Kunkel 721* (B20 0057576); Nimba Mts, near Iron mine of L.A.M.C.O., 1200 m, 29 July 1962, *A.J.M. Leeuwenberg & A.G. Voorhoeve 4743* (B20 0069226, K).

MALAWI. Northern Region: Mzimba Distr., South Viphya, Chamambo Forest, 1750 m, 21 September 1982, *F. Dowsett-Lemaire 404* (K); North Viphya, Uzumara Forest, in small tufts on slopes, 1700–1850 m, 17 June 1983, *F. Dowsett-Lemaire 799* (K). Southern Region: Mulanje Distr., Mt Mulanje, L. Ruo Plateau, riverine *Widdringtonia* evergreen forest, 1763 m, 17 August 1956, *E.I. Newman & T.C. Whitmore 477* (BM). Zomba Distr., Zomba Plateau, forest to the south of Chingwe's hole, 27 November 1998, *J.P. Roux 2857* (NBG).

MOZAMBIQUE. Zambesia Province: Gúruè Distr., Namuli, Makua Country, 1887, *J.T. Last s.n.* (K).

NIGERIA. Cross River State: (Oguja Province): Obudu, grotto below the cattle ranch, 26 March 1966, *W.G. Chaloner 10/1* (K); (Ogoja Province), Sonkwala area of Obudu Div., river Ata, below Koloishe, high forest in ravine, ca. 1216 m, 20 December 1948, *H.J. Savory & R.W.J. Keay FHI25063* (BM); (Ogoja Province), Sonkwala area of Obudu Div., high forest Ikvette-Balegett path, grass plateau, 29 December 1948, *H.J. Savory & R.W.J. Keay FHI25204* (BM, FHI).

SIERRA LEONE. Northern Province: Koindugu Distr., Loma Mts, camp 1, 16 November 1965, *D. Gledhill & Morton SL2584* (FHI); Tingi Mts, on plateau near camp, 12 December 1965,

*D. Gledhill & Morton SL2973* (K); Sierra Leone, Mt Loma, galarie forest, 490 m, 30 March 1966, *P. Jaeger 9683* (P).

TANZANIA. Morogoro Region: Kilombero Distr., Udzundwe Mts, above Sanje waterfalls, 1000–1300 m, *M. de Boer 787* (K); Mwanihana Forest Reserve above Sanje village, Motogoro Region, 1400–1700 m. Forest on steep slopes with small streams and swamps, and patches of elfin forest on ridge top, 10 October 1984, *D.W. Thomas 3802* (K, MO); Mwanihana Forest Reserve above Sanje village, Kilombero Distr., Morogoro region. 7°50'S, 36°55'E, 1400–1700 m. Forest on steep slope with small streams and swamps, and patches of elfin forest on ridge top, 10 October 1984, *D.W. Thomas 3881* (K, MO); Kilosa Distr., Ukaguru Mts, Mamiwa Forest Reserve, valley forest above Uponela road, 1 km N of Mandege Forest Station, 1600 m, 8 August 1972, *D.J. Mabberley 1415* (K); Mvomero Distr., Kanga Mtn, Northern Nguru, moist forest on steep sided mountain, 1600 m, 2 December 1987, *J. Lovett & D.W. Thomas 2756* (MO); Kanga Mtn, Northern Nguru, moist forest on steep sided mountain, 1600 m, 2 December 1987, *J. Lovett & D.W. Thomas 2811* (MO); Ulanga Distr., Bezirk Mahenge: Muhulu-Gebirge SSW von Station Mahenge; Nebelwald ca. 1200 m, 24 February 1932, *H.J. Schlieben 1827* (M). Tanga Region: Lushoto Distr., Shume Magamba Forest Reserve, 2 May 1987, *C. Kisena 620* (K); Mubeza Distr., Usagara Mts, August 1884, *J. Kirk s.n.* (K).

UGANDA. Western Region: Bushenyi Distr., Igara County, Saw Mill W of Rubuzigye in Kalinzu Forest, road bank, 1455 m, 19 September 1969, *R.B. Faden 69/1171* (K); Igara county, sawmill W of Rubuzigye, Kalinzu Forest, roadside bank in forest, 1450 m, 19 September 1969, *K.A. Lye 4176* (BOL); Bushenyi, Kasyoha-Kitomi Forest Reserve, lower montane forest, 1550 m, 26 November 1994, *A.D. Poulsen 717* (K,); Kanungu Distr., Bwindi National Park, North Sector (Kayonza), on slopes near the Ishasha River, 1400 m, 22 March 1995, *A.D. Poulsen 806* (K).

ZIMBABWE. Manicaland Province: Chimanimani Distr., Bvumba (Vumba) Mts, stream on S slope of Bunga Forest, deeply shaded forest floor, 1641 m, 10 July 1980, *J.E. Burrows 1676* (BOL, NBG); Mutare, Vumba Hotel, streamside, 1520 m, 17 July 1952, *N.C. Chase 4582* (BM, BOL, PRE, MO); Melsetter, Mwenji farm, S of Melsetter village, 1760 m, 11 March 1953, *N.C. Chase 4832* (BM, BOL, MO); Mutare, Vumba Mountains Hotel, streamside, 1520 m, 31 October 1953, *N.C. Chase 5119* (BM, BOL, MO); Mutare, Vumba Mts Hotel, in deep shade of forest stream bank, 1520 m, 20 June 1955, *E.A.C.L.E. Schelpe 5429* (BM, BOL, NBG); Mutare, Vumba Mts, in shade in closed canopy forest, 1610 m, 5 August 1955, *N.C. Chase 5705* (BM, BOL, K,

PRE); Vumba Mts Hotel, ravine in closed canopy forest, 1520 m, 7 July 1957, *N.C. Chase 6572* (BOL, K).

**Remarks:**—Diagnostic of *Dryopteris manniana* are the scaled proliferous buds borne adaxially on the rachises, mostly near the lamina apices, the denticulate scales, and the exindusiate sori. A micromorphological feature distinguishing it from other *Dryopteris* species is the large stomata size, which supports it being a tetraploid.

**Variation:**—The species appears to be stable throughout its distribution with little variation of significance having been observed.

INSERT FIGURE 20

**17. *Dryopteris occidentalis* Roux** (2004b: 214, figs. 5A, B, 6A–G). Figs. 5M–O; 8H & Ha; 20.

Type:—GUINEA. Fouta-Djallon, Dalaba, September 1954, *R.A.A. Schnell 6825* (holotype K!).

*Plants* terrestrial. *Rhizome* short-decumbent, to 75 mm long, to 6 mm in diameter, closely set with roots, persistent stipe bases and scales, the scales dull ferruginous, thinly chartaceous, sessile, broadly attached, narrowly triangular, narrowly ovate to filiform, to 9 x 2.4 mm, narrowly to broadly cuneate, irregularly denticulate, with scattered capitate glands along the margin, or with scattered glands and long, pluricellular filiform outgrowths of which the apex terminates in several oblong thin-walled cells, the scale apex terminates in a short series of oblong cells, the scales regularly with one or more pluricellular filiform outgrowths from the base. *Fronde*s crowded, arching, to 950 mm long; *stipes* stramineous, proximally adaxially flattened, sulcate higher up, to 380 mm long, to 4 mm in diameter, proximally densely scaled, sparsely scaled higher up, the scales to 10 x 2.4 mm, similar to those on the rhizome, the smaller scales simple or with a filiform pluricellular outgrowth from the base; *laminae* narrowly ovate, to 570 mm long, to 325 mm wide, to 2-pinnate-pinnatifid, with up to 12 petiolated pinna pairs, distally the pinnae become sessile and eventually adnate and increasingly basiscopically decurrent; *rachises* stramineous, adaxially shallowly sulcate, narrowly winged near the apex, sparsely scaled, the scales fugaceous, stramineous, thinly chartaceous, sessile, narrowly lanceolate to filiform, to 6 x 1.2 mm, cuneate, often glandular at the base, or with pluricellular filiform outgrowths at the base, irregularly set with short or long, filiform, pluricellular outgrowths of which the apex terminates in an oblong or

subglobose cell, the scale apex terminates in a short uniseriate series of oblong cells, the smaller scales often short-stalked, simple or with a filiform pluricellular outgrowth from the base; *pinnae* petiolate, the petiole to 10 mm long, proximally spaced to slightly overlapping, near opposite to alternate, the basal pinna pair longest, to 1-pinnate-pinnatifid, the basal pinna to 168 mm long, to 80 mm wide, the basal pinna pair basicopically developed, inaequilaterally narrowly triangular to lanceolate, oblong acuminate to linear acuminate towards the lamina apex, with up to 4 petiolated pinna pairs; *pinna-rachises* stramineous, narrowly winged for most of the length, adaxially shallowly sulcate, sparsely set with filiform scales, abaxially sparsely scaled, the scales stramineous to ferruginous, chartaceous, sessile or short-stalked, lanceolate to subulate, to 2.5 x 0.3 mm, eglandular or with a few capitate glands along the margin, regularly with one or more pluricellular, uniseriate filiform outgrowths from near the base, the scale apex terminates in a short uniseriate series of cells of which the apical cell varies from oblong or subglobose; *pinnules* petiolate, the petiole to 3 mm long, near opposite to alternate, proximally widely spaced, more closely spaced distally, herbaceous, proximally pinnatifid, progressively more shallowly lobed distally, basicopic pinnule on the basal pinnae to 50 mm long, to 24 mm wide, narrowly ovate to oblong-acuminate, acrosopic pinnule on the basal pinnae to 28 mm long, to 19 mm wide, ovate to oblong-acuminate; *costae* shallowly sulcate adaxially, glabrous to sparsely set with filiform scales, abaxially sparsely scaled, the scales stramineous, chartaceous, sessile, ovate to subulate, to 2.5 x 0.8 mm, the scale margins irregularly set with a few short pluricellular outgrowths, the scale apex terminates in a short uniseriate series of thin-walled cells; *segments* sessile, broadly ovate, to 14 mm long, to 8 mm wide, lobed; *lobes* oblong-obtuse to oblong-truncate, to 8 mm long, to 4 mm wide, denticulate, adaxially glabrous or sparsely set with clavate glands and 4- to 6-celled moniliform hairs along the veins, abaxially sparsely set with clavate glands (56–)77(–92)  $\mu\text{m}$  long along the veins, and 4- to 8-celled moniliform hairs to 340  $\mu\text{m}$  long along and near the veins, the hairs rarely with a glandular cell near the base. *Venation* anadromous, catadromous towards the apex, immersed adaxially, evident abaxially, ending in the teeth near the margin. *Stomata* mostly of the polocytic type, guard cells (48–)55(–64)  $\mu\text{m}$  long. *Sori* essentially 2-seriate on the pinnules, 2-seriate on the segments in larger specimens, discrete at maturity, inframedial on essentially the anadromous vein branches. *Indusia* ferruginous, firmly herbaceous, reniform, to 1.6 mm in diameter, entire to strongly repand, eglandular. *Sporangia* stalk simple, glandular, or haired, the capsule with (10–)12(–14) indurated annulus cells, epistomium (3–)4(–5)-celled, hypostomium

(3–)4(–5)-celled. *Spores* brown, 64 per sporangium, monolete, plano-convex, perispore smooth, forming tall but narrow reticulate ridges, exospore (38–)40(–46) x (24–)27(–30)  $\mu\text{m}$ .

**Distribution and ecology:**—*Dryopteris occidentalis* appears to be restricted to, but widespread in the mountainous regions of West Africa, occurring in Côte d’Ivoire, Guinea and Nigeria. It is a forest species and is described from Fouta-Djallon, a mountainous plateau region with an average elevation of 910 m, at ca. 900 m on Mount Tonkoui in Côte d’Ivoire, and at ca. 1094 m in the Plateau State in central Nigeria.

No true *Dryopteris* species were recorded from Fouta-Djallon by Jeanpert (1910), and for Guinea as a whole by Tardieu-Blot (1943) and Tardieu-Blot & Des Abbayes (1951). Later collections of *Dryopteris* from there have all erroneously been ascribed to *Dryopteris inaequalis* (Schltdl.) Kuntze.

**Etymology:**—*occidentalis* — western, with reference to the distribution of species in Africa.

**Additional specimens studied:**—CÔTE D’IVOIRE. Dix-Huit Montagnes Region: Mt Tonkoui, forest along track side, ca. 900 m, 29 July 1979, *R. Viane 1024* (K).

GUINEA. Labé Region: Fouta-Djallon, Dalaba, September 1954, *R.A.A. Schnell 6825* (K).

NIGERIA. Plateau State: in valley on scarp S of William Camp, 1094 m, 8 July 1962, *D.W. Lawlor & J.B. Hall 737* (K).

**Remarks:**—*Dryopteris occidentalis* differs from *D. inaequalis*, to which it has been ascribed in the past, in the shorter clavate glands, the slightly larger stomata, suggesting the species may be a tetraploid, the eglandular indusia, and the moniliform hairs occurring abaxially on the laminae. Also the distribution of the taxa differ, with *D. inaequalis* being restricted to South Africa. From *D. pentheri* it differs in the absence of 2-celled hairs, and the presence of clavate glands (56–)77(–92)  $\mu\text{m}$  long rather than cylindrical glands (60–)137(–260)  $\mu\text{m}$  long as in *D. pentheri*.

**18. *Dryopteris oligodonta* (Desv.) Pichi Sermolli** (1951: 147–154, fig. 2). Figs. 5P–W; 8I & J; 21.

*Aspidium oligodonton* Desvaux (1811: 322). Type:—SPAIN. Canary Islands: ‘Hab. in Insula Teneriffae (Canarii)’, *Bory de St. Vincent s.n.*, Herb. A.N. Desvaux (lectotype P00301444!, duplicates P00301442!, P00301443!, FI), designated by Pichi Sermolli (1951: 148). *Nephrodium oligodontum* (Desv.) Desvaux (1827: 261).



*Aspidium aquilinoides* Bolle (1866: 221), non (Desv.) Mett. ex Kuhn (1868). Type:—SPAIN. Canary Islands: Teneriffa, Laguna, *Bory de St. Vincent s.n.* (holotype B-W 19805).

*Dryopteris elongata* (Ait.) A.Chev. var. *simplex* Chevalier (1935: 328). Type:—CAPE VERDE ISLANDS. ‘Archipel des Iles du Cap Vert, Sto. Antão, Covão’, September 1934, *A. Chevalier 45476* (lectotype P00301449, P00483233!), designated by Lobin *et al.* (1998).

*Aspidium elongatum* sensu Webb (1849: 194).

*Dryopteris filix-mas* sensu Tardieu (1946: 335).

*Plants* terrestrial. *Rhizome* short, suberect, to 15 mm in diameter, closely set with roots, crowded persistent stipe bases and scales, the scales castaneous to ferruginous, chartaceous, linear-acuminate, adnate, to 22 x 3 mm, the margins variously set with unicellular capitate glands and pluricellular, mostly uniseriate, filiform outgrowths, the apical cell long, filiform, the scale apex flagellate, terminating in a filiform cell. *Fronde*s crowded, caespitose, to 1.1 m long; *stipes* proximally castaneous, stramineous higher up, proximally adaxially flattened, shallowly sulcate higher up, to 425 mm long, to 7 mm in diameter, densely set with capitate glands, proximally densely scaled, moderately to sparsely scaled higher up, the scales ferruginous to stramineous, chartaceous, to 15 x 2.4 mm, adnate, similar, but slightly smaller than those on the rhizome; *laminae* herbaceous, ovate to broadly ovate in outline, 2-pinnate to 2-pinnate-pinnatifid, to 470 mm long, to 450 mm wide, with up to 10 petiolated pinna pairs, the petiole to 3 mm long, anadromous at the base, catadromous towards the apex; *rachises* stramineous, adaxially sulcate, narrowly winged towards the apex, set with capitate glands, hairs and scales, the glands closely set, clavate, hairs ferruginous, isocytic, pluricellular, scales ferruginous to stramineous, chartaceous, to 4 x 1 mm, adnate, oblong-acuminate, the margins variously set with clavate glands and pluricellular, uniseriate outgrowths; *pinnae* opposite to alternate, proximally widely spaced to overlapping, with 1–3 basal pinna pairs often conspicuously basiscopically developed, inaequilaterally lanceolate, to 250 mm long, to 75 mm wide, with up to 6 petiolated pinnule pairs, the petiole to 1 mm long, adnate and basiscopically decurrent towards the apex, the upper pinnae symmetric, oblong-acuminate; *pinna-rachises* shallowly sulcate adaxially, the sulcus not confluent with that of the rachis, narrowly winged towards the apex, set with glands and hairs similar to those on the rachis, sparsely scaled, the scales to 4 x 2.5 mm, ferruginous, chartaceous, sessile, broadly ovate to subulate, often bullate, cordate to narrowly cuneate, the margins variously set

with oblong and clavate glands which often also occur on scale lamina, and pluricellular, mostly uniseriate outgrowths, often with one or more glands near the base, the apex terminates in a short uniseriate series of cells; *pinnules* opposite to alternate, proximally spaced to slightly overlapping, ovate, oblong-acute to narrowly triangular, to 62 mm long, to 18 mm wide, incised to about 0.5 mm from the costa into oblong-obtuse to oblong-truncate segments, to 9 mm long, to 6 mm wide, shallowly lobed; *lobes* dentate, adaxially sparsely set with capitate glands along the veins, abaxially moderately set with capitate glands along, but often also between veins, glands more closely set at the pinnule base attachment, glands (36–)51(–60)  $\mu\text{m}$  long; *costae* sulcate adaxially, the sulcus not confluent with that of the pinna-rachis, abaxially set with glands, hairs and scales, but smaller than those on the pinna-rachis. *Venation* anadromous to catadromous, evident abaxially, lateral veins in pinnule lobes pinnately branched, forked, or simple, vein branches end in the teeth near the margin. *Stomata* mostly of polycytic type, guard cells (30–)38(–48)  $\mu\text{m}$  long. *Sori* circular, medial to inframedial on predominantly acroscopic vein branch of each pinnule segment, up to 1.5 mm in diameter. *Sporangia* stalk simple or glandular, capsule with (12–)14(–16) indurated annulus cells, epistomium (3–)4(–5)-celled, hypostomium (4–)5(–6)-celled. *Indusia* ferruginous, firmly chartaceous, reniform, up to 1.4 mm in diameter, set with unicellular clavate cells along margin and on surface. *Spores* dark brown, (40–)42(–44) x (24–)28(–34)  $\mu\text{m}$ . *Chromosome number*:  $n = 41$  (Page 1968);  $2n = 82$  (Vida in Widén *et al.*, 1973).

**Distribution and habit:**—*Dryopteris oligodonta* is confined to the Canary and Cape Verde archipelagos. In the Canary Islands it occurs on La Palma, Hierro, La Gomera, Tenerife and Gran Canaria and in the Cape Verde Islands it has been recorded from Santo Antão and Fogo. In Covão on Santo António it occurs mostly above 900 m in moist situations among boulders in the caldera. The species has not been recorded on Fogo since Chevalier found it in 1934. Lobin *et al.* (1998) described the species as rare and critically endangered in the archipelago.

**Etymology:**—From *olig* (Greek) meaning ‘few’, and *odont* (Greek) meaning ‘tooth’, referring to the few teeth on the pinna margins.

**Additional specimens studied:**—CAPE VERDE ISLANDS. Santo António: Covão, September 1934, *A. Chevalier* 45476 (P); São Antão, Covão, 23 September 1934, *A. Chevalier* 45532 (K, P); São Antão, Covão, September 1934, *A. Chevalier* 45533 (COI, K, P); São Antão, Covão. Zwischen Blöcken der Felssturzhalde, gen Paúl. ca. 1250 m, 12 November 1980, *K. Lewejohann* CV-80-093 (BM000800997); São Antão, Blockhalde im Krater von Covão, ca. 1100

m, 12 November 1980, *W. Lobin 2142* (BM000800996, Herb. Lobin); São Antão, Umgebung von Covão, ca. 600–700 m, 13 November 1980, *W. Lobin 2149* (Herb. Lobin); São Antão, Umgebung des Pico da Cruz, 1580 m, 21 November 1982, *W. Lobin 2530* (Herb. Lobin); Cabo da S. Antão, Ribeira do Paul, 25 January 1866, *Lowe s.n.* (K); Ile São Antão, Covão, 26 November 1934, *A. Nobre 4* (COI, K).

**Remarks:**—Confusion existed in the application of the name for this *Dryopteris* species, but this was resolved by Pichi Sermolli (1951). Bolle (1866) remarked that the specimen labelled *Aspidium elongatum* in the Willdenow Herbarium (B-W 19805-01 0), collected by *Bory* in the forests of Laguna on Teneriffe, is most likely the one on which Willdenow based the description on that appeared in his *Species Plantarum* (1810). Bolle based his *Aspidium aquilinoides* on this specimen. I unfortunately have not had access to this specimen, but *A. aquilinoides* Bolle, non (Desv.) Mett. ex Kuhn (1868) is considered synonymous with *D. oligodonta* (Milde 1867, Cardoso 1915, Dansereau 1961, Fraser-Jenkins 1982, Lobin *et al.* 1982). In 1935 Chevalier based *Dryopteris elongata* var. *simplex* on several collections, but was later lectotypified by Lobin *et al.* (1998). Even though some of the collections cited belong to *D. oligodonta*, *Chevalier 45113* does not but represents a different species described as *D. gorgonea* by Roux (2004d).

Roux (2009) erroneously placed *Aspidium canariense* A. Braun as a synonym of *D. oligodonta*, but this taxon, based on *Polypodium elongatum* Ait. is in fact a synonym of *D. aitoniana* Pic. Serm.

Diagnostic of *D. oligodonta* are the frond axes and laminae that are variably set with short capitate glands, a feature not observed in any other African species. Fraser-Jenkins (1982) suggests it may be an ancient relict species. *Dryopteris oligodonta* is similar to *D. gorgonea* J.P. Roux, but differs in the shorter clavate glands [(36-)51.3(-60) vs. (50-)68.5(-98)  $\mu\text{m}$ ] and smaller stomata [(30-)37.5(-48) vs (42-)53.3(-64)  $\mu\text{m}$ ] (Roux 2004d: 33). *Dryopteris oligodonta* is diploid (Fraser-Jenkins 1982), whereas the larger stoma size of *D. gorgonea* suggests it being tetraploid.

INSERT FIGURE 21

**19. *Dryopteris pentheri* (Krasser) Christensen** (1905: 284). Figs. 5X & Y, AA & BB; 8J & Ja; 12A; 22.

*Nephrodium pentheri* Krasser (1900: 5). Type:—SOUTH AFRICA. 'Orange Free State: Van Reenens Pass', 4 March 1895, *P. Krook s.n., sub Pl. Penther 36* (lectotype W8042!, duplicates BM!, W!), designated by Pichi Sermolli (1984: 329).

*Dryopteris filix-mas* Schott subsp. *elongatum* sensu Bonaparte (1923: 208), non *Dryopteris elongata* (Wall. ex Hook.) Kuntze (1891: 811), nec *D. elongata* (Sw.) Chevalier (1935: 328).

*Dryopteris filix-mas* (L.) Schott var. *elongata* sensu Brause (1910: 3), non *Dryopteris elongata* (Sw.) Sim (1915: 104, 105).

*Dryopteris inaequalis* sensu Schelpe (1970: 221, 222).

*Plants* terrestrial or epilithic. *Rhizome* short-decumbent, sparsely and irregularly branched, to 20 mm in diameter, set with roots, closely spaced stipe bases and scales, the scales stramineous to ferruginous, chartaceous, broadly attached, linear, oblong or narrowly ovate, to 37 x 6 mm, truncate, the margins irregularly set with long, twisted, pluricellular filiform outgrowths, the scale apex filiform, twisted. *Fronde*s caespitose, erect to arching, to 1.8 m long; *stipes* proximally castaneous, brown to stramineous higher up, proximally adaxially flattened, shallowly sulcate higher up, to 485 mm long, to 10 mm in diameter, proximally densely scaled, the scales higher up fugaceous, stramineous to ferruginous, chartaceous, the larger scales to 40 x 7 mm, broadly attached, the smaller scales sessile or short-stalked, narrowly lanceolate to filiform, cordate to cuneate, the margins irregularly set with long, twisted, pluricellular filiform outgrowths and often also with scattered glands, the scale apex filiform; *laminae* anadromous, catadromous towards the apex, herbaceous to firmly herbaceous, 2-pinnate to 3-pinnate, ovate to ovate-triangular, to 780 mm long, to 460 mm wide, with up to 16 petiolated pinna pairs; *rachises* stramineous, adaxially shallowly sulcate, becoming narrowly winged towards the apex, initially moderately scaled, the scales fugaceous, broadly attached or short-stalked, narrowly lanceolate to linear, to 7 x 2 mm, cuneate, the margins irregularly set with long, filiform outgrowths, often also with scattered glands, the scale apex filiform, twisted; *pinnae* petiolate, the petiole to 18 mm (rarely to 38 mm) long, the basal pinna pair inaequilaterally ovate to narrowly ovate, narrowly lanceolate to oblong-acuminate towards the lamina apex, to 315 mm long, to 185 mm wide, to 2-pinnate, the basal pair the longest, mostly basiscopically developed, subopposite to alternate, basally widely spaced, often somewhat imbricate higher up, with up to 9 petiolated pinnule pairs; *pinna-rachises* adaxially shallowly sulcate, the sulcus confluent with that of the rachis, pronounced abaxially,

narrowly winged distally, abaxially moderately to sparsely set with scales and hairs, the scales and hairs stramineous to ferruginous, chartaceous to membranous, broadly attached or short-stalked, to 5 x 1.6 mm, narrowly to broadly cuneate, the margins irregularly set with long pluricellular, filiform outgrowths, the scale apex filiform, twisted, the hairs are of three types, 1) unicellular cylindrical glands, 2) bicellular hairs with straight or oblique transverse walls, and 3) pluricellular simple or branched, mostly isocytic hairs often bearing a single gland near the base; *pinnules* petiolate, the petiole to 3 mm long, the pinnules symmetric to inaequilaterally lanceolate to oblong-acuminate, basiscopically decurrent, 1-pinnate to lobed, the acroscopic pinnule on the basal pinnae to 90 mm long, to 35 mm wide, basiscopic pinnule on the basal pinnae to 112 mm long, to 42 mm wide, widely spaced or imbricate; *costae* adaxially shallowly sulcate, pronounced abaxially, narrowly winged, the wing continuous with that of the pinna-rachis, variously set with scales, isocytic hairs and 2-celled hairs; *segments* widely spaced to imbricate, ovate to oblong-obtuse, to 22 mm long, to 9 mm wide, basiscopically decurrent, lobed; *lobes* serrate, adaxially glabrous, with oblong glands along and between the veins, or with a few pluricellular mostly isocytic hairs along the costules, abaxially sparsely set with cylindrical glands (60–)137(–260)  $\mu\text{m}$  long, 2-celled hairs, and isocytic and/or moniliform hairs, those near the segment base often with a gland near the base, and filiform scales, the scales short-stalked, the stalk often with one or more glandular cells, hairs and scales mostly occurring along the costules and veins. *Venation* anadromous, becoming catadromous towards the lamina and pinna apex, pinnately branched in the segments, the vein branches pinnately branched, forked or simple near the apex, evident, ending in the teeth near the margin, the endings slightly enlarged and often conspicuous adaxially. *Stomata* of the anomo- and polocytic types, guard cells (34–)53(–72)  $\mu\text{m}$  long. *Sori* circular, to 1.8 mm in diameter at maturity, medial on the predominantly anadromous vein branches, discrete, essentially uniseriate in the segments; *sporangia* stalk simple, or with one or more glandular cells, but mostly with a long multicellular, uniseriate hair, the capsule with (11–)13(–20) indurated annulus cells, epistomium (3–)6(–8)-celled, hypostomium (3–)6(–8)-celled. *Indusia* persistent, pale brown, firmly herbaceous, reniform, to 1.8 mm in diameter, the margins entire, repand, or erose, (rarely glandular along margin), often strongly revolute. *Spores* ellipsoidal, monolete, perispore folded into tubercles or reticulate ridges, finely rugose to ruminant, (38–)45(–60) x (27–)31(–40)  $\mu\text{m}$ . *Chromosome number*:  $2n = \text{ca. } 164$  (Vida, in Widén *et al.* 1973).

**Distribution and habitat:**—*Dryopteris pentheri* is widespread in the eastern and western mountainous regions of sub-Saharan Africa, occurring in Bioko, Burundi, Cameroon, the Democratic Republic of the Congo, Ethiopia, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mozambique, Nigeria, Réunion, Rwanda, São Tomé, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe. The species occurs from near sea-level in the southern Cape to 2425 m in Lesotho. Although predominantly confined to moist forests, at higher elevations it occurs in open habitats. In these habitats, however, plants are mostly confined to boulder bases and rock crevices on ridges and along mountain streams. *Dryopteris pentheri* also inhabits disturbed sites, such as road cuts and old pine plantations. In grassland habitats the species is exposed to regular burning but this appears to have little effect on the subterranean rhizomes.

**Etymology:**—The epithet honours Arnold Penther (15 October 1865–6 April 1931), zoologist, who collected in South Africa and Zimbabwe between 1894–1895.

**Additional specimens studied:**—EQUATORIAL GUINEA. Bioko (Fernando Po): Bioko North, Pico, 2090 m, 2 January 1976, *G. & U. Benl FP 357a* (M); Pico, 2650 m, 2 January 1976, *G. & U. Benl FP 363* (M, US3341060); cumbre del Pico Basilé, paradera-matorral con brezos, 2950 m, 3 July 1986, *J.F. Casas 10144* (MA555978); cumbre del Pico Basilé, 2950 m, pradera-matorral con brezos, 3 July 1986, *J. Fernández Casas 10144* (K); Pico Basilé (Pico de Santa Isabel), 1 March 1947, *E. Guinea 2771* (K, MA); Pico Basilé (Pico de Santa Isabel), 1 March 1947, *E. Guinea 2773* (MA412195); Pico Basilé (Pico de Santa Isabel), ±2900 m. s. m., 1 March 1947, *E. Guinea 2775* (MO); Pico Basilé (Pico de Santa Isabel), 1 March 1947, *E. Guinea 2853* (MA186566); Pico Basilé, borde de carretera, 2770 m, 23 October 1999, *R. Pérez-Viso 1465* (MA638487). Loco incerto: Bioko, *Mann, G. s.n.* (K).

BURUNDI. Bubanza Province: Bubanza, Musigati, route de Bubanza, 1300 m, 23 November 1967, *J. Lewalle 2366* (BR). Kayanza Province: Kayanza, 1900 m, *J. Lewalle 6623* (BR). Muramvya Province: à 4 ou 5 km de Bugarama, la route de Gitega, ca. 1900 m, 13 May 1988, *Saintenoy 65* (BR).

