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Composição e impressão das Oficinas da Tip. Alcobacense, Lt.ª — Alcobaça

NOVIDADES FLORÍSTICAS ENCONTRADAS NA REGIÃO DE VENDAS NOVAS

por

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NA primavera de 1946, o Instituto Botânico da Universidade de Coimbra, acedendo ao amável convite que lhe foi endereçado pelo Conselho Administrativo da Fundação da Casa de Bragança, efectuou importantes herborizações nas propriedades de Vendas Novas desta Instituição.

No decurso das explorações, tivemos oportunidade de colher abundante material, cujo estudo pormenorizado nos revelou, além de apreciáveis esclarecimentos relativos à área de distribuição de diversas plantas, algumas novidades para a flora portuguesa e mesmo para a Ciência.

Entre as plantas herborizadas, são particularmente interessantes as que constam da lista que a seguir publicamos, a qual, para maior facilidade de consulta, foi elaborada segundo a ordem estabelecida na Flora de Portugal de PEREIRA COUTINHO (1939).

Oportunamente, daremos uma notícia circunstanciada referente a todo o material colhido, e aos trabalhos realizados nessa excursão de estudo.

Azolla caroliniana Willd.

Vidigal, nos arrozais.

Equisetum arvense L.

Cuncos, próximo do ribeiro.

* Bolseiro do Instituto para a Alta Cultura.

Bromus rigidus Roth. subsp. **macrantherus** (Hack.)

Polígono da Escola Prática de Artilharia.

Scirpus pseudo-setaceus Dav.

Vale do Arneiro.
Vale do Falagueiro.

Carex helodes Link

Vale do Arneiro.
Vale do Boi.
Vale de Travessos.
Barranco da Malhada das Vacas.

Carex riparia Curt.

Vidigal.

Juncus conglomeratus L.

Vale do Arneiro.

Juncus Emmanuelis nob. n. sp.

J. perennis, glaucescens, 25-50 cm. altus. Radices filiformes, 0,4-0,8 mm. diam., pallide fuscæ vel castaneæ, fibrosæ, interdum nodulis tuberosis 10-15 mm. longis et 3-5 mm. latis incrassatæ. Rhizoma horizontale stoloniforme, stramineum, internodiis 1-5 cm. longis et 1-2 mm. diam., nodis incrassatis radicantibus. Caules erecti, validi, leviter striati, ca. 2-3 mm. diam., teretes vel subcompressi, basi valde tuberoso-incrassati, superne longe fistulosi. Folia caule breviora, basilaria 2-3, cataphyllina, interdum superne furcata, caulina 2-4 (raro 5), frondosa; vagina longa, dilatata, leviter striata, superne unitubulosa, septata, anguste membranaceo-marginata, in auriculas duas oblongo-obtusas producta; lamina erecto-patens, unitubulosa, septis completis externe valde conspicuis intercepta, teres vel a latere subcompressa, 2-4 mm. diam., supra leviter infra medium canaliculata, superne sensim attenuata, acuta. Inflorescentia anthelata, composita vel decomposita, capitulis 3-8 (raro 2-1), sphæricis vel hemisphæricis, laxe echinatis, 8-15 mm. diam., 10-30-(rarius 3-10-vel 30-50-) floris, pallide viridibus, demum rubescentibus. Bractea infima parum frondosa vel hypsophyllina, anthelæ dimidio breviore, ceteræ hypsophyllinæ, lanceolato-acuminatæ. Bracteæ florum ovato-lanceolatæ, acuminato-aristatæ vel -mucronatæ, hyalinæ, nervo dorsali castaneo, flore dimidium superantes vel æquantes. Flores post anthesin trigono-pyramidatæ, 4,5-6 mm. longæ; tepala æquilonga vel interna paulo breviora, glumacea, lanceolato-subulata, acumine sæpe recurvato, 3-5 nervia, anguste scarioso-marginata,

demum dorso sub apice rubescentia, externa concava, basi subgibbosa, interna subplana. Stamina 6, tepalis dimidium superantia; filamenta brevia, albida; antheræ oblongo-lineares, flavidæ, filamentis 4-6-plo longiores. Ovarium trigono-ovato-pyramidatum; stilus longus, perigonium subæquans; stigmata longe exserta. Capsula inclusa, longe ovato-pyramidata, rostrata, triquetra, lateribus subplanis, unilocularis, nitida, stramineo-viridis vel subfuscata. Semina ca. 0,6 mm. longa, obovata, obtusa, apiculata, subquadratim reticulata, castanea vel ferruginea. Numerus chromosomatum, 2 n = 40. (V. v.).

Typus in Herbario Instituti Botanici Universitatis Conimbrigensis (leg. *J. Matos* s. n.).

Habitat in paludosis, loco dicto *Vale do Falagueiro* pr. *Vendas Novas* in Transtagana (1).

Fl. et fr.: Maj.-Jun.

Affinis *J. nodoso* L., specie Americæ borealis incola, a quo differt radicibus interdum nodulis tuberosis incrassatis; caulibus validis; foliis caulem nunquam superantibus, lamina crassa, 2-4 mm. diam., supra leviter infra medium canaliculata; capitulis 1-8, laxe echinatis, 8-15 mm. diam.; bractea infima anthela dimidio breviore; floribus 4,5-6 mm. longis; staminibus tepalis dimidium superantibus; capsula inclusa.

Juncus Emmanuelis, nomen in memoriam D. Emmanuelis II, Portugaliæ Regis, Fundationis Domus Brigantinæ institutoris, et Artium Scientiarumque protectoris.

Scilla Ramburei Boiss. var. **albiflora** nob. n. var.

Differt a typo bracteis et floribus albis, pedicellis brevioribus.

Typus in Herbario Instituti Botanici Universitatis Conimbrigensis (leg. *Garcia* et *Sousa* 1303).

Habitat in pratis humidis, loco dicto *Barranco da Malhada das Vacas* pr. *Vendas Novas* in Transtagana.

Floret Aprili.

Scilla Ramburei Boiss. var. **intermedia** nob. n. var.

Differt a præcedenti et a typo bracteis et floribus roseis. An *S. Ramburei* Boiss. × *S. Ramburei* Boiss. var. *albiflora* nob. ?

Typus in Herbario Instituti Botanici Universitatis Conimbrigensis (leg. *Garcia* et *Sousa* 1305).

(1) Os exemplares classificados como *J. striatus* Schousb. β. *diffusus* Huet de Pav., colhidos em Montargil por J. Cortezão (6-1883, COI.), e em Setúbal, estrada de Algeruz, nas fossas, por A. Luisier (6-1901, COI., e 5-1907, PO.), pertencem, certamente, a esta espécie.

Habitat in eodem loco ubi præcedens.
Floret Aprili.

Scilla italica L. var. **albiflora** nob. n. var.

Differt a typo floribus albis.
Typus in Herbario Instituti Botanici Universitatis Conimbrigensis (leg. *Garcia* et *Sousa* 1304).
Habitat in eodem loco ubi præcedens.
Floret Aprili.

Muscari comosum (L.) Mill. var. **Gomesii** nob. n. var.

Differt a typo scapo longiore (ad 70 cm. longo), floribus sterilibus breviter pedicellatis, albis, reliquis fertilibus longius pedicellatis, albidis.
Typus in Herbario Instituti Botanici Universitatis Conimbrigensis (leg. *Garcia* et *Sousa* 1112).
Habitat in arenosis humidiusculis, ad margines agrorum pr. *Casa de Bragança*, *Vendas Novas*, in Transtagana.
Floret Aprili.

Varietas in honorem Cl. D. Antonii Ludovici Gomes, Fundationis Domus Brigantinæ Præfecti, dicata.

Iris Sisyrinchium L. var. **albiflora** nob. n. var.

Differt a typo floribus albis.
Typus in Herbario Instituti Botanici Universitatis Conimbrigensis (leg. *Garcia* et *Sousa* s. n.).
Habitat in arenosis, ad margines viæ inter *Vendas Novas* et *Montemor-o-Novo*.
Floret Aprili.

Gladiolus illyricus Koch

Encosta do Vale de Travessos.

Thymelæa villosa (L.) Endl.

Encosta da Serra da Arriça.

Montia rivularis Gmel.

Vale do Arneiro.
Vale do Boi.

Illecebrum verticillatum L. forma **fluitans** (Matr.) nob. n. comb.

Polígono da Escola Prática de Artilharia, nos charcos.
Vale do Falagueiro, nos charcos.

Forma nova para a flora portuguesa.

Cerastium glomeratum Thuill. var. **apetalum** (Dum.) Mert. et Koch

Próximo da Casa de Bragança.

Silene longicaulis Pourr.

Polígono da Escola Prática de Artilharia.

Ranunculus hederaceus L.

Ribeira de Canha, próximo da Ameira.
Vale de Travessos.

Ranunculus Lenormandii F. Schultz subsp. **lotarius** (Revel)

Vale do Arneiro.

Ranunculus Flammula L.

Vale do Arneiro.

Ranunculus flabellatus Desf. var. **subpinnatus** Freyn

Vale de Travessos.

Brassica oxyrrhina Coss.

Polígono da Escola Prática de Artilharia.
Vale de Travessos.

Cratægus monogyna Jacq. var. **flabellata** Lange

Margens da ribeira de Canha, próximo da Ameira.

Pirus communis L. subsp. **Boræana** Rouy et Camus

Cuncos, na planície

Lupinus Rothmaleri Klink.

Vale de Travessos.
Serra da Arriça.

Genista Tournefortii Spach subsp. **decipiens** (Spach)

Outeiro de Santo António.

Ulex genistoides Brot.

Próximo da Casa de Bragança.
Vidigal.
Margem da ribeira de Canha, próximo da Ameira.
Vale de Travessos.

Trifolium nigrescens Viv. var. **roseum** Gib. et Belli

Vale do Boi.

Variedade nova para a flora de Portugal.

Ornithopus sativus Brot. var. **isthmocarpos** (Coss.)

Espadaneira.
Próximo da Casa de Bragança.

Vicia sativa L. var. **linearis** Lange

Ameira, próximo da ribeira de Canha.

Variedade não mencionada na Flora de Portugal.

Vicia atropurpurea Desf. var. **aquitanica** Clav.

Lameiros próximos das Adegas da Casa de Bragança.

Variedade não mencionada na Flora de Portugal, mas citada no Manual da Flora Portuguesa de Gonçalo Sampaio.

Euphorbia Welwitschii Boiss. et Reut. var. **ramosissima** Dav.

Margens do ribeiro de Cuncos.

Euphorbia transtagana Boiss.

Outeiro de Santo António.

Euphorbia bætica Boiss.

Polígono da Escola Prática de Artilharia.
Vale do Boi.

Rhamnus Frangula L. forma **genuina** (Rouy)

Vale de Travessos.

Helianthemum lasianthum (Lam.) Pers.

Polígono da Escola Prática de Artilharia.
Pinhal das Adegas.
Vale do Falagueiro.

Helianthemum retrofractum Pers.

Cova do Boi.

Helianthemum tymifolium (L.) Pers. var. **glutinosum** (L.)

Vale do Falagueiro.
Vale da Curralada.

Helianthemum thymifolium (L.) Pers. var. **juniperinum** (Dunal)

Herdade da Chaminé.

Viola canina L.

Vidigal.

Apium inundatum (L.) Reichenb.

Vale do Arneiro.

Anchusa undulata L. var. **decolorata** nob. n. var.

Differt a typo floribus albis, cærulantibus vel pallide roseis.