CAMEROON. Central Region: Mont Ngoro (soit Ngoleo dans l'appellation locale) dans le Massif Ngoro, environ 35 km nord de Bafia, 1500—1600 m, *D. Dang 256* (YA). Northwest Region, Oku-Mt, Nordosthang, ca. 2100 m, 2 January 1971, *G. & U. Benl Ka 70-71/133* (M); Bui, Elak, 2800 m, 30 October 1996, *M. Cheek 8536* (YA); piste du village d'Okou au mont Okou,

3008 m, 45 km SSO de Nkambe), *R. Letouzey* 8923 (YA); piste du village d'Okou au mont Okou, 3008 m, (45 km SSO de Nkambe), en forêt de *Podocarpus milanjanus*, *Nuxia congesta*, *Syzygium staudtii* etc., 14 July 1967, *R. Letouzey* 8939 (K); on forest floor near lake Oku, 2300 m, April 1986, *D.W. Thomas & H.L. Mcleod* 5988 (MO, YA); forest, near Lake Oku, 6°11'N, 10°28'E, 2300 m, April 1986, *W.W. Thomas & H.L. Mcleod* 6039 (MO). Southwest Region: Mt Cameroon, Johann-Albrechtshütte, 2850 m, 30 January 1962, *F.J. Breteler et al.* MC14 (K); Mt Cameroon, near Johann-Albrechtshütte, ca. 2800 m, in seasonally moist gully, 1 February 1962, *F.J. Breteler et al.* MC92 (K, LISC, P); Mt Cameroon, above hut 2, below 1st ridge, SE side, 3040 m, 22 April 1947, *H. Gregory* 109 (K); Mt Cameroon, above Musake, 1980 m, 4 April 1937, *J. Hutchinson & C.R. Metcalfe* 27 (K); Mt Cameroon, 3340 m, 6 April 1937, *J. Hutchinson & C.R. Metcalfe* 60 (K); Cameroon Mtn., SW of hut no. 2, *R.W.J. Keay FHI* 28604 (BM000787475); Mt Cameroon, Tongo Camp, 2030 m, *T.D. Maitland* 1046 (K); Mt Cameroon, Meyer Crater, amongst boulders, *T.D. Maitland* 1214 (K); Mt Cameroon, 2130 m, *G. Mann* 1369 (K); Cameroon Mtn, 2130–3040 m, December 1862, *G. Mann* 2053 (K); Mt Cameroon, NW de Buea, 2780–3000 m, 31 March 1981, *W. Meijer* 15419 (YA); Mt Cameroon, 3040 m, 17 November 1927, *F.W.H. Migeod* 185 (K); Mt Cameroon, oberhalb Buea, Grassland-Region, 2800 m, *J. Mildbraed* 10854 (B20 0056325, K); Kamerun-Berg oberhalb Buea, Graslang Region über dem Walde, 2800 m, 22 December 1928, *J. Mildbraed* 10876 (B20 0056326, B20 0056327, K); Victoria, Mt Cameroon, Mann's Spring, below Liwonge, fringe of montane forest, 28 March 1948, *P.W. Richards* 4249 (K); Victoria, Mt Cameroon, Mann's Spring, Jongo, moist montane forest, 3 April 1948, *P.W. Richards* 4381A (FHI, K); Mt Cameroon, Musake, common in shade, 1825 m, 14 January 1932, *M. Steele* 11 (K); Mt Cameroon, NE side of the mountain, along road to VHF radio station, 2615 m, 30 October 1963, *R.M. Tryon & A.F. Tryon* 6510 (K). Loco incerto: Cameroon, *M.H. Kingsley s.n.* (K).

DEMOCRATIC REPUBLIC OF THE CONGO. Katanga Province (Shaba Meridional): route Mwashya-Koni km 1 Riviere Kalombe, foret galarie, 970 m, *A. Bodenghien & F. Malaisse* 2102 (PRE).

ETHIOPIA. Addis Ababa Region: Lake Wonchi, outer rim of caldera, 1030 m, in deep shade in relatively undisturbed *Erica arborea/Philippia abyssinica* bushland, 18 January 1974, *M.G. Gilbert & B. G.-E. Tewolde* 3278 (K). Amhara Region: Choké Mts, Gojjam, vicinity of the upper Ghiedeb Valley, 10°40'N, 37°50'E, 6 August 1957, *I.M. Evans* 99 (K); Simien, Mindigabsa, near

river, 16 November 1952, *H. Scott* 266 (K). Oromia Region: Bale, Mendoyu Awraja, in Hareenna Forest, ca. 1 km S of Rira village, 2800 m, *Hagenia-Schefflera-Hypericum-Rapanea* forest, 17 August 1986, *T. Mesfin* 5488 (ETH); Bale Mts, above Rira, upper montane *Philippia-Hagenia*-forest on 20-40° N-facing rocky slope, 3400 m, 9 February 1990, *G. & S. Miehe* 2173 (K); Bale Mts, above Rira, W of Aduka range, 3560 m, *Philippia*-woodlands and thicket, SW-facing slope, 12 February 1990, *G. & S. Miehe* 2412 (K). Southern Nations, Nationalities and Peoples Region: at foot of Gecchia waterfall, Catholic Mission, 3 km S of Bonga, 36°13'E, 07°15'N, 1800 m, 8 January 1972, *J. Ash* 1482 (K); foresta tra Bonga e Uota, 9 March 1939, *G. Cei* 20 (FI); 43 km S of Agere Selam, on the road to Kebre Mengist, 2650 m, *Schefflera abyssinica-Hagenia abyssinica* forest, *I. Friis et al.* 734 (ETH, K); E side of Ballata Forest, slightly shaded damp rock slope, 2070 m, 9 September 1962, *Reading University* 77 (K).

GUINEA. Kindia Region: Médina, Mjuelandé, 23 June 1958, *J.G. Adam* 14612 (P). Labé Region: Fouta-Djallon, Mont Lowa, 'bis mali', 1500 m, September 1954, *R. Schnell* 7256 (K).

KENYA. Central Province: Thika East Distr., Kimakia Forest Station, Gatare Road, ca. 1 mile from Kimakia Forest Station, 2500 m, 14 February 1970, *R.B. Faden & A. Evans* 70/55 (K). Coast Province: Taita-Taveta Distr., Taita-Taveta (Taita) Distr., Taita Hills, sunny slope along the road from Werug to Mgange, ca. 1650 m, 19 November 1969, *P.R.O. Bally et al.* 2972 (PRE); Taita Hills, Weruga, roadside banks and ditches, 1760 m, *R.B. Faden & A. Evans* 69/884 (K); Taita Hills, Ngangao Forest, base of Ngangao, 1800–1900 m, *R.B. Faden* 71/245 (US). Eastern Province: Igembe South Distr. (Meru Distr.), Nyambeni Hills, 1 mile N of Maua on Maua-Kangeta road, roadside forest, 1550 m, 31 May 1969, *R.B. Faden et al.* 69/649 (BOL, K); Machakos Distr., Nzau Mt, evergreen forest patch, 1690 m, 16 February 1969, *R.B. Faden & A. Evans* 69/191 (BOL, K). Rift Valley Province: Sotik Distr. (Kericho Distr.), Sotik, by stream in deep shade, February 1950, *H.D. van Someren* 315 (K); Sotik, by stream in deep shade, February 1950, *H.D. van Someren* 316 (K); Trans-Nzoia West Distr., Kapolet, Cherangani, 2010 m, forest in deep valley with high rainfall, August 1963, *Tweedie* 2681 (K, NBG); Cherangani, Kiptoi farm, 1975 m, in forest near grassy swamp, November 1971, *Tweedie* 4180 (K); Uasin Gishu (Trans-Nzoia) Distr., Moi's bridge (Hoey's Bridge), 15 August 1963, *H. Smith & S. Paulo s.n.* (K). Loco incerto: Kenya, in deep hole, *R.B. Faden & A. Evans* 69/211 (K); pr. 'West Kenia Forest Station', ad marginem silvae montanae, 2300 m, 30 December 1921, *R.E. Fries & T.C.E. Fries* 547 (BM).



LESOTHO. Leribe Distr.: —2828 (Bethlehem) Leribe, slopes, shady spots (–CC), *A. Dieterlen* 283 (NBG, PRE, SAM); Leribe, *A. Dieterlen* 283a (PRE); Leribe, Mtn slopes, under rocks, *A. Dieterlen* 695 (PRE); Leribe, *A. Dieterlen s.n.* (SAM7065). Maseru Distr.: —2927 (Maseru) Maseru, Devil Mountain, in deep rock crevices near summit (NW aspect), 1828 m (–AD), *A.P. Bowmaker* 61 (BOL); Lancer's Gap waterfall, 1798 m (–BC), *A.P. Bowmaker* 31 (BOL); Roma, behind hospital near dam under S-facing pediment cliff, 1675 m, May 1977, *M. Schmitz* 7600 (K, PRE); Roma, in hole at foot of cave sandstone cliff, 1900 m, April 1977, *M. Schmitz* 7382 (PRE); Roma, Popa Valley, at base of W-facing Clarens sandstone boulder on mountain slope, 1690 m, 19 February 2006, *J.P. Roux* 3835 (NBG); Roma, rocky outcrop near Thorns, S side of river, February 1976, *M. Schmitz* 6584 (PRE); Roma, Roma Valley, S-facing slope to left of rock-fall, 1612 m, 20 February 2006, *J.P. Roux* 3860 (NBG). Qacha's Nek Distr.: —2929 (Underberg) Sehlabathebe National Park, ca. 2425 m (–CC), *F.K. Hoener* 1719 (BOL, MO). Sine loco: Lesotho, 1861, *T. Cooper* 963 (K).

MALAWI. Northern Region: Chitipa Distr., Nyika Plateau, Chelinda, in ditch behind Chelinda Lodge, in valley going down to Chelinda, ca. 2130 m, 31 December 1968, *A. Berrie* 194 (K); Nyika Plateau, 2 miles from Zambia Rest House on path to Chipopma Waterfall, in crevices of rock outcrop with other vegetation, 27 November 1967, *H.M. Richards* 22771 (K); Nyika National Park, Chelinda, Demo Bridge/River area, montane grassland, 2217 m, 29 March 2000, *C. Willis* 19 (PRE). Southern Region: Blantyre Distr., Chiradzulu Mtn, 500 m, 24 September 1944, *F.M. Benson* 461 (PRE); Shire highlands, near Blantyre, June 1887, *J.T. Last s.n.* (K, a only); Mulanje Distr., Mt Mulanje foot, Limbuli Estate, on road-banks and among rocks, 914 m, 15 November 1988, *J.D. Chapman* 9411 (MO, PRE); Limbuli Estate, in tall grass at edge of woodland, 950 m, 26 July 1984, *I.F. LaCroix* 3170 (PRE); Zomba Distr., Zomba Plateau, Mulungusi River, at roadside and steep bank of stream, ca. 1600 m, 18 July 1967, *A. Berrie* 167 (K). Loco incerto: Malawi, 1940, *Erens* 557 (PRE).

MOZAMBIQUE. Sofala Province: Gorongosa Distr., Gorongosa Mtn, Morambodzi falls, forest undergrowth near waterfall, 823 m, *E.A.C.L.E. Schelpe* 5462 (BOL).

SÃO TOMÉ. Ins. St. Tome, 1950 m, 1885, *A. Moller* 35 (US).

SOUTH AFRICA. Eastern Cape: —3028 (Matatiele) Maclear, farm Woodcliffs, hillside opposite house, 1500 m (–CC), 6 February 1992, *A. Abbott* 5653 (PRE). —3029 (Kokstad) Mzimkhulu Distr., E of Lubhukwini vlei, NE of Nsikeni Mtn (–AB), 29 February 1992, *A.M.*

*Ngwenya 980* (NH, PRE). —3126 (Queenstown) Molteno (–AD), *H.G. Flanagan 1683* (SAM). —3127 (Lady Frere) Engcobo Mtn (–BB), January 1896, *H.G. Flanagan 2713* (PRE). —3225 (Somerset East) Boschberg (–DA), *MacOwan 2252* (K); Somerset East, Boschberg, May 1869, *MacOwan s.n.* (NBG, SAM24756.). —3226 (Fort Beaufort) Hogsback Forest Reserve, 800 m (–DB), 29 March 1972, *K.Å. Dahlstrand 2908* (MO); Hogsback Forest Reserve, 750 m (–DB), 29 March 1972, *K.Å. Dahlstrand 2910* (MO); Hogsback Forest, on main road to Alice, in open, grassy patch in forest, 1100 m (–DB), 30 January 1974, *W.B.G. Jacobsen 4568* (FR). —3227 (Stutterheim) Toise River, on bare hillsides, 910 m (–AD), September 1891, *T.R. Sim 479* (PRE); Amatola Mts, near Hogsback, along Hogsback Pass, 1110 m (–CA), 9 November 1984, *P.B. Phillipson 939* (MO); Kingwilliamstown, Pirie Forest (–CC), 1891, *B.H. Holland s.n.* (NBG); Amabele (–DA), September 1940, *N. Fisher s.n.* CH5521 (PRE). Loco incerto: Kaffraria, 1860, *T. Cooper 1421* (NY). Free State: —2828 (Bethlehem) farm Nonnashoek 1760. Talus slope below Molteno Sandstone, ca. 1640 m (–AB) 24 June 1969, *J.C. Scheepers 1804* (PRE); Clarence (–CB) November 1917, *E.E. van Hoepen 18228* (PRE); Witsieshoek, wooded ravines of Qua Qua, 1825 m (–DB), March 1896, *J. Thode s.n.* STE6348 (NBG). —2829 (Harrismith) Golden Gate, Katedraalgrotkloof (–AC), *L.F. Rossouw 508* (BOL); Harrismith, Rensburgskop, in shallow dongas, 1830 m, *A. van der Zeyde s.n.* (NBG); Van Reenen, farm Bosch Hoek, on deeply shaded moist forest floor (–AD), 12 December 1980, *J.P. Roux 894* (NBG, PRE); Harrismith, farm Waterfall, 30 December 1981, *J.P. Roux 1063* (NBG). Gauteng: —2527 (Rustenburg) Krugersdorp Distr., Jack Scott Private Nature Reserve, cliff forest (–DC), 5 February 1961, *M.J. Wells 2451* (PRE). —2528 (Pretoria) Pretoria Distr, Donkerpoort (–BA), 4 May 1937, *A.M. Bottomley & E.M. Doidge s.n.* CH4930 (PRE); Wolwekloof Valley (–CD), 23 February 1929, *A.M. Bottomley s.n.* CH2786 (PRE); Pretoria Distr., Donkerhoek, 25 April 1937, *J.E. Repton 1032* (PRE). —2627 (Potchefstroom) Doorn Kop (–BB), *Burke s.n.* (K). KwaZulu-Natal: —2729 (Volksrust) Kranzkop, ca. 910 m (–DA), *Robinson 13* (K); Newcastle/Memel Distr., short closed woodland (–DD), 6 March 1989, *R. Smith 1066* (MO). —2828 (Bethlehem) Royal Natal National Park, Devil's Hoek (–DB), *D. Edwards 534* (NU); Cascades, *E.A.C.L.E. Schelpe 1265* (NU, PRE); Royal Natal National Park, near hut, Mont-aux-Sources, *E.A.C.L.E. Schelpe 1338* (NU); Royal Natal National Park, Gudu Forest, 1520 m, 2 April 1946, *E.A.C.L.E. Schelpe 1459* (NU); Royal Natal National Park, Gudu Forest, *E.A.C.L.E. Schelpe 1510* (NU); Royal Natal National Park, 1520 m, April 1956, *J.L. Sidey 90* (NU); Mont-aux-Sources (–DD), 20 April 1919, *A.O.D. Mogg*

5300 (PRE). —2829 (Harrismith) Van Reenen (–AD), *Krook 36* (BM); Van Reenen's Pass, 1700–1900 m, March 1894, *sine coll. s.n.* (NY); Oliviershoek Pass, farm Klawervlei (–CA), 11 December 1980, *J.P. Roux 875* (NBG); Cathedral Peak Forest Research Station (–CC), *D.J.B. Killick 1133* (NU); Cathedral Peak Hotel, to Mlambonja (Umlambonja) Path, close to hotel, 1700 m, *P. Goetghebeur 4536* (PRE); Cathedral Peak, along road to the Neck, 9 March 1990, *J.P. Roux 2300* (NBG); Spitskop, Emangweni, open hillsides by stream, 1520–2130 m (–DC), October 1890, *J. Thode s.n.* STE27319 (NBG). —2831 (Stanger) prope Maphumulo (–AA), 1865–1866, *S.L. Abraham 20* (NY). —2929 (Underberg) Bergville, Injisuthi area, rock outcrop on outlying spur of mountains, 1520 m (–AB), July 1956, *E. Esterhuysen 26031* (BOL); Bergville, Injisuthi area, forest in kloof, 1520 m, July 1956, *E. Esterhuysen 26035* (BOL, K, MO, NBG, US2293830, US2293831, US2293832, US2293833); Champagne Castle, on way to the Sphinx from the hotel, 1620 m, 25 April 1989, *W.B.G. Jacobsen 5763* (FR); Giants Castle Nature Reserve, 22 January 1991, *M.K.P. Meyer 8014* (PRE); Giants Castle Camp, under sandstone rock overhang in grassland, ca. 1500 m, 18 August 1979, *B.S. Parris & J.P. Croxall 7283* (K); Giants Castle, 1980 m (–AD), November 1914, *R.E. Symons 135* (PRE); Kamberg, 'Game Pass' (–BC), *C. Gordon-Gray 86* (NU); Mpendhle Distr., Mulangane ridge, above Carter's Nek, 2130–2220 m, 2 December 1983, *O.M. Hilliard & B.L. Burt 17026* (K, NU); Mulangane ridge, above Carter's Nek, 2133–2225 m, *O.M. Hilliard & B.L. Burt 18410* (BOL, K, PRE); Kamberg, Game Pass farm, 11 January 1990, *R. Williams 749* (NH); Drakensberg Gardens State Forest, near Mlambonja River amongst sandstone boulders (–CA), *E.J. van Jaarsveld, 6487* (NBG); Cobham Forest Reserve, 'Lakes' cave area, ca. 2133 (–CB), *J. Manning, O.M. Hilliard & B.L. Burt 15992* (BOL, NU); Giants Cup Trail, Bathplug Cave, between Polela and Mzimkulwana Huts, ca. 1800 m, 22 June 1982, *A. Nicholas & N. van den Berg 1317* (PRE); upper tributaries of S of Mkomazi River, 2255 m, *O.M. Hilliard & B.L. Burt 15869* (BOL, NU); Drakensberg Garden (–CC), *P. Thomas 82* (NU); Loteni Nature Reserve (–DA), *A.J. Phelan 138* (NU); Loteni Nature Reserve, *A.J. Phelan 393* (NU); Impendhle Distr., Loteni Nature Reserve, on rock at edge of stream below waterfall, 1550 m, 20 June 1979, *A.J. Phelan 397* (NU); Impendhle Distr., just W of Ivanhoe Estate on road to Impendhle, 1538 m (–DB), 13 December 1985, *W.B.G. Jacobsen 5691* (FR); Impendhle Distr., Hazelmere, 2 km S of Everglades on road to Boston at the foot of a bank of rocks in half shade, 1462 m, 19 December 1985, *W.B.G. Jacobsen 5712* (FR); Hlabeni Forest, frequent on road banks in *Eucalyptus* forest (–DC), 5 March 2002, *J.P. Roux 3365* (NBG); Polela Distr., farm 'Sunset' (–

DD), *M.A. Rennie s.n.* (NU). —2930 (Pietermaritzburg) Caversham (–AC), 10 October 1918, *A.O.D. Mogg 1483* (PRE); Caversham, 15 October 1918, *A.O.D. Mogg 1488* (PRE); Lidgetton, 13 February 1920, *A.O.D. Mogg 6704* (PRE); Howick, near Umgeni River, 20 November 1941, *H.B. Rycroft 505* (BM000787474); Karkloof, 'Braco', *E.A.C.L.E. Schelpe 5137* (BOL); Howick Distr., farm Mbona 13856, on road Howick-Rietvlei, 11 km S of Rietvlei at edge of montane forest in half shade, 1460 m (–AD), 29 September 1978, *W.B.G. Jacobsen 4977a* (FR); upper reaches of Mpise River below area where Baptism takes place (–BB), *E.J. van Jaarsveld, & A. Jacobs 5911* (BOL); upper reaches of Mpise River below area where Baptism takes place, *E.J. van Jaarsveld & A. Jacobs 5912* (BOL); Natal Botanic Garden, Pietermaritzburg, forest along Umsindusi River (–CB), *S. Schultz 126* (NBG); Bei Pietermaritzburg, October 1883, *F. Wilms 2423* (K); above Deepdene, Richmond, 760 m (–CD), November 1864, *J. Sanderson 102* (K). —2931 (Stanger) 9 km from Kwasizabantu to Kranskop, S-slope of mountain (–AA), *E.J. van Jaarsveld & B. Lang 5113* (BOL, MO). —3029 (Kokstad) Kokstad, Mt Currie (–CB), *D. Edwards 40* (NU); Kokstad, Mt Currie, *E.M. Edwards 42* (NU); Kokstad, Mt Currie, 1520 m, 28 January 1940, *A.G. McLoughlin 734 s/13* (BOL); Mt Currie Nature Reserve, *N. Crouch 518* (NU); Kokstad, Palmiet, *L.E. Taylor 5482* (NBG). Loco incerto: Drakensberg, July 1937, *A.M. Bottomley s.n.* CH5022 (PRE); Natal, February 1867, *M.I. McKen 30* (K); Natal, *J. Sanderson s.n.* (K). Limpopo: —2230 (Messina) Soutpansberg, Entabeni (–CC), *E.A.C.L.E. Schelpe 6018* (BOL); Entabeni Forest, near guest house, main forest (–CD), 2 February 1981, *E.J. van Jaarsveld 6063 & 6065* (BOL). —2329 (Pietersburg) Soutpansberg, Mountain Inn, occasional in shade in dense stream bank shade, 1220 m (–BB), *E.A.C.L.E. Schelpe 4095* (BOL); 2329 (Pietersburg) Woodbush, Mountain Home farm (–DD), January 1934, *A.O.D. Mogg s.n.* CH4749 & CH4750 (PRE); Houtboschberg, *W. Nelson 472* (PRE); Pietersburg, Houtboschdorp, 7 June 1961, *D. van Vuuren, 1201* (PRE). —2330 (Tzaneen) Woodbush (–CC), November 1909, *T.J. Jenkins 795* (PRE); Magoebaskloof, near De Hoek Forest Station, mountain forest, *E.J. van Jaarsveld, 6078* (BOL, MO). —2430 (Pilgrim's Rest) Lekgalameetse Nature Reserve, The Downs, Seteleng towards Cypress Point, 1580 m (–AA), 21 January 1986, *M. Stalmans 991* (MO, PRE); Hoogste Punt farm, Makwedi, 3 September 1936, *A.O. Mogg s.n.* CH4884 (PRE); Farm Forest Reserve 8KT, *F. Venter 10978* (NU). Mpumalanga: —2430 (Pilgrim's Rest) Graskop area, Erasmus Kop, in dryish forest from 970–1520 m (–DB), January 1946, *W.N.B. Hardcastle 60* (PRE); Mariepskop, frequent in moist evergreen forest, shaded (–DB), 28 February 2002, *J.P. Roux 3256* (NBG); Ohrigstad Nature

Reserve, gully forest, 1670 m (–DC), 8 December 1970, *N. Jacobsen 1594* (PRE); Ohrigstad Nature Reserve, in gully forest and scrub, in deep shade, 1676 m, 8 December 1970, *N. Jacobsen 4248* (FR); Mount Sheba Nature Reserve, Kearney Spruit, 1524 m, 7 June 1972, *W.B.G. Jacobsen 4458* (FR); Ohrigstad Dam Nature Reserve, open glass veld to kloof, 22 September 1986, *Krynauw 1272* (PRE); in sylvis Drakensberg prope Pilgrim's Rest gold fields (–DD), December 1874, *McLea 3031, p.p.* (K); occasional on floor of woodland, *E.A.C.L.E. Schelpe 6102* (BOL); Blyde Forest Reserve, tributary of Lisbon River, N of Driekoppe, 1220 m, 15 May 1972, *W.B.G. Jacobsen 4373* (FR, PRE). —2530 (Lydenburg) Dullstroom Distr., farm Die Berg 71JT, on N-facing montane grassland slope, in sunlight, 2250 m (–AA), March 1981, *N. Jacobsen 5260* (FR); Lydenburg Distr., Klipspruit (–AB), August 1880, *W. Nelson 386* (K); Lydenburg, farm Knapdaar, in narrow montane cleft, amongst *Impatiens*, 1980 m (–AD), 24 April 1981, *W.B.G. Jacobsen 5296* (PRE); 18 km from turnoff to Lydenburg on Lydenburg-Machadodorp Road, Basfontein Farm, opposite the Braam Raubenheimer Dam, Marantan Hiking Trail, hill slope, 18 April 1997, *E.D. Marinus 1* (PRE); gorge on the forestry area at Tweefontein, Sabie (–BB), February 1932, *V.A. Wager 45* (PRE); Witklip, along stream, 1030 m (–BD), 18 October 1974, *J.P. Kluge 609* (PRE); Nelspruit Distr., Rooiwal (–DD), 17 July 1934, *M. Bosman s.n.* CH4781 (PRE). —2531 (Komatipoort) Lomati Falls and kloof behind Barberton (–CC), 1 August 1932, *V.A. Wager 152* (PRE). —2630 (Carolina) Marieriestad, kloof (–CA), *R. Pott 4846* (BOL, PRE). Western Cape:—3318 (Cape Town) Table Mountain above garden (–CD), March 1882, *Blafare s.n.* (K); Paradise, 1855, *Rawson s.n.* (SAM24762); Cape Town, Table Mountain, Newlands Forest, Porcupine trail. In seasonally moist S-facing soil bank in forest 13 May 2003, *J.P. Roux 3815* (NBG); Stellenbosch, Jonkershoek, Langrivier (–DD), *O. Kerfoot 5789* (BOL). —3322 (Oudtshoorn) Swartberg Pass in small sheltered ravine, 1400 m (–AC), *C.J. Geldenhuys 974* (BOL); Bloukrans Pass, occasional on roadside in forest, 122 m (–BA), *E.A.C.L.E. Schelpe 4339* (BOL); George, 304 m, in old pine plantations (–CD), *J.B.C. Cameron 69* (BOL); George, Silverriver Valley on Old Knysna road, 152 m (–DC), *J.B.C. Cameron 87* (BOL). *Loco incerto, sine loco, Barkly s.n.* (SAM); Cape of Good Hope, 1862, *T. Cooper 953* (K); *sine loco, Gueinzius s.n.* (K); *sine loco, C.B.S., Harvey, s.n.* (K).

SOUTH SUDAN. Eastern Equatoria State: Imatong Mts, Golo, near the bridge across Ngairifi River, upland rain forest with *Albizia gummifera*, 1750 m, 9 November 1980, *I. Friis & K.*

*Vollesen 102* (K); Thallanga Forest, Katire, sides of steep ravine cut by watercourse through dense depression forest, 1520 m, 1 January 1950, *K.N.G. MacLeay 378* (K).

SWAZILAND. Hhohho Distr.: —2531 (Komatipoort) Pigg's Peak, Kings Forest, ca. 1520 m (–CD), *Compton, R.H. 27829* (NBG, SDNH). —2631 (Mbabane) Malolotja Nature Reserve, path through forest opposite Environmental Education Centre, 1478 m (–AA), 2 May 1990, *K.P. Braun 948* (PRE); Nkwalini, proposed Mbabane landfill site SSE from quarry, below spur of rock running E, 1494 m (–AC), 23 March 1993, *K.P. Braun 1396* (PRE). Manzini Distr.: —2631 (Mbabane) Ntondozi summit, frequent in seasonally moist forest patch along drainage line, 1274 m (–CA), 13 May 2002, *J.P. Roux 3579* (NBG). Shiselweni Distr.: —2631 (Mbabane) Mtungulube area, SE-facing wooded ravine, frequent in deep shade on forest floor and along streambanks, 1190 m (–CC), 16 May 2002, *J.P. Roux 3652* (NBG).

TANZANIA. Iringa Region: Livingstone Mts, steep E-facing slope of Ligala Mts along foot trail from mission at Madunda, at foot of vertical rock wall in transition between woodland and montane forest, 2140 m, 9°51'S, 34°27'E, 13 February 1991, *R.E. Gereau & C.J. Kayombo 4003* (K, MO); E flank of Livingstone Mts, 8.6 km N of village offices in Mbwila where Luepele River (small tributary of Luana River) crosses road from Mlangali to Ludewa, 1500 m, 9°54'S, 34°32'E. 20 March 1991, *R.E. Gereau & C.J. Kayombo 4416* (K, MO); Njombe Distr., Valley below Milo Mission, 1800 m, in loam soil under trees by Lwimo River, 30 January 1961, *H.M. Richards 14047* (K); Mbwila Village, Nyamlunga Peak in Livingstone Mts, 2080–2140 m, 13 March 1991, *H. Suleiman & M.J. Fundi 100* (K, MO). Kigoma Region: Kasye Forest, 900 m, 23 March 1994, *S. Bidgood et al. 2920* (K); Mpanda Distr., Mahali Mts, Ujamba, valley forest, 1820 m, 23 August 1958, *T.G. Jefford et al. 1735* (K); Kasakela Reserve, in forest, wooded grassland marginal area, 1065 m, 20 November 1962, *B. Verdcourt 3387* (K, PRE). Kilimanjaro Region: Pr. Kibosho in sylvis pormaevis, 1906, *I. Daubenberger 39* (M); Moshi Distr., Kilimanjaro, rain gauge area, under *Philippia excelsa* in peat soil, ca. 2700 m, 23 July 1993, *J.M. Grimshaw 93448* (K); Korongo, moorland above rain gauge (Sheffield camp), 2850 m, in peaty soil below *Philippia excelsa*, 4 August 1993, *J.M. Grimshaw 93520* (K); above Kidia (Old Moshi), ericaceous bushland, 2800 m, 18 January 1997, *A. Hemp 1440* (K); Moshi, from a shamba boundary in Marangu, 26 December 1982, *E.M. Mtui 236* (K); Mission Moschi, Buschwald, 1500 m, 26 April 1909, *M. Mücke 59* (PRE). Lindi Region: Rondo Plateau, Rondo Forest Reserve, 700 m, steep escarpment with dense thicket under *Brachystegia microphylla*, *Albizia* and *Faurea saligna*, 10

February 1991, *S. Bidgood et al.* 1456 (K). Manyara Region: Mt Hanang, moorland among rocks in stony soil on the rocky knife edge of a mountain ridge below Werther's Peak, 2900 m, 12 February 1946, *P.J. Greenway* 7726 (K, PRE). Mbeya Region: Ngozi crater, forest, 2500 m, 4 July 1991, *C.J. Kayombo* 1100 (US3352473, US3352009); near Kiwira Forest Station, January 1963, *J. Procter* 2300 (K); Mbozi Circle, Mchembo Estate, in bed of Mchembo River, 1400 m, 11 January 1961, *H.M. Richards* 13853 (K); Nyassa Hochland, Station Kyimbila, 1350 m, 17 February 1912, *A. Stolz* 645 (M); N slopes of Mt Rungwe, in *Philippia-Protea* scrub, 2860 m, 14 March 1932, *Thompson* 973 (K); Ukaguru (Usagura), Itumba, 14 March 1905, *A.N. Wood s.n.* (K). Ruvuma Region: Matengo Hills, Luwiri Kitesa in bushland on slopes among rocks, 1710 m, 5 March 1956, *E. Milne-Redhead & P. Taylor* 9031 (K). Tanga Region: Mkussu (M'Kussu), forest, 1610 m, 15 February 1959, *H. Faulkner* 2245 (K); Shume-Magamba forest reserve, 2 May 1987, *C. Kisena* 462 (K); Usambara, Mlalo in d. Nähe von Gebirgsreisen, November 1891, *C. Holst* 162 (PRE). Loco incerto: Tanzania, forest edge, *R.B. Faden* 71/244 (US unmounted); Tanzania, *L.E. Taylor* 9031 (SRGH); Tanzania, Lushoto Distr., Camphor Regeneration Forest, in drainage trench, to 1 m high, 27 April 1982, *E.M. Mtui* 128 (K).

UGANDA. Western Region: Buhweju Distr., Buhweju, Nyagoma-Rugongo, moist shaded bushland, 9 February 1990, *P.K. Rwaburindore* 2949 (MO); Kasese Distr., Mt Ruwenzori, Mihunga, 1820 m, 13 January 1939, *M.V. Loveridge* 358 (K); Mbarra Distr., Kigezi, Kirata gap, ravine between hills near mountain, 2375 m, *Chandler & Hancock* 2532 (K).

ZAMBIA. Central Province: Serenje Distr., Kundalila Falls, in gorge, March 1969, *G. Williamson* 1561 (K). Northern Province: Mbala Distr., Kalambo Falls, in bed of seasonal stream, shade, 30 March 1952, *H.M. Richards* 1241 (K, US2360697). Northwest Province: Ndola Distr., Mwekera protected forest area, termite hill in miombo woodland, humid and shaded soil, 1350 m, 12°50'S, 28°32'E, 9/03/1973, *J. Kornaś* 3439 (K).