Typus in Herbario Instituti Botanici Universitatis Conimbrigensis (leg. *Garcia* et *Sousa* 1166),

Habitat in arvis incultis, loco dicto *Vale do Boi* pr. *Vendas Novas* in Transtagana.

Floret Aprili.

Thymus villosus L. subsp. **typicus** Cout.

Outeiro de Santo António.

Stachys arvensis L. var. **colorata** Guss.

Polígono da Escola Prática de Artilharia.
Vale do Falagueiro.

Variedade nova para a flora portuguesa.

Stachys arvensis L. var. **albiflora** Bolz.

Vale do Falagueiro.

Variedade nova para a flora portuguesa.

Valerianella coronata (L.) DC.

Vale do Boi.

Evax lusitanica Samp.

Próximo do monumento a Duarte Pacheco.

Espécie não mencionada na Flora de Portugal.

Evax carpetana Lange var. **castellana** (Rouy) Cout.

Polígono da Escola Prática de Artilharia.

Evax asterisciflora (Lam.) Pers. var. **minor** Nym.

Próximo do monumento a Duarte Pacheco.

Evax asterisciflora (Lam.) Pers. var. **ramosissima** Mariz

Espadaneira.

Variedade não mencionada na Flora de Portugal.

Gnaphalium uliginosum L. var. **ramosum** (Lam.) Fiori

Vidigal.
Margens da ribeira de Canha.

Variedade não mencionada na Flora de Portugal.

REVISÃO DO HERBÁRIO DE MOÇAMBIQUE DO INSTITUTO BOTÂNICO DA UNIVERSIDADE DE COIMBRA *

por

J. G. GARCIA

III

STERCULIACEÆ E TILIACEÆ

INTRODUÇÃO

COMO resultado do estudo que vimos realizando sob o patrocínio da Junta das Missões Geográficas e de Investigações Coloniais, damos hoje notícia da revisão das famílias das *Sterculiaceæ* e *Tiliaceæ* do Herbário de Moçambique do Instituto Botânico da Universidade de Coimbra.

O trabalho até agora efectuado diz respeito às famílias das **Ranunculaceæ, Dilleniaceæ, Annonaceæ, Menispermaceæ, Nymphæaceæ, Papaveraceæ, Cruciferæ, Capparidaceæ, Violaceæ, Flacourtiaceæ, Pittosporaceæ, Polygalaceæ, Caryophyllaceæ, Elatinaceæ, Hypericaceæ, Guttiferæ, Bombacaceæ, Malvaceæ, Sterculiaceæ** e **Tiliaceæ**, representando uma pequena contribuição para um estudo mais completo que venha a efectuar-se (1).

A distribuição geográfica do material estudado continua a ser feita por províncias, mas tendo em consideração a nova divisão administrativa da Colónia (2).

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* Trabalho subsidiado pela Junta das Missões Geográficas e de Investigações Coloniais. — *Vide* Bol. Soc. Broteriana, vol. XIX (2.ª série), 1945, p. 507-518, e vol. XX (2.ª série), 1946, p. 33-42.

(1) Queremos deixar consignados aqui os nossos melhores agradecimentos ao Sr. FRANCISCO CABRAL JÚNIOR, zeloso empregado do Instituto Botânico e nosso distinto auxiliar nos trabalhos relativos ao estudo da flora das nossas colónias, pelo valioso auxílio que nos tem prestado.

(2) *Vide* Decreto n.º 35.733, Diário do Governo n.º 147, de 4 de Julho de 1946.

STERCULIACEÆ

Melhania Forsk.

Melhania prostrata DC., Prodr. Syst. Nat. Regni Veg. I (1824) 499.

SUL DO SAVE: — Ressano Garcia, *Schlechter* 11946.

LOURENÇO MARQUES: — Matola, *Quintas* 45.

Fl. e fr. XII, IV.

Melhania didyma Eckl. et Zeyh. var. **linearifolia** (Sond.) Szyszyl., Pl. Rehm. (1887) 137 ex p.; *Melhania linearifolia* Sond. in Linnæa XXIII (1850) 18.

SUL DO SAVE: — Incomati, *J. Borle* 398.

LOURENÇO MARQUES: — Lourenço Marques, *J. Borle* 273.

Fl. e fr. I-III.

Melhania Forbesii Planch. ex Mast. in Oliv., Fl. Trop. Afr. I (1868) 231.

SUL DO SAVE: — Massinga, *Gomes e Sousa* 1728. Determinação de Kew, segundo lista de Gomes e Sousa. — Inhambane, *Torre* 1571, 1583.

LOURENÇO MARQUES: — Lourenço Marques (Delagoa Bay), *Schlechter* 11982.

Fl. e fr. IV-VI, X-I.

Melhania ferruginea A. Rich., Tent. Fl. Abyss. I (1847) 76.

SUL DO SAVE: — Margem esquerda do rio Incomati, *Quintas* 124.

Fl. e fr. V.

Melhania sp. (sub nom. *M. Junodi* Schinz).

LOURENÇO MARQUES: — Lourenço Marques (Delagoa Bay), *Junod* s. n.

Fl. e fr.?

Dombeya Cav.

Dombeya lasiostylis K. Schum. in Engl., Monogr. Afr. Pfl.-Fam. u. -Gatt. V (1900) 24.

NIASSA: — Nampula, margens do rio Ligonha, estrada de Murrupula, *Gomes e Sousa* 615.
Fl. e fr. VII.

Dombeya Burgessiæ Gerr. in Harv. et Sond., Fl. Cap. II (1861-1862) 590.
Colónia de Moçambique, sem indicação de localidade, *Carvalho* s. n.
Fl. e fr.?

Dombeya aff. **quinqueseta** (Del.) Exell, Journ. of Bot. LXXIII (1935) 263; *Xeropetalum quinquesetum* Del., Cent. Pl. Afr. Voy. Méroé (1826) 84.
NIASSA: — Metónia, *Gomes e Sousa* 1552.
Fl. e fr. IX.

Dombeya Ringoeti De Wild. in Bull. Jard. Bot. Brux. V (1915) 24.
NIASSA: — Vila Cabral, *Torre* 437.
Fl. e fr. XI.

Dombeya shupangæ K. Schum. em. Sprague in Journ. of Bot. LIX (1921) 349; *D. shupangæ* K. Schum. in Engl., Monogr. Afr. Pfl.-Fam. u. -Gatt. V (1900) 39.
NIASSA: — Entre Sanga e Mecaloja, *Torre* 438.
Fl. e fr. VIII.

Dombeya sp.
NIASSA: — Vila Cabral, Planalto da Lichinga, *Torre* 4.
Fl. e fr. XI.

Dombeya sp.
NIASSA: — Massangulo, *Gomes e Sousa* 1455.
Fl. e fr. VI.

Dombeya sp.
?: — Ribau, 3 km. ao sul da povoação, *Gomes e Sousa* 2281.
Fl. e fr. IX.

Melochia L.

Melochia corchorifolia L., Sp. Pl. (1753) 675.

NIASSA:—Nampula: arredores de Mucuburi, *Torre* 1286. —De Namina a Ribaué, *Torre* 1471. — Nampula, *Torre* 1248.

Fl. e fr. III-IV.

Melochia melissifolia Benth. in Hook., Journ. of Bot. IV (1842) 129.

?: — Macuri, *Carvalho* s. n.

Fl. ?

Waltheria L.

Waltheria indica L., Sp. Pl. (1753) 673.

NIASSA: — Margem do Lago Niassa pr. M'Bueca, *Gomes e Sousa* 1512. — De Ribaué a Lalaua, *Torre* 1434. — Malema, *Torre* 896. — Mossuril e Cabeceira, *Carvalho* s. n. — Nampula, *Torre* 690. — De Muatua a Angoche, *Torre* 970.

MANICA E SOFALA: — Tete, *Pomba Guerra* 88. — Vila Fontes (Fontesvilla), *Schlechter* 1229.

SUL DO SAVE: — Massinga, *Gomes e Sousa* 1720. — Inhambane, *Torre* 1582. — Incomati, margem do rio, *Quintas* 62.

LOURENÇO MARQUES: — Lourenço Marques (Delagoa Bay), *Junod* 360.

Fl. e fr. III-XI.

Hermannia L.

Hermannia glanduligera K. Schum. in Verh. Bot. Ver. Prov. Brandenb. XXX (1880) 232.

ZAMBÉZIA: — Margem do Zambeze, *Carvalho* s. n.

Fl. e fr. ?

Hermannia borraginiflora Hook., Ic. Pl. VI (1843) t. 597.

SUL DO SAVE: — Margem esquerda do rio Incomati, *Quintas* 125.

Fl. e fr. V.

Hermannia aff. **modtesa** (Ehrenb.) Planch. in Ann. Sc. Nat. sér. 4 III (1855) 292; *Trichanthera modesta* Ehrenb. in Linnæa IV (1829) 401.

ZAMBÉZIA: — Baixa Zambézia, *Sarmento* s. n.
Fl. e fr.?

Hermannia Kirkii Mast. in Oliv., Fl. Trop. Afr. I (1868) 233.

MANICA E SOFALA: — Tete-Mandi, *Pomba Guerra* 78.
Fl. II.

Hermannia tigreensis Hochst. ex A. Rich., Tent. Fl. Abyss. I (1847) 74, t. 17.

ZAMBÉZIA: — Margens do Zambeze, *Carvalho* s. n.
Fl. e fr.?

Hermannia brachypetala Harv. in Harv. et Sond., Fl. Cap. I (1859-1860) 202.

LOURENÇO MARQUES: — Lourenço Marques, *Schlechter* 11576.
Fl. e fr. XII.

Sterculia L.

Sterculia quinqueloba (Garcke) K. Schum. in Engl. Bot. Jahrb. XV (1893) 135; *Cola quinqueloba* Garcke in Peters, Reise Mossamb. Bot. I (1862) 130.

NIASSA: — Entre Cuamba e o rio Lúrio, *Torre* 860.
Fl. VI.

Sterculia cf. **Triphaca** R. Br. in Benn., Pl. Jav. Rar. III (1844) 221.

ZAMBÉZIA: — Chilomo, *leg.*? s. n.
Fl. VII.

Sterculia sp.

NIASSA: — Nampula, *Torre* 1163.
Fl. e fr. VIII.

TILIACEÆ

Glyphæa Hook. f.

Glyphæa lateriflora (G. Don) Hutch. et J. M. Dalz., Fl. W. Trop. Afr. I 1 (1927) 239, et Bull. Misc. Inf. Kew (1928) 229; *Grewia lateriflora* G. Don, Gen. Syst. I (1831) 549.

NIASSA: — Entre Nampula e Meconta, *Torre* 780. — Nampula, *Torre* 1225. — Entre Corrane e Liupo, *Torre* 1022. — De Muatua a Angoche, *Torre* 968.

Fl. e fr. XI-II.

Corchorus L.

Corchorus trilocularis L., Mant. Pl. (1767) 77.

SUL DO SAVE: — Incomati, margem direita do rio, *Quintas* 161.

Fl. VI.

Corchorus tridens L., Mant. Pl. (1771) 566.

NIASSA: — Nampula, *Torre* 718, 814.

LOURENÇO MARQUES: — Matola, *Quintas* 50. — Lourenço Marques (Delagoa Bay), *Schlechter* 11996.

Fl. e fr. I-IV.

Corchorus Junodii (Schinz) N. E. Brown in Bull. Misc. Inf. Kew (1908) 287; *Triumfetta Junodii* Schinz in Mém. Herb. Boiss. X, 49.

SUL DO SAVE: — Ilha do Bazaruto, extremo norte, pr. farol, *Gomes e Sousa* 1983. — Inhambane, *Torre* 1575. — Inhambane, pr. rio das Pedras, *Gomes e Sousa* 1759. — Manhiça: Pateque, *Pomba Guerra* 408.

LOURENÇO MARQUES: — Polana, *J. Borle* 39. — Lourenço Marques, *Schlechter* 11561.

Fl. e fr. VI-XI.

Corchorus aff. **hirsutus** L., Sp. Pl. (1753) 530.

SUL DO SAVE: — Boane, *leg.?* 175.

Fl. IX.

Corchorus aff. **hirsutus** L., l. c.
SUL DO SAVE: — Boane, *leg.* ? s. n.
Fl. e fr. XI.

Corchorus sp.
NIASSA: — Nampula, *Torre* 1275.
Fl. e fr. II.

Grewia L.

Grewia microthyrsa K. Schum. ex Burret in Engl., Bot, Jahrb. XLV (1910) 163.
SUL DO SAVE: — Inhambane: Manhica, *Gomes e Sousa* 1950. Determinação de Kew, segundo lista de Gomes e Sousa.
LOURENÇO MARQUES: — Lourenço Marques, *Schlechter* 11632; *J. Borle* 324.
Fl. e fr. XII, II.

Grewia Holstii Burret in Engl., Bot. Jahrb. XLV (1910) 167.
SUL DO SAVE: — Inhambane: Manhica, *Gomes e Sousa* 1951. Determinação de Kew, segundo lista de Gomes e Sousa.
Fl. XII.

Grewia cf. **flavescens** Juss. in Ann. Mus. Par. IV (1804) 91.
NIASSA: — Moçambique: Mossuril e Cabeceira, *Carvalho* s. n.
SUL DO SAVE: — Inhambane, no litoral, *Torre* 1593.
LOURENÇO MARQUES: — Chiringa, *Pomba Guerra* 336.
Fl. I; fl. e fr. III.

Grewia Forbesii Harv. ex Mast. in Oliv., Fl. Trop. Afr. I (1868) 250.
NIASSA: — Niassa, *Torre* 1560. — Moçambique: Mossuril e Cabeceira, *Carvalho* s. n. — Nampula, *Torre* 810.
Fl. XII; fl. e fr. II-IV.

Grewia caffra Meisn. in Hook., Lond. Journ. Bot. II (1843) 53.

LOURENÇO MARQUES: — Lourenço Marques, *Schlechter* 11549.

Fl. XI.

Grewia cf. **ferruginea** Hochst. ex A. Rich., Tent. Fl. Abyss. I (1847) 87.

NIASSA: — Nampula, *Torre* 1246.

Fl. III.

Grewia columnaris Sm. in Rees, Cyclop. XVII, n. 5.

NIASSA: — Moçambique: Ilha de Ibó, *Carvalho* s. n.

Fl. e fr.?

Grewia sulcata Mast. in Oliv., Fl. Trop. Afr. I (1868) 252.

NIASSA: — Moçambique: Mossuril e Cabeceira, *Carvalho* s. n. — Nampula, *Torre* 1426.

Fl. e fr. V.

Grewia sulcata Mast. var. **obovata** (K. Schum.) Burret in Engl., Bot. Jahrb. XLV (1910) 188; *G. obovata* K. Schum. in Engl., Pflanzenw. Ost.-Afr. C (1895) 263.

SUL DO SAVE: — Inhambane: Massinga, *Gomes e Sousa* 1766. — Inhambane: pr. praia de Inhambane-Velho, *Gomes e Sousa* 2150. — Inhambane: pr. rio Inhassombe, *Gomes e Sousa* 1874.

Fl. e fr. VI-VII, IX.

Grewia occidentalis L., Sp. Pl. (1753) 964.

SUL DO SAVE: — Inhambane: Dunas de Pomene (Barra Falsa), 120 km. a norte de Inhambane, *Gomes e Sousa* 1690. — Inhambane: Massinga, *Gomes e Sousa* 1931. — Costa de Inhambane, 20 km. a leste da vila, *Gomes e Sousa* 1741. Determinações de Kew, segundo lista de Gomes e Sousa.

Fl. e fr. XII.

Grewia tembensis Fresen. in Mus. Senck. II (1837) 158.
NIASSA: — Nampula: de Mucuburi a Muite, *Torre* 1072.
Fl. XI.

Grewia sp.
SUL DO SAVE: — Inhambane: entre Mocodoene e Mavume, *Gomes e Sousa* 2019.
Fl. e fr. IX.

Grewia sp.
SUL DO SAVE: — Inhambane: Zavala, *Gomes e Sousa* 2049.
Fl. e fr. X.

Grewia sp.
LOURENÇO MARQUES: — Pessene, *Quintas* 96.
Fr. V.

Triumfetta L.

Triumfetta cf. **Kirkii** Mast. in Oliv., Fl. Trop. Afr. I (1868) 259.
NIASSA: — Nacala: Fernão Veloso, *Torre* 1424.
Fl. e fr. V.

Triumfetta Sonderii Ficalho et Hiern in Trans. Linn. Soc. ser. 2 Bot. II (1881) 17.
NIASSA: — Vila Cabral, junto do regato de Litunde, *Torre* 155.
Fr. VII.

Triumfetta aff. **Welwitschii** Mast. in Oliv., Fl. Trop. Afr. I (1868) 255.
NIASSA: — Arredores de Maniamba, *Torre* 567.
Fl. e fr. XI.

Triumfetta tomentosa Boj., Hort. Maurit. (1837) 43, nomen; et in Bouton, Douzième Rapp. Ann. Maur. (1842) 19.
NIASSA: — De Nampula a Ribaué, *Torre* 1468.
Fl. IV.

Triumfetta semitriloba Jacq., Enum. Pl. Carib. (1760) 22.
SUL DO SAVE: — Inhambane: Massinga, *Gomes e Sousa* 1778.
Fl. e fr. VII.

Triumfetta Bartramia L., Syst. ed. 10 (1759) 1044; Sp. Pl. ed. 2 (1762) 638; *Bartramia indica* L., Sp. Pl. (1753) 389.
NIASSA: — Mossuril e Cabeceira, *Carvalho* s. n. — Nampula, *Torre* 1237. — António Enes (Angoche): Malatane, *Torre* 1547.
SUL DO SAVE: — Manhiça, região litoral, *Gomes e Sousa* 39.
Fl. e fr. III-VIII.

Triumfetta pentandra A. Rich. in Guill. et Perr., Fl. Seneg. Tent. I (1831) 93, t. 19.
NIASSA: — Nampula, *Torre* 696.
SUL DO SAVE: — Inhambane, *Gomes e Sousa* 1723.
LOURENÇO MARQUES: — Marracuene, *Gomes e Sousa* 3406.
Fl. e fr. III-V.

Triumfetta cf. **pilosa** Roth, Nov. Pl. Sp. (1821) 223.
NIASSA: — Vila Cabral, *Torre* 112.
Fl. e fr. V.

Triumfetta effusa E. Mey. ex Harv. in Harv. et Sond., Fl. Cap. I (1860) 228.
NIASSA: — Vila Cabral, *Torre* 26. — De Nampula a Mucuburi, *Torre* 1241.
Fl. I-II.

Triumfetta sp.
NIASSA: — Arredores de Maniamba, *Torre* 565.
Fl. e fr. II.

Triumfetta sp.
NIASSA: — Unango, Vila Cabral, *Torre* 111.
Fl. e fr. VI.

Triumfetta sp.
NIASSA: — Entre Mossuril e Monapo, *Torre* 1514.
Fl. e fr. V.

Triumfetta sp.
NIASSA: — Nametil, Nampula, *Torre* 1374.
Fl. IV.

Triumfetta sp.
ZAMBÉZIA: — Gurué, *Torre* 1540.
Fl. e fr. V.

Triumfetta sp.
ZAMBÉZIA: — Chilomo, *leg.?* 177.
Fl. e fr. ?

Triumfetta sp.
SUL DO SAVE: — Inhambane, pr. Rio das Pedras, *Gomes e Sousa* 1768.
Fl. e fr. VII.

IDENTIFICAÇÃO DE *LAMIUM AMPLEXICAULE* × *PURPUREUM* COUT., NON G. MEY.

por

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Recebido para publicação em 20 de Junho de 1947.

INTRODUÇÃO

EM Novembro de 1943, ao elaborarmos a notícia da existência de *Lamium hybridum* Vill. em algumas localidades de Trás-os-Montes e Beira Alta, tivemos ocasião de verificar que a planta descrita por PEREIRA COUTINHO (1907 e 1907 *a*) e registada na sua Flora de Portugal (1913 e 1939) sob a denominação *L. amplexicaule* × *purpureum* não podia ser incluída naquela espécie (*vide* GARCIA, 1944). Este facto levou-nos a procurar resolver o problema do estabelecimento da categoria e posição sistemática desta curiosa labiada.

Tornava-se, porém, necessário observar a planta no seu *habitat*, e colher mais material, que permitisse efectuar o estudo pormenorizado da sua morfologia. Com estes objectivos, projectámos, desde logo, realizar uma exploração nos campos de Celorico da Beira, local onde JÚLIO CÉSAR LUCAS herborizou o exemplar que serviu de tipo à diagnose latina publicada por PEREIRA COUTINHO. Esse exemplar (Tab. I) era o único que se conhecia, e a raridade da planta preocupava o nosso espírito, fazendo-nos, por vezes, perder a esperança de serem conduzidas a bom termo as nossas investigações. No entanto, em 9 de Maio de 1944, durante uma viagem de estudo através da Beira, visitámos deliberadamente Celorico, onde procurámos o suposto híbrido, com o maior cuidado. Depois de algumas buscas infrutíferas, um feliz acaso chamou a nossa atenção para uma planta que, tendo nascido nas fendas do muro

que ladeia a estrada que percorre a vila, constituía um interessante motivo ornamental. Ao aproximarmo-nos, verificámos que se tratava de um belo exemplar de *L. amplexicaule* × *purpureum* Cout., non G. Mey., que recolhemos e acondicionámos o melhor que nos foi possível (Tab. II).

Animado por este sucesso, continuámos a explorar os terrenos compreendidos entre a vila e o rio Mondego, e aí tivemos oportunidade de herborizar mais alguns exemplares.

Procurando, por toda a área percorrida, os indigitados progenitores, apenas conseguimos encontrar *L. purpureum* L., e em pontos bastante afastados daqueles em que a planta vegetava. Assim, a labiada em estudo, que, no seu aspecto geral, é bem distinta das congéneres, apresentava-se como uma espécie autónoma.

A fim de confirmarmos as conclusões a que nos levaram as observações *in loco*, procedemos à cultura da planta no Jardim Botânico da Universidade de Coimbra. Os resultados obtidos mostraram claramente que esta labiada possui fertilidade normal e constância de caracteres.

Os factos apontados e o estudo morfológico e taxonómico da planta revelam que ela é, indubitàvelmente, uma boa espécie, diferente das conhecidas até hoje.

Dada a circunstância de não ter sido ainda encontrada em outras áreas, é muito provável que se trate de uma espécie endémica na região onde foi herborizada.

MORFOLOGIA E TAXONOMIA

O estudo morfológico que Pereira Coutinho efectuou de *L. amplexicaule* × *purpureum* Cout., non G. Mey., incidiu apenas sobre o exemplar que então se conhecia, e, por isso, não pode considerar-se completo. Deste modo, julgamos necessário publicar uma nova descrição da planta, baseada na observação de todo o material de que dispomos. Esta descrição é feita sob o novo nome *Lamium Coutinhoi*, que dedicamos à memória do sábio autor da Flora de Portugal, lídima glória da Botânica portuguesa.