ZIMBABWE. Harare: Gilnockie, ca. 19 mls from Harare on Arcturus road, 1524 m, *D. Mitchell* 63 (BOL). Manicaland Central Province: Mazowe Distr., Impinge Pass, N of Umvukwes, at base of serpentine rocks on rocky hillside in woodland, 27 March 1983, *J.E. Burrows* 3052 (K). Manicaland Province: Mutare Distr., Vumba Mts, *N.C. Chase* 3989 (SRGH); Vumba Hotel, forest on path below native compound, narrow glade, 1670 m, 17 July 1952, *N.C. Chase* 4581 (K); Vumba Mts, on side of path at side of Leopard Rock Hotel leading to Leopard Rock Homestead, 1520 m, 27 April 1951, *N.C. Chase* 5022 (PRE); near Vumba Mountain Hotel, Umtali, 31 October

1953, *N.C. Chase 5119* (PRE); Elephant Forest, Vumba Mts, Umtali, in shade in closed canopy forest, 5 August 1955, *N.C. Chase 5705* (PRE); Mutare, Vumba Mts, at edge of montane forest, below Mountain Lodge Hotel, 1676 m, 21 January 1967, *W.B.G. Jacobsen 3016* (PRE); Imbeza Forest Reserve, Zuwane Forest, on contour path in shade, 1570 m, 13 March 1969, *W.B.G. Jacobsen 3845* (FR); Banti South indigenous forest, in shade, 1770 m, 21 March 1969, *W.B.G. Jacobsen 3865* (FR); Mutare, 1904, *Holland s.n.* (SAM); Mutare, in forest to S of W slopes of Mt Reza, *D. Mitchell 307* (BOL); M'Tavarye Falls, 30 June 1963, *I.B. Pole Evans 6557* (PRE); Vumba Mts, road between Burma Valley and Mutare, *J.P. Roux 2811* (NMG); Mutare, 25 miles from Cashel towards Melsetter, 1676 m, occasional in stream bank forest, *E.A.C.L.E. Schelpe 4075* (BOL); Mutare, Cloudlands, 1580 m, occasional on marshy stream bank in forest in light shade, *E.A.C.L.E. Schelpe 5368* (BOL); Mutare, farm Cloudlands, occasional on forest floor, 1585 m, *E.A.C.L.E. Schelpe 5377* (BOL); falls 5 miles N of Inyanga Downs, 1981 m, *L.E. Taylor 3143* (BOL); Matusa Distr., Inyanga Distr., NW side of Mare River, opp. trout hatchery, in old slave pit, 1830 m, 9 March 1969, *W.B.G. Jacobsen 3821* (FR); Inyanga Distr., forest near Mtarazi Falls, on escarpment over Hondi Valley, 1520 m, 27 February 1964, *D.S. Mitchell 841* (MO, PRE); Nyanga (Inyanga) Distr., Mare River, below Rhodes Hotel, 1676 m, *W.B.G. Jacobsen 3765* (BOL, PRE); Nyamuziwa Falls, on N-side in deep shade, 1676 m, 6 March 1969, *W.B.G. Jacobsen 3771* (FR); NW side of Mare Dam, 1920 m, *W.B.G. Jacobsen 3813* (BOL, PRE); NW side of Mare Dam, small inlet, opposite rest huts, in marshy thicket, 1890 m, 9 March 1969, *W.B.G. Jacobsen 3819* (PRE). Masvingo Province: Chiredzi Distr., Runde (Lundi) River, *D. Williams LR1* (BOL); Runde (Lundi) River, *D. Williams LR2* (BOL); Runde (Lundi) River, *D. Williams LR3* (BOL); Runde (Lundi) River, *D. Williams LR6* (BOL); Runde (Lundi) River, *D. Williams LR7* (BOL); Runde (Lundi) River, *D. Williams LR8* (BOL); Runde (Lundi) River, *D. Williams LR9* (BOL). Matabeleland North Province: Hwange Distr., Hwange (Wankie), in rain forest in moist places, 4 October 1964, *J.A. Whellan 2193* (K).

**Remarks:**—The taxonomic history of *Dryopteris pentheri* is closely interwoven with *D. inaequalis* and is partly discussed under that species. Baker (1867) was first to recognise the existence of two taxa, *Nephrodium inaequale* (Schltdl.) Hook. and *N. filix-mas* var. *elongatum* Hook. & Baker, in the complex. Sim (1891, 1892) also recognised the existence of two taxa and in 1915 raised var. *elongatum* to species level as *D. elongata* (Sw.) Sim. This name, based on



*Polypodium elongatum* Ait., is illegitimate and was replaced by the new name *D. aitoniana* Pichi Sermolli (1951).

Soon after the publication of *N. pentheri* by Krasser (1900), Christensen (1905) transferred it to *Dryopteris*. Later, however, Christensen (1917) reverted the species to *D. filix-mas* var. *elongata* (Ait.) C.Chr. following Sim (1915).

In 1952 the name *D. pentheri* was revived by Alston & Schelpe, but later it was considered to be synonymous with *D. inaequalis* (Schelpe 1969, 1970, Schelpe & Anthony 1986, Burrows 1990). Jacobsen (1978) suggested the re-institution of two forms, the smaller species with non-triangular laminae and distinctly reduced basal pinnae, and a larger species with 3- to 4-pinnatifid triangular laminae. The first form he considered synonymous with Schlechtendal's plant, the latter may be interpreted as being synonymous with *D. pentheri*.

*Dryopteris pentheri* is distinguished from the similar *D. inaequalis* and *D. lewalleana*, by the cylindrical glands and 2-celled hairs occurring on the frond axes and veins. The glands, stomata and spores are also larger than those of both *D. inaequalis* and *D. lewalleana*, this as a result of it being a tetraploid rather than a diploid (as the other two species). *Dryopteris pentheri* also occupies exposed habitats more frequently than *D. inaequalis* and *D. lewalleana*.

**Variation:**—*Dryopteris pentheri* is extremely variable in gross morphology, and attempts by several authors to separate this species, *D. inaequalis* and *D. lewalleana* based on macromorphological characters has failed. Micromorphological characters and cytological observations are more reliable in separating *D. pentheri* from other taxa generally included in the complex. Micromorphological characters of significance in separating this species from other taxa in the group are the presence or absence of bicellular hairs, gland length, as well as stomata and spore size. These characters, however, all show some variation. Bicellular hairs occurring abaxially on the laminae were observed on the costa, costules or veins in 64.5% of the collections studied. These hairs mostly occur centrally on an epidermal cell, but rarely also near the distal end of a cell. The periclinal wall of the epidermal cells bearing the hairs is flat or the hairs are positioned on a low but prominent bulge. The transverse wall between the two cells of the hair may be straight or oblique. Glands were observed in 96.8% of the collections studied. These oblong hairs, 60–260 µm long, are positioned on the epidermal cells in a similar fashion as bicellular hairs. Pluricellular hairs 6 to 21 cells long occur adaxially and abaxially on or near the costae, costules and veins. They are of the isocytic or moniliform type and are positioned centrally

on or near the distal margins of an epidermal cell. They often bear a single (rarely 2) glandular cell near the base. The indusia also show significant variation in size and margin sculpture. In a few exceptional cases glands have been observed along indusium margins.

INSERT FIGURE 22

**20. *Dryopteris rodolfii* Roux** (2004c: 143, figs. 1, 3–5). Figs. 6A–D; 9A & Aa; 23.

Type:—ETHIOPIA. Bale mountains: above Goba (6°54'N, 39°56'E), upper montane *Phillipia-Hagenia* forest, upper limit on fire sheltered 10° NW-facing upper slope, 3500 m, 4 March 1990, G. & S. Miehe 3239 (holotype K!).

*Plants* terrestrial. *Rhizomes* not seen but probably short decumbent. *Fronde*s to 755 mm long; *stipes* proximally castaneous, stramineous higher up, firm, proximally adaxially flattened, shallowly sulcate higher up, to 305 mm long, to 5 mm in diameter, proximally densely scaled, less so distally, the scales ferruginous, chartaceous, broadly attached, cordate, to 19 x 5 mm, narrowly to broadly ovate-caudate, denticulate, often with a few scattered glands, and with a few irregularly scattered pluricellular, mostly uniseriate filiform outgrowths, the scale apex filiform, terminating in a short series of oblong cell; *laminae* firmly herbaceous, to 2-pinnate-pinnatifid, broadly ovate to deltate-acuminate in outline, to 460 mm long, to 380 mm wide, with up to 8 petiolated pinna pairs, the basal pair longest or slightly shorter than the pair higher up; *rachises* stramineous, adaxially sulcate, sparsely to moderately scaled, the scales spreading, ferruginous, chartaceous, broadly attached to short-stalked, cordate to cuneate, linear-caudate to ovate-caudate, to 9 x 2.5 mm, denticulate, often with a few scattered oblong glands, and mostly basally with a few irregularly scattered pluricellular, mostly uniseriate filiform outgrowths, the scale apex terminates in a series of oblong cells; *pinnae* petiolate, the petiole to 10 mm long, to pinnate-pinnatifid, near opposite to alternate, the basal pair basiscopically developed, inaequilaterally triangular to narrowly ovate, linear-acuminate towards the apex, to 217 mm long, to 80 mm wide, with up to 3 petiolated pinnule pairs; *pinna-rachises* stramineous, adaxially shallowly sulcate, narrowly winged for most of the length, the wing between the pinnules straight, generally parallel to the pinna-rachis, and with a conspicuously thickened margin, abaxially sparsely to moderately scaled, the scales spreading, ferruginous, chartaceous, sessile to short-petiolate, the petiole often with one or

more oblong gland-like cells and/or with a pluricellular filiform outgrowth, narrowly to broadly cuneate, linear-caudate to lanceolate-caudate, to 4 x 1.2 mm, denticulate, often with scattered oblong gland-like cells along or on the surface near the margin, and basally often also with one or more pluricellular filiform outgrowths, the scale apex terminates in a series of oblong cells; *pinnules*, the basal pairs short petiolate, becoming sessile and eventually adnate and basiscopically decurrent towards the pinna apex, lanceolate to oblong-obtuse, to 60 mm long, to 20 mm wide, pinnatifid, but mostly lobed, adaxially more or less glabrous, abaxially sparsely to moderately set with ferruginous to stramineous scales and hairs, chartaceous, the scales confined to the costa and veins, the scales short-stalked, narrowly to broadly cuneate, linear-caudate to lanceolate-caudate, to 2.4 x 0.8 mm, repand to denticulate, often with a few scattered oblongs and few-celled filiform outgrowths, the scale apex terminates in a series of oblong cells, isopiliferous or anisopiliferous, the hairs predominantly isocytic, but often also moniliform, (4–)8(–22)-celled, 0.2 to 1.3 mm long, costa adaxially shallowly sulcate; *lobes* oblong-obtuse to oblong-truncate, 6–10 mm long, 3–5 mm wide, dentate. *Venation* evident, the apices slightly thickened, ending in the teeth near the margin. *Stomata* mostly of the polocytic type, guard cells (44–)60(–80)  $\mu\text{m}$  long. *Sori* essentially 2-seriate on the pinnules, but often 2-seriate on the basal lobes in larger and more divided laminae, circular, to 1.8 mm in diameter at maturity, spaced, but often touching at maturity in smaller laminae, inframedial on unmodified, predominantly anadromous vein branches; *indusia* brown to ferruginous, firmly chartaceous, persistent, broadly ovate to reniform in outline, 1.6–2.6 mm in diameter, basally entire to repand, erose distally. *Sporangia* stalk uniseriate at the base, 3-seriate below the capsule, simple or with a uniseriate, pluricellular hair, the capsule broadly elliptic to obovate in outline, somewhat laterally flattened, with (12–)14(–22) indurated annulus cells, epistomium (4–)6(–7)-celled, hypostomium (4–)6(–7)-celled. *Spores* 64 per sporangium, dark brown, ellipsoidal, monolete, the laesura  $\frac{1}{2}$  the spore length, perispore regularly tuberculate, exospore (42–)48(–56) x (24–)32(–38)  $\mu\text{m}$ . *Chromosome number*: unknown.

**Distribution and habitat:**—*Dryopteris rodolfii* is a high elevation species confined to Mt Kenya and the Bale Mountains in Ethiopia. On Mt Kenya the species occurs in the *Hagenia*-bamboo zone at an elevation ranging between ca. 2750 and 2918 m. On the Bale Mountains it also occurs in the *Philippia*-*Hagenia* forests at elevations ranging between 3250 and 3500 m.

**Etymology:**—The epithet honours Italian botanist Rodolfo Emilio Giuseppe Pichi-Sermolli (24 February 1912–22 April 2005) for his contribution to pteridology.

**Additional specimens studied:**—ETHIOPIA. Oromia Region: Bale Mts, above Rira, 6°43'N, 39°42'E, upper montane *Philippia-Hagenia* forest on 20° ESE-facing slope, 3310 m, 9 February 1990, G. & S. Miehe 2088 (K); Bale Mts, above Rira, 6°43'N, 39°42'E, upper montane *Philippia-Hagenia* forest, lower ericaceous belt, 3380 m, 9 February 1990, G. & S. Miehe 2121 (K); Bale Mts, above Rira, 6°43'N, 39°42'E, upper montane *Philippia-Hagenia* forest, on 10° S-facing slope, 3250 m, 10 February 1990, G. & S. Miehe 2190 (K); Bale Mts, above Goba, 6°54'N, 39°56'E, upper montane *Philippia-Hagenia* forest, 3 March 1990, G. & S. Miehe 3204 (K); Bale Mts, above Goba, 6°54'N, 39°56'E, upper montane *Philippia-Hagenia* forest, 10° NW-facing upper slope, 3500 m, 4 March 1990, G. & S. Miehe 3239 (K); Bale Mts, above Goba, 6°54'N, 39°56'E, upper montane *Philippia-Hagenia* forest, on 35–40° slope, 3450–3500 m, 4 March 1990, G. & S. Miehe 3266 (K).

KENYA. Eastern Province: Meru Distr., Mt Kenya National Park, near Sirimon Gate, in *Hagenia*-bamboo zone, ca. 2750 m, 24 August 1986, A.C. Jermy 17507 (BM); Mt Kenya, Forest End camp, 2918 m, 29 August 1942, A.G. McLoughlin 696 (BOL).

**Remarks:**—The diagnostic features distinguishing between *D. rodolfii*, *D. fadenii* and *D. ruwenzoriensis*, all considered to be closely related, is discussed by Roux (2004c).

INSERT FIGURE 23

**21. *Dryopteris ruwenzoriensis* C.Chr. ex Fraser-Jenkins** (1986: 204, fig. 4). Figs. 6E–H; 23.

Type:—DEMOCRATIC REPUBLIC OF THE CONGO. 'Massif du Ruwenzori, versant Ouest (Congo Belge, Ituri)', 2000 m, 22 July 1930, Mission H. Humbert-Plantes de l'Afrique Equatoriale 8825 (holotype BM000605445!).

*Plants* terrestrial or epilithic. *Rhizomes* short, decumbent to suberect, to 15 mm in diameter, set with roots, crowded persistent stipe bases, and scales, the scales dull, castaneous to ferruginous, chartaceous, broadly attached, narrowly ovate to lanceolate, to 12 x 4 mm, broadly cuneate, the margins repand to erose, often with a few scattered glandular cells, the scale apex terminates in a short uniseriate series of oblong cells. *Fronde*s caespitose, erect to arching, to 1.35 m long; *stipes* proximally castaneous, stramineous higher up, proximally adaxially flattened, shallowly sulcate

higher up, to 720 mm long, to 9 mm in diameter, proximally densely scaled, moderately scaled higher up, and variously set with hairs and minute, membranous scales, fugacious, the larger scales sessile, narrowly ovate to lanceolate, to 12 x 2.5 mm, cordate to cuneate, denticulate, often with a few scattered glands along the margin, the scale apex terminates in a short uniseriate series of oblong cells, the aerophores in larger plants often displayed as paler dorso-lateral lines; *laminae* anadromous, catadromous towards the apex, firmly herbaceous, ovate to triangular, to 640 mm long, to 540 mm wide, 2-pinnate-pinnatifid to 3-pinnate, with up to 5 petiolated pinna pairs; *rachises* stramineous, adaxially shallowly sulcate, becoming narrowly winged near the apex, initially variously set with hairs and minute scales, the scales fugacious, the larger scales short-stalked, narrowly lanceolate to oblong-acuminate, to 5 x 1 mm, repand to denticulate, the scale apex terminates in a short series of oblong cells; *pinnae* petiolate, the petiole to 6 mm long, near opposite to alternate, proximally more widely spaced, slightly imbricate or not, the basal pair conspicuously basiscopically developed, inaequilaterally narrowly ovate to triangular, 1-pinnate-pinnatifid to 2-pinnate, the basal pair the longest, to 310 mm long, to 125 mm wide, with up to 2 stalked pinnule pair; *pinna-rachises* adaxially shallowly sulcate, the sulcus confluent with that of the rachis, pronounced abaxially, narrowly winged distally, abaxially initially moderately scaled, the scales stramineous, thinly chartaceous, sessile or short-stalked, lanceolate to linear-acuminate, the scale apex terminates in a short series of oblong cells; *pinnules* petiolate, the petiole to 2 mm long, sessile and progressively more broadly attached and basiscopically decurrent towards the apex, lanceolate to oblong-acuminate, pinnatifid to deeply lobed, the acroscopic pinnule on the basal pinna to 51 mm long, to 20 mm wide, the basiscopic pinnule on the basal pinna to 88 mm long, to 26 mm wide, near opposite to alternate, spaced to slightly imbricate; *costae* adaxially shallowly sulcate, pronounced abaxially, narrowly winged along the entire length, variously scaled, the scales stramineous, thinly chartaceous, short-stalked, subulate to narrowly lanceolate, to 1.5 x 0.8 mm, irregularly denticulate, the scale apex terminate in a short series of oblong cells; *segments* closely spaced but not imbricate, oblong-obtuse to oblong-truncate, to 16 mm long, to 9 mm wide, shallowly and inconspicuously lobed; *lobes* with conspicuously and acutely dentate apices, adaxially glabrous or with a few hairs and hair-like scales along the costules, abaxially variously set with subulate scales and (4–)9(–17)-celled isocytic hairs, (78–)308(–670)  $\mu\text{m}$  long along the veins. *Venation* anadromous, becoming catadromous, pinnately branched in the segments, the vein branches pinnately branched, forked, or simple near the apex, evident, ending

in the teeth near the margin. *Stomata* mostly of the polocytic types, guard cells (36–)48(–62)  $\mu\text{m}$  long. *Sori* circular, to 1.5 mm in diameter at maturity, medial to inframedial, predominantly on the anadromous vein branches, discrete, essentially 2-seriate on the segments; *sporangia* stalk simple or haired, the capsule with (10–)15(–20) indurated annulus cells, the epistomium (3–)4(–7)-celled, the hypostomium (4–)6(–7)-celled. *Indusia* lacking. *Spores* ellipsoidal, monolete, perispore without ridges, echinate, (36–)41(–54) x (22–)26(–34)  $\mu\text{m}$ .

**Distribution and habitat:**—*Dryopteris ruwenzoriensis* occurs on the Ruwenzori Mountain range between the Democratic Republic of the Congo, Uganda and Rwanda. Occurring at elevations ranging between 1350 and 3500 m the species appears to be confined to mountainous regions. At lower elevations the species is confined to moist evergreen forests, but at higher elevations it occupies bamboo forests and the ericaceous belt.

**Etymology:**—The epithet refers to the Ruwenzori Mountains on the border between the Democratic Republic of the Congo and Uganda, the type locality of this species.

**Additional specimens studied:**—DEMOCRATIC REPUBLIC OF THE CONGO. Oriental Province: Ituri, Massif du Ruwenzori, versant Ouest, vers 2000 m, July 1929, *H. Humbert 8825ter* (BM); Ituri, Massif du Ruwenzori, versant Ouest, vers 2000 m, forêt ombrophile, haute vallée de la Budagu, *H. Humbert 8849* (B20 0065472); Ituri, Massif du Ruwenzori, versant Ouest, 2600–3000 m, July 1929, *H. Humbert 8900bis* (BM).

RWANDA. Ruhengeri Province: Kinigi Distr., Parc des Volcans, in park, S slope of Mt Sabinio, 2800 m, occasional under bamboo, 10 March 1975, *W.G. d'Arcy 8428* (MO); Mutara Distr., Parc des Volcans, small creek in *Hagenia* zone, Karisimbi/Visoke saddle, 2900 m, 7 February 1975, *W.G. d'Arcy 7629* (MO); Parc des Volcans, Karisimbi/Visoke saddle, below camp, 2800 m, 13 February 1975, *W.G. d'Arcy 7762* (MO); Parc des Volcans, upper gorge of Sousa river, S-side of Mt Karisimbi, 3300 m, 20 February 1975, *W.G. d'Arcy 7972* (MO).

UGANDA. Western Region: Kasese Distr., Ruwenzori (Est), fr. le Vall. du Mobuku, montée du col de Buamba, 3300–3400 m, January 1909, *Ch. Alluaud 303* (BM); Mobuku Valley, Ruwenzori Mts, rain forest, 1824–2432 m, 10 January 1956, *E. Esterhuysen 25178a* (BOL); Ruwenzori, Bujuku valley, near Bigo camp, in moist *Philippia*-forest, 3450 m, 25 March 1948, *O. Hedberg 471* (K); Ruwenzori, Mijusi valley, ericaceous belt, on steep earth slope in the lower part of the valley, 3500 m, *O. Hedberg 614* (K); Bigo, R. Bujuku, 3450 m, riverside, 23 July 1952, *H.A. Osmaston 1687* (BR, BM); Bigo, R. Bujuku valley, calcareous outcrop, 3550 m, 27 July 1952,

*H.A. Osmaston 1745* (BM); Ruwenzori, Bigo, 3500 m, January 1951, *H.A. Osmaston 3731* (K); Ruwenzori, Namwamba Valley, in heath forest, 3200 m, 6 January 1935, *G. Taylor 2954* (BM); Ruwenzori, Namwamba valley, on rocks in river, 3160 m, 7 January 1935, *G. Taylor 2990* (BM); Ruwenzori, Namwamba valley, under *Podocarpus* trees, 2890 m, 11 January 1935, *G. Taylor 3079a* (BM).

**Remarks:**—Although *Dryopteris ruwenzoriensis* was recognised as a distinct species by Christensen, he never published the name. Christensen's diagnoses and comments typed on a sheet in a capsule mounted with the type specimen at the British Museum (BM) was published verbatim by Fraser-Jenkins (1986).

Fraser-Jenkins (1986) found the dense blunt spines of the spores to be unique among the species known to him at the time and suggested it to be close to *D. schimperiana* (Hoch. ex A.Braun) C.Chr. The diagnostic features of *D. ruwenzoriensis* and its putative relationships have been discussed by Roux (2004c).

**22. *Dryopteris schimperiana* (Hochst. ex A.Braun) Christensen** (1905: 91). Figs. 6I–L; 9C & Ca; 12; 24.

*Aspidium schimperianum* Hochst. ex Braun (1841: 708). Type:—ETHIOPIA. 'locis umbrosis ad rupes superioris et mediae partis septentrionalis, montis Scholoda', 26 October 1837, *G.H.W. Schimper s.n.* (holotype B20 0065670!, B20 0065671!, B20 0065672!, B20 0065673!, isotypes BM!, H, K!, M!, NY!, WAG03526!). *Polystichum schimperianum* (Hochst. ex A.Braun) Keyserling (1873: 44).

*Plants* terrestrial. *Rhizomes* short, decumbent, unbranched, to 18 mm in diameter, set with roots, crowded stipe bases and scales, the scales often rugose, dull brown to ferruginous, chartaceous, broadly attached, linear to narrowly lanceolate, truncate, cuneate, or cordate, the margins subentire, with scattered oblong glands and irregularly set with long filiform outgrowths, the outgrowths twisted, pluricellular, oblong glands also occur on the scale surface and marginal outgrowths, the scale apex filiform, twisted, to 35 x 5 mm. *Fronde*s caespitose, 5–7 per plant, erect to arching, to 1,6 m long; *stipes* proximally castaneous, stramineous to greenish higher up, proximally adaxially flattened, shallowly sulcate higher up, to 870 mm long, to 8 mm in diameter,

proximally densely scaled, the scales higher up fugacious, stramineous to ferruginous, membranous to chartaceous, the larger broadly attached, the smaller sessile, narrowly lanceolate to filiform, truncate to cuneate, the margins irregularly set with long, twisted, pluricellular filiform outgrowths, these often confined to, or near the point of attachment, often also with oblong glands which may also occur on the scale lamina and on the marginal outgrowths, the scale apex filiform, twisted, to 22 x 3 mm; *laminae* firmly herbaceous, ovate to broadly ovate, to 3-pinnate, anadromous, catadromous towards the apex, to 730 mm long, to 450 mm wide, with up to 14 petiolated pinna pairs; *rachises* stramineous, adaxially shallowly sulcate, becoming narrowly winged towards the apex, initially moderately to densely scaled, the scales fugacious, ferruginous to stramineous, chartaceous, broadly attached or sessile, narrowly lanceolate-caudate to ovate-caudate, cordate to narrowly cuneate, the margins entire, repand or irregularly set with a few filiform outgrowths, mostly near the point of attachment, the outgrowths are pluricellular and twisted, often also with scattered oblong glands, which may also occur on the scale lamina, the scale apex filiform and twisted, to 8 x 1.2 mm; *pinnae* petiolate, the petiole to 8 mm long, the basal pair inaequilaterally ovate to narrowly ovate, narrowly ovate to oblong-acuminate towards the lamina apex, to 2-pinnate, the basal pair the longest, mostly basiscopically developed, to 230 mm long, to 145 mm wide, opposite to alternate, basally not or slightly imbricate, mostly imbricate higher up, often not significantly so, with up to 10 petiolated pinnule pairs; *pinna-rachises* adaxially shallowly sulcate, the sulcus confluent with that of the rachis, pronounced abaxially, narrowly winged distally, abaxially initially moderately to sparsely scaled, the scales stramineous to ferruginous, chartaceous to membranous, sessile or short-stalked, ovate-caudate to filiform, narrowly cuneate to cordate, the margins entire, repand, or irregularly set with few filiform outgrowths predominantly at or near the point of attachment, the outgrowths pluricellular and twisted, often also with scattered oblong glandular cells, the scale apex filiform, twisted, to 6 x 1 mm; *pinnules* petiolate, the petiole to 3 mm long, inaequilaterally oblong-acuminate to narrowly trullate, obtuse, lobed, to 1-pinnate, the acroscopic pinnule on the basal pinnae to 72 mm long, to 19 mm wide, the basiscopic pinnule on the basal pinnae to 84 mm long, to 22 mm wide, basally mostly widely spaced, never imbricate, rarely with up to 2 petiolated segment pairs; *costae* adaxially shallowly sulcate, pronounced abaxially, narrowly winged, variously set with scales and isocytic hairs; *segments* and *lobes* spaced, inaequilaterally oblong-obtuse to oblong-acute, basiscopically decurrent, to 10 mm long, to 5 mm wide, crenate to serrate, adaxially glabrous, with



a few glands along and between the veins, or with a few filiform scales along the costa, abaxially sparsely to moderately set with scales and hairs, the scales similar, but smaller than those on the pinna-rachis, the margin proximally often with glandular cells, the hairs (5–)7(–18)-celled, (210–)354(–1000)  $\mu\text{m}$  long, occurring mostly along the costa and veins, rarely with a glandular cell near the base, often also with scattered glands (58–)108(–182)  $\mu\text{m}$  long. *Venation* anadromous, isodromous to catadromous towards the lamina and pinna apex, pinnately branched in the segments, the vein branches pinnately branched, forked or simple near the apex, evident, ending in the teeth near the margin, the endings slightly enlarged. *Stomata* of the anomo- and polocytic types, guard cells (32–)42(–54)  $\mu\text{m}$  long. *Sori* circular, inframedial on the anadromous vein branches, discrete, or the sporangia often touching at maturity, to 2 mm in diameter; *sporangia* stalk simple, with a single glandular cell, or haired, capsule with (13–)15(–19) indurated annulus cells, epistomium (4–)6(–8)-celled, hypostomium (4–)6(–7)-celled. *Indusia* persistent, brown to ferruginous, firmly herbaceous, reniform and strongly revolute, entire or (infrequently) glandular along the margin and on the surface, to 2 mm in diameter. *Spores* ellipsoidal, monolete, perispore folded into low reticulate ridges and bulges, rugose to ruminant, (40–)43(–48)  $\times$  (26–)30(–34)  $\mu\text{m}$ . *Chromosome number*:  $2n = \pm 82$  (Vida in Widén *et al.* 1973: 2130).

**Distribution and habitat:**—*Dryopteris schimperiana* is widespread in East and tropical Central Africa, occurring in Burundi, the Democratic Republic of the Congo, Eritrea, Ethiopia, Kenya, Malawi, Rwanda, South Sudan, Sudan, Tanzania and Uganda. The species occurs from approximately 1400 m to 3580 m, and mostly occurs along streams and rivers in seasonally moist woodland and gallery forests.

**Etymology:**—The epithet honours Georg Heinrich Wilhelm Schimper (19 August 1804–October 1878), German (Reichenschwand) born botanist and naturalist who worked throughout northern Africa, settling during the 1830's in Ethiopia, where he resided in the Tigray and Semien provinces.

**Additional collection studied:**—BURUNDI. Bururi Province: Tora, 2150 m, massif de bambous, 16 November 1969, *J. Lewalle 4078* (BR). Muramvya Province: Muramvya, Bugarama, jachère à *Lobelia giberroa*, 18 June 1971, *J. Lewalle 5983* (BR).

DEMOCRATIC REPUBLIC OF THE CONGO. South Kivu Province: Tshibati, 02°14'S, 28°47'E, 1900 m, terrestre, 6 June 1993, *M. Becker 15* (BONN); Tschivanga, 02°20'S, 28°44'E, 2200 m, 25 June 1993, *M. Becker 168* (BONN); Mt Kahuzi, 02°15'S, 28°41'E, 2290 m, 29 June

1993, *M. Becker 193* (BONN); Mt Kahuzi, 02°15'S, 28°41'E, 2810 m, 2 July 1993, *M. Becker 246* (BONN); Idjwi, 1870 m, 7 September 1993, *M. Becker 425* (BONN); Lake Kivu, Idjwi Island, 1670 m, in forest, 17 February 1939, *M.V. Loveridge 520* (K).

ERITREA. Northern Red Sea Region: Monte Zagher, 2600 c.s.m., 20 May 1902, *A. Pappi 5307* (BOL).

ETHIOPIA. Addis Ababa: Mt Wuchacha, ca. 37 km W of Addis Ababa via the Ambo road, among rocks on dry bank of a stream, 3000 m, 1 April 1973, *J. Ash 1859* (K); near Addis Ababa, 2280–2580 m, 1956, *H.F. Mooney 6713* (K); Addis Ababa, half way up Entotto Mt, road past American Embassy, ca. 2800 m, on moist shaded streambanks, 30 November 1961, *F.G. Meyer 7573* (K, US2426179); Entoto, near Addis Ababa, frequent on stream bank, 2890 m, 16 September 1952, *E.A.C.L.E. Schelpe & C. Curle 66* (BM). Amhara Region: 5 km from Adwa along Adigrat road. Soloda (near the riverine Gerae), 1950 m, 22 August 1973, *G. Aweke & M.G. Gilbert 753* (K); Dangila, 50 mls S of Lake Tana, 1825 m, 14 March 1926, *R.E. Cheesman s.n.* (BM); Shewa, Wof Washa Forest, 3000–3500 m, (turnoff 18 km past Debre Birhan, at Koit Village, 2940 m, *S. Edwards et al. 3603* (ETH); Choké Mts, Gojjam, vicinity of the upper Ghiedeb valley, 10°40'N, 37°50'E, 6 August 1957, 3040 m, *I.M. Evans 99* (K); 34 km E of Debre Birhan, on the road to Ancober, 3050 m, escarpment with *Erica* scrub, along a small stream, 26 November 1972, *I. Friis et al. 1361* (K); near Debra Tabor, 15 January 1924, *H.V. Harlan s.n.* (US1029883); Mt Zik'wala, 74 km SSE of Addis Ababa. Inside rim of the crater, dry forest dominated by *Juniperus procera* on the slopes, 2840–3000 m, 8°32'N, 38°51'E, *K. Hylander et al. 29* (ETH); Semien (Simien), Mindigabsa near river, 16 November 1952, *H. Scott 266* (K); Debre Sina, ca. 185 km from Addis Ababa, on the way to the Wef Washa forest, ca. 1 km out of town, on a steep hillside, 2710 m, 10 June 1978, *M. Tadesse & D. Sebsebe 382* (ETH); Wofwasha Natural Forest, ca. 162 km N from Addis Ababa, 27 km NE of Debre Birhan, 3700–2700 m, along Yesebat Woira River, 10 April 1992, *D. Teketay 1450* (ETH). Oromia Region: Mt Wuchacha, ca. 45 km W of Addis-Ababa, on road to Ambo, 3000 m, 31 October 1971, *J. Ash 1303* (K, MO); Arussi Mts, ca. 35 km S of Mt Chillalo, 23 km from turnoff on track to Ticcio via Robie, ca. 10 km of campsite, 2600 m, 12 January 1974, *J. Ash 2334* (K); NW face of Gara Mullata Mtn, ca. 50 km due W of Harar, 2500–3000 m, 14 February 1962, *W. Burger 1468* (K); Gara Mullata Mtn, under bushes and trees, ca. 3040 m, 10 June 1962, *W. Burger 1905* (ETH, K, US2577772); Gara Ades, steep mountain slopes with remnant *Podocarpus* forest, 29 September 1963, *W. Burger 3256* (K, US2577779); Debre

Libanos: 115 km N of Addis Ababa on the Gojjam road. Village associated with the Church and Monastery of Debre Libanos on the first shelf of the gorge above the Jemma River, 2350–2500 m, October–November 1994, 9°40'N, 38°30'E, *L. Davidson & J. Defar 325* (ETH); near Adaba, *Juniperus* forest, 2500 m, April 1976, *Forest Inventory 1046* (ETH); Mengeste State Forest, on the W-slope of Mt Wuchacha, 2600 m, *Juniperus procera-Olea africana* forest, 19 November 1972, *I. Friis et al. 1197* (K); Menagesha State forest, on the W-slope of Mt Wuchacha, 2600 m, along a small stream in the *Juniperus* forest, 19 November 1972, *I. Friis et al. 1278* (K); Mt Maigudo, ca. 40 km from Jimma-Addis road on Omo-Adda track, 2650 m, *Erica-Hagenia-Arundinaria-Maesa-Agauria-Ilex*-scrub along the road, 3 December 1972, *I. Friis et al. 1474* (K); S of Ghibe river, ca. 12 km S of Jimma, 7°34'N, 36°53'E, ca. 2000 m, in scrub along the road under medium shade, 8 November 1970, *I. Friis, A. Hounde & K. Jacobsen s.n.* (K); Mt Fure, SW of Addis Ababa, ca. 2600 m. Open grassy slopes with a few *Juniperus*, *Maesa* & *Rhus retinorrhoea*, 23 June 1974, *M.G. Gilbert 3481* (K); Kondudo Mtn, 2675 m, in dense clumps on limestone slopes, 1933, *J.B. Gillett 5227* (K); Lake Wonchi, forest near lake, 2850 m. Montane forest with *Olinia aequipetala*, *Olea africana*, *Nuxia congesta*, *Hagenia abyssinica* & *Erica arborea*, 17 February 1974, *M.G. Gilbert & B. G.-E. Tewolde 3230* (K); Lake Wonchi, outer rim of caldera, in relatively undisturbed *Erica arborea/Philippia abyssinica* bushland, 3400 m, 8°48'N, 37°55'E, 18 February 1974, *M.G. Gilbert & B. G.-E. Tewolde 3278* (ETH); Bale, near Adaba, cleared *Juniperus* forest, 2500 m, 7°N, 39°25'E, April 1976, *M. Gutetta 1046* (K); Daga, ca. 4.8 km SSW of Goba, flat valley near stream, 2890 m, 6 August 1962, *E.J. Herbert 40* (K); Omo Nada rd to Omo River, turning off Jimma-Addis Ababa rd, at Little Ghibie River, 2600 m, 7°34'N, 37°22'E, *F.G. Meyer 9037* (K); Asella, shady bank in moist valley, *Podocarpus* forest, 2430 m, 22 December 1953, *H.F. Mooney 5227* (K); Soddu road above Nadda, shady moist bank, 2280 m, 26 October 1954, *H.F. Mooney 6211* (K, US2360699); near Trba Moda, Sidamo, 2700 m, in shade in evergreen forest, 11 October 1959, *H.F. Mooney 8204* (ETH, K); 8 km NW of Nejo, Welega, N-facing slope. Mixed evergreen *Schefflera-Nuxia-Acacia* forest, 1880 m, 19 November 1980, *D. Sebsebe & Erich 540* (ETH); Harrarghe, Gara Mulleta Awraja, 75 km SW of Dire Dawa closer to Girawa town in a forest dominated by *Schefflera abyssinica*, 2500 m, 20 April 1983, *D. Sebsebe & K. Ensermu 1400* (ETH); Dello Awraja, in Harenna Forest, Kecha- ca. 45 km on Dello Mena-Goba road, along steep banks of River Kacha, 2400 m, 6°42.5'N, 39°44'E, 3 August 1986, *M. Tadesse 4849* (ETH).

Southern Nations, Nationalities and Peoples Region: 22 km N of Kebre Mengiste on the road to

Hagere Selam, montane evergreen forest with *Olea hochstetteri* and *Podocarpus gracilior*, 2100 m, 5 November 1972, *I. Friis et al. 1069* (K); Bonga, forest and waterfall behind the Catholic Mission, 1700 m, *Olea*-forest with much *Dracaena afromontana* and *D. steudtneri*, on stones in the stream below the waterfall, 7°15'N, 36°13'E, 6 January 1973, *I. Friis et al. 2097* (ETH, K); Amaro Mts, E slopes of Mt Delo, 5°48'N, 37°54'E, margin of bamboo forest, 2918 m, 27 January 1953, *J.B. Gillett 14953* (K, US2360772); between Sheshemana and Cofole, occasional in *Podocarpus* forest, 2280 m, 21 September 1952, *E.A.C.L.E. Schelpe & C. Curle 108* (BM). Somali Region: Mendeyou Auraja ca. 5–7 km on Fincha Haberra-Soddota track, in shade of *Erica* bushes on steep slopes between boulders 3500–3580 m, 30 December 1989, *M. Tadesse 7815* (ETH). Sine loco: Ethiopia, Hedscha, 30 October 1862, *M.W. Schimper 311* (BM, K, NH); Ethiopia, locis umbrosis ad superioris et mediae partis septentrionalis, montis Scholoda, 26 October 1837, *G.H.W. Schimper 6* (BM, K, M, MO, NY); Ethiopia (Abyssinie), 1853, *M.W. Schimper 523* (K); Ethiopia, June 1975, *A.C.B. Thomerson 462* (K).

KENYA. Rift Valley Province: Trans-Nzoia West Distr., Kabolet River, Cherangani, riverine forest, 1975 m, June 1964, *Tweedie 2844* (K); R. Marun, upper waters in Cherangani, 2432 m, March 1965, *Tweedie 3012* (K).

MALAWI. Northern Region: Chitipa Distr., Nyika Plateau, Rufifi stream, 35 mls SE from rest house, 2400 m, 28 October 1958, *N.K.B. Robson 442* (K).

RWANDA. Giseyi Province: Nyamyumba Distr., Kiraga, near Kisenyi, 1520 m, in continual spay from water, 10 February 1939, *M.V. Loveridge 505* (K, MO). Ruhengeri Province: Mutara Distr., Parc des Volcans, Karisimbi/Visoke saddle, below camp, *Hagenia*-zone, 2800 m, 13 February 1975, *W.G. d'Arcy, 7745* (MO).

SOUTH SUDAN. Central Equatoria: summit of Mt Kineti, Imatong Mts, 3180 m, 27 July 1939, *J.G. Myers 11649* (K). East Equatoria: Imatong Mts., summit of Mt Konoro, 2500 m, *Loudetia* grassland on skeletal soil, 16 March 1982, *I. Friis et al. 1217* (K); Imatong Mts, ridge leading to the summit of Mt Kinyeti, 3000 m, mountain grassland in thin skeletal soil with numerous rocky outcrops 22 March 1982, *I. Friis & Vollesen 1287* (K); Imatong Mts, Gilo, 1 mile from R. Ngairigi waterfall, in damp undergrowth of *Acacia abyssinica* forest, 1945 m, 7 January 1950, *MacLeay 454* (K); Koppia, Imatong Mts, grassland, 2432 m, 29 December 1935, *A.S. Thomas 1820* (BM, K).

SUDAN. Darfur: Geneina Region, Jebel Marra Mts, Topolin plateau, about 120 km E of Zalingei, ca. 2700 m, in shade in crevices in dry creek bed, *H.J.J.O. de Wilde et al.* 5559 (K); Jebel Marra Mts, at the end of Beldong road, near Belong, 1840 m, 25 January 1965, *H.J.J.O. de Wilde et al.* 5584 (K); Jebel Marra, Mid Robo spring, 2610 m, 24 December 1921, *H. Lynes* 187 (BM, US1348986); Jebel Marra, Karunga, stone dyke of garden beside salt stream, ca. 1800 m, 19 December 1956, *K.N.G. Mac Leay* 1042 (BM).

TANZANIA. Iringa Region: Makete Distr., Kitulo (Elton) Plateau, top of waterfall above Matamba-Kitulo road on Ndumbi River to source of right-hand fork, 2600–2650 m, 14 February 1989, *R. Gereau, J. Lovett & J. Mtweve* 3198 (K, MO, PRE); Kikondo camp, Poroto Mts, in swamp, 1950 m, 20 January 1961, *H.M. Richards* 13968 (K). Kilimanjaro Region: Moshi Distr., Kilimanjaro, forest above Mandara Hut, in shallow koroago with *Philippia* etc., ca. 2800 m, 10 February 1994, *J.M. Grimshaw* 94230 (K); Kilimanjaro, forest above Kilimanjaro Timbers, ca. 2700 m, common below *Philippia excelsa*, 27 July 1994, *J.M. Grimshaw* 94648 (K). Mbeya Region: Rungwe Distr., Ngozi forest, *Hagenia* forest and bamboo (*Arundinaria alpina*) zone, 26 June 1996, *R.B. Faden et al.* 96/407 (K, US3350668, US3350669, US3350670); Inkuya, lower Rungwe forest, 1520 m, June 1957, *Watermeyer* 9 (K); Rungwe forest, 2130 m, June 1957, *Watermeyer* 37 (K). Morogoro Region: Kilosa Distr., Ukaguru Mts, waterfall in pine plantation, granite rocks, 1400 m, 31 July 1972, *D.J. Mabberley* 1319 (K); Morogoro Rural Distr., Nguru Mts (Tuliani), between Kombola and Maskal Mafulumla mountain, ca. 1700 m, 20 August 1971, *H.-J. Schlieben* 12244 (K, PRE). Shinyanga Region: Shinyanga Distr., W-slopes of Nguru Mts, above Maskati, 1700–1800 m, montane *Albizia-Podocarpus* forest, *S. Bidgood et al.* 500 (K).

UGANDA. Central Region: Kalanga Distr., Kisaba Gap, 2380 m, December 1938, *Chandler & Hancock* 2539 (K); Kisaba Gap, small ravine between hills, 2380 m, December 1938, *Chandler & Hancock* 2547 (K). Ruhengeri Province: Kinigi Distr., Mt Sabinio, hill side scrub, 2128 m, *J.W. Pursglove* 2453 (K). Western Region: Bundibugyo Distr., Bwamba Pass, 2370 m, 16 November 1935, *A.S. Thomas* 1442 (K); Kabale Distr., Kanaba Pass, 2130–2430 m, 28 December 1959, *Lind & McLeay* 3047 (BM); Kachwekano farm, 2128 m, edge of plantation, May 1949, *J.W. Pursglove* 2877 (K); Kigezi, Kachwelrano, 1975 m, 3 July 1945, *A.S. Thomas* 4222 (K, MO); Kanaba Gap, bamboo forest, June 1950, *H.D. van Someren* 642 (K); Kasese Distr., Mt Ruwenzori, Mihunga, in forest clearing, 13 January 1939, *M.V. Loveridge* 354 (K, MO); Virunga-Ostgruppe, Sattel zwischen Muhavura und Mgahinga, ca. 3000 m, 14 November 1954, *U. Stauffer* 781 (BR,

K, PRE); Kisoro Distr., Mushongero, Lake Mutanda, on bank beside lake, 31 January 1939, *M.V. Loveridge* 457 (K, MO).

**Remarks:**—*Dryopteris schimperiana* can be confused with *D. pentheri*, but it is distinguished from it by the sessile or shortly petiolated narrowly lanceolate-caudate to ovate-caudate scales of which the margins are entire or irregularly set with a few filiform outgrowths, and the rigid isocytic hairs occurring along the frond axes and abaxially along the veins. The occurrence of 2- and 3-celled hairs along the lamina axes and veins and the large indusia with strongly revolute margins are also characteristic of the species. From *D. pentheri* it can also be separated by the smaller stomata and shorter glands. The occurrence of 3-celled hairs in this species suggests it being related to *D. tricellularis* J.P.Roux. From this species it is distinguished by the presence of glandular hairs occurring on lamina axes and veins, the smaller stomata and the indusiate sori.

**Variation:**—*Dryopteris schimperiana* varies in lamina size and in the degree to which it is dissected. These variations appear to be environmentally induced. Variations in several micromorphological structures were also observed. The scale margins can be glandular or eglandular and they often also have glands occurring on the scale surface. The indusium margins may also be glandular or eglandular. Even though some collections may be devoid of glands and 2-celled hairs, others are variably set with these structures. The sporangium stalk is mostly simple, but some may bear a gland or a simple uniseriate hair near its base.

INSERT FIGURE 24

**23. *Dryopteris schnellii*** Tardieu (1948: 370, pl. 1, figs. 7, 8). Figs. 6M–Q; 9D & Da; 24.

Type:—GUINEA. 'près de Nzo', July 1942, *R.A.A. Schnell* 1499 (holotype P00483261!, isotype P00279994).

*Plants* terrestrial. *Rhizomes* suberect to erect, unbranched, to 15 mm long and 5 mm in diameter, closely set with roots, stipe bases, and scales, the scales chartaceous, ferruginous, adnate, narrowly ovate to ovate, to 6 x 2.5 mm, the margins with short filiform outgrowths. *Fronde*s caespitose, 2–4 per plant, erect to arching, to 200 mm long; *stipes* proximally castaneous, stramineous higher up, proximally adaxially flattened, shallowly sulcate higher up, to 68 mm long, to 1.5 mm in diameter, proximally moderately scaled, the scales similar to, but narrower than those

on the rhizome; *laminae* herbaceous, lanceolate, to 170 mm long, to 50 mm wide, to 2-pinnate, anadromous, catadromous towards the apex, with up to 12 petiolated pinna pairs, the distal pinnae increasingly more broadly attached and adnate; *rachises* stramineous, adaxially shallowly sulcate, becoming very narrowly winged towards the apex, sparsely scaled, the scales ferruginous to stramineous, thinly chartaceous, broadly attached, linear-caudate to narrowly lanceolate-caudate, to 3.5 x 1 mm, the margins with few short filiform outgrowths; *pinnae* petiolate, the petiole to 2 mm long, pinnatifid, the basal one or two pairs slightly reduced, ovate to narrowly ovate, acroscopically developed and inaequilaterally ovate to somewhat trapezoidal higher up, longest pinnae to 30 mm long, to 16.5 mm wide, near opposite to alternate, not overlapping, pinnatifid, mostly with only the proximal acroscopic pinnule petiolate, the distal pinnules, obtusely lobed, lobes shallowly crenate, becoming increasingly more broadly attached; *pinna-rachises* adaxially sulcate, the sulcus confluent with that of the rachis, abaxially sparsely set with scales and pluricellular hairs, the scales thinly chartaceous, sessile, linear-caudate to filiform; *pinnules* sessile, ovate to inaequilaterally ovate to oblong-obtuse, lobed to shallowly crenate, to 10 mm long, to 5 mm wide, adaxially with clavate glands 40–70 µm long, and pluricellular, isocytic hairs often bearing one or two glands near the base, abaxially sparsely set with hairs, the hairs similar to those on the adaxial surface mostly occurring along the veins. *Venation* anadromous, catadromous towards the lamina and pinna apex, pinnately branched in the segments, the ultimate vein branches end in the teeth near the margin. *Stomata* of the anomo- and polocytic types, guard cells (36–)43(–48) µm long. *Sori* circular, inframedial on anadromous vein branches, discrete, to 1.5 mm in diameter; *sporangia* stalk glandular. *Indusia* persistent, brown to ferruginous, firmly herbaceous, reniform, margin repand, the margin and lamina glandular, to 1.4 mm in diameter. *Spores* unknown. *Chromosome number*: unknown.

**Distribution and habitat:**—*Dryopteris schnellii* is currently known from Guinea only. No information on its habit and habitat is known.

**Etymology:**—This species is named in honour of Raymond Albert Alfred Schnell (1913–1999), Professor of botany at the University of Paris, France.

**Remarks:**—The species is known from the type specimen only. Due to an electronic blunder the species was erroneously placed as a synonym of *Athyrium newtonii* by Roux (2009).

Diagnostic of the species is its small stature and the conspicuous acroscopic pinna development.

**24. *Dryopteris squamiseta* (Hook.) Kuntze** (1891: 813). Figs. 5CC–EE; 9B & Ba; 25.

*Nephrodium squamisetum* Hooker (1862: 140); (1863: pl. 268). Type:—EQUATORIAL GUINEA. Bioko (Fernando Po): Clarence Peak, 4000 ft., *G. Mann 380* (holotype K000351166!, K000351167!). *Aspidium squamisetum* (Hook.) Kuhn (1868: 24). *Nothoperanema squamiseta* (Hook.) Ching (1966: 25, 26).

*Nephrodium buchananii* Baker (1874: 498), as '*buchananii*'. Type:—SOUTH AFRICA. Natal, *Buchanan 108* (lectotype K000351168!, K000351169!, designated by Roux (2011: 61); RÉUNION (Bourbon). *Boivin s.n.* (syntype K?). *Lastrea buchananii* (Baker) Beddome (1883: 255). *Dryopteris buchananii* (Baker) Kuntze (1891: 812).

*Plants* terrestrial. *Rhizome* erect to suberect, usually unbranched, to 60 mm long and 8 mm in diameter, closely set with roots, stipe bases, and scales, the scales chartaceous, castaneous, adnate, narrowly triangular to subulate, to 11 x 2 mm, the margins regularly set with short multicellular, uniseriate hairs and capitate glands, the glands also occur on the scale lamina, the scale apex terminates in a short uniseriate series of cells. *Fronde*s up to 8 per plant, suberect to arching, to 925 mm long; *stipes* firm, proximally castaneous, brown to stramineous higher up, adaxially sulcate, to 460 mm long and 5 mm in diameter, closely set with patent scales, hairs, and glands, the scales chartaceous to thinly crustaceous, castaneous, adnate, narrowly triangular to subulate, to 11 x 2 mm, entire, or those near the base often with short multicellular, uniseriate hairs and capitate glands, the glands often also occur on the scale lamina, the scale apex terminates in a short uniseriate series of cells, the hairs are of 2 kinds: 1) inconspicuous, pale, multicellular uniseriate appressed hairs and, 2) castaneous, multicellular uniseriate patent hairs, the cells collapsing in the ctenitoid fashion upon drying, the glands clavate; *laminae* proximally anadromous, catadromous towards the apex, to 3-pinnate, ovate, to 460 mm long, to 390 mm wide, with up to 10 petiolated pinna pairs; *rachises* stramineous, adaxially sulcate, the sulcus open to that of the pinna-rachis, closely set with scales similar to, but smaller than those on the stipe; *pinnae* petiolate, the petiole up to 13 mm long, opposite to alternate, overlapping, the basal pinna pair strongly basiscopically developed, inaequilaterally narrowly ovate, lanceolate to oblong-acute towards the apex, to 220 mm long, to 125 mm wide, 1-pinnate-pinnatifid to 2-pinnate, with up to 5 free pinnule pairs; *pinna-rachises* stramineous, adaxially shallowly sulcate, moderately scaled, the scales patent,



chartaceous, castaneous, adnate, subulate, to 3 mm long; *pinnules* petiolate, the petiole to 2 mm long, catadromous, alternate, spaced or overlapping, oblong-acute to oblong-attenuate, acroscopic pinnule on basal pinnae to 44 mm long, to 17 mm wide, basiscopic pinnule on basal pinnae to 82 mm long, to 24 mm wide, pinnatifid to 1-pinnate; *segments* herbaceous, trapeziform to inaequilaterally oblong-obtuse, often acroscopically auricled, basiscopically decurrent along the costa towards the pinnule apex, lobed to crenulate, up to 14 x 6 mm, adaxially with simple, proximally multistratose subulate hairs along the veins, to 1.2 mm long, abaxially with proximally multistratose subulate hairs and clavate, pluricellular, uniseriate hairs, up to 0.85 mm long, and capitate glands to 30  $\mu\text{m}$  long along the veins. *Venation* anadromous, evident, pinnately branched, free vein branches end near the margin, fertile vein branches undifferentiated or variously shortened beyond the sorus. *Stomata* of the anomo- and polocytic types, guard cells (32–)48(–64)  $\mu\text{m}$  long. *Sori* circular, usually restricted to the pinnule and segment apices, medially to inframedially on unmodified vein branches, to 1.5 mm in diameter; *indusia* firmly herbaceous, brown, persistent, reniform to subcircular, entire, to 1.2 mm in diameter, adaxially with numerous capitate glands and rarely also with a few short hairs near the point of attachment; *sporangia* long-stalked, the stalk simple or with a long uniseriate trichome, 3-seriate below the capsule, the capsule globose, with 13(–15) indurated annulus cells, epistomium 4(–5)-celled, hypostomium 4(–5)-celled. *Spores* 64 per sporangium, brown, ellipsoidal, monolete, with prominent folds, tuberculate, (32–)35(–36) x (18–)20(–22)  $\mu\text{m}$  (Tryon & Lugardon, 1990: 422, figs. 158.4; 158.5).

**Distribution and habitat:**— The species is widespread in sub-Saharan Africa, occurring in Bioko, Cameroon, Equatorial Guinea, Ethiopia, Kenya, Malawi, Rwanda, Somalia, South Africa, Sudan, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe, extending to Madagascar and Réunion. The species is generally confined to moist evergreen forests at altitudes ranging from near coast level in the eastern parts of South Africa to 3100 m in Ethiopia.

**Etymology:**—*squamiseta*; *squama* - scale, and *seta* - bristle, with reference to the bristle-like scales occurring on the frond axes and veins.

**Additional specimens studied:**—ETHIOPIA. Province unknown: Ghini Rain Forest, 2160 m, 12 January 1968, *D.L. Rankin 117* (K); Garramba, 3100 m, 17 March 1958, *J. Eriksson F71* (S).

KENYA. Central Province: Nyeri Distr., S Kinangop, Aberdares Forest Reserve, ca. 2620 m, 24 November 1957, *B. Molensworth-Allen 3638* (K). Eastern Province: Meru Distr., Marimba Forest, 2<sup>nd</sup> bridge on road to Volcanic Cone Kirui, on slope of Ithanguni, NE side of Mt Kenya,

wet evergreen forest, 28 February 1970, *R.B. Faden 70/76* (BOL); Kamweti Track above Kamweti Forest Station, *Aurundinaria alpina* thicket, 16 October 1971, *R.B. Faden, P. Holland & D. Elder 71/862* (BOL); Ithanguni Forest, road along base of Kirue volcanic cone, 2335 m, 22 June 1969, *R.B. Faden, A. Evans, J. Maara & P. Mwirigi 69/765* (BOL, K).

MALAWI. Central Region: Dedza Distr., Dedza Mtn forest, 2050–2100 m, 22 November 1983, *F. Dowsett-Lemaire 1085* (K). Northern Region: Karongo Distr., Nyika Plateau, in a few forest patches of Zovochipolo, 2200 m, August 1981 (K).

SOUTH AFRICA. Eastern Cape: —3129 (Port St John's) Port St John's (–DA), January 1929, *H.A. Wager s.n.*, CH 2920 (PRE). —3226 (Fort Beaufort) Alice, Chumie (–DB), *Young TRV 475C* (PRE). KwaZulu-Natal: —2731 (Louwsburg) Ngome Forest (–CD), 16 July 1956, *E.A.C.L.E. Schelpe 6217* (BOL). —2830 (Dundee) Qudeni (–DB), 18 February 1945, *R.J. Allsopp 775* (PRE); Qudeni Forest, 18 February 1945, *B.S. Fisher 886* (PRE); Qudeni Forest, 1670 m, *E.A.C.L.E. Schelpe 6259* (BOL). —2930 (Pietermaritzburg) Karkloof, farm Ehlateni, on streambanks in deep shade of forest (–AC), 19 October 1981, *J.P. Roux 1000* (NBG); Karkloof forest, Nebelwald, 20 April 1992, *M. Weigend 2516* (M); Zwartkop (–CB), *T. Hill s.n.*, TRV 1679C (PRE); Richmond (–CD), *J.M. Wood s.n.* TRV 474C (PRE). Sine loco:—Natal, *J. Buchanan s.n.* (BOL). Limpopo: —2329 (Pietersburg) Haenertsburg (–DD), 1905, *A.K. Eastwood 9* (PRE). —2330 (Tzaneen) Woodbush Forest Reserve, near S.A.T.V. towers, in evergreen mist forest (–CC), 26 November 1983, *J.E. Burrows 3260* (BOL); Woodbush, *Eastwood s.n.*, TRV 761C (PRE); New Agatha Forest Reserve, Wolkberg 634LT, in kloof, 22 April 1971, *P.J. Muller & J.C. Scheepers 102* (PRE); Pietersburg, Woodbush, 10 July 1956, *E.A.C.L.E. Schelpe 6048* (PRE); Woodbush, near forester's office, 4 February 1981, *E.J. van Jaarsveld 6112* (BOL); Pietersburg, Woodbush Forest Reserve, 7 May 1962, *D.R.J. van Vuuren 1468* (PRE); Woodbush, *H.A. Wager s.n.*, CH 7418 (PRE). Mpumalanga: —2430 (Pilgrim's Rest) The Pinacle, near Graskop, ca. 1370 m (–DB), 2 January 1961, *A.F. Braithwaite 208* (BOL); Graskop, Fairyland, in climax montane forest, 6 January 1979, *J.E. Burrows 1380* (BOL); Graskop Distr., Erasmus Kop, January 1946, *W.N.B. Hardcastle 57* (PRE); forest below Erasmus Kop, 1380 m, 21 May 1972, *W. Jacobsen 4385* (FR); Mariepskop, in very wet area along the road to the summit, 28 February 2002, *J.P. Roux 3251* (NBG); Mariepskop, in forest near homestead of the forester, 5 December 1957, *Schweickerdt 2432* (M); Pilgrim's Rest, Mariepskop, Bedford trail, 7 January 1969, *P.J. Vorster 66* (PRE); Blyde River Forest Reserve, in forest in ravine W of Quartoskop, 1560 m (–DD), 29 May 1972, *W.B.G.*

*Jacobsen 4409* (FR, PRE); Pilgrim's Rest Gold Fields, in forest, 1874, *J.H. McLea s.n.* (BOL, SAM); Graskop, Fairyland, along stream in montane forest, 28 March 2011, *J.P. Roux 5358* (NBG). —2530 (Lydenburg) farm Knapdaar, in narrow montane cleft, 1980 m (–AD), 25 April 1981, *N. Jacobsen 5289* (FR); escarpment in Berlin Forest near TV tower, 1450 m, (–DA), 13 August 1981, *J.P. Kluge 2457* (NBG); Berlin State Forest, escarpment of Berlin State Forest near TV tower, 13 May 1981, *J.P. Kluge 4557* (PRE). Sine loco: *Barkly s.n.* (SAM); September 1867, *J. Buchanan 20* (K).

SWAZILAND. Hhohho Distr. —2531 (Komatipoort) Havelock, King's Forest, 1520 m (–CA), 13 July 1956, *E.A.C.L.E. Schelpe 6178* (BOL).

TANZANIA. Iringa Region: Mufindi Distr., Mufindi, Kigogo Forest, 1915 m, 18 December 1961, *D. Vesey-Fitzgerald 3655* (BOL). Kilimanjaro Region: Moshi Rural Distr., Kilimanjaro, Kibosho, 2000 m, 1906, *Daubenberger 40* (M); Kilimanjaro, forest above Manderu Hut, ca. 2750 m, 12 October 1993, *J.M. Grimshaw 93865* (K); Bezirk Moschi, Kilimandsharo, ca. 2800 m, 7 March 1934, *H.J. Schlieben P900* (M).

UGANDA. Western Region: Kasese Distr., ca. 4 mls N of Kilema, above water supply intake, 2580 m, 16 February 1969, *M. Lock 69/1* (K).

ZIMBABWE. Manicaland Province: Mutare Distr., Stapleford Forest Reserve, between end of Henkel's Gap level road and SE mountain forest boundary, 1670 m, 25 September 1952, *N.C. Chase 4640* (NBG); Mutare (Umtali), Cloudlands, 25 June 1955, *N.C. Chase 5614* (BOL); Bvumba (Vumba) Mts, Elephant Forest, Mountain, forest, above waterfall in ravine, 1610 m, 5 August 1985, *N.C. Chase 5704* (NBG); Stapleford Estate, montane forest, on gentle mountain slope, 23 November 1998, *J.P. Roux 2831* (NBG); Mutare (Umtali), Cloudlands, 1580 m, 25 June 1955, *E.A.C.L.E. Schelpe 5376* (BOL); Mutasa Distr., Nyanga (Inyanga), ravine S of Pungwe Falls, 2067 m, 22 October 1955, *N.C. Chase 5830* (BOL); Pungwe Gorge, 1730 m, 15 July 1955, *E.A.C.L.E. Schelpe 5704* (BOL, NBG). Sine loco: Zimbabwe, *D. Williams CD3* (BOL).

INSERT FIGURE 25

**25. *Dryopteris tricellularis* Roux** (2002: 735, figs. 1, 2). Figs. 6R–X; 26.

Type:—UGANDA. Mt Elgon, bamboo zone, 9000 ft. (2736 m), January 1918, *R.A. Dümmer 3557* (holotype K, isotypes BOL!, NBG0105534-0!).

*Plants* terrestrial. *Rhizome* short, decumbent, sparsely branched, to 15 mm in diameter, set with roots, closely spaced stipe bases, and scales, the scales dark brown, crustaceous, broadly attached, ovate to lanceolate, cordate to truncate, entire, with short and long filiform outgrowths, and/or with scattered unicellular glands, the apex flagelliform, terminating in a long uniseriate series of oblong cells, to 15 x 7 mm. *Fronde*s suberect to arching, to 1.1 m long; *stipes* proximally castaneous, ferruginous to stramineous higher up, adaxially shallowly sulcate, abaxially often with a low central ridge (in dried specimens), to 570 mm long, to 9 mm in diameter, proximally densely scaled, higher up moderately to sparsely set with scales and hairs, the basal scales brown to dark brown, crustaceous to chartaceous, the scales higher up stramineous to ferruginous, chartaceous, the larger scales broadly attached, broadly ovate to lanceolate, cordate to cuneate, entire, with a few scattered unicellular glands, or with uniseriate filiform outgrowths, the apex flagelliform, terminating in a uniseriate series of oblong cells, to 15 x 7 mm, the smaller scales sessile, oblong to filiform, twisted, entire, with one or more glandular cells along the margin, usually near the base, or with scattered filiform outgrowths, the hairs uniseriate and composed of 3–5 oblong cells; *lamina* firmly herbaceous, ovate to narrowly triangular, to 3-pinnate, anadromous, catadromous towards the apex, to 555 x 440 mm, with up to 18 petiolated pinna pairs; *rachises* stramineous, adaxially shallowly sulcate, often with a central ridge abaxially (in dried material), becoming narrowly winged towards the apex, initially moderately to densely set with scales and hairs, the scales stramineous, membranous to chartaceous, sessile, narrowly lanceolate to filiform, narrowly to broadly cuneate, entire, with one or more glandular cells, usually near the base, and/or with a few scattered uniseriate hairs, the apex filiform, to 6 mm long, to 1.8 mm wide; *pinnae* petiolated, the petiole to 12 mm long, the basal pair inaequilaterally ovate to oblong-acuminate, lanceolate to oblong-acuminate towards the lamina apex, to 2-pinnate, the basal pair slightly shorter or longer than the pair above, basiscopically developed in the lower half of the lamina, to 330 mm long, to 180 mm wide, basally closely to widely spaced, often imbricate higher up, with up to 11 pairs of short-petiolated pinnules; *pinna-rachises* adaxially shallowly sulcate, the sulcus confluent with that of the rachis, narrowly winged along the entire length in smaller specimens, pronounced abaxially, abaxially moderately to densely set with scales and hairs, the scales and hairs stramineous to ferruginous, chartaceous to membranous, sessile or short-stalked, ovate to narrowly lanceolate, or filiform, narrowly to broadly cuneate, entire or subentire, often with a

uniseriate hair from near the base, the scale apex filiform, terminating in an oblong cell, to 4 mm long, to 1.2 mm wide; *pinnules* petiolate, the petiole to 2 mm long, narrowly triangular to oblong-obtuse, pinnatifid to 1-pinnate, the acroscopic pinnule on the basal pinnae to 80 mm long, to 35 mm wide, the basiscopic pinnule on the basal pinnae to 90 mm long, to 28 mm wide, widely to closely spaced; *costae* adaxially shallowly sulcate, the sulcus confluent with that of the pinna-rachis, narrowly winged, abaxially moderately to densely set with scales similar, but smaller than those on the pinna-rachis, and with 3- or more celled hairs; *segments* spaced, oblong-obtuse, basiscopically decurrent, to 12 mm long, to 4 mm wide, lobed; *lobes* serrate, adaxially glabrous or sparsely set with 2- and 3-celled hairs, abaxially closely set with predominantly 3-celled hairs along the costae, costules, and veins, the hairs often with strongly oblique walls, to 0.8 mm long, the unicellular hairs, if present to 130  $\mu\text{m}$  long, and largely isocytic hairs. *Venation* anadromous becoming isodromous to catadromous towards the lamina and pinna apex, pinnately branched in the segments, the vein branches pinnately branched, forked or simple near the apex, evident abaxially, ending in the teeth near the margin. *Stomata* of the anomo- and polocytic types, guard cells (32–)48(–64)  $\mu\text{m}$  long. *Sori* circular, medial to inframedial on the anadromous vein branches, discrete at maturity, to 1.2 mm in diameter; *sporangia* stalk simple, glandular, or haired, capsule with (9–)14(–23) indurated annulus cells, epistomium (3–)4(–7)-celled, hypostomium (3–)4(–7)-celled. *Indusia* brown, firmly herbaceous, cordate to reniform, repand to irregularly lobed, to 1.0 mm in diameter. *Spores* ellipsoidal, monolete, perispore with prominent reticulate ridges, with granulate deposits, (32–)38(–52) x (22–)26(–38)  $\mu\text{m}$ . *Chromosome number* unknown.