Lamium Coutinhoi nob.

Lamium amplexicaule × *purpureum* Cout., As Labiadas de Portugal (1907) 76; non G. Mey.

L. annuum, viride vel ± purpurascens, 10-40 cm. altum. Radix fibrosa. Caules validi, omnes adscendentes vel centralis erectus, simplices vel ramosi, glabriusculi, interdum supra basin longe denudati. Folia obtusa, paulo profunde inciso-crenata, villoso-hispida: basilaria cordato-subrotundata, longe petiolata; caulina late cordato-ovata, brevius petiolata; floralia late ovato-triangularia, sæpissime basi subtruncata, breve petiolata vel subsessilia. Inflorescentiæ terminales, verticillastris dense approximatis, inferioribus interdum valde remotis. Bracteolæ lineari-subulatæ, longe ciliatæ, calyce breviores. Flores mediocres, plerumque 10-15 mm. longi; calyx tubuloso-campanulatus, villoso-hispidus, dentibus tubo longioribus, triangulari-subulatis, longe ciliatis, demum divaricatis; corolla purpurea, tubo longo, exserto vel subincluso, ad faucem repente dilatato, intus piloso-annulato, et labio superiore integro, galeato, ecarinato, extus villoso-hirsuto. Antheræ flavidæ, hirsutæ. Achenia 2,5-3,5 mm. longa, tenuiter granulata. (V. v.).

Fl. et fr.: Maj.-Jun.

Habitat in aridis graniticis. *Celorico*, in Beira Alta.

Typus in Herbario Instituti Botanici Universitatis Conimbrigensis (Ic. nostr.: Tab. I).

Exsiccata: *Celorico da Beira*, s. d., *J. C. Lucas* s. n., COI. (typus); eodem loco, 9-5-1944, *J. G. Garcia* 333, COI. (Ic. nostr.: Tab. II); inter *Celorico da Beira* et fluvium Mundam, 9-5-1944, *J. G. Garcia* 333A, COI.; in Horto Botanico Conimbrigensi cultum, 7-6-1945, *F Sousa* s. n., COI.

Planta inter *L. amplexicaule* L. et *L. intermedium* Fries media, sed affinior *L. intermedio* Fries. Differt a *L. amplexicauli* L. foliis proportionaliter longioribus, floralibus in petiolum brevem attenuatis; corollæ tubo breviore et intus piloso-annulato. Differt a *L. intermedio* Fries, specie

Europæ borealis incola, caulibus validioribus; foliis proportionaliter latioribus, villoso-hispidis; corollæ tubo longiore et intus piloso-annulato.

É de toda a justiça salientar que foi Pereira Coutinho (1907) quem primeiro duvidou da identificação da planta que descreveu com o verdadeiro *L. amplexicaule* × *purpureum* G. Mey., sinónimo de *L. hybridum* Vill., dizendo: «An ad *L. hybridum* Vill. *(L. incisum* Willd.) ducenda v. pro forma distincta consideranda?».

Júlio Henriques (1911), ao fazer referência ao exemplar descrito por Pereira Coutinho, manifesta a mesma dúvida, denominando-o «*L. amplexicaule* × *purpureum* G. Mey.?».

Pereira Coutinho (1907) admitia, porém, que a planta, embora fosse uma forma distinta de *L. hybridum* Vill., era, no entanto, um verdadeiro híbrido entre *L. amplexicaule* L. e *L. purpureum* L.: «parece que d'estas mesmas duas especies progenitoras podem resultar formas hybridas mais ou menos distinctas, o que não é para admirar: assim, uns auctores descrevem o tubo da corolla do *L. hybridum* sem annel piloso interior, e outros acrescentam que o pode ter ás vezes. A planta portugueza acima indicada é de certo hybrida, e a sua grande raridade parece mostrar que tem pouca tendencia para a fixação.» Se atendermos, todavia, a que a planta se apresenta dotada de fertilidade normal, e com caracteres morfológicos que não permitem atribuir-lhe tal origem híbrida, concluímos que estas últimas afirmações de Pereira Coutinho carecem de fundamento sólido.

Nas experiências de Müntzing (1926) e Jörgensen (1927), os numerosos cruzamentos realizados entre as formas naturais diploides de *L. amplexicaule* L. e *L. purpureum* L. nunca deram resultado positivo, o que levou o segundo autor a afirmar que «*purpureum and amplexicaule cannot produce interspecific hybrids.*» (1).

(1) Mais recentemente, Bernström (1941) conseguiu obter experimentalmente formas tetraploides de *L. amplexicaule* L. e *L. purpureum* L., e efectuou cruzamentos entre elas «in order to ascertain wether the tetraploidy of the

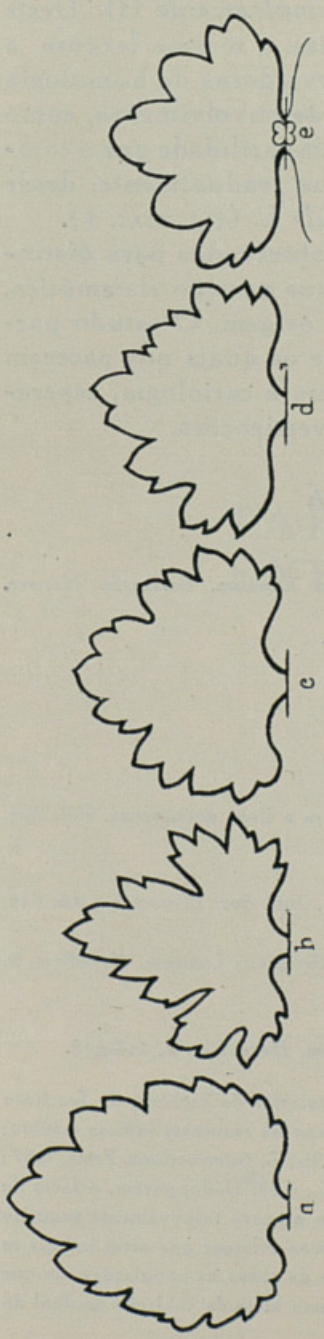

Fig. text. 1. — *Lamium* L. Contorno do limbo de folhas adultas da inflorescência, situadas em posições homólogas. *a) L. purpureum* L.; *b) L. hybridum* Vill.; *c) L. intermedium* Fries; *d) L. Coutinhoi* Garcia; *e) L. amplexicaule* L. Os desenhos foram reduzidos à mesma largura, de modo a poder notar-se fàcilmente a diminuição gradual do comprimento relativo.

No que respeita à posição sistemática, *L. Coutinhoi* faz parte do grupo de espécies anuais, a que pertencem *L. purpureum* L., *L. hybridum* Vill., *L. intermedium* Fries e *L. amplexicaule* L., e, atendendo aos seus caracteres morfológicos, fica compreendido entre as duas últimas espécies.

Entre os caracteres que mais se evidenciam na comparação destas cinco espécies, destacam-se os que se referem à morfologia das folhas. Estabelecendo, na série *purpureum, hybridum, intermedium, Coutinhoi, amplexicaule*, a relação entre o comprimento e a largura do limbo das folhas adultas inferiores da parte terminal da inflorescência (situadas, portanto, em posições homólogas e em estado análogo de desenvolvimento), verifica-se que, normalmente, essa relação, a que podemos chamar *índice foliar*,

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members of the cross possibly removes the barrier of incompatibility that has been shown to exist between them in the diploid state.». Não temos, porém, conhecimento da publicação dos resultados destes cruzamentos.

decresce no sentido *purpureum* → *amplexicaule* (1). Deste modo, atribuindo, nas cinco espécies, a mesma largura a folhas adultas da inflorescência, possuidoras de homologia de posição e em estado análogo de desenvolvimento, como acima dissemos, pode observar-se com facilidade que o comprimento relativo do limbo diminue gradualmente, desde *L. purpureum* L. até *L. amplexicaule* L. (fig. text. 1).

Outros caracteres poderão ser observados para distinguir a espécie em estudo, marcar a sua posição sistemática, e, possìvelmente, determinar a sua origem. O estudo pormenorizado desses caracteres, entre os quais nos parecem de grande importância os referentes à cariologia, esperamos poder realizá-lo em futuras investigações.

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(1) Nas determinações efectuadas em material de herbário do Instituto Botânico da Universidade de Coimbra, obtivemos os seguintes índices médios: *L. purpureum* L., 1,05; *L. hybridum* Vill., 0,96; *L. intermedium* Fries, 0,87; *L. Coutinhoi* Garcia, 0,74; *L. amplexicaule* L., 0,63. Dado, porém, o facto de estas determinações terem sido efectuadas sobre o número relativamente pequeno de exemplares de que dispúnhamos, não podemos afirmar que estes índices se aproximem muito dos que resultariam do estudo de todas as populações, no que respeita a este carácter. No entanto, dão-nos uma ideia da variação gradual do mesmo carácter, de uma espécie para outra.

TABULARUM EXPLICATIO

TABULA I

Lamium Coutinhoi Garcia in Herbario Instituti Botanici Universitatis Conimbrigensis.

L. amplexicaule × *purpureum* Cout., non G. Mey.

Typus.