**Distribution and habitat:**—*Dryopteris tricellularis* is confined to the East- and Central African mountains of Ethiopia, Kenya, Tanzania and Uganda, on Mt Elgon (2736–3600 m), Mt Kenya (2918 m) and the nearby Aberdare Mountains. On Mt Elgon the species occurs in the bamboo zone between 2740 and 3600 m, but on the Aberdare Mountains in Kenya the species occurs between 2075 and 2980 m in forest habitats along streambanks and at waterfalls.

**Etymology:**—The epithet refers to the predominantly 3-celled cylindrical hairs occurring on the frond axes and veins.

**Additional specimens studied:**—ETHIOPIA. Amhara Region: Ahmar Mts, about 62 km W of Kulubi, along the road to Asbe Tafari, 9°10'N, 41°04'E, ca. 2700 m, montane forest (*Podocarpus*, *Juniperus*, etc.) on humid slope in forest, 10 May 1969, J.J.F.E. de Wilde 5005 (M, MO).

KENYA. Central Province: Kiambu Distr., Aberdares National Park, Nyeri Chania River falls, 2980 m, along river below falls, 29 June 1969, *R.B. Faden 69/802* (K); Aberdare Mts, Kiandongoro Track above Tucha (Tusha), crossing of a small tributary of the Chania River, *R.B. Faden 71/885* (H1142546, US); Nyeri Distr., Kamweti track, crossing of Gathiba River, 2075 m, 26 January 1969, *R.B. Faden 69/112* (K). Eastern Province: Meru Distr., Mt Kenya, Naro Moru Track, 2620 m, *Arundinaria alpina* (bamboo) thicket with emergent *Podocarpus milanjianus*, 23 October 1971, *R.B. Faden 71/873* (US); forest end camp above Timau, Mt Kenya, 2918 m, 28 August 1942, *McLoughlin 683* (BOL, NBG); W slopes of Mt Kenya, along the trail from West Kenia Forest Station to summit, at 3630 m, 21–27 September 1909, *E.A. Mearns 1500* (US631558); W slopes of Mt Kenya, along the trail from West Kenia Forest Station to summit, 3000 m, 7 October 1909, *E.A. Mearns 1700* (US631652); Mt Kenya National Park, Naro Moru Track, bamboo zone, 2800 m, 27 July 1978, *E. Zogg, K.U. Kraker & H. Gassner 252/4* (US2903094). Western Province: Mt. Elgon Distr., Mt Elgon, Suam, Saw Mill Track, forest near Kisano Waterfall on Kisano stream, a tributary of the Kiptogot stream, ca. 2400 m, 13 June 1971. Cult. in Switzerland, Reichstein herb. no. 3248, diploid, *R.B. Faden 71/468* (PRE, US); Kenya, Baringo Distr., Mt Elgon, in the crater, at Maji ya Moto (hot spring), on moist rock above the spring, 3600 m, 13 May 1948, *O. Hedberg 907* (K).

TANZANIA. Mbeya Region: Rungwe Distr., Rungwe forest, 2130 m, June 1957, *Watermeyer 37* (K). Morogoro Region: Morogoro Distr., Ulugurus, Bunduki, planted *Cupressus* forest, 1250 m, 11 January 1935, *E.M. Bruce 42* (BM000787479); Nguru Mts, (Taliani), mountain rainforest, ca. 1700 m, between Kombola and Maskah Mafulumla Mts, 20 August 1971, *H.J. Schlieben 12244* (PRE).

UGANDA. Eastern Region: Mbale Distr., Mt Elgon, 2736 m, January 1918, *R.A. Dümmer 3557* (BOL, K, NBG); Mt Elgon, 2736–3040 m, January 1918, *R.A. Dümmer 3352* (BOL, K, NBG); at Bulambuli, *W.J. Eggeling 2450* (K); Bulambuli, Mt Elgon, 2736 m, January 1936, *W.J. Eggeling 2451* (K); above Bulambuli, Mt Elgon, ca. 2740 m, 24 December 1957, *B. Molesworth Allen 3664* (NBG); Mt Elgon, Bulambuli, in semi open ground, 2736 m, August 1934, *P.M. Synge 1027* (K); Bulambuli, Bugishu, bamboo forest, 2736 m, 4 September 1932, *A.S. Thomas 539* (K, US2200547); Mt Elgon, Sasa Trail, common in upper montane forest, 3200 m, 28 December 1997, *K. Wesche 471* (US3370032); Mt Elgon, Sasa Trail, common in upper montane forest, 3200 m, 27 December 1996, *K. Wesche 649* (US3370031); Mt Elgon, 2750 m, *Podocarpus* forest, 28

December 1996, *K. Wesche 1160* (K). Western Region: Kasese Distr., Toro, Bwamba Pass, forest, 2370 m, 16 November 1935, *A.S. Thomas 1442* (K).

**Remarks:**—*Dryopteris tricellularis* and *D. fadenii* occur in similar areas and vegetation types. The similar scale morphology of these species suggests that they may be related. *Dryopteris tricellularis* can be separated from *D. fadenii* in the lamina axes and veins mostly closely set with 2- and 3-celled hairs absent in the latter. The lamina hairs are mostly isocytic whereas those of *D. fadenii* are mostly moniliform. The smaller lamina scales are generally sessile, but in *D. fadenii* they are mostly short-stalked. *Dryopteris tricellularis* is mostly exindusiate, whereas *D. fadenii* has mostly small and scale-like indusia. Spore size of the two taxa are similar but the perispore in *D. tricellularis* forms prominent narrow reticulate ridges that are closely set with granulate deposits, when in *D. fadenii* the perispore forms low reticulate bulges and ridges which are rugate. *Dryopteris tricellularis* is most similar to *D. schimperiana* among African *Dryopteris* species. The putative affinity of these species is reflected by the presence of the rigid isocytic hairs occurring on the lamina axes and veins, but differs from it in the larger stomata, which suggests it may be tetraploid, and the mostly exindusiate sori.

**Variation:**—Marginal outgrowths on the scales vary in abundance. Also the density of 2- and 3-celled hairs occurring on the lamina axes and veins show some variation. In some collections the 2- and 3-celled hairs are somewhat gnarled, but in others they are thin and straight-walled. Most sori bear sporangia of which the stalk is simple or haired, but in others also a (mostly) simple glandular hair is borne. The indusia vary significantly in shape and size. Apart from hair density none of the variations can be directly linked to obvious environmental factors.

INSERT FIGURE 26

**26. *Dryopteris wallichiana*** (Spreng.) Hyl. subsp. ***reichsteinii*** Fraser-Jenkins (1996: 71), *non D. reichsteinii* Fraser-Jenkins (1986: 191). Figs. 6Y & Z; 9E & Ee; 16.

Type:—ZIMBABWE. Inyanga Mountains, source of the Pungwe River, under *Widdringtonia*, ± 2100 m, 3.III.1979, *J.J. Schneller 237* (holotype BM).

*Plants* terrestrial. *Rhizomes* short, erect to suberect, to 150 mm tall, to 22 mm in diameter, set with roots, crowded persistent stipe bases and scales, the scales castaneous, chartaceous, broadly

attached, subulate, to 15 mm long, to 2 mm wide, cordate, the margins variously set with short and long, apically or basally directed, often branched outgrowths that reduce in number and size towards the scale apex, the scale apex terminates in an elliptic thin-walled cell. *Fronde*s crowded, caespitose, erect to suberect, to 1.2 m long; *stipes* proximally castaneous, slightly paler higher up, firm, adaxially shallowly sulcate, cicatricate, densely scaly, the smaller scales concolorous, ferruginous to stramineous, stalked, the larger scales often bicolorous, if bicolorous then ferruginous to stramineous with castaneous streaks, chartaceous, sessile, subulate, to 17 mm long, to 2.4 mm wide, cordate to cordate-imbricate, the margins proximally variously set with outgrowths similar to those on the rhizome scales, the outgrowths reduced in number and size towards the scale apex, the scale apices terminating in a subulate cell or an elliptic thin-walled cell; *laminae* anadromous, catadromous towards the apex, 1-pinnate-pinnatifid, narrowly elliptic, to 935 mm long, to 270 mm wide, with up to 47 petiolated pinna pairs, with several pinna pairs gradually reducing in length towards the base; *rachises* stramineous, adaxially sulcate, cicatricate, moderately to densely scaly, the scales to 13 × 0.8 mm, the smaller scales mostly concolorous, ferruginous to stramineous, short-stalked, the larger scales concolorous or bicolorous, if bicolorous then ferruginous with castaneous streaks, chartaceous, sessile, subulate, cordate to cordate-imbricate, the margins variously set with outgrowths similar to those on the rhizome scales, the scale apices terminating in a subulate cell or an elliptic thin-walled cell; *pinnae* petiolate, the petiole to 2 mm long, the pinnae pinnatifid, subopposite to alternate, imbricate or not, the proximal pinnae generally more widely spaced, dark green and glossy adaxially, paler and matte abaxially, oblong-acuminate to narrowly triangular, to 138 mm long, to 26 mm wide; *costae* adaxially sulcate, the sulcus not confluent with that of the rachis, narrowly winged, adaxially with narrow ridges on either side of the costae extending between adjacent lateral veins, initially moderately set with ferruginous, filiform scales, abaxially moderately scaled, the scales ferruginous to stramineous, chartaceous, sessile to short-stalked, subulate, to 6 mm long, to 1 mm wide, cordate to cordate-imbricate, the margins irregularly set with outgrowths similar to those on the rhizome scales, the scale apex terminates in a subulate cell or an elliptic thin-walled cell; *lobes* firmly herbaceous, rectangular and parallel-sided, to 16 × 7 mm, denticulate, the proximal acroscopic lobe often slightly longer than the next, the proximal basiscopic lobe mostly basiscopically auriculate, adaxially glabrous, or sparsely set with filiform scales along the costae and veins, abaxially moderately scaly along the costules, veins and lobe margins, the scales along



the veins ferruginous to stramineous, chartaceous, short-stalked, subulate, to  $4.0 \times 0.6$  mm, cordate-imbricate, the margins variously set with outgrowths similar to those on rhizome scales, the scale apex terminates in a subulate cell, an elliptic thin-walled cell, or an undifferentiated apical cell, scales along the lobe margins are ferruginous, chartaceous, filiform, to 5 mm long, to 0.1 mm wide, long-stalked, proximally with few marginal outgrowths at the base, entire distally, the apex terminates in a subulate cell, an slightly enlarged apical cell, or an undifferentiated apical cell. *Venation* evident adaxially and abaxially, the lateral veins in the lobes forked once or twice in proximal veins to form 2 or 3 veinlets ending near the margin, the endings slightly enlarged. *Stomata* mostly of the polocytic type, guard cells (42–)48(–54)  $\mu\text{m}$  long. *Sori* 2-seriate on the lobes, circular, to 1.5 mm in diameter, discrete at maturity, inframedial on unmodified, predominantly anadromous vein branches, confined to the distal parts of the lamina and pinnae; *indusia* brown, firmly chartaceous, reniform, to 1.5 mm in diameter, entire. *Sporangia* stalk simple or with a 1- or 2-celled glandular hair, the capsule obovate, the annulus with (13–)14(–17) indurated annulus cells, the epistomium 4 (–5)-celled, the hypostomium 4 (–6)-celled. *Spores* brown, 32 spores per sporangium. *Chromosome number*:  $2n=123$ , triploid apomict (Vida in Widén *et al.* 1996).

**Distribution and habitat:**—*Dryopteris wallichiana* subsp. *reichsteinii* is known from a single location near the source of the Pungwe River in the Nyanga Mountains in eastern Zimbabwe. It occurs at an elevation of approximately 1975 m where it is confined to forests of *Widdringtonia whytei* Rendle trees.

**Etymology:**—Species named after Nathaniel Wallich (28 January 1786–28 April 1854), Danish surgeon, appointed as assistant to William Roxburgh, the East India Company's botanist in Calcutta, India, becoming superintendant of the garden in 1817, retired to London in 1847. Subspecies named for Tadeus Reichstein (20 July 1897–1 August 1996), Polish born, moved to Zürich in 1905, became professor of pharmaceutical chemistry at the University of Basel in 1938. Nobel Prize laureate in 1950 for the elucidation and synthesis of corticosteroids. Reichstein studied ferns after his retirement.

**Additional specimens examined:**—ZIMBABWE. Manicaland Province: Mutasa Distr., source of Pungwe River at foot of Mount Nyangani (Inyangani Mtn.), stream bank in shade, 1976 m, 23 April 1953, *N.C. Chase 4928* (BM); Nyanga (Inyanga), Rhodes Inyanga Estate, source of Pungwe River, in shade of *Widdringtonia whytei*, 1976 m, 25 May 1954, *N.C. Chase 5233* (BM, BOL,

NU); Nyanga (Inyanga) Distr., in light shade at source of Pungwe River, foot of Inyangani Mtn, on circular drive, 1976 m, 1 May 1960, *N.C. Chase 7337* (BM, BOL, K, M).

**Remarks:**—*Dryopteris wallichiana* (Spreng.) Hyl. (1953: 352) is often considered as a species confined to the palaeotropics whilst *D. paleacea* (Lag. ex Sw.) C.Chr. (1911: 94) is treated as its sister species in the neotropics (Tryon & Tryon 1982). Others, however, consider them conspecific (Smith & Fraser-Jenkins 1982, Fraser-Jenkins 1986, 1989, Stolze 1981). Smith & Fraser-Jenkins (1982) discuss the application of the names *D. wallichiana* versus *D. paleacea* for the species. In current understanding, *Dryopteris wallichiana* has a world-wide tropical and subtropical distribution with its centre of distribution in SW China and the eastern Himalayas (Fraser-Jenkins 1989). The phloroglucinol derivatives of the species have been studied by Widén *et al.* (1996). Fraser-Jenkins (in Widén *et al.* 1996) recognises four subspecies in the *D. wallichiana* complex, one of them occurring in the study area.

*Dryopteris wallichiana* subsp. *reichsteinii* differs from the typical subspecies in being a triploid apomict rather than a diploid apomict (Widén *et al.* 1996). A more obvious feature of *D. w.* subsp. *reichsteinii* are the smaller scales occurring along the pinna margins. In *D. wallichiana* subsp. *wallichiana* the scales along the costae and costules are stalked and subulate with numerous long and short, straight and curved, often branched outgrowths that reduce in size and number towards the apex. The apex of these scales mostly terminates in an oblong thin-walled cell. Scales occurring in a similar position on the fronds of *D. w.* subsp. *reichsteinii* are more rigid, have less marginal outgrowths at the base, and the scale apices are more or less entire. The apices of these scales also terminate in a subulate cell, is undifferentiated, or the apical cell may be somewhat enlarged. Scales occurring along the lobe margins in *D. w.* subsp. *wallichiana* the are much longer than those in subsp. *reichsteinii*, are long-stalked and subulate-caudate to narrowly lanceolate-caudate in outline, have numerous straight or curved, simple or branched outgrowths at the base whilst the apices are linear and mostly devoid of marginal outgrowths. They usually terminate in an oblong thin-walled cell. In *D. w.* subsp. *reichsteinii* the scales are stalked, subulate in outline and have few, often angular, marginal outgrowths. The apical cells are undifferentiated or enlarged, but rarely thin-walled. The stomata are (42–)48(–54)  $\mu\text{m}$  long in *D. wallichiana* subsp. *reichsteinii* while those of subsp. *wallichiana* are (48–)56(–64)  $\mu\text{m}$  long. Fraser-Jenkins (1989) refers the Madagascan and Zimbabwean specimens of *Dryopteris wallichiana* to *Dryopteris reichsteinii*. In 1996 he found the Zimbabwean plants to be a triploid apomict and ascribed these

as *D. wallichiana* subsp. *reichsteinii*. He stated in that paper that the Madagascan material may be related to this subspecies.

In general, *Dryopteris wallichiana* subsp. *madagascariensis* (C.Chr.) J.P.Roux (2011: 18) appears to be smaller than the other subspecies as the fronds may only be up to 1.1 mm long and up to 270 mm wide. In this subspecies the proximal basispic lobes are basispically auricled and frequently also shallowly lobed. The lamina scales terminate in a subulate cell rather than an elliptic thin-walled cell and the larger guard cell length, (40–)53(–64)  $\mu\text{m}$ , suggest it being a different cytotype than either subspecies *wallichiana* and subsp. *reichsteinii* (Roux 2011).

### ***Dryopteris* names appearing in literature relevant to the region and their current application.**

Names referable to thelypterid genera follow the classification of Holttum (1974) since many species have not been formally transferred to the genera as defined by Smith *et al.* (2006).

- Dryopteris adenochlamys* C.Chr. = **Christella microbasis** (Baker) Holttum  
*Dryopteris adiantiformis* (G.Forst.) Kuntze = **Rumohra adiantiformis** (G.Forst.) Ching  
*Dryopteris aequibasis* C.Chr. = **Pseudocyclosorus pulcher** (Bory ex Willd.) Holttum  
*Dryopteris afra* Christ = **Pneumatopteris afra** (Christ) Holttum  
*Dryopteris africana* (Desv.) C.Chr. = **Stegnogramma pozoi** (Lag.) K.Iwats.  
*Dryopteris afzelii* (C.Chr.) Holttum = **Christella afzelii** (C.Chr.) Holttum  
*Dryopteris anateinophlebia* C.Chr. = **Amauropelta bergiana** (Schltdl.) Holttum  
*Dryopteris arbuscula* (Willd.) Kuntze = **Sphaerostephanos arbuscula** (Willd.) Holttum  
*Dryopteris arthrothrix* (Hook.) C.Chr. = **Pseudotectaria arthrothrix** (Hook.) Holttum  
*Dryopteris barteriana* (Hook.) C.Chr. = **Lastreopsis barteriana** (Hook.) Tardieu  
*Dryopteris bergiana* (Schltdl.) Kuntze = **Amauropelta bergiana** (Schltdl.) Holttum  
*Dryopteris bicolor* Bonap. = **Lastreopsis subsimilis** (Hook.) Tindale  
*Dryopteris biformis* C.Chr. = **Pseudotectaria biformis** (Mett.) Holttum  
*Dryopteris blepharochlamys* C.Chr. = **Ctenitis blepharochlamys** (C.Chr.) Tardieu  
*Dryopteris blepharorachis* C.Chr. = **Pseudotectaria fibrillosa** (Baker) Holttum  
*Dryopteris boivinii* Kunze = **Lastreopsis boivinii** (Baker) Kuntze

*Dryopteris boryana* (Willd.) C.Chr. = **Deparia boryana** (Willd.) M.Kato  
*Dryopteris buchananii* (Baker) Kuntze = **Dryopteris squamiseta** (Hook.) Kuntze  
*Dryopteris catoptera* (Kunze) Kuntze = **Megalastrum lanuginosum** (Willd. ex Kaulf.) Holttum  
*Dryopteris caudiculatus* (Sieber ex Kunze) C.Chr. = **Pneumatopteris prismaticus** (Desv.)  
 Holttum  
*Dryopteris cirrhosa* (Schumach.) Kuntze = **Ctenitis cirrhosa** (Schumach.) Ching  
*Dryopteris contigua* Rosenst. = **Christella hispidula** (Decne.) Holttum  
*Dryopteris costularis* C.Chr. = **Pneumatopteris unita** (Kunze) Holttum  
*Dryopteris crenata* (Forssk.) Kuntze = **Hypodematum crenatum** (Forssk.) Kuhn  
*Dryopteris crinobulbon* (Hook.) C.Chr. = **Ctenitis cirrhosa** (Schumach.) Ching  
*Dryopteris cruciata* (Willd.) C.Chr. = **Pseudophegopteris cruciata** (Willd.) Holttum  
*Dryopteris currori* (Mett.) Kuntze = **Lastreopsis currori** (Mett. ex Kuhn) Tindale  
*Dryopteris dentata* (Forssk.) C.Chr. = **Christella dentata** (Forssk.) Brownsey & Jermy  
*Dryopteris diana* C.Chr. = **Pseudophegopteris diana** (Hook.) Holttum  
*Dryopteris didymosora* C.Chr. = **Christella parasitica** (L.) Lév.  
*Dryopteris distans* (Hook.) Kuntze = **Christella distans** (Hook.) Holttum  
*Dryopteris divisa* Kuntze = **Deparia boryana** (Willd.) M.Kato  
*Dryopteris doiana* (Spreng.) Ching = **Dryopteris wallichiana** (Spreng.) Hylander  
*Dryopteris efulensis* (Baker) C.Chr. = **Lastreopsis currori** (Mett.) Tindale var. **currori**  
*Dryopteris elata* C.Chr. = **Pneumatopteris venulosa** (Kunze) Holttum  
*Dryopteris eurostotrichum* C.Chr. = **Christella distans** (Hook.) Holttum  
*Dryopteris exaggerata* (Baker) C.Chr. = **Ctenitis exaggerata** (Baker) Ching  
*Dryopteris extensa* (Blume) Kuntze = **Amphineuron opulentum** (Kaulf.) Holttum  
*Dryopteris foliosa* C.Chr. = **Arachniodes webbiana** subsp. **foliosa** (C.Chr.) Gibby *et al.*  
*Dryopteris fragilis* (Baker) C.Chr. = **Metathelypteris fragilis** (Baker) Holttum  
*Dryopteris friesii* Brause = **Christella friesii** (Brause) Holttum  
*Dryopteris glabrata* (Mett. ex Kuhn) Kuntze = **Deparia glabrata** (Mett. ex Kuhn) M.Kato  
*Dryopteris gladiata* C.Chr. = **Pneumatopteris unita** (Kunze) Holttum  
*Dryopteris goggylodus* (Schkuhr) Kuntze = **Cyclosorus interruptus** (Willd.) H.Itô  
*Dryopteris gueinziana* (Mett.) C.Chr. = **Christella gueinziana** (Mett.) Holttum  
*Dryopteris guineensis* Christ = **Christella guineensis** (Christ) Holttum

*Dryopteris hemitelioides* Christ = **Cyclosorus striatus** (Schumach.) Ching  
*Dryopteris heteroptera* C.Chr. = **Amauropelta heteroptera** (Desv.) Holttum  
*Dryopteris hornei* Kunze = **Lastreopsis hornei** (Baker) Tindale  
*Dryopteris impressa* Posth. = **Amphineuron opulentum** (Kaulf.) Holttum  
*Dryopteris jenseniae* C.Chr. = **Triplophyllum jenseniae** (C.Chr.) Holttum  
*Dryopteris kiboschensis* (Hieron.) C.Chr. = **Deparia boryana** (Willd.) M.Kato  
*Dryopteris lanigera* (Mett. ex Kuhn) Tardieu = **Ctenitis lanigera** (Mett. ex Kuhn) Tardieu  
*Dryopteris lanuginosa* (Willd. ex Kaulf.) C.Chr. = **Megalastrum lanuginosum** (Willd. ex Kaulf.)  
 Holttum  
*Dryopteris longicuspis* (Baker) C.Chr. = **Pseudocyclosorus pulcher** (Bory ex Willd.) Holttum  
*Dryopteris lucida* (Baker) C.Chr. = **Cyclosorus interruptus** (Willd.) H.Itô  
*Dryopteris madagascariensis* C.Chr. = **Pneumatopteris unita** (Kunze) Holttum  
*Dryopteris magna* (Baker) Tardieu = **Ctenitis magna** (Baker) Tardieu  
*Dryopteris maranguensis* C.Chr. = **Amauropelta bergiana** (Schltdl.) Holttum  
*Dryopteris mascarenarum* Urban = **Ctenitis mascarenarum** (Urban) Tardieu  
*Dryopteris mascarensis* (Baker) Kuntze = **Christella distans** (Hook.) Holttum  
*Dryopteris mauritiana* C.Chr. var. *gardineri* C.Chr. = **Sphaerostephanos subtruncatus** (Bory)  
 Holttum  
*Dryopteris membranifera* C.Chr. = **Amauropelta membranifera** (C.Chr.) Holttum  
*Dryopteris microbasis* (Baker) Kuntze = **Christella microbasis** (Baker) Holttum  
*Dryopteris modesta* C.Chr. = **Ctenitis ochrorachis** (Baker) Tardieu  
*Dryopteris multifrons* (C.Chr.) Holttum = **Christella multifrons** (C.Chr.) Holttum  
*Dryopteris nigrisianum* (Baker) C.Chr. = **Lastreopsis nigrisianum** (Baker) Tindale  
*Dryopteris nimbaensis* Tardieu = **Ctenitis cirrhosa** (Schumach.) Ching  
*Dryopteris oppositifolia* C.Chr. = **Pneumatopteris oppositifolia** (Hook.) Holttum  
*Dryopteris oppositifoliformis* C.Chr. = **Amauropelta oppositifoliformis** (C.Chr.) Holttum  
*Dryopteris orientalis* (J.F.Gmel.) C.Chr. = **Arthropteris orientalis** (J.F.Gmel) Posth.  
*Dryopteris pallidivenia* Kuntze = **Cyclosorus striatus** (Schumach.) Ching  
*Dryopteris palmii* C.Chr. = **Amauropelta bergiana** (Schltdl.) Holttum  
*Dryopteris parallela* (Baker) C.Chr. = **Arthropteris parallela** (Baker) C.Chr.  
*Dryopteris parasitica* Kuntze = **Christella parasitica** (L.) Lév.

*Dryopteris parvisora* (C.Chr.) = **Deparia parvisora** (C.Chr.) M.Kato  
*Dryopteris pauciflora* (Hook.) C.Chr. = **Menisorus pauciflorus** (Hook.) Alston  
*Dryopteris pentagona* Bonap. = **Triplophyllum pentagonum** (Bonap.) Holttum  
*Dryopteris prismatica* (Desv.) C.Chr. = **Pneumatopteris prismaticus** (Desv.) Holttum  
*Dryopteris prolifera* (Retz.) C.Chr. = **Ampelopteris prolifera** (Retz.) Copel.  
*Dryopteris proluxa* (Willd.) Kuntze var. *bergiana* (Schltdl.) Alston = **Amauropelta bergiana**  
(Schltdl.) Holttum  
*Dryopteris protensa* C.Chr. var. *fraterna* C.Chr. = **Ctenitis fraterna** (Mett.) Tardieu  
*Dryopteris protensa* C.Chr. var. *speciosa* (Mett.) C.Chr. = **Triplophyllum speciosum** (Mett.)  
Holttum  
*Dryopteris pseudogueinziana* Bonap = **Christella pseudogueinziana** (Bonap.) J.P.Roux  
*Dryopteris pulvinata* C.Chr. = **Ctenitis cirrhosa** (Schum.) Ching  
*Dryopteris punctata* (Thunb.) C.Chr. subsp. *rugosula* C.Chr. = **Hypolepis villosoviscida**  
(Thouars) Tardieu  
*Dryopteris pungens* (Kaulf.) Kuntze = **Polystichum pungens** (Kaulf.) C.Presl  
*Dryopteris quadrangularis* (Fée) Alston = **Christella hispidula** (Decne.) Holttum  
*Dryopteris remotipinna* Bonap. = **Pneumatopteris remotipinna** (Bonap.) Holttum  
*Dryopteris securidiformis* (Hook.) C.Chr. = **Triplophyllum securidiforme** (Hook.) Holttum  
*Dryopteris securidiformis* (Hook.) C.Chr. var. *nana* Bonap. = **Triplophyllum securidiforme**  
(Hook.) Holttum var. **nanum** (Bonap.) Holttum  
*Dryopteris setigera* C.Chr. = **Macrothelypteris torresiana** (Gaudich.) Ching  
*Dryopteris sewellii* Baker = **Amauropelta bergiana** (Schltdl.) Holttum  
*Dryopteris silvatica* (Pappe & Raws.) C.Chr. = **Pneumatopteris unita** (Kunze) Holttum  
*Dryopteris spekei* (Baker) Kuntze = **Ctenitis cirrhosa** (Schumach.) Ching  
*Dryopteris striata* (Schum.) C.Chr. = **Cyclosorus striatus** (Schumach.) Ching  
*Dryopteris strigosa* C.Chr. = **Amauropelta strigosa** (Willd.) Holttum  
*Dryopteris subbiaurita* Kunze = **Arthropteris orientalis** (J.F.Gmel.) Posth. var. **subbiaurita**  
(Hook.) Bonap.  
*Dryopteris subcoriacea* C.Chr. = **Lastreopsis vogelii** (Hook.) Tindale  
*Dryopteris subgranulosa* C.Chr. = **Lastreopsis boivinii** (Baker) Tardieu  
*Dryopteris subpennigera* C.Chr. = **Pneumatopteris subpennigera** (C.Chr.) Holttum

*Dryopteris subsimilis* (Hook.) C.Chr. = **Lastreopsis subsimilis** (Hook.) Tindale  
*Dryopteris sulcinervia* (Hieron.) C.Chr. = **Diplazium zanzibaricum** (Baker) C.Chr.  
*Dryopteris tenericaulis* Ching = **Macrothelypteris torresiana** (Gaudich.) Ching  
*Dryopteris thelypteris* (L.) A.Gray var. *squamigera* (Schltdl.) C.Chr. = **Thelypteris confluens**  
 (Thunb.) C.V.Morton  
*Dryopteris tomentella* C.Chr. = **Lastreopsis currori** (Mett.) Tindale  
*Dryopteris tomentosa* (Thouars) Holttum = **Amauropelta tomentosa** (Thouars) Holttum  
*Dryopteris totta* (Schltdl.) Masam. = **Stegnogramma pozoi** (Lag.) K.Iwats.  
*Dryopteris trichodes* Rosenst. = **Macrothelypteris torresiana** (Gaudich.) Ching  
*Dryopteris trichophlebia* C.Chr. = **Arthropteris orientalis** (J.F.Gmel.) var. **subbiaurita** (Hook.)  
 Bonap.  
*Dryopteris truncicola* C.Chr. = **Ctenitis truncicola** (C.Chr.) Ching  
*Dryopteris uliginosa* Kunze = **Macrothelypteris torresiana** (Gaudich.) Ching  
*Dryopteris unita* Kuntze = **Sphaerostephanos unitus** (L.) Holttum  
*Dryopteris variabilis* (Hook.) Alston var. *barteri* (Hook.) Alston = **Triplophyllum principis**  
 Holttum  
*Dryopteris venulosa* Kuntze = **Pneumatopteris venulosa** (Kuntze) Holttum  
*Dryopteris vogelii* Tardieu, non C.Chr. = **Ctenitis fraterna** (Mett.) Tardieu  
*Dryopteris wakefieldii* (Baker) C.Chr. = **Amphineuron opulentum** (Kaulf.) Holttum  
*Dryopteris warburii* C.Chr. = **Pseudotectaria warburii** (C.Chr.) Holttum  
*Dryopteris wilsonii* (Baker) C.Chr. = **Arthropteris orientalis** (J.F.Gmel.) Posth.  
*Dryopteris zambesiaca* C.Chr. = **Pseudocyclosorus pulcher** (Bory ex Willd.) Holttum  
 var. **mascarensis** (Baker) Tardieu

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Table 1. Range and mean guard cell length ( $\mu\text{m}$ ), gland length ( $\mu\text{m}$ ), and ploidy level in *Dryopteris* species occurring in sub-Saharan Africa.