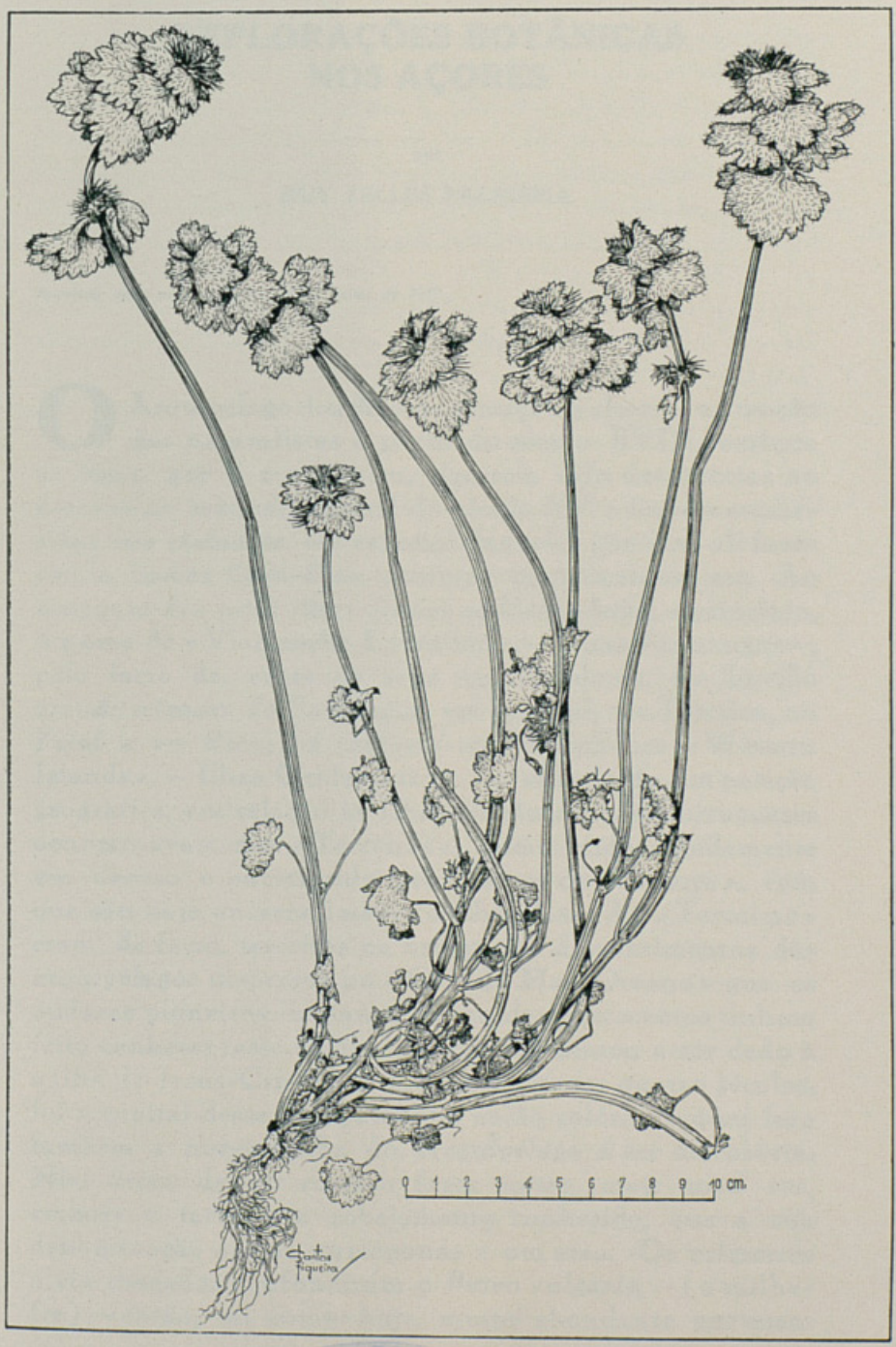
TABULA I

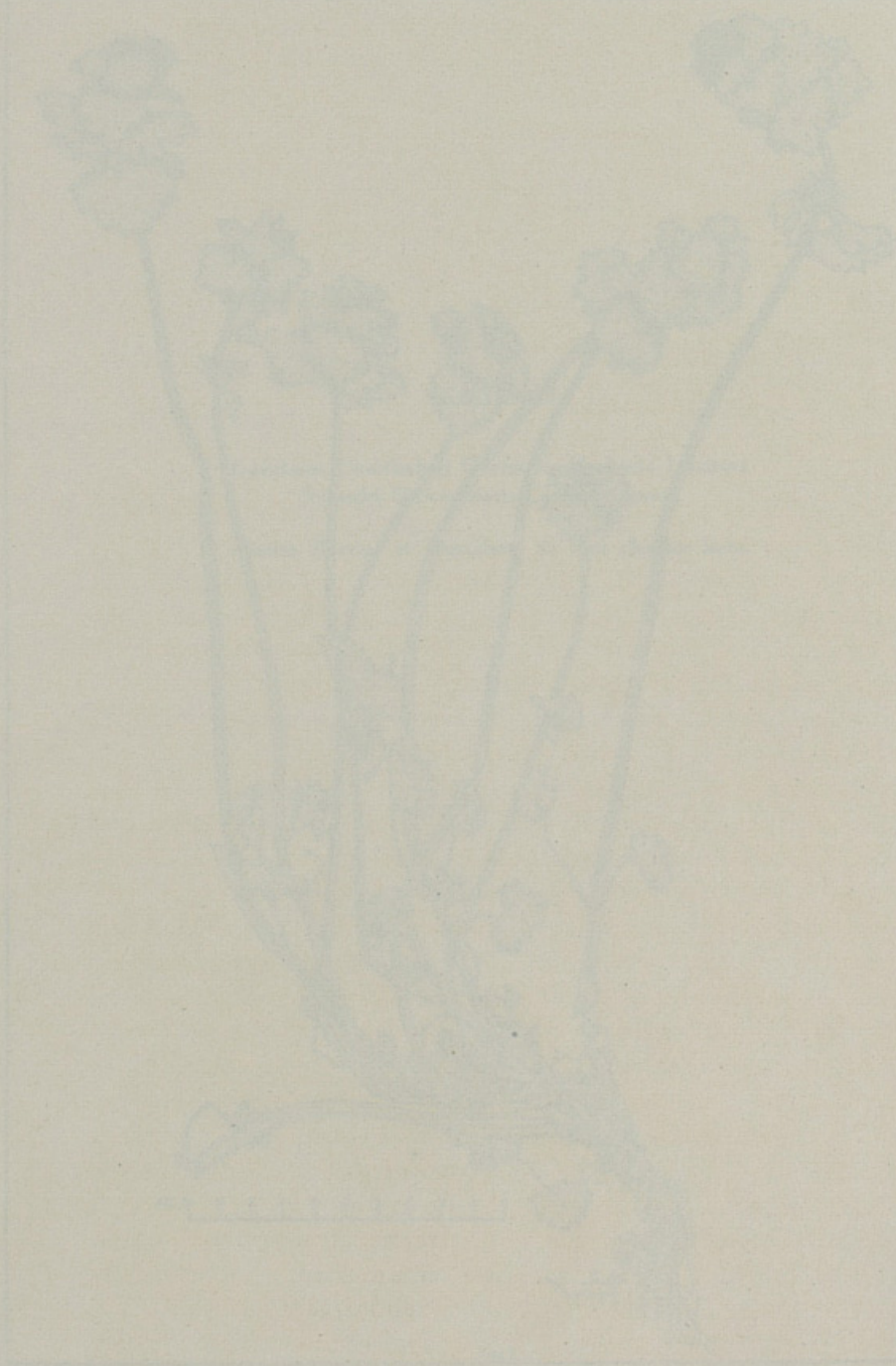
TABULA II

Lamium Coutinhoi Garcia in Herbario Instituti Botanici Universitatis Conimbrigensis.

Planta florens et fructifera, in loco classico lecta.

TABULA II





EXPLORAÇÕES BOTÂNICAS NOS AÇORES

por

RUY TELLES PALHINHA

Recebido para publicação em 10 de Julho de 1947

O Arquipélago dos Açores começou a chamar a atenção dos naturalistas a partir do século XVIII, embora as ilhas, que o constituem, tivessem sido descobertas no decurso do segundo quartel do século XV e fossem conhecidas dos viajantes, em especial daqueles que iam ali fazer escala, buscar água-doce, procurar mantimentos, etc. Ao conjunto das nove ilhas deram os Holandeses, a princípio, o nome de « Vlaamsche Eylanden », — Ilhas Flamengas—, pelo facto de, entre os seus colonizadores, ter havido grande número de flamengos, em especial, na Terceira, no Faial e no Pico; os ingleses apelidavam-nas « Western Islands », — Ilhas Ocidentais —, em virtude da sua posição geográfica, em relação às Ilhas Britânicas; os Portugueses denominavam-nas « Terceiras », nome caído ràpidamente em desuso e substituido pelo nome de « Açores », com que são hoje universalmente conhecidas. As « Terceiras » eram, de facto, terceiras na ordem dos descobrimentos dos arquipélagos dispersos no « Grande Mar Oceano » que os audazes pioneiros lusitanos da era de quatrocentos tinham feito conhecer; esse ordinal apenas continuou a ser dado à « Ilha de Jesus-Cristo » que, durante quase quatro séculos, foi a capital desse agrupamento, então colónia, a qual fora também a terceira ilha do Arquipélago a ser descoberta. Não deixa de ser curioso fazer notar, mais uma vez, embora o facto seja sobejamente conhecido, que a sua denominação actual corresponde a um erro. Os primeiros a ela chegados confundiram o *Buteo vulgaris*, — (o milhafre) — então, tal como hoje, muito abundante por essas

paragens, com o *Astur nisus* — (o açor) —, ave que ali não existia. Essas ilhas, ricas de produtos naturais, passagem quase obrigatória das naus que se dirigiam para a Europa, ou dela partiam, foram procuradas, durante larguíssimo período, por piratas e corsários de diferentes nacionalidades e pelas armadas que degladiavam a sua posse política. Mas observadores e amadores de ciências naturais, como hoje se diz, só aparecem em períodos de paz e de sossego, quando o espírito encontra calma e está livre de inquietações pelo presente e de cuidados pelo futuro.

Adanson é o primeiro naturalista que visitou o Faial, ou, pelo menos, é o primeiro de que tenho menção. O navio, que o transportou ao Senegal, fez escala pela Baía da Horta; nela se demorou de fins de Outubro a princípios de Novembro de 1753; aproveitou o sábio viajante essa estadia para tomar nota sobre as produções naturais e o aspecto daquela ilha, apontamentos, que utilizou, mais tarde, ao escrever na «Histoire Naturelle du Sénégal, (Paris, 1757), algumas páginas referentes a esse incidente da sua viagem.

Francis Masson, enviado à África Austral pelo Jardim Botânico de Kew com o fim de aumentar as colecções, já então notáveis, desse portentoso estabelecimento, fez, no seu regresso, escala pelas Canárias, Madeira e Açores, e dessas ilhas levou para a Inglaterra espécimes de plantas, sementes e elementos documentais. Em «Philosophical Transactions, LXVIII (London, 1778)», podemos ler o relato de algumas observações, feitas por esse grande colector em «An Account of the Island of S. Miguel». As plantas, novas para a Ciência botânica, provenientes dos lugares por ele visitados, foram descritas no «Hortus Kewensis (London, 1789)», publicado por William Aiton, então director daquele Jardim.

Tais são, entre outras: *Hypericum foliosum* Dryander, *Ilex Perado* Aiton, *Erythraea Massonii* Sweet, *Myrica Faya* Dryander.

George Forster, professor de Botânica que percorreu grande parte do Globo e foi companheiro de Cook, visitou

entre outras, grande número de ilhas atlânticas, dando em «Fasciculus Plantarum Magellanicarum et Plantae Atlanticae ex Insulis Madeira, S. Jacobi, Adscencionis, S.tae Helenae et Fayal, (Goettingae. 1787)», bem como no «Herbarium australe», publicado na mesma cidade dez anos mais tarde, referências à vegetação desta última, nas «Commentationes Societatis Regiae Scientiarum Gottingensis, vol. IX».

Passa o Mundo por período de grande agitação; as transformações sociais do final do século XVIII são advento de enormes convulsões políticas, de guerras duradoiras, largamente espalhadas, e decorrem muitos anos, cerca de meio século, antes de encontrarmos novas explorações botânicas do Arquipélago açoriano.

A Guthnick de Berna, Director do Jardim Botânico dessa cidade, se deve a primeira exploração científica do Arquipélago, pois que os três naturalistas anteriormente citados tinham acidentalmente passado por algumas ilhas e não as haviam visitado intencionalmente.

Em 8 de Março de 1838 saíu de Berna notável grupo de naturalistas, formado por Guthnick, Christian Friederich Hochstetter, professor de botânica em Esslingen, o qual era acompanhado por seu filho Carlos, e Rudolph Gygax, mineralogista suiço. Dirigiram-se a Londres para procurar navio que os conduzisse a Lisboa, onde chegados, receberam do Governo Português cartas para as autoridades insulares, partindo seguidamente com rumo a S. Miguel, em 18 de Abril. Demoraram-se nessa ilha e na Terceira até 7 de Junho, percorrendo-as, colhendo materiais, no que foram auxiliados por açorianos, como o Barão das Laranjeiras, micaelense ilustre, e por estrangeiros que ali viviam, em especial aqueles que exerciam funções consulares; entre outros os irmãos Hintze, hamburgueses; William Read, consul geral britânico; Scholz, consul borússico. A 8 de Junho desembarcaram na Horta e aí tiveram na pessoa de Charles William Dabney, o segundo dos cônsules gerais dos Estados Unidos da América, nos Açores, proprietário da mais importante casa comercial faialense dessa época, um auxiliar de extraordi-

nário valor. Foi esse prestantíssimo varão que tornou possível a esses naturalistas a ida à Ilha das Flores e do Corvo, então exploradas pela primeira vez botânica e mineralògicamente, transportando-os para esses pontos no seu iate « Esperança ».