Taxon	Guard cell length	Gland length	Ploidy level
<i>D. amblydonta</i>	(42–)54(–68)	(68–)96(–144)	?
<i>D. antarctica</i>	(40–)50(–64)	(52–)116(–156)	tetraploid
<i>D. athamantica</i>	(34–)49(–76)	(50–)78(–142)	diploid
<i>D. aurantiaca</i>	(32–)36(–44)	(50–)56(–64)	?
<i>D. caperata</i>	(32–)42(–52)	eglandular	?
<i>D. cicatricata</i>	(40–)46(–52)	eglandular	?
<i>D. dracomontana</i>	(34–)40(–52)	(66–)93(–124)	?
<i>D. fadenii</i>	(30–)44(–80)	eglandular	diploid
<i>D. filipaleata</i>	(40–)50(–60)	eglandular	?
<i>D. glandulosopaleata</i>	(44–)54(–70)	(62–)111(–146)	?
<i>D. gorgonea</i>	(42–)53(–64)	(50–)68(–98)	?
<i>D. inaequalis</i>	(30–)42(–58)	(74–)109(–170)	?
<i>D. katangaensis</i>	(30–)39(–48)	eglandular	?
<i>D. kilmensis</i>	(30–)39(–50)	(46–)66(–84)	diploid
<i>D. lewalleana</i>	(30–)41(–62)	(46–)95(–166)	?
<i>D. manniana</i>	(40–)56(–70)	(56–)62(–72)	tetraploid
<i>D. occidentalis</i>	(48–)55(–64)	(56–)77(–92)	?
<i>D. oligodonta</i>	(30–)38(–48)	(36–)51(–60)	diploid
<i>D. pentheri</i>	(34–)53(–72)	(60–)137(–260)	tetraploid
<i>D. rodolfii</i>	(44–)60(–80)	eglandular	?
<i>D. ruwensoriensis</i>	(36–)48(–62)	eglandular	?
<i>D. schimperiana</i>	(32–)42(–54)	(58–)108(–182)	diploid
<i>D. schnellii</i>	(36–)43(–48)	(40–)51(–70)	?
<i>D. squamiseta</i>	(40–)48(–56)	(54–)72(–92)	?
<i>D. tricellularis</i>	(32–)48(–64)	eglandular	?
<i>D. wallichiana</i> subsp. <i>reichsteinii</i>	(42–)48(–54)	eglandular	triploid apomict

## CAPTIONS TO THE FIGURES

**FIGURE 1.** Distribution of *Dryopteris* in sub-Saharan Africa and the Cape Verde Islands.

**FIGURE 2.** Lamina glands and hairs in African *Dryopteris* species. A & B, *D. amblyodonta*, Jones 341 (BM); C–E, *D. antarctica*, Roux 2632 (NBG); F–H, *D. athamantica*, Friis et al. 185 (ETH); I–K, *D. athamantica*, Roux 2897 (NBG); L–O, *D. aurantiaca*, Wrigley & Melville 215 (K); P & Q, *D. caperata*, Exell 135 (BM); R–U, *D. caperata*, Rozeira 856 (K); V & W, *D. dracomontana*, Esterhuysen 21663 (NBG).

**FIGURE 3.** Lamina glands and hairs in African *Dryopteris* species. A–C, *D. dracomontana*, Cilliè s.n. (NBG); D & E, *D. fadenii*, Alluau 52 (BM); F & G, *D. fadenii*, Faden & Evans 69/907 (K); H & I, *D. filipaleata*, Dümmer 1727 (K); J & K, *D. filipaleata*, Lovett & Thomas 2802 (MO); L–N, *D. glandulosopaleata*, Breteler et al. MC 163 (K); O–R, *D. glandulosopaleata*, Dunlap 225 (K); S–U, *D. gorgonea*, Chevalier 45113 (K).

**FIGURE 4.** Lamina glands and hairs African *Dryopteris* species. A–D, *D. gorgonea*, Bolle s.n. (K); E–G, *D. inaequalis*, Roux 3816 (K); H–J, *D. inaequalis*, Taylor 3598 (NBG); K & L, *D. katangaensis*, Milne-Redhead 787 (PRE); M & N, *D. katangaensis*, Malaisse 4478 (BOL); O–Q, *D. kilmensis*, Burrows 1675 (NBG); R–T, *D. kilmensis* Osmaston 1517 (BR); U–W, *D. lewalleana*, Harris 2323 (K).

**FIGURE 5.** Lamina glands and hairs in African *Dryopteris* species. A–C, *D. lewalleana*, Schelpe 7952 (BOL); D & E, *D. manniana*, Cowan s.n. (BM); F & G, *D. manniana*, Dümmer 1727 (K); H & I, *D. pentheri*, Schelpe 4339 (BOL); J–L, *D. occidentalis*, Viane 1024 (K); M–O, *D. occidentalis*, Lawlor & Hall 737 (K); P–R, *D. oligodonta*, Aldridge 1345 (MO); S–W, *D. oligodonta*, Aldridge 1277 (MO); X & Y, *D. pentheri*, Schelpe 5368 (BOL); AA & BB, *D. pentheri*, Gereau & Kayombo 4416 (K); CC–EE, *D. squamiseta*, Kluge 2457 (NBG).

**FIGURE 6.** Lamina glands, hairs and scales in African *Dryopteris* species. A & B, *D. rodolfii*, Miehe 2088 (K); C & D, *D. rodolfii*, Miehe 3266 (K); E & F, *D. ruwenzoriensis*, Taylor 2990

(BM); G & H, *D. ruwenzoriensis*, D'Arcy 7629 (MO); I & J, *D. schimperiana*, Lynes 187 (BM); K & L, *D. schimperiana*, Cheesman s.n. (BM); M & Q, *D. schnellii*, Schnell 1499 (P); R–U, *D. tricellularis*, De Wilde 5005 (MO); *D. tricellularis*, Dümmer 3557 (NBG); Y & Z, *D. wallichiana* subsp. *reichsteinii*, Chase 7337 (M).

**FIGURE 7.** Indusia in African *Dryopteris* species. A, Aa, & Ab, *D. amblyodonta*, Jones 341 (BM); B & Ba, *D. antarctica*, Roux 2632 (NBG); C & Ca, *D. athamantica*, Faden & Evans 69/2054 (BOL); D & Da, *D. aurantiaca*, Wrigley & Melville 215 (K); E, *D. caperata*, Rozeira 2105 (PO); F & Fa, *D. cicatricata*, Rozeira 5136 (PO); G & Ga, *D. dracomontana*, Roux 1376 (NBG).

**FIGURE 8.** Indusia in African *Dryopteris* species. A & Aa, *D. fadenii*, Faden et al. 71/68 (K); B & Ba, *D. glandulosopaleata*, Maitland 1046 (K); C, *D. gorgonea*, Chevalier 45113 (P); D & Da, *D. inaequalis*, Roux 3185 (NBG); E & Ea, *D. katangaensis*, Roux 2989 (NBG); F, *D. kilmensis*, Lewalle 3829 (BR); G & Ga, *D. lewalleana*, Lewalle 2366 (BR); H & Ha, *D. occidentalis*, Schnell 6825 (K); I & J, *D. oligodonta*, Bory de St. Vincent s.n.; J & Ja, *D. pentheri*, Geldenhuys 974 (BOL).

**FIGURE 9.** Indusia in African *Dryopteris* species. A & Aa, *D. rodolfii*, Miehe 3239 (K); B & Ba, *D. squamiseta*, Kluge 2457 (NBG); C & Ca, *D. schimperiana*, Mooney 6211 (K); D & Da, *D. schnellii*, Schnell 1499 (P); E & Ea, *D. wallichiana* subsp. *reichsteinii*, Chase 7337 (K).

**FIGURE 10.** Sporangium of *Dryopteris inaequalis* with haired stalk, MacOwan s.n. (NBG).

**FIGURE 11.** Spores of African *Dryopteris* species. A, *D. athamantica*, Compton 24689 (NBG); B, *D. dracomontana*, Roux 1367 (NBG); C, *D. fadenii*, Isaac 3008 (BOL); D, *D. inaequalis*, Roux 2941 (NBG); E, *D. katangaensis*, Roux 2989 (NBG); F, *D. kilmensis*, Faden et al. 71/871 (K).

**FIGURE 12.** Spores of African *Dryopteris* species. A, *D. pentheri*, Manning et al. 15992 (BOL); B, *D. schimperiana*, Mooney 8204 (K).

**FIGURE 13.** Distribution of *Dryopteris amblyodonta*, *D. antarctica*, *D. aurantiaca*, *D. caperata*, *D. cicatricata* and *D. dracomontana* in sub-Saharan Africa.

**FIGURE 14.** Distribution of *Dryopteris athamantica* in sub-Saharan Africa.

**FIGURE 15.** Distribution of *Dryopteris fadenii*, *D. glandulosopaleata*, *D. inaequalis* and *D. katangaensis* in sub-Saharan Africa.

**FIGURE 16.** Distribution of *Dryopteris filipaleata* and *D. wallichiana* subsp. *reichsteinii* in sub-Saharan Africa.

**FIGURE 17.** Distribution of *Dryopteris gorgonea* in the Cape Verde Islands.

**FIGURE 18.** Distribution of *Dryopteris kilmensis* in sub-Saharan Africa.

**FIGURE 19.** Distribution of *Dryopteris lewalleana* in sub-Saharan Africa.

**FIGURE 20.** Distribution of *Dryopteris manniana* and *D. occidentalis* in sub-Saharan Africa.

**FIGURE 21.** Distribution of *Dryopteris oligodonta* in the Cape Verde Islands.

**FIGURE 22.** Distribution of *Dryopteris pentheri* in sub-Saharan Africa.

**FIGURE 23.** Distribution of *Dryopteris rodolfii* and *D. ruwenzoriensis* in sub-Saharan Africa.

**FIGURE 24.** Distribution of *Dryopteris schimperiana* and *D. schnellii* in sub-Saharan Africa.

**FIGURE 25.** Distribution of *Dryopteris squamiseta* in sub-Saharan Africa.

**FIGURE 26.** Distribution of *Dryopteris tricellularis* in sub-Saharan Africa.

Figure 1

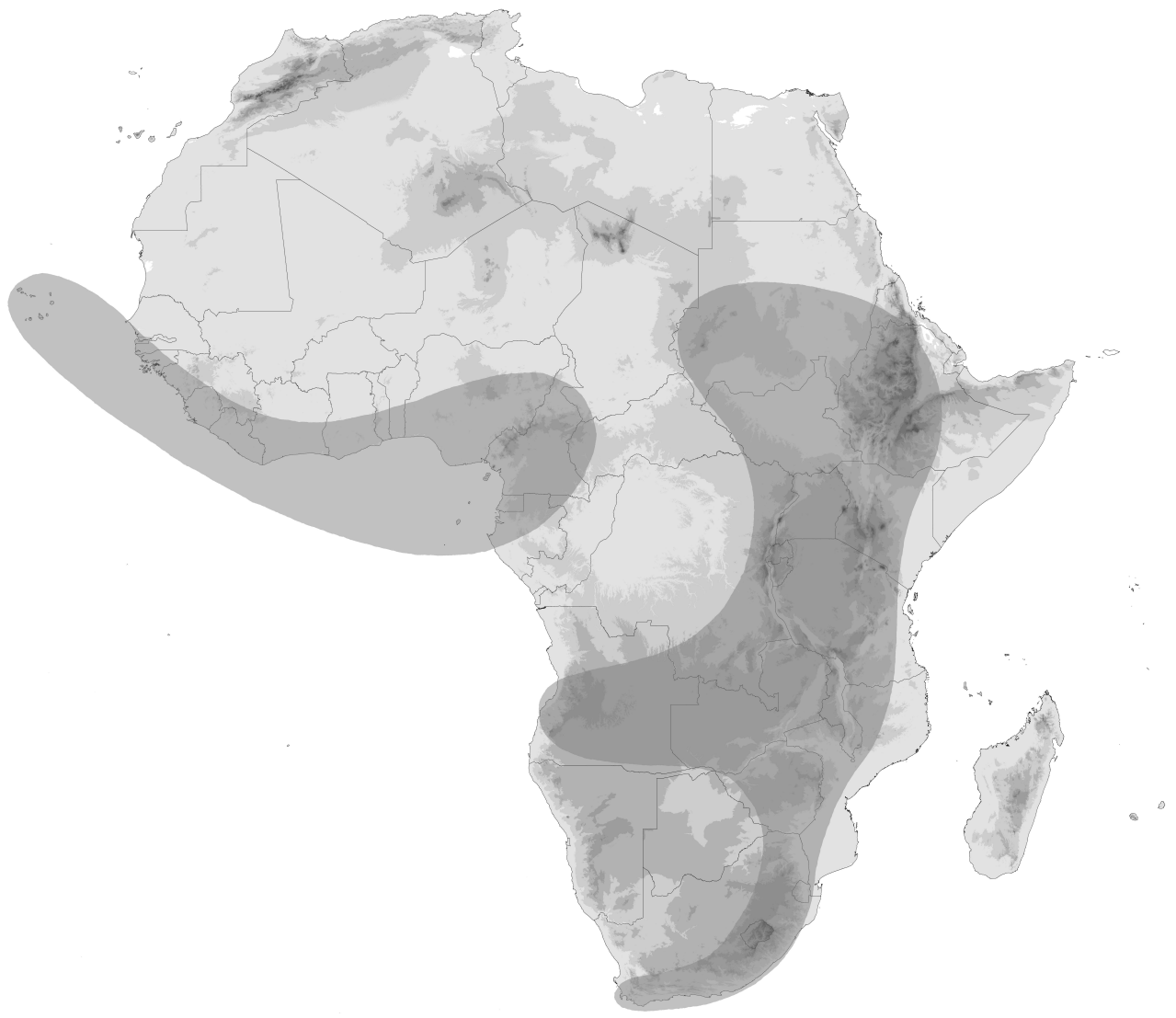


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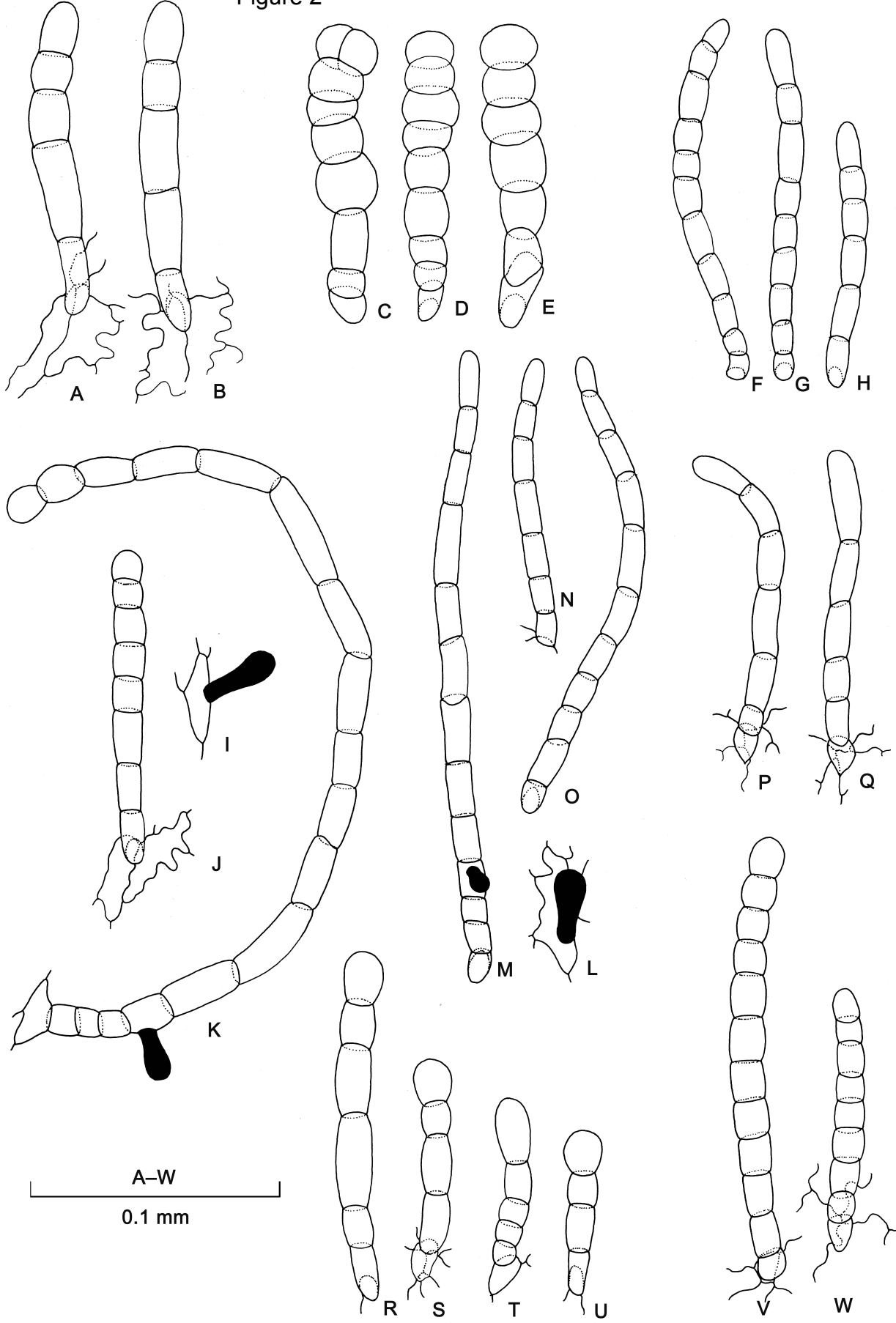




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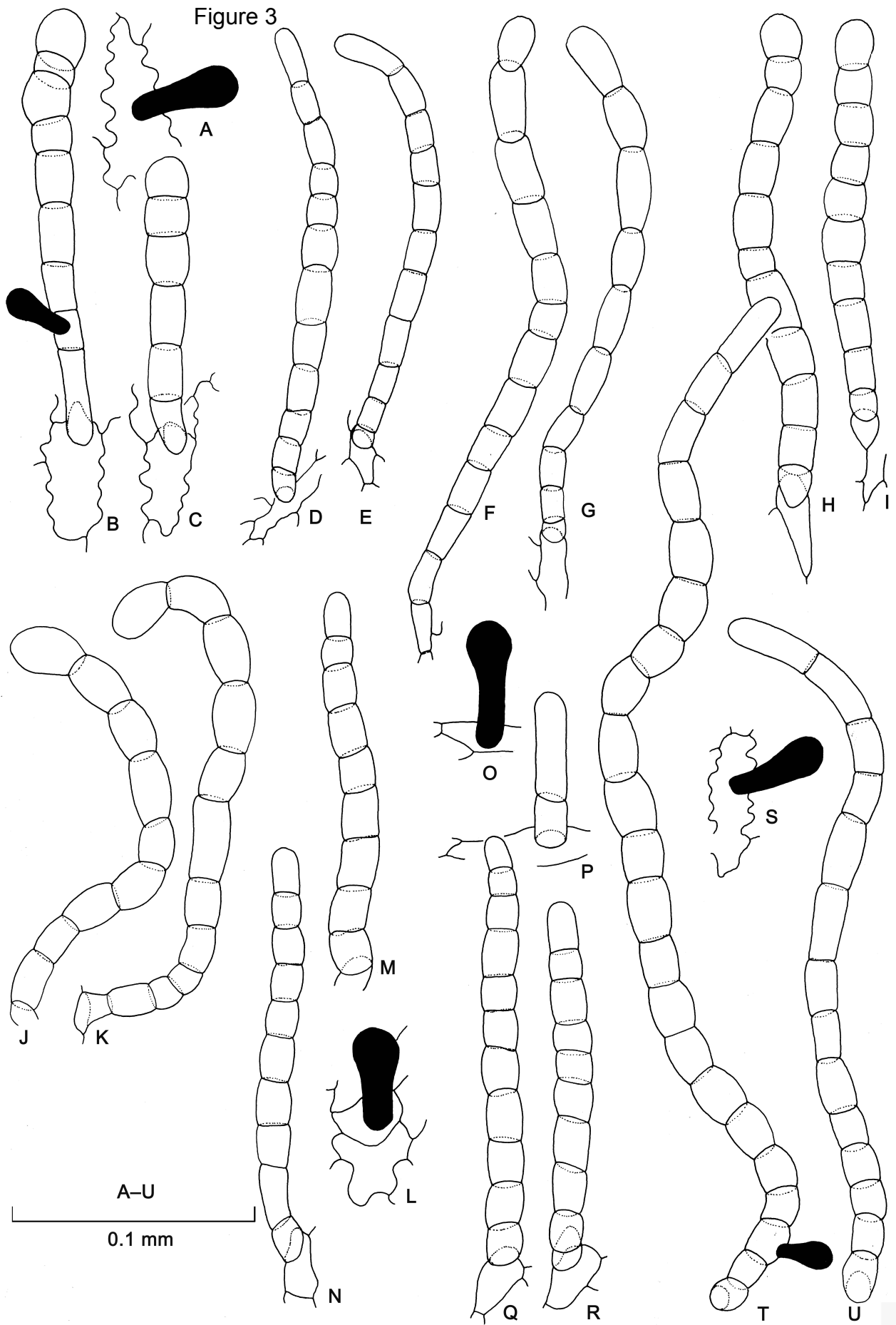


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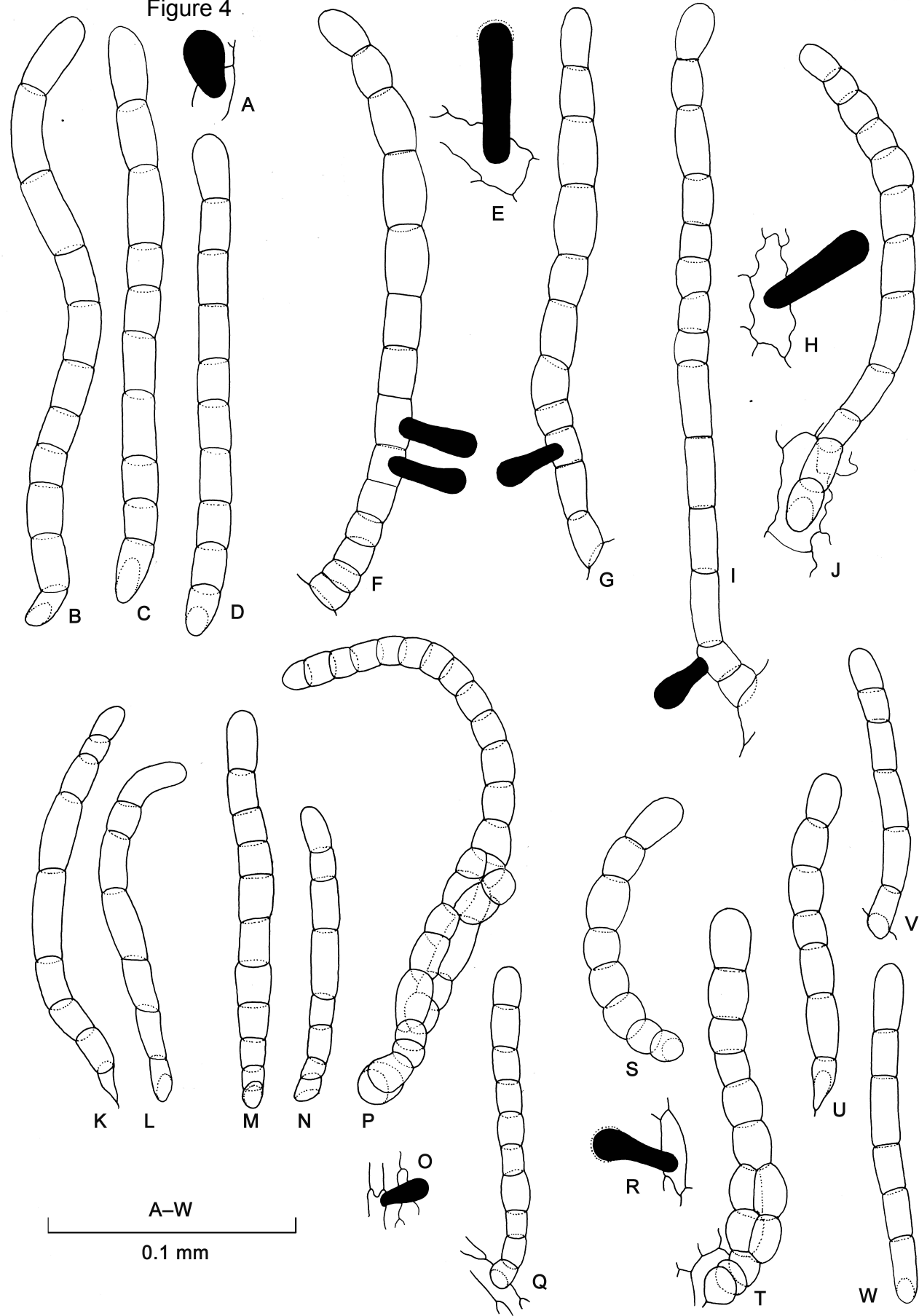


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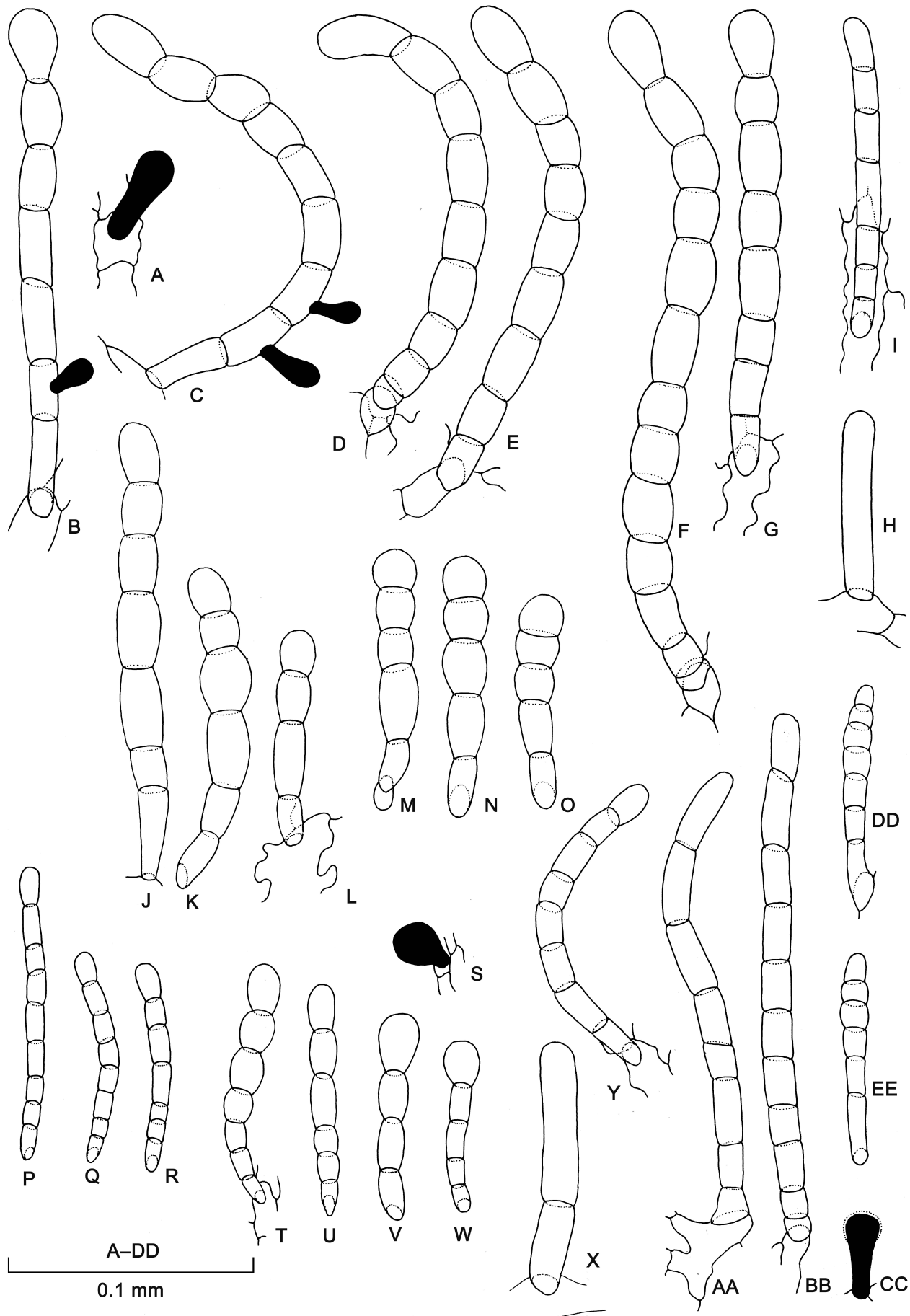


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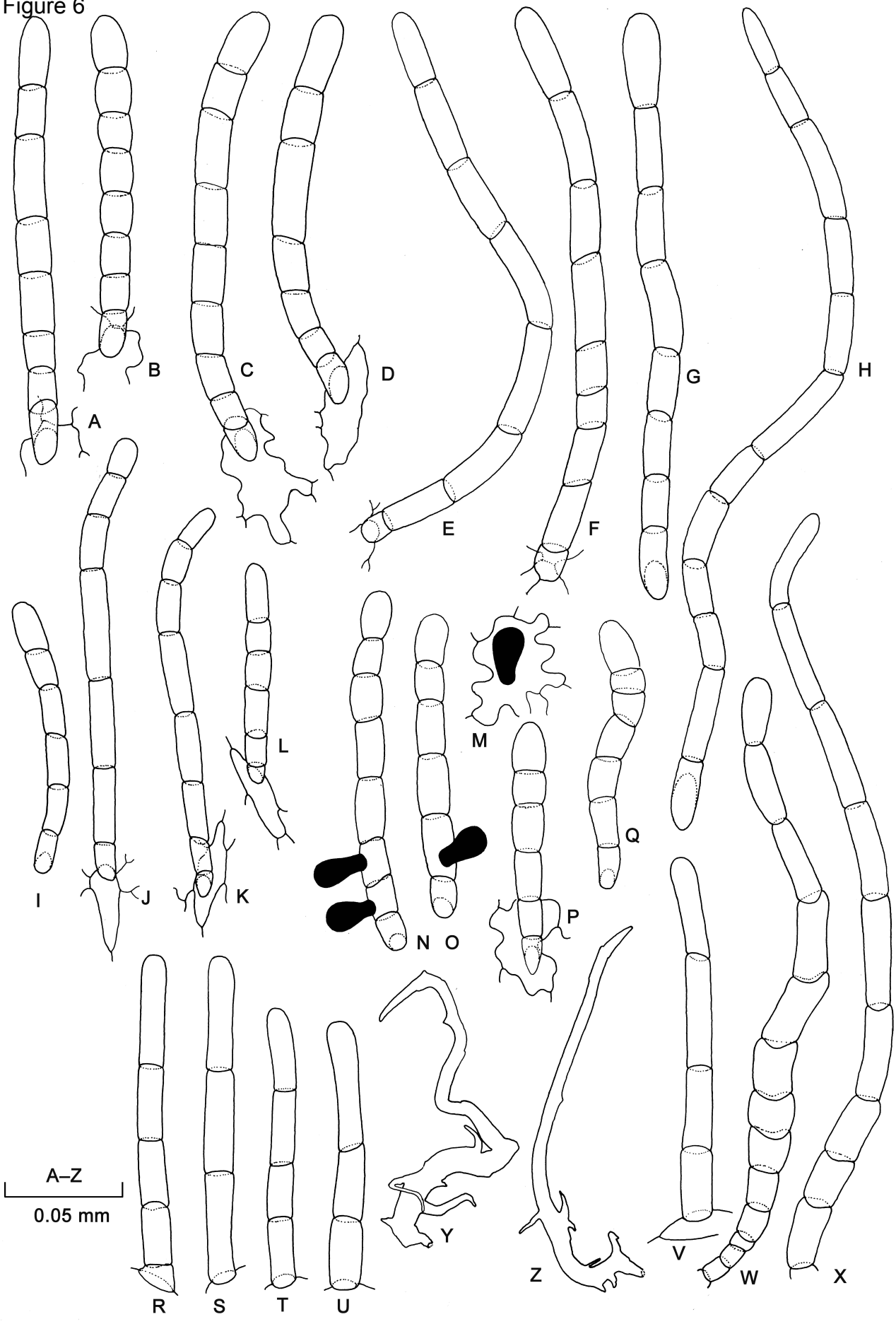


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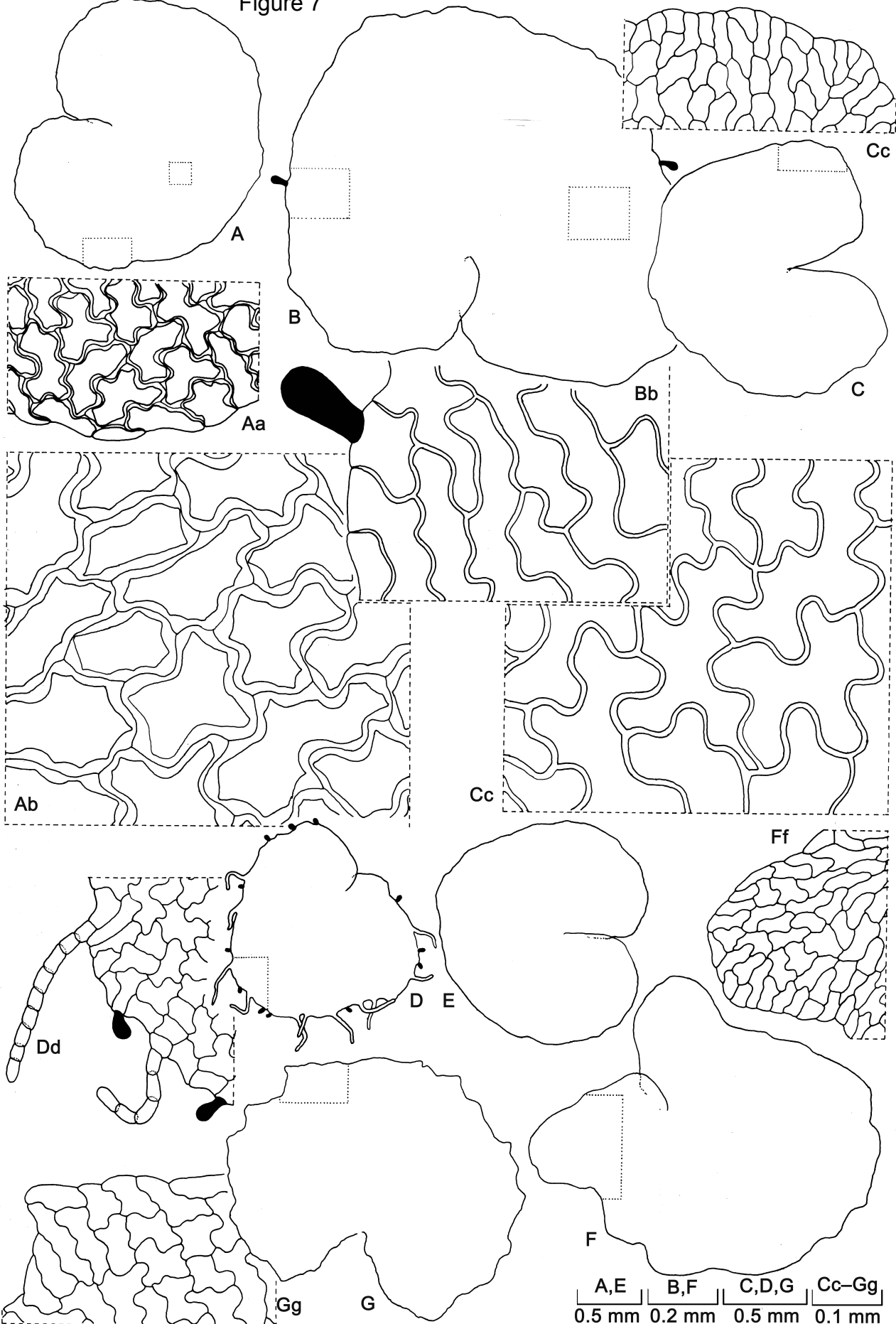


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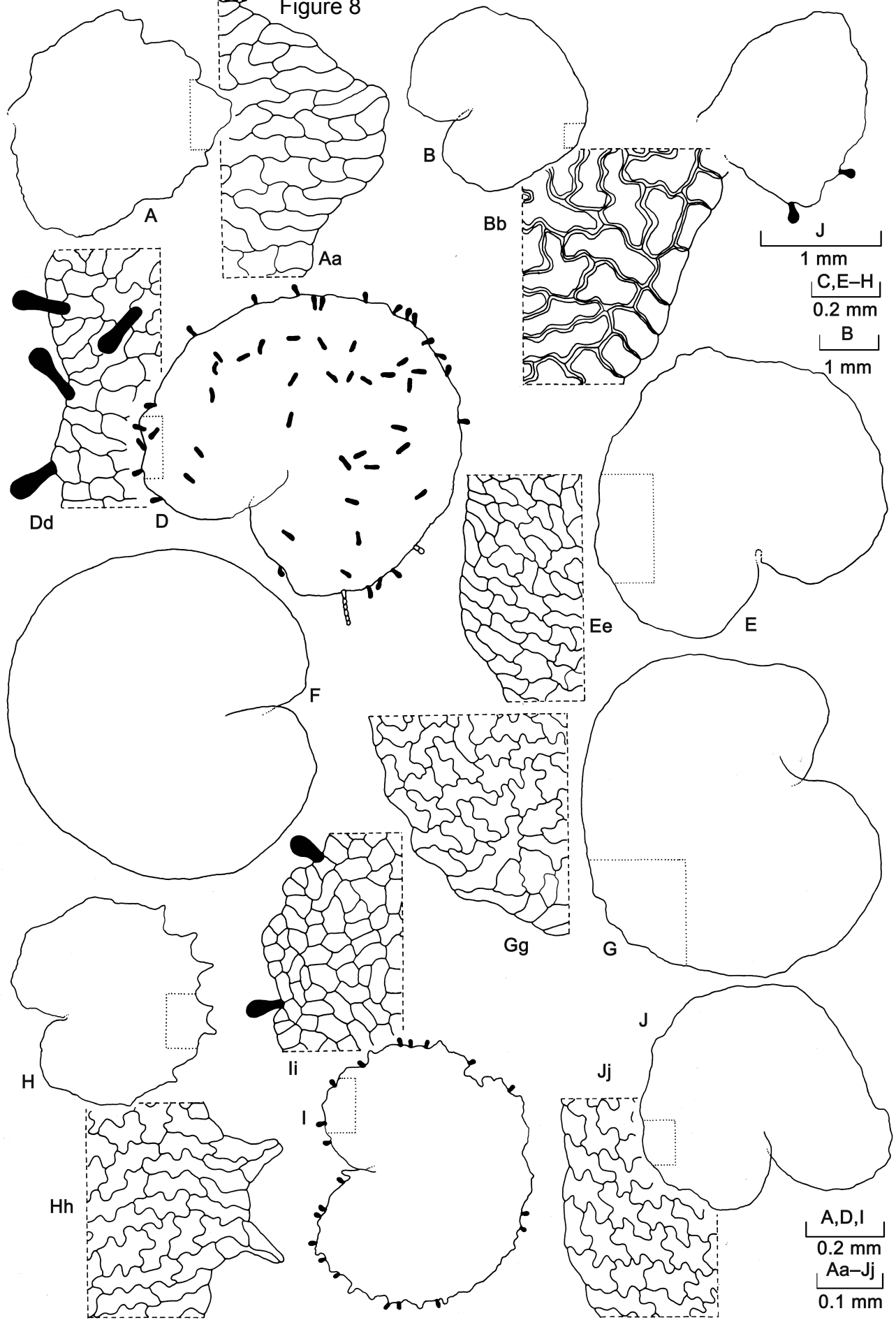


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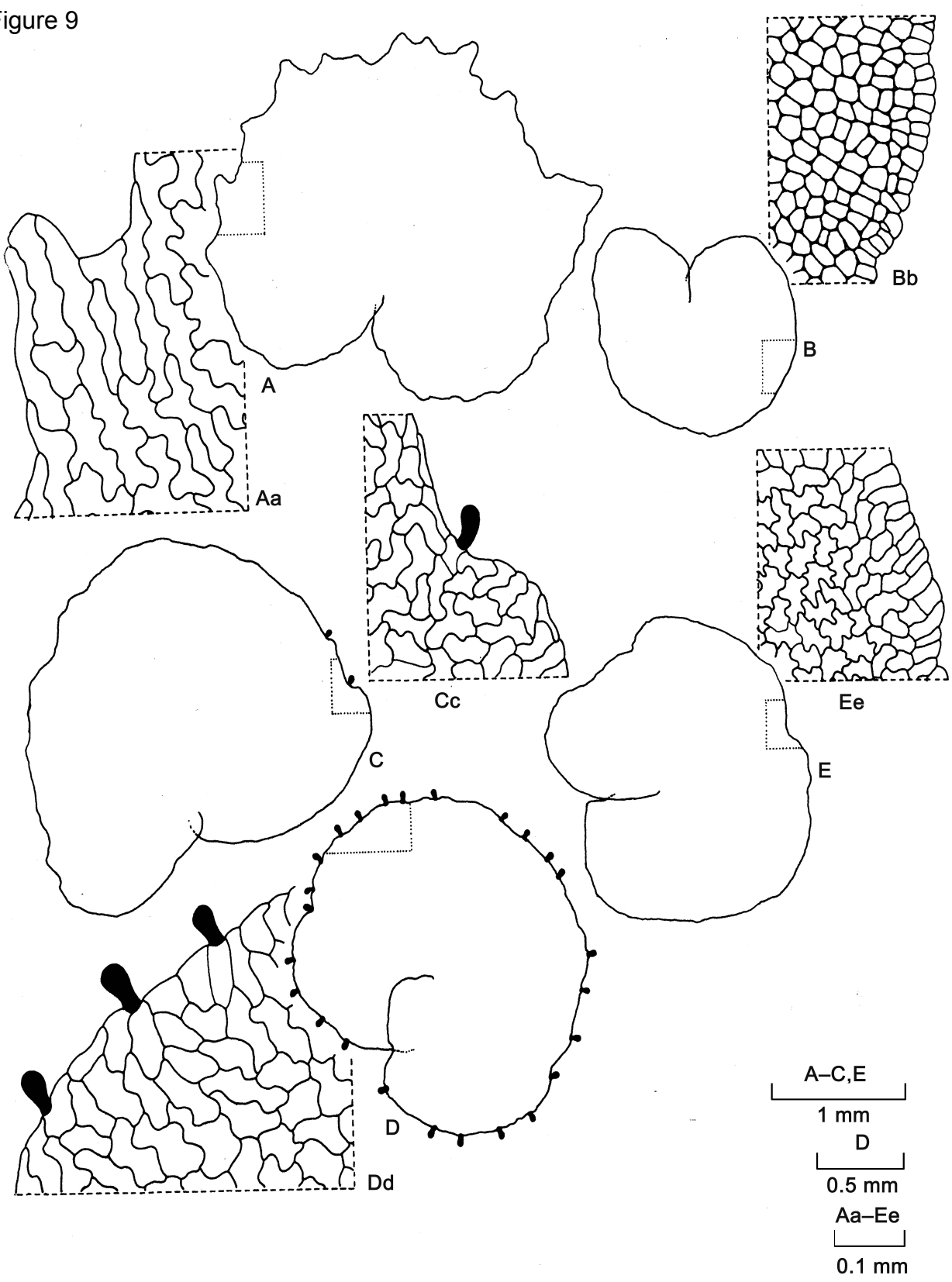


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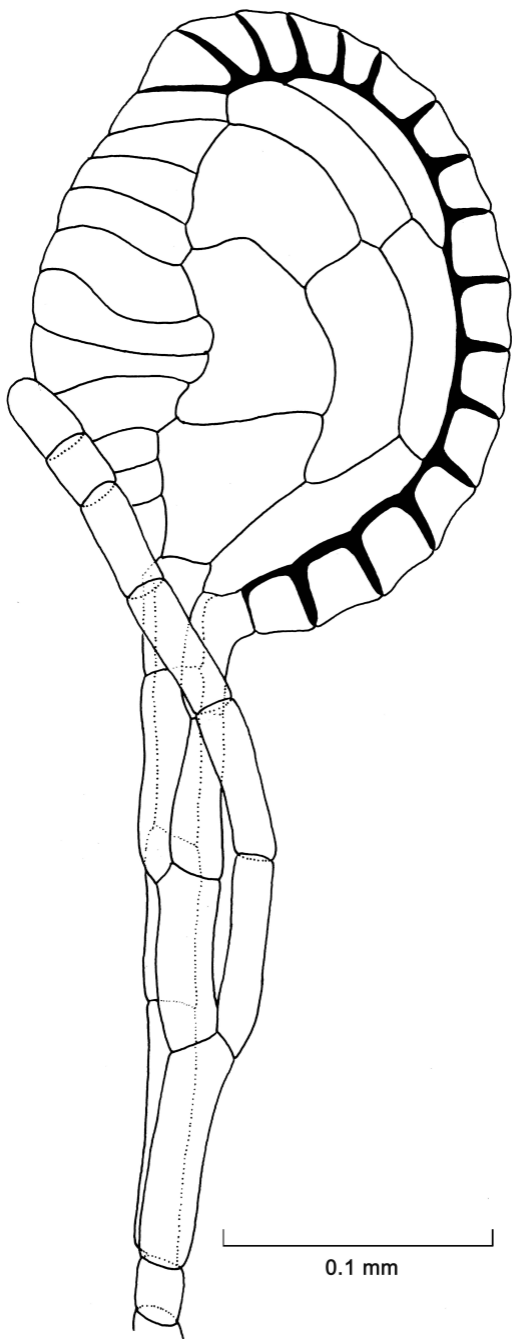
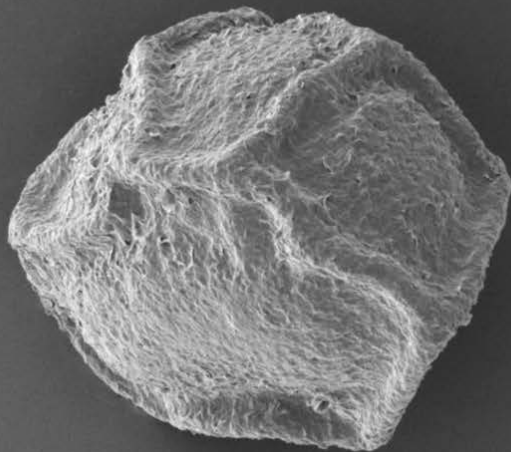


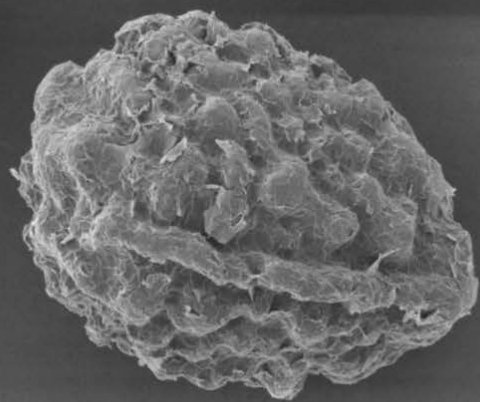


Figure 11



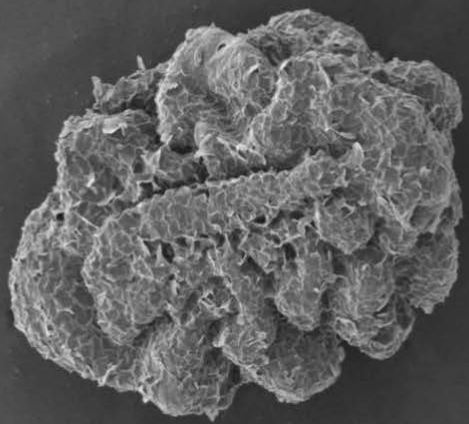
A

Landing	E	det	mode	WD	mag	spot	20 $\mu$ m
3.00 keV	ETD	SE		7.3 mm	5 000 x	2.5	Nova NanoSEM 230



B

Landing	E	det	mode	WD	mag	spot	20 $\mu$ m
3.00 keV	ETD	SE		5.8 mm	5 000 x	2.5	Nova NanoSEM 230



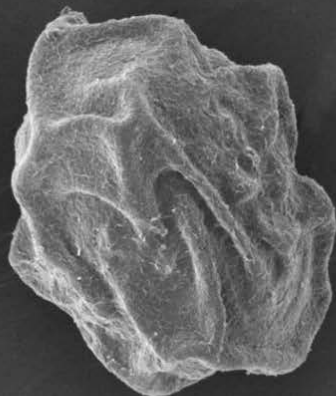
C

Landing	E	det	mode	WD	mag	spot	20 $\mu$ m
3.00 keV	ETD	SE		6.3 mm	5 000 x	2.5	Nova NanoSEM 230



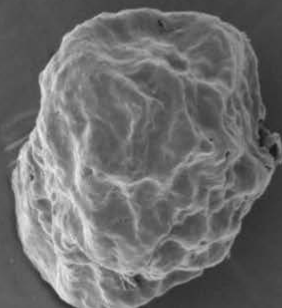
D

Landing	E	det	mode	WD	mag	spot	20 $\mu$ m
3.00 keV	ETD	SE		7.2 mm	5 000 x	2.5	Nova NanoSEM 230



E

Landing	E	det	mode	WD	mag	spot	30 $\mu$ m
3.00 keV	ETD	SE		6.5 mm	4 114 x	2.5	Nova NanoSEM 230



F

Landing	E	det	mode	WD	mag	spot	20 $\mu$ m
3.00 keV	ETD	SE		7.6 mm	5 000 x	2.5	Nova NanoSEM 230

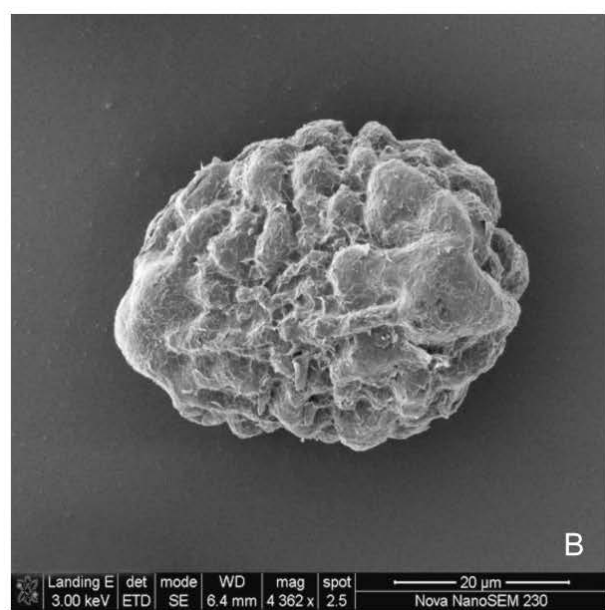
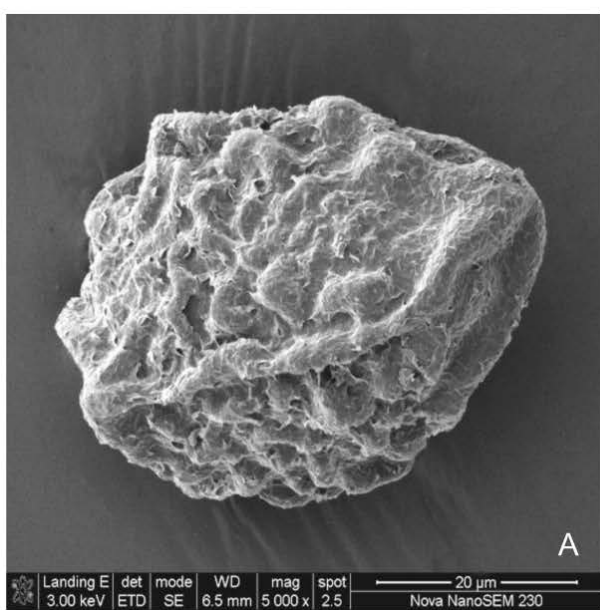


Figure 12

Figure 13

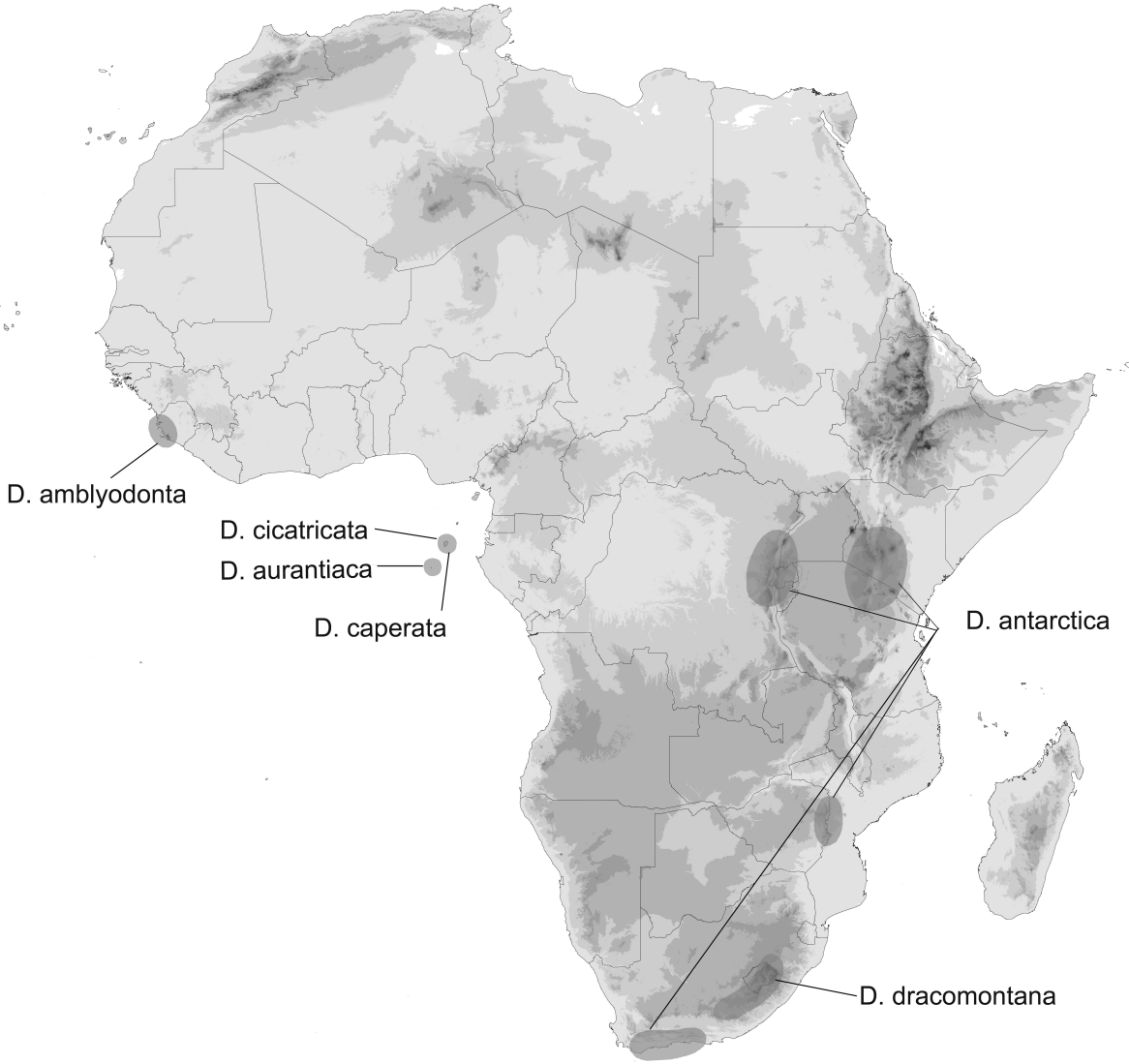


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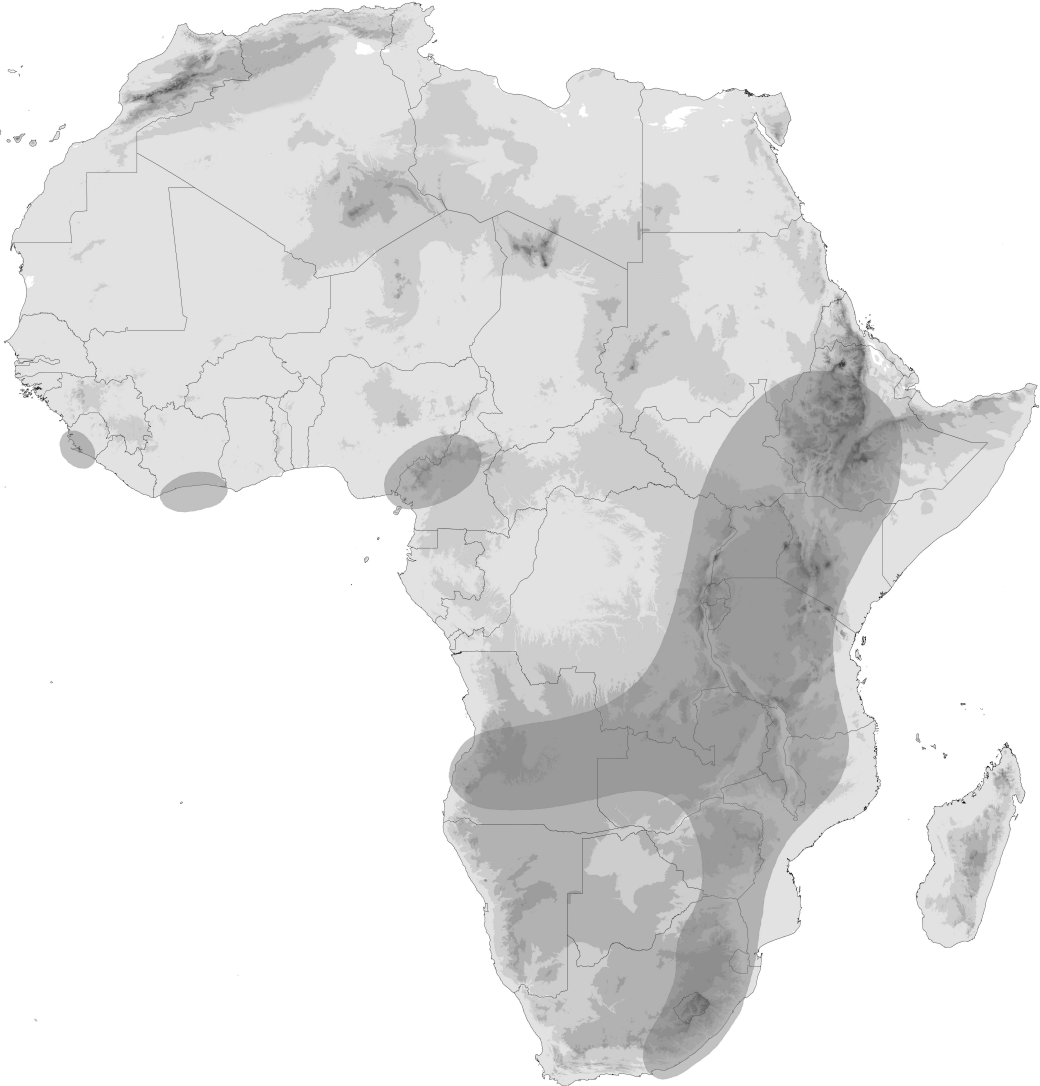
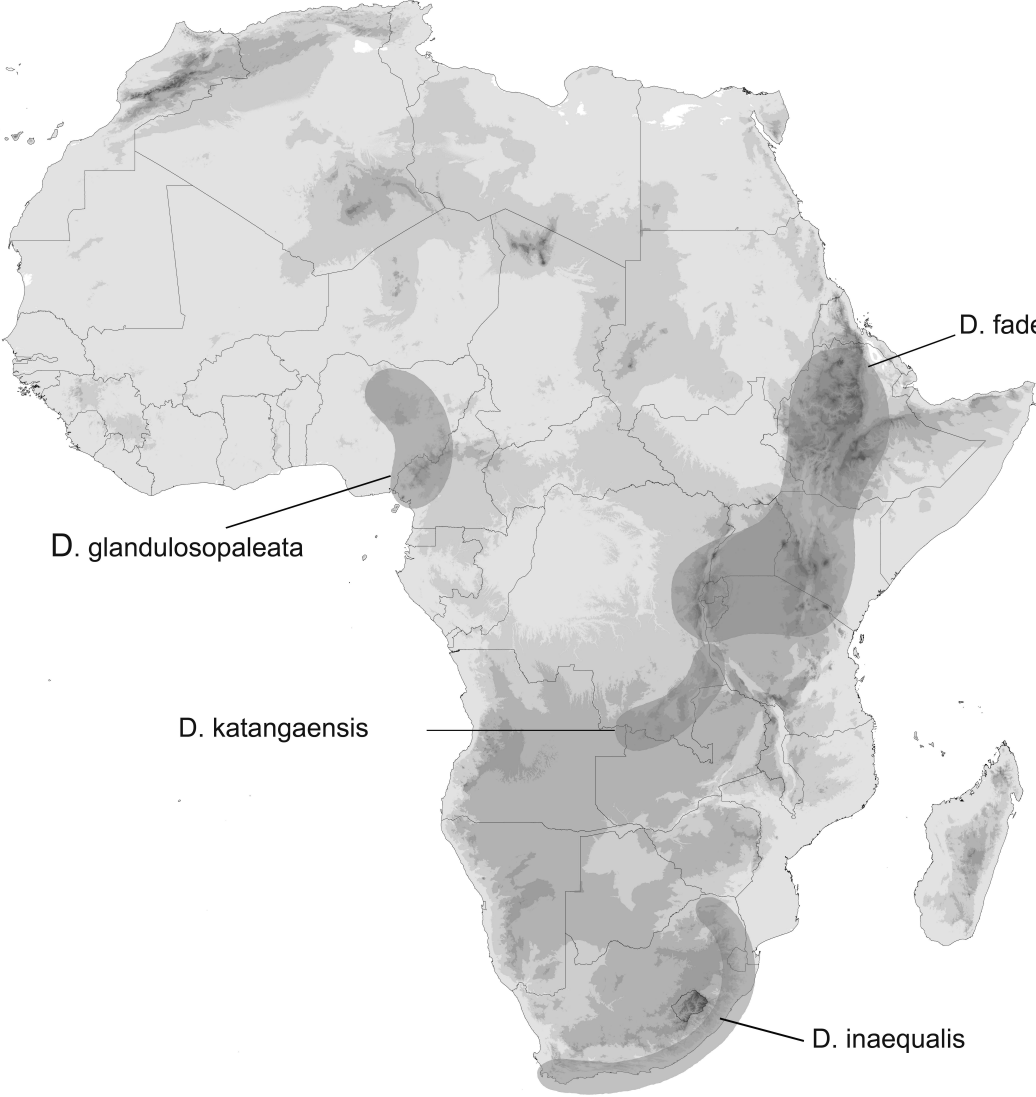