Nos primeiros dias de Julho, GUTHNICK, ou por se achar realmente doente, ou sob este pretexto, regressou à Europa, ficando os outros naturalistas na Horta, donde foram à fronteiriça Ilha do Pico, que visitaram, tendo subido ao cimo da montanha nos dias 17 e 18 desse mês. Havendo-se-lhes oferecido possibilidade de transporte para a Madeira, no princípio de Agosto, aproveitaram essa oportunidade para não ficarem retidos até o fim do ano, época em que. só novamente, obteriam passagem para a Europa nalgum barco entre os que aos Açores iam buscar laranjas, grande fonte do comércio exportador insular nesse tempo.

O primeiro trabalho resultante dessa exploração foi publicado no «Wiegmanns Archiv für Naturgeschicht, (IX, 1843)», por GUTHNICK e HOCHSTETTER e tem o título: « Uebersicht der Flora der Azorischen Inseln ». Este artigo no qual estão citadas 308 espécies, colhidas no Arquipélago açoriano e que é ilustrado por uma estampa, começa por considerações gerais sobre a vegetação e o clima açóricos, mas não tem a importância do segundo trabalho também resultado dessas colheitas, a « Flora Azorica » do Dr. MORITZ SEUBERT publicada em Bona, em 1844. Esta obra que, na realidade, se pode considerar o primeiro trabalho acerca da flora açoriana tem, ainda hoje, passado mais de um século sobre a sua publicação, valor fundamental, clássico, e deve ser compulsada por todos os que pretendam travar conhecimento com a flora do arquipélago ou visitar essas ilhas com o intuito de estudar a sua vegetação. Embora CHRISTIAN HOCHSTETTER só tivesse falecido em 1860, com setenta e três anos de idade, nenhuma intervenção teve na sua publicação; foi o Dr. MORITZ SEUBERT, quem, ùnicamente baseado nas colecções e cédulas que daquela exploração tinham trazido os dois botânicos, escreveu as II-50 páginas que o formam, e quem desenhou

e mandou gravar as XV estampas que enormemente aumentam o seu valor, tendo apenas num pequeno número de casos, consultado especialistas: MARTIUS em Algas, BISCHOFF em Líquenes, SCHIMPER em Musgos. Nela estão mencionadas 391 plantas, muitas citações são acompanhadas da descrição de espécies ou de variedades novas, ou como tal pelo próprio SEUBERT consideradas, vinte e quatro das quais desenhadas com extraordinária perícia e grande cuidado. Contudo pode e deve dizer-se que tem imperfeições, para as quais é necessário pôr o estudioso de sobreaviso. Os HOCHSTETTER não tinham visitado S.ta Maria, nem Graciosa, nem S. Jorge, e apesar disso SEUBERT emprega, repetidas vezes o termo *Omnium insularum*, termo pouco explícito, o qual pode ser compreendido em sentido lato, existente em todo o arquipélago, ou em sentido restrito apenas encontrada nas seis ilhas que os HOCHSTETTER visitaram. Há falta de clareza e de propriedade quando escreve expressões como «in insulis azoricis», «hinc inde». Há citações de espécies que nunca mais foram encontradas, cuja colocação, entre as plantas açóricas, pode ser devida a erros de interpretação, como deve ter sucedido com a *Scilla maritima* L. (*Urginea maritima* Bak.), citada por SEUBERT, planta que não existe e provàvelmente nunca existiu nos Açores, inclusão esta que WATSON explica por ter a parte vegetativa da *Amaryllis Belladonna* L. sido confundida com a daquela liliácea. O facto da «Flora Azorica» ter sido escrita exclusivamente sobre material seco, colhido por outras pessoas, com indicações dadas por essas mesmas personalidades e, ainda por cima, por um indivíduo que jámais fora aos Açores e, por consequência, não conhecia nem podia conhecer aquelas ilhas, é razão suficiente para se desculparem essas pequenas incorrecções, as quais não diminuem o valor do trabalho, que, sem dúvida, prestou grandes serviços sob o ponto de vista do conhecimento da cobertura vegetal do Arquipélago e que, ainda agora, é indispensável àqueles que se dediquem ao estudo da flora açoriana. Dessa mesma viagem resultou para a ciência botânica o conhecimento de plantas novas que a seguir se enumeram: *Bryopsis penicillata* Suhr.;

Festuca petraea Guthn.; *Carex azorica* Gay; *Carex Hochstetteriana* Gay; *Carex vulcani* Hochst.; *Luzula purpureo-splendens* Seub.; *Habenaria longebracteata* Hochst.; *Habenaria micrantha* Hochst.; *Juniperus brevifolia* (Hochst.) Antoine; *Euphorbia azorica* Hochst.; *Persea azorica* Seub.; *Bellis azorica* Hochst.; *Tolpis nobilis* Hochst.; *Tolpis Filii* (Hochst.) B. et Hook.; *Myosotis maritima* Hochst.; *Veronica Dabneyi* Hochst.; *Euphrasia grandiflora* Hochst.; *Erica azorica* Hochst.; *Sanicula azorica* Guthn.; *Cardamine caldeirarum* Guthn.; *Cerastium azoricum* Hochst.; *Rubus Hochstetterorum* Seub.

Quatro anos depois Hewett Cottrell Watson realizou, por sugestão do grande botânico inglês e sábio director dos Jardins Reais de Kew, Sir William Hooker, uma exploração botânica às Ilhas dos Açores. Foi-lhe dado um camarote a bordo do «Styx», navio a vapor do Almirantado Britânico comandado pelo Capitão Alexander Vidal, encarregado de proceder a um levantamento hidrográfico, com o fim principal de escolher, a pedido da West Indian Company, local onde construir uma doca. O naturalista demorou-se nos Açores de Maio a Setembro de 1842, não conseguindo, porém, desempenhar-se, a seu contento, do trabalho que imaginara realizar. Numerosas foram as circunstâncias impeditivas, tendo durante esse período visitado apenas quatro Ilhas: Faial, Pico, Flores e Corvo, não podendo ir a nenhuma das outras, nem mesmo às duas maiores, S. Miguel e Terceira. A disciplina de bordo, mantida rigorosamente pelo Capitão Vidal, até mesmo sobre o cientista, que, por certo, não fazia parte da tripulação, coagia este a vir dormir todas as noites ao «Styx», e a compartilhar da ignorância extensiva à oficialidade, sobre o que fariam no dia imediato. Dlficuldades nas ligações entre o navio e a terra, entre esta e aquele, por vezes muito afastado da Baía da Horta, ocasionavam grandes perdas de tempo. Para seu mal, dispunha de pouquíssimo espaço para a secagem dos exemplares colhidos, a qual tinha de ser feita na exiguidade do seu camarote, — cinco pés por seis, diz Watson —, donde resultou limitação forçada no número de exemplares de cada espécie

a secar e a guardar, reduzido a três, salvo se se tratava de planta com especial interesse. De tudo isso proveio: colecção menor do que seria de esperar, número relativamente pequeno de espécimes a distribuir; alguns erros de classificação.

Os resultados do estudo desse material apareceram no «London Journal of Botany» editado por WILLIAN HOOKER: no vol. II (1843) «Notes of a Botanical Tour in the Western Azores» (destas notas fez HALLE um extracto, em alemão, que publicou no seu «Botanische Zeitung»); no vol. III (1844), «Notes on the Botany of the Azores», e no vol. IV (1847), «Supplementary Notes on the Botany of the Azores», trabalhos onde o número de espécies se elevou a 470. Neste último artigo aparecem indicações relativas a plantas de S. Miguel e S.ta Maria, devidas ao cônsul britânico, THOMAS CAREW HUNT, autor da «Description of the Islands of Santa Maria and San Miguel» publicada em Londres (1845), no «Journal of the Royal Geographic Society». HUNT, de 1844 a 1848, enviou a WATSON exemplares colhidos naquelas ilhas, as mais orientais do Arquipélago, estudando-se assim, coasequentemente, uma área muito maior, e considerável número de espécies novas. É de lastimar que a transferência deste botânico amador para Estocolmo tivesse cortado brusca e definitivamente a continuação de remessas de material. A WATSON e a HUNT, — este último também colhia e enviava sementes —, deve-se ainda a cultura de diversas plantas açóricas no jardim que aquele possuia no Condado de Surrey e a dispersão das mais interessantes por diversos jardins botânicos, quer de sementes, por eles colhidas directamente, quer provenientes de plantas já cultivadas em Inglaterra. Terei, ainda, de voltar a referir-me a WATSON, mas antes disso torna-se necessário assinalar outra exploração e outro grupo de exploradores.

Em 25 de Abril de 1857 desembarcaram em S. Miguel dois zoólogos franceses de Dijon, HENRI DROUET e ARTHUR MORELET, aos quais se reuniu outro viajante, que casualmente ali se encontrava, o geólogo alemão GEORG HARTUNG; cada um desses cientistas ia visitar o Arquipélago dos

Açores com o fim de estudar assuntos das suas especialidades, e incidentalmente, se dedicaram também, à preparação de exemplares botânicos.

HARTUNG publicou em 1860, em Leipzig, «Die Azoren in ihren ausseren Erscheinung und nach ihren geognostichen Naturgeschildert», obra que nunca ví e que não sei, portanto, se faz quaisquer referências a vegetais açorianos. MORELET fez sair em Paris, no mesmo ano de 1860, «Notice sur l'Histoire Naturelle des Açores», trabalho que igualmente apenas conheço de citação. DROUET apresentou, em Troyes (1858 e 1859), o relatório àcerca da sua viagem, e dois trabalhos sobre Moluscos marinhos, e sobre Coleópteros, e, em Paris, (1871) «Éléments da la Faune Açoréenne». Só cinco anos mais tarde, também em Paris, foi impresso o «Catalogue de la Flore des îles Açores», precedido do itinerário da sua viagem, catálogo no qual se mencionam 736 espécies e variedades. Nessa obra o autor nota que as explorações foram realizadas em todas as ilhas, embora os três colectores nem sempre tivessem andado juntos e que, por isso, apresenta espécies que os seus antecessores na exploração botânica dos Açores não tinham encontrado, computando o seu número em cerca de cento e cinquenta. Chama a atenção para o carácter essencialmente europeu da flora açórica e para a instabilidade de muitas das espécies que a constituem, e lastima a impossibilidade de realizar o trabalho, extremamente interessante, da comparação dessa flora com a de Portugal, assim como com a dos dois arquipélagos atlânticos mais próximos, — Madeira e Canárias — e com a de Marrocos, e dá grande cópia de indicações gerais sobre as ilhas por onde passou, em regra com cuidada observação. É, porém, necessário fazer referência a algumas imperfeições, que nessa obra se encontram. Organizada por um zoólogo, que de mais a mais era especialista em determinados grupos de animais, aconteceu, por mais de uma vez, duplicar e até triplicar no «Catálogo» a mesma planta, em virtude de não estar suficientemente familiarizado com a sinonimia, e aparecem duas espécies não só do mesmo género, como até de géneros diferentes, quando,

na realidade, era apenas uma única de que se tratava. O facto era tanto mais fácil de se dar, quanto DROUET se referia não sòmente a plantas colhidas por ele ou por um dos seus dois companheiros, como também às espécies já citadas anteriormente para essas ilhas por SEUBERT e por WATSON. Assim, vêem-se citadas como espécies distintas — *Papaver somniferum* L. e *Papaver setigerum* DC.—, esta última variedade da primeira; ou — *Hypericum foliosum* Ait. e *Androsaemum Webbianum* Spach — que são dois sinónimos. Daqui provém que o número de espécies indicado no Catálogo, 736, está exagerado. A expressão que se encontra largamente espalhada pelo livro «tout l'archipel» é da mesma natureza e deve ter reparos análogos aos da já citada expressão de SEUBERT «Omnium insularum». Nos nomes vulgares apresentados há, outrossim, a notar que grande foi o número tirado de BROTERO e, não ouvidos nos Açores, de modo que sucede encontrarmos expressões que nunca foram empregadas naquelas ilhas, como *Arisaro*, entre outras. Esses defeitos, contudo, não fazem perder interesse à obra de DROUET.