Figure 15



*D. glandulosopaleata*

*D. fadenii*

*D. katangaensis*

*D. inaequalis*

Figure 16



Figure 17

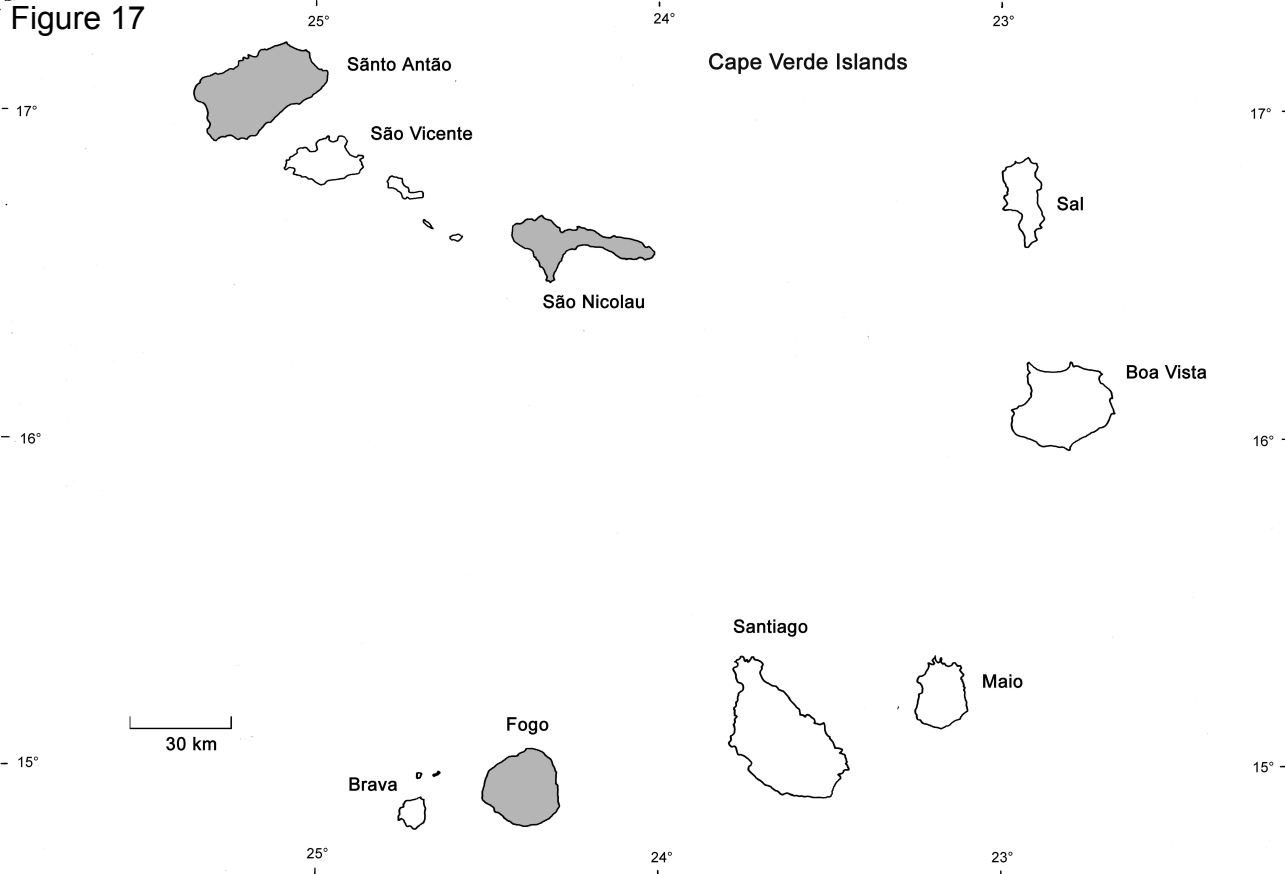


Figure 18

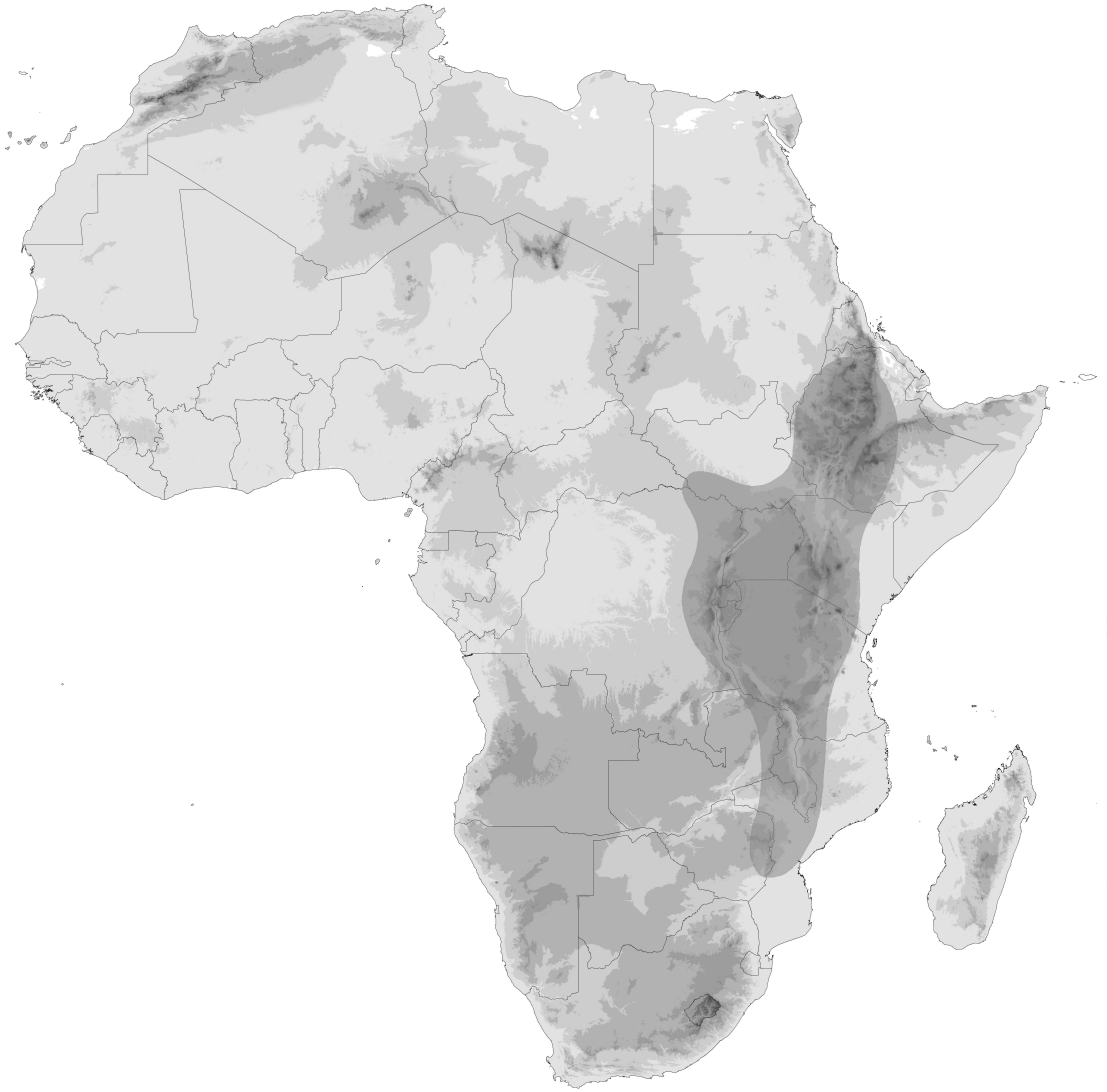




Figure 19

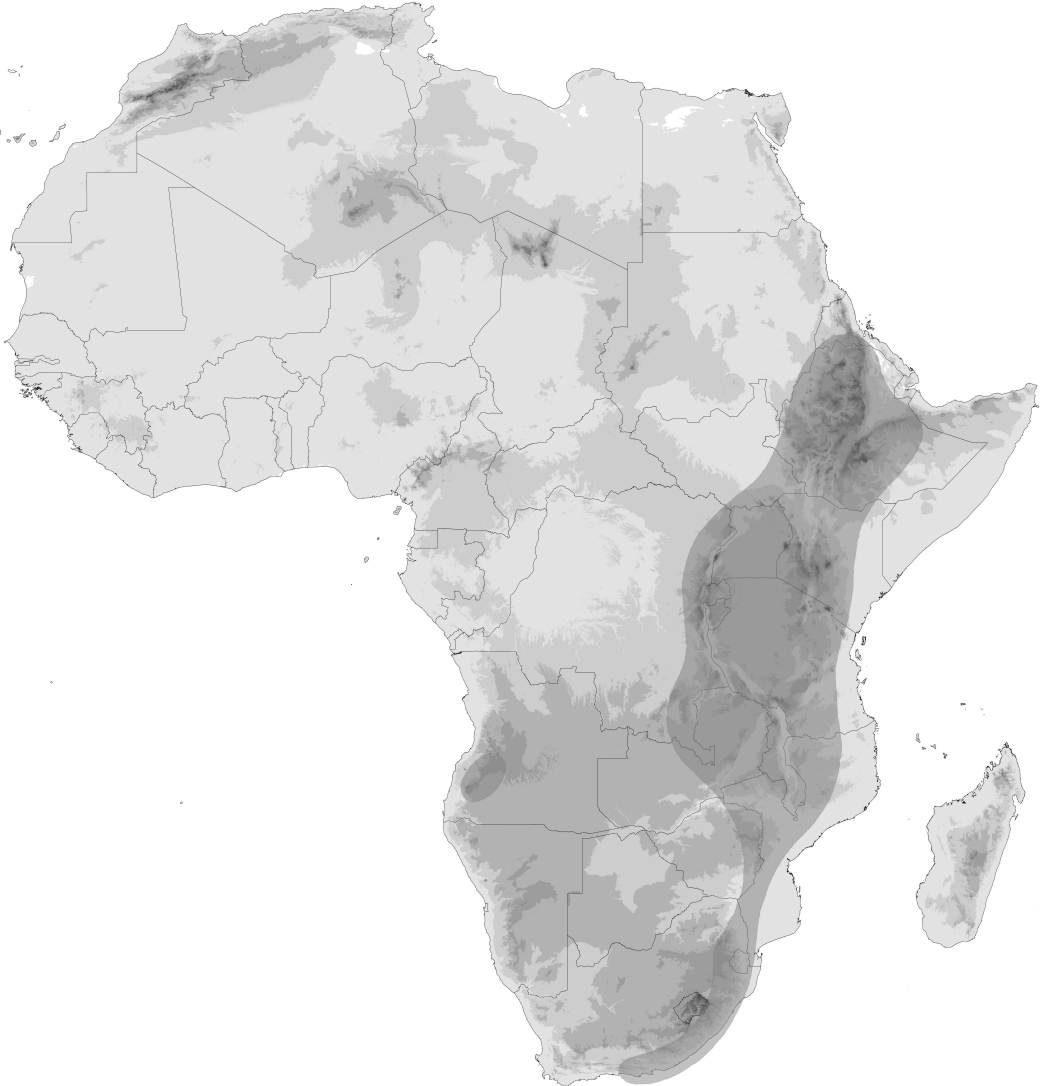


Figure 20

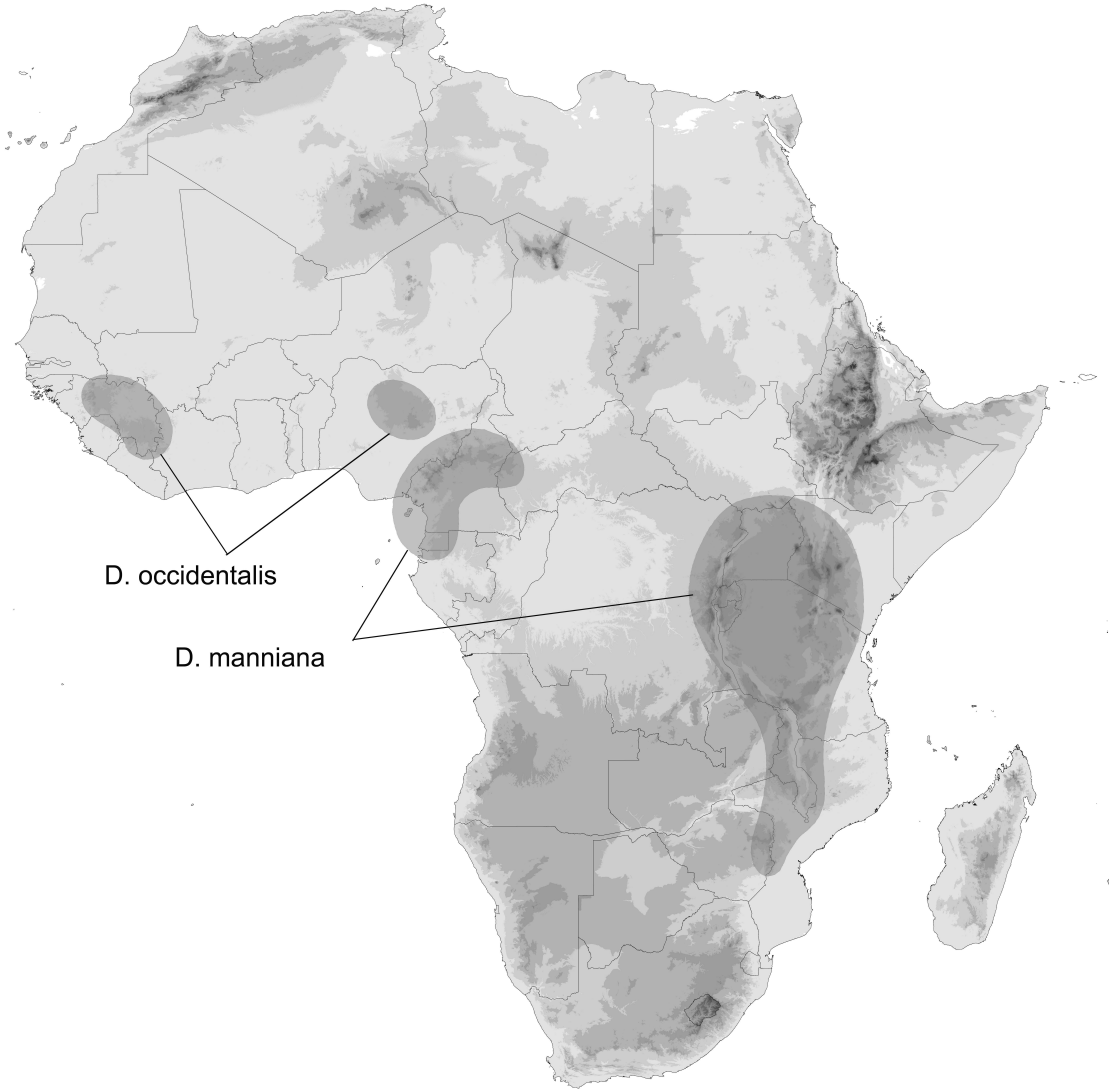


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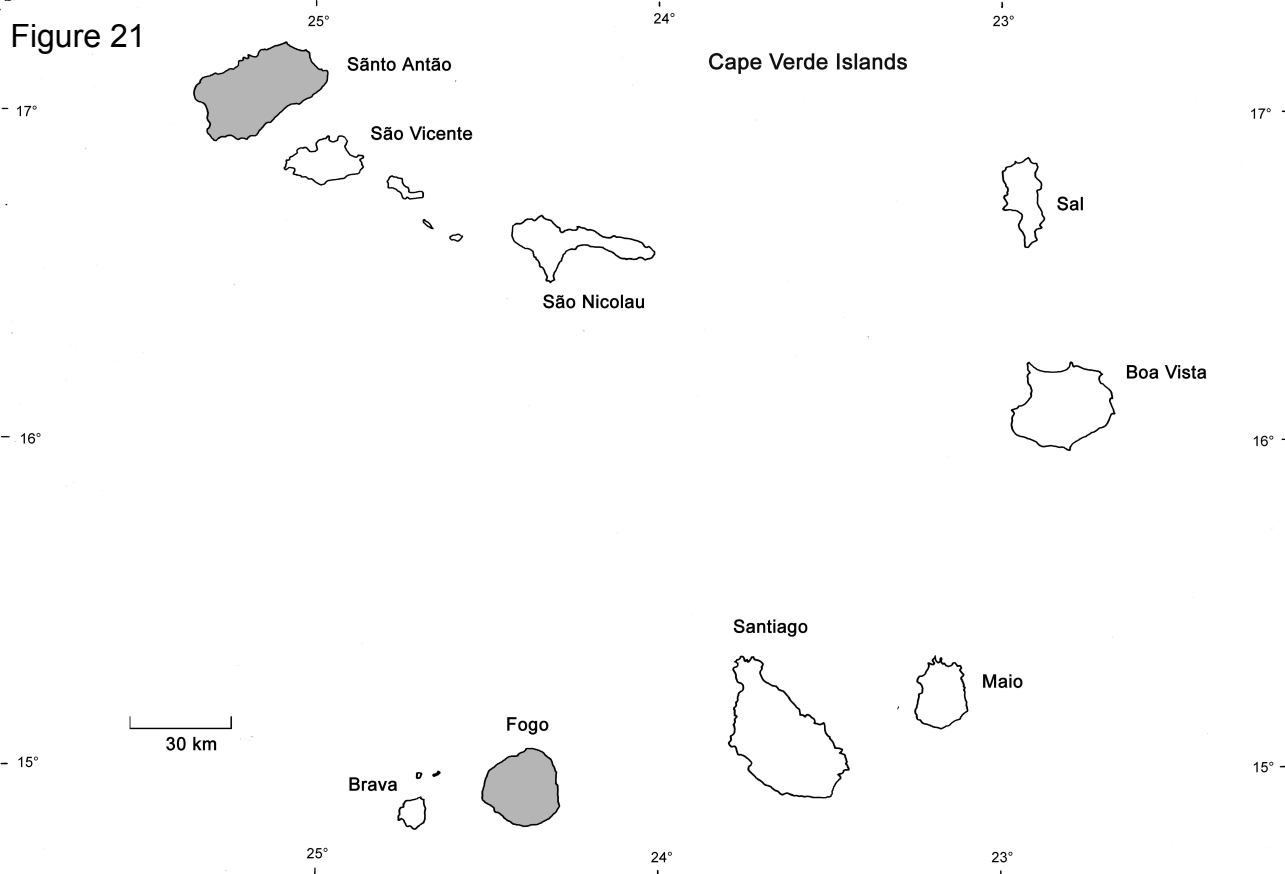


Figure 22

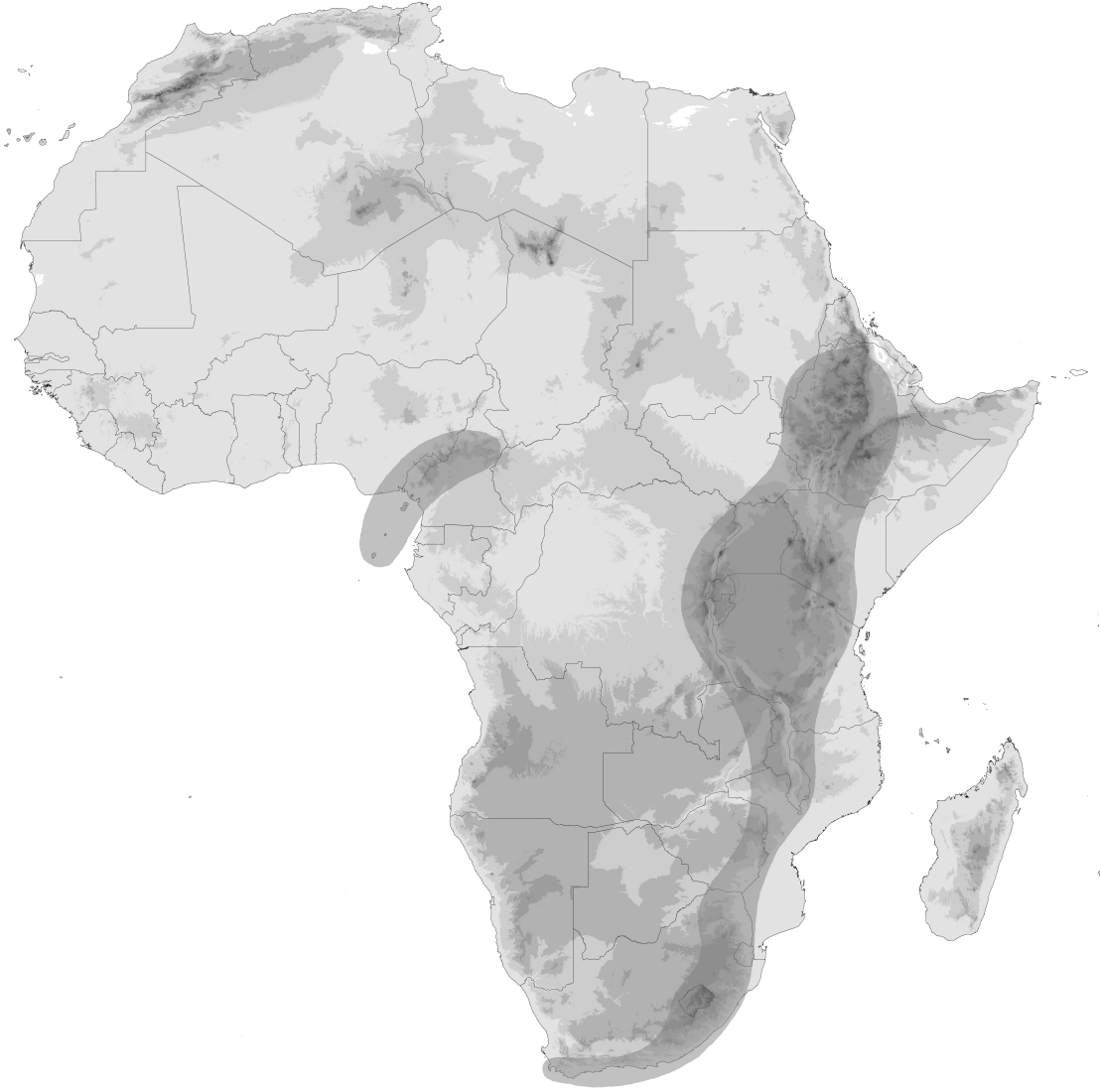


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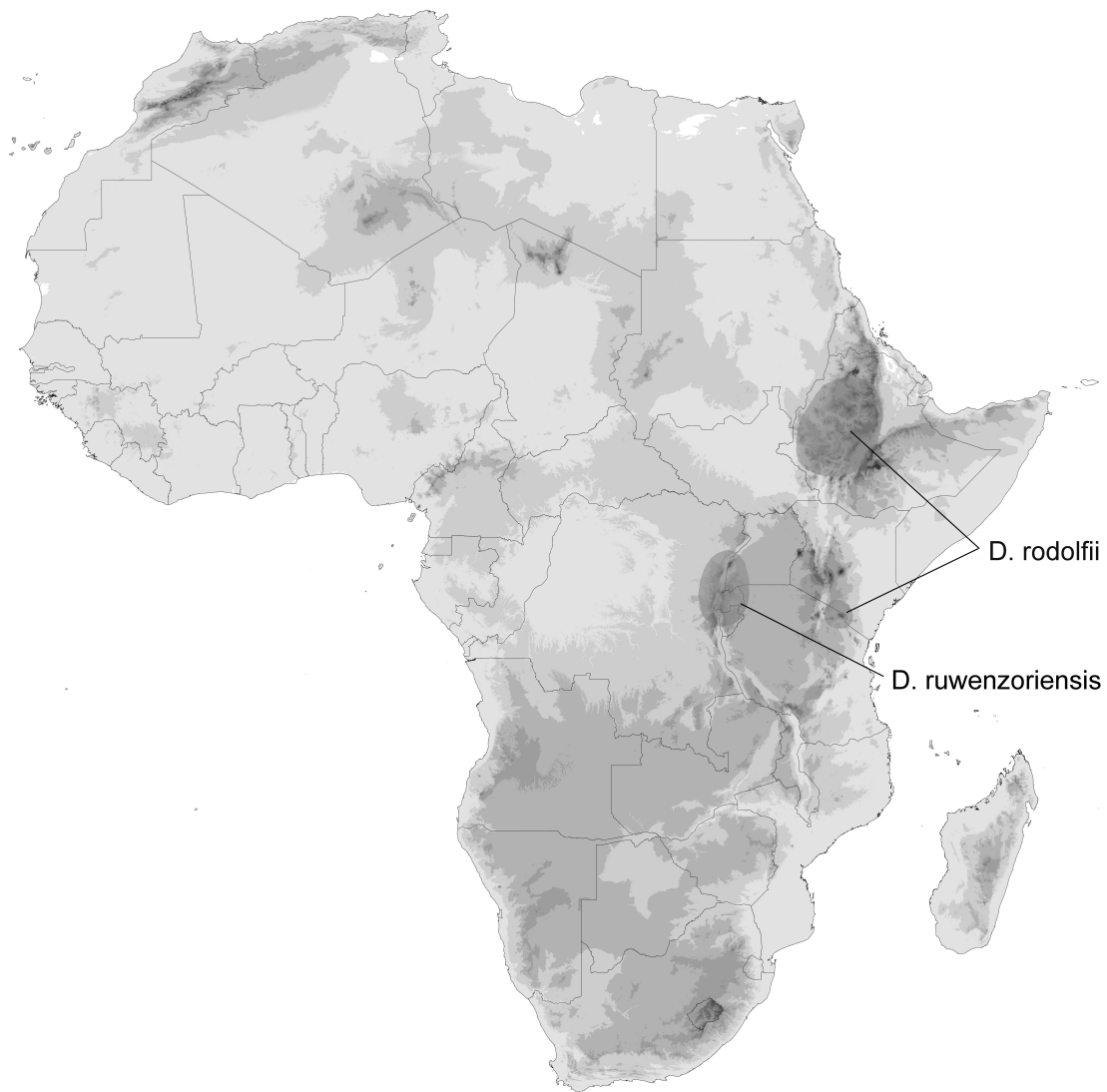


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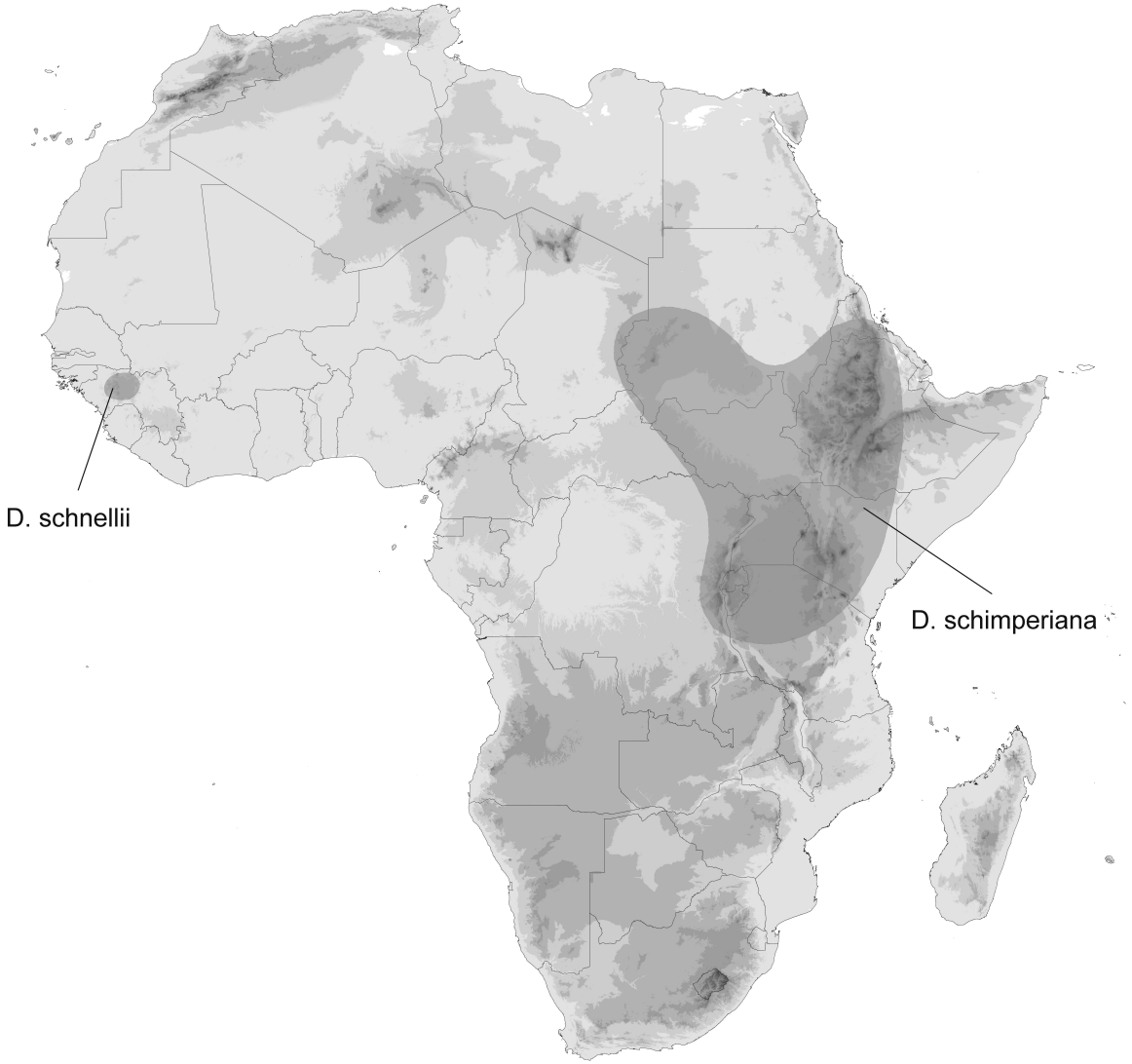


Figure 25

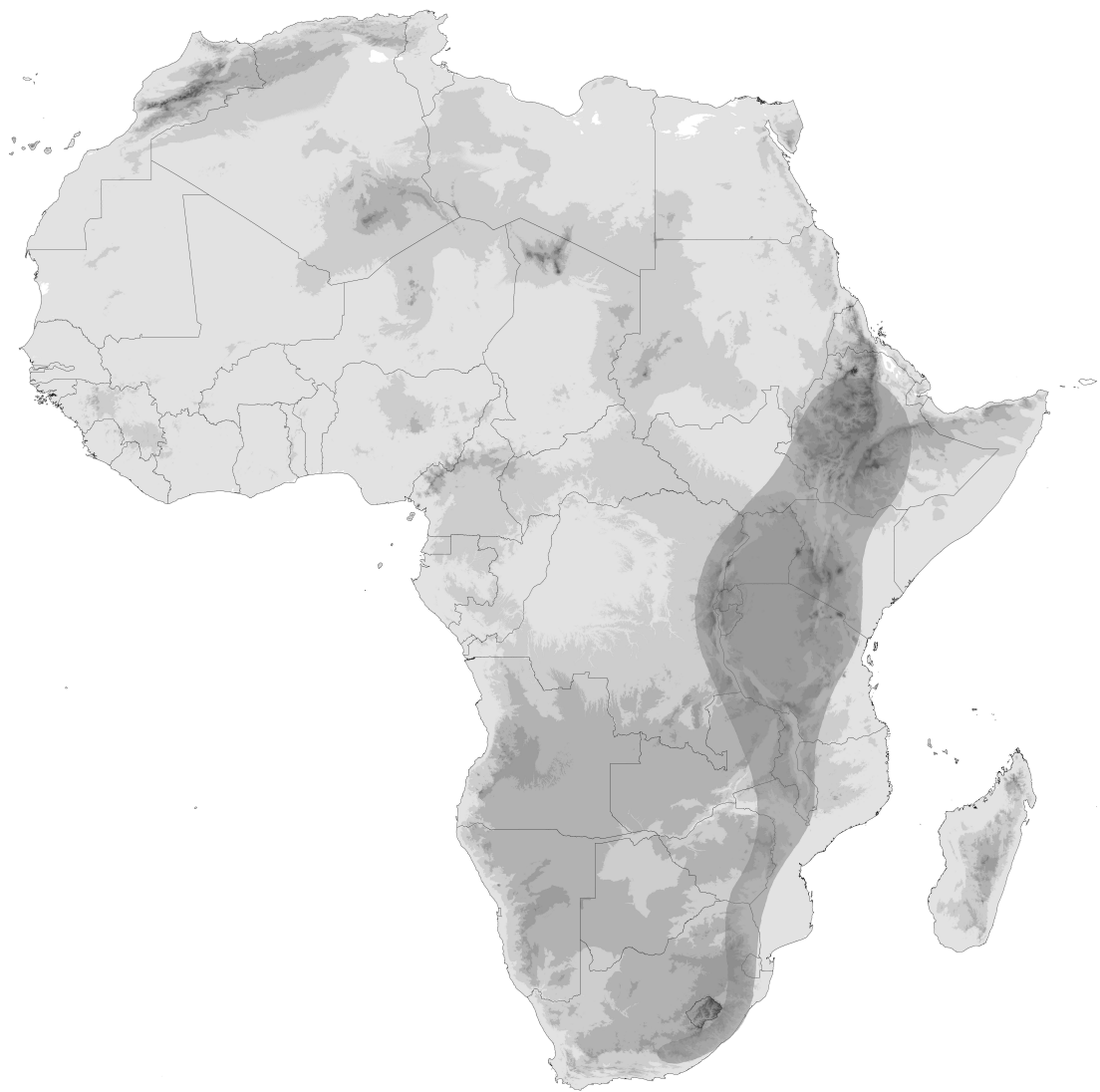


Figure 26