Em 1865 aparece nos Açores novo naturalista inglês, FREDERICK DU CANE GODMAN, da Sociedade Lineana e da Sociedade Zoológica. Tendo já passsado p r ali em 1861, quando ia de Southampton para as Índias Ocidentais, ficara com o desejo de os visitar mas, conforme suas palavras, ao regressar a Ing'aterra quase que os olvidara, tão cheia tinha a alma com as maravilhas do clima tropical, onde estivera, e foi só na Primavera de 1865 que se resolveu a realizar esse projecto.

Tinha para ele particular interesse o estudo da fauna e da flora do Arquipélago açoriano por se tratar de um grupo de ilhas situado longe das costas, muito afastado tanto da Europa, como da América, separado dos dois continentes por grandes profundidades oceânicas e esperava encontrar nesses estudos argumentos acerca da origem e da distribuição das espécies. GODMAN visitou quase todas as ilhas percorrendo S. Miguel, Faial, Flores, Corvo e Terceira, passando pela Graciosa e S. Jorge, não tendo podido ir ao Pico, como desejava, nem a S.ta Maria, aonde

enviou o seu colector, BREWER. As colecções assim obtidas foram estudadas por especialistas, sendo as plantas vasculares examinadas por WATSON e os Musgos e Hepáticas por W. MITTEN. Utilizando seguidamente todos esses elementos, GODMAN publicou «Natural History of the Azores or Western Islands (London, 1870)», que é, também, uma das obras clássicas sobre a História Natural açórica. WATSON estava claramente indicado para a parte botânica relativa às plantas vasculares pois, como já se disse, realizara explorações em diversas ilhas, e tinha continuado a interessar-se por esse assunto; W. MITTEN dedicara-se aos Briófitos e publicara na «Linnean Society» diversos trabalhos. Quarenta páginas de livro de GODMAN são escritas por esse briólogo e duzentas e sessenta e seis, — quatro quintas partes de toda a obra — devem-se a WATSON. Ás plantas colhidas por este e por HUNT, que tinham sido base dos trabalhos publicados no «London Journal of Botany», vieram reunir-se as que haviam sido colhidas por GODMAN, outras enviadas pelo BARÃO DE CASTELO DE PAIVA aos Herbários de Kew, algumas remetidas pelo Dr. MAC KAY, médico nas Flores e ali Vice-cônsul inglês. Trabalho realizado por pessoa largamente experimentada na observação quer de plantas vivas, quer de plantas secas, dispondo de um número extraordinário de espécimes e das obras publicadas sobre a flora açoriana, esse estudo constitui um dos melhores livros de consulta que se pode utilizar. São poucos os nomes botânicos que não estão de acordo com as regras de nomenclatura; tem, cada um, a indicação geográfica da espécie fora dos Açores, se bem que, por vezes, a informação não seja bem clara; aponta, igualmente, em que ilhas tinha sido encontrada e onde está essa espécie mencionada ou quem colheu exemplares, e termina por observações críticas, sendo muito pouco numerosas as citações que as não têm. São 478 espécies de plantas vasculares as apontadas por WATSON nessa obra, número bastante inferior às 599 citações de DROUET; apenas 38, dentre aquela cifra, tinham deixado de ser vistas por ele. A parte do livro de GOEMAN, que se refere aos Musgos e às Hepáticas e que foi descrita por

MITTEN, trata não só dos Briófitos açorianos como dos dos outros dois arquipélagos atlânticos subtropicais — Madeira e Canárias — ; referindo-me apenas àquelas observo que o número de espécies é maior tanto num como noutro grupo, do que o citado no Catálogo de DROUET. o que resulta do exame dos exemplares colhidos por GODMAN, poucos sendo aqueles que trazem indicação de outros colectores: HUNT, WATSON, HOCHSTETTER.

De Fevereiro a Agosto de 1873 realizaram explorações os naturalistas que iam a bordo do « Challenger », as quais tiveram como resultado a publicação de diversos trabalhos subordinados ao título « Contributions to the Botany of the Expedition of H. M. S. Challenger », que sairam no « Journal of the Linnean Society, Botany, 14 », e que foram subscritos: por W. B. HEMSLEY, a Introdução à parte botânica; W. ARCHER, Algas e outros organismos da Lagoa das Furnas; H. N. MOSELEY, Algas de água-doce das fontes termais das Furnas; M BERKELEY, Fungos; J. STIRTON, Líquenes.

Em 1885, por intermédio do meu mestre FRANCISCO AFONSO DE CHAVES, nesse ano professor de Introdução às Ciências Naturais no Liceu de Ponta Delgada, uma das três pessoas a quem mais devo a minha educação e amor pelas ciências experimentais e de observação, conheci dois indivíduos de nacionalidade alemã: J. ZERVAS e D. ZERVAS, pai e filho, que faziam explorações, colhendo exemplares de História Natural, os primeiros a quem vi secar plantas, observá-las à lupa e etiquetá-las; embora tenha procurado, já depois de professor, encontrar vestígios de aproveitamento desse material, foram infrutíferas todas as minhas tentativas; ou se perdeu ou não foi publicado trabalho algum com indicação dos seus nomes.

Em 1894 C. S. BROWN, americano, visitou o Faial, Pico e S. Miguel, mais demoradamente a primeira destas ilhas, e fez uma colecção de 435 números, que TRELEASE estudou e aproveitou juntamente com as plantas que colheu e com aquelas que constituiam o Herbário do Museu Municipal de Ponta Delgada, rico de plantas, devidas principalmente, a dois médicos que dedicaram parte do tempo que a clínica

lhes deixava disponível ao estudo da Natureza, — Carlos Maria Gomes Machado e Bruno Tavares Carreiro, — e ainda os duplicados do Herbário particular de outro médico, este terceirense, José Augusto de Nogueira Sampaio. William Trelease esteve nos Açores em 1894, durante os três meses de verão, e em 1895 menos tempo, mas na mesma estação, com o intuito de coligir plantas e de estudar a flora açórica, publicando em 1897, no «Eighth Annual Report of the Missouri Botanical Garden» um trabalho de grande valor, absolutamente indispensável para o estudo dessa flora, ao qual deu o nome de «Botanical Observations of the Azores». Não é, como ele próprio diz, uma flora completa das nove ilhas portuguesas do Atlântico Norte, mas é um catálogo cheio de preciosas indicações para os colectores e estudiosos que queiram trabalhar para seu mais completo conhecimento, que pretendam realizar estudos especiais para cada uma dessas ilhas. Nos Espermatófitos e nos Pteridófitos poucas adições tem havido posteriormente; a maioria delas indicam apenas novas localidades, raras vezes plantas que tivessem escapado aos olhos dos observadores e outras recentemente introduzidas. Os Briófitos têm dado maior número de novas citações, mas ainda há nos Talófitos campo enormíssimo para investigações.

K. Bohlin esteve em S. Miguel durante parte do verão de 1898, passou pela Terceira e pelo Faial, e nessas ilhas colheu Algas; dessas colheitas e da consideração das espécies anteriormente enumeradas resultou um trabalho publicado em 1901, nos «Bih. Kgl. Sv. Vetensk. Akad.», intitulado «Étude sur la flore algologique d'eau douce des Açores». As Diatomáceas, porém, foram tratadas à parte por J. Holmboe, o qual, também em 1901, publicou «Süswasser Diatomeen von den Azorischen Inseln, Nyt Magaz. Naturvidensk. Ab. 39».

H. B. Guppy visitou o Arquipélago açoriano por duas vezes: de meados de Fevereiro a Abril de 1913 e de meados de Junho a meados de Agosto de 1914.

Da primeira vez estacionou três semanas em S. Miguel, trepando aos principais montes, consultando o herbário

existente no Museu Municipal de Ponta Delgada, para se familiarizar com a flora insular, e em seguida passou à ilha do Pico, cuja montanha explorou até o cimo, subindo não só pelo lado sudoeste, o habitual, partindo da Madalena, pelas Lombas, como pelos outros lados, mais ásperos, a ponto de ter tido dificuldade em conseguir guias, o que lhe permitiu ser o primeiro explorador botânico que descobriu a existência de *Arceuthobium Oxycedri* M. Bieb, nos Açores. Da segunda vez realizou, na Terceira, uma subida ao Pico de S.ta Bárbara, a montanha mais elevada desta ilha, e voltou no fim de Junho ao Pico, tornando a explorar a montanha, os arredores do Cais-do-Pico e da Prainha do Norte. A eclosão da grande guerra — Agosto de 1914 — obrigou-o a regressar a Inglaterra, impedindo-o de visitar S. Jorge, como tencionava. Dessas observações resultaram dois trabalhos: « Notes on the Native Plants of the Azores as illustrated on the Slopes of the Mountain of the Pico » publicado no « Bulletin of Miscellaneous Information » dos Reais Jardins Botânicos de Kew, 1914, pag. 305-321, e os três últimos capítulos de « Plants, Seeds and Currents in the West Indies and Azores, London, 1917, pag. 359-440 »; nesta obra Guppy desenvolve o primeiro trabalho, com grande interesse para todo aquele que deseje estudar a flora macaronésica quer toda, quer na sua parte açórica ou, mesmo, para quem apenas queira tomar contacto com o Arquipélago sob o ponto de vista florístico. É curioso notar que as zonas de vegetação determinadas por Guppy, no Pico, são muito semelhantes às que Hochstetter pai observou e sobre cujas notas Seubert as descreveu na sua « Flora Azorica ».

C. O. M. Schmidt visitou diversas ilhas açorianas em 1928, com o intuito de estudar a sua vegetação marinha, e nos vol. 68 e 69 de « Hedwigia » publicou em 1929 « Beitrage zur Kenntniss der Meeresalgen der Azoren » e em 1931, na Biblioteca Botanica, 102, « Die marine Vegetation der Azoren in ihren Grundzügen dargestellt ». Colheu, igualmente, algumas Algas de água doce, utilizadas por W. Krieger num artigo publicado nesse ano

em «Hedwigia», 70, que tem por título «Algenassoziationen von den Azoren und aus Kamerun».

Nesse mesmo ano, 1931, no «Bulletin de l'Institut Océanographique», vamos encontrar trabalhos com os resultados das campanhas científicas realizadas por S. A. Albert II, Principe Soberano de Mónaco, cujas explorações deram à ciência conhecimentos novos sobre a História Natural do Arquipélago açoriano. Nesse mesmo ano de 1931 há ainda a citar Eleonora Armitage que no vol. 69 do «Journal of Botany» publicou «Some Bryophytes of the Azores». Embora estivesse apenas poucas horas em Ponta Delgada, poude, auxiliada por dois companheiros de viagem, — Miss Crosse e Mr. Mac Harg —, organizar uma lista de trinta espécies, três das quais novas para os Açores.

L. Chopard publicou em «Terre et Vie» — n.° 1, Fev. 1931, pág. 27 a 39 — um artigo de vulgarização muito interessante e acertado, depois de curta estadia em Agosto e Setembro de 1930, principalmente em S. Miguel. Logo a seguir, em 1931, também no «Journal of Botany», vol. 70, T. G. Tutin e E. F. Warburg publicaram «Notes on the Flora of the Azores», onde estudam as plantas vistas ou colhidas durante a sua estadia no Pico, S. Jorge, Faial, Terceira e S. Miguel, desde os fins de Junho a princípios de Agosto de 1931, nas quais se encontram numerosas citações novas, principalmente referentes ao Pico e S. Jorge.

O Dr. Alphonse Luisier, briólogo dos mais distintos, português de adopção, embora suiço por nascimento, tem feito à Madeira e aos Açores diversas viagens, durante suas férias, e desde 1932 tem publicado em «Brotéria» diversos trabalhos provenientes não sòmente das suas herborizações como de material colhido por amigos seus e por auxiliares.

Em 1934, durante o mês de Agosto, o autor destas linhas percorreu todas as ilhas do Arquipélago, com o fim de estudar a possibilidade de organizar campanha de exploração botânica que trouxesse material para os Herbários do Instituto Botânico da Faculdade de Ciências de Lisboa; nessa viagem extremamente curta, poucos exem-

plares colheu. Mas em Maio e Junho de 1937 acompanhado pelo Auxiliar de Naturalista L. SOBRINHO percorreu as nove ilhas, demorando-se nas dos grupos central e oriental algum tempo, realizando nas Flores um passeio muito rápido, embora proveitoso, e passando apenas pelo Corvo, devido à escassez de tempo. Na Terceira encontrou um briólogo, HERMAN PERSON, que foi seu companheiro de excursões nas Flores, no Faial, no Pico e em S. Jorge. Tendo sabido em Ponta Delgada que se encontravam nas Furnas, em exploração, dois briólogos, PIERRE e VALENTINE ALLORGE, seus amigos e conhecidos de viagens anteriores. telefonou-lhes convidando-os a irem a S.ta Maria; desta forma, os teve por companheiros, companheiros excelentes, magníficos, os quais nesse mesmo ano visitaram outras ilhas, de 27 de Maio a 24 de Agosto.

Quer HERMAN PERSON, quer PIERRE ALLORGE, publicaram no vol. 11 dos «Annales Briologici», saído em 1938, trabalhos referentes aos Açores. No «Boletim da Sociedade Broteriana vol. XIII da 2.ª série» dedicado à memória do ilustre professor CARRISSO, foi impresso outro trabalho de P. ALLORGE e V. ALLORGE referente às Hepáticas epifilas dos Açores e no ano 38.º de «Le Monde des Plantes» existe um artigo dos mesmos autores intitulado «Quelques Nouveautés pour la Flore des Açores» no qual se identificam quatro pteridófitos, duas dicotiledóneas e cinco monocotiledóneas por eles encontradas e ainda não citadas por outros botânicos.

Em 1938 continuou a exploração botânica da Faculde Ciências de Lisboa, tendo o Primeiro Assistente, Dr. GONÇALVES DA CUNHA, acompanhado do mesmo Auxiliar de Naturalista, visitado o Faial, Pico, S. Jorge e S. Miguel, durante os meses de Agosto e Setembro; o material colhido nestas duas visitas está quase estudado.

No verão de 1938, de 12 de Maio a 5 de Agosto o Dr. RICHARD FREY, acompanhado de RAGNAR STORA e CARL CEDERCRANTZ, realizou uma viagem entomológica e botânica às ilhas da Madeira e dos Açores; ponho de parte o que diz respeito à Madeira e o que trata de entomologia e faço apenas referência aos trabalhos de CEDERCRANTZ,

«Beitrag zur Kenntniss der Gefässpflanzen auf den Azoren» e «Beitrag zur Kenntniss des Süsswasseralgen der Azoren», publicados em 1941. Não visitaram Santa Maria; na Graciosa apenas fizeram pequeníssima excursão, três horas, mas estiveram nas outras sete ilhas. Este botânico ao publicar o primeiro daqueles trabalhos não tinha conhecimento do de TUTIN e WARBURG, embora fosse de 1932, como diz no trabalho sobre as algas de água doce; desse facto resultou dar como novas, algumas espécies indicadas anteriormente, para o Arquipélago. Nesse mesmo ano de 1941, PALHINHA, GONÇALVES DA CUNHA e SOBRINHO, tinham dado como novas para a Terceira algumas das plantas por ele assim citadas; simultaneidade de publicação.

A guerra que devastou o mundo de 1939 a 1945, e as dificuldades dela consequentes, interromperam a ida de botânicos quer estrangeiros quer portugueses aos Açores; na Universidade de Lisboa há grande desejo de realizar novas explorações, principalmente nas ilhas de S.ta Maria, das Flores e do Corvo, que têm sido menos visitadas e em todo o Arquipélago no campo das não vasculares. Oxalá se possam tornar realidade esses desejos.

Para terminar, devem ainda citar-se aqueles que, habitando nos Açores, contribuiram para um mais completo conhecimento da flora local, quer dedicando seus ócios à ciência amável, quer colhendo plantas acidentalmente com fim científico. Que me lembrem, neste momento, mas com receio de algum esquecimento, CARLOS MARIA GOMES MACHADO, BRUNO TAVARES CARREIRO, JOSÉ AUGUSTO NOGUEIRA SAMPAIO, EDUARDO DE ABREU, MAC KAY, todos médicos, FRANCISCO AFONSO DE CHAVES, Padre ERNESTO FERREIRA e TEOTÓNIO DA SILVEIRA, este felizmente ainda vivo.

São nomes que os cultores das Ciências Naturais não podem nem devem esquecer.

SUCULENTAS AFRICANAS

VI. A LUZ, FACTOR DETERMINANTE DE POLARIDADE NA PLANTA ADULTA

por

FLÁVIO RESENDE

Instituto Botânico de Lisboa: Depart. de fisiologia e genética

Recebido para publicação em 21 de Julho de 1947.

NO trabalho anterior desta série (RESENDE 1946) comuniquei que plantas de *Bryophyllum Daegremonteanum* (R. Hamet et Perrier) Berg. podem formar raizes adventícias na parte superior do caule (polo apical) e ramos na parte inferior (polo basal) — v. l. c. fig. 3 —.

Esta inversão de potencial das substâncias rizogénicas (1) foi conseguida, não com qualquer tratamento de heteroauxina, ou outra substância química, mas apenas submetendo *as plantas à acção da luz de fraca intensidade luminosa* (l. c., pág. 392).

Pensei, ao observar este efeito da luz, colocar os polos, ramo e raiz, nas suas posições naturais, isto é, inverter fisicamente a planta, colocando na terra a parte apical com raízes e no ar a parte basal com ramos. Devido, porém, ao depauperamento físico, que apresentam estas plantas, causado pela acção duradoira da luz de fraca intensidade, raros são os individuos que sobrevivem a esta operação.

Para inverter os polos, e ao mesmo tempo conservar a vitalidade da planta, lembrei-me de manter as plantas sob a acção da luz de intensidade luminosa normal e de cobrir com um pano, ou papel preto, apenas uma delimitada zona do caule. Pensei, — baseado nos resultados comunicados no trabalho anterior —, que esta região, privada de luz, desenvolvesse raízes com grande intensidade e que, na parte inferior a esta zona, se formassem

(1) Pràticamente auxinas.

talvez ramos, caso passasse, na zona obscurecida, a quantidade suficiente de auxinas para tal.

A prática deste processo mostrou-me que, de facto, na região coberta pelo pano preto, se formam muitas raízes e que, na zona iluminada abaixo daquela zona escurecida, se forma (passados alguns meses) não *ramos*, mas sim apenas *um único (!) ramo* (fig. 1).

Conseguido, assim, na planta normalmente robusta, a inversão dos polos pela inversão de potencial das substâncias rizogénicas (= auxinas), isolei então, com dois cortes (v. setas *a*, *b*,), esta região da planta de polos invertidos, e coloquei, na terra, o polo apical (= polo-raiz v. (fig. 2).

O ramo ficou voltado para baixo, fazendo com a parte inferior do eixo um ângulo agudo (fig. 2). A acção geotrópica faz-se imediatamente sentir, neste ramo, e ele começa a voltar-se (fig. 3 e foto 1).

Neste voltar do ramo, as folhas torcem-se também pelos pecíolos de forma a voltarem para cima, numa rotação de 180°, a página normalmente superior do limbo. As folhas morrem, nesta volta, com frequência. Basta, porém, que *uma folha sobreviva para que o vértice vegetativo continue em desenvolvimento sem interrupção.* Quando isto se realiza, *a planta não pára de viver activamente, apesar da inversão sofrida:* comparando entre si a parte inferior duma planta, que conserva a polaridade normal inicial, e a parte superior da mesma planta, onde se fez uma inversão de polos, verifica-se que o desenvolvimento dos rebentos, numa e noutra, é sensìvelmente o mesmo (fotos 2 e 3).

Se, àquela rotação de 180°, nenhuma folha sobrevive, o vértice vegetativo morre também geralmente e as plantas invertidas ficam, longo tempo, sem produzirem qualquer rebento aério, tendo apenas caule e raízes, e estas com um crescimento muito deminuto.

Este facto indica que o desenvolvimento contínuo do ramo é responsável pela manutenção da vida activa da planta, sem qualquer interrupção, durante a operação da inversão física.

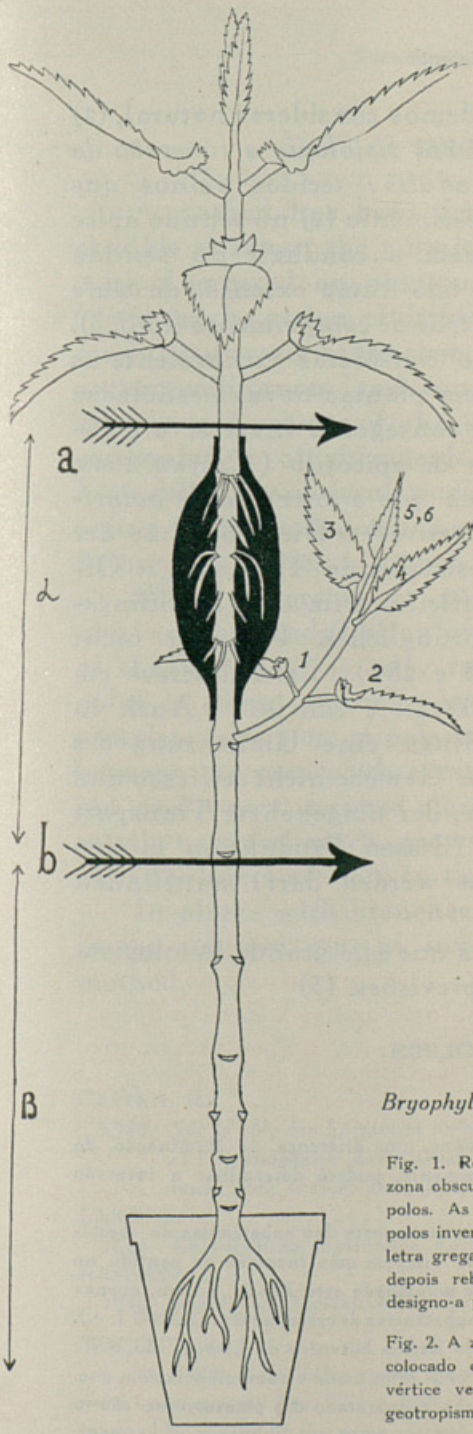


Fig. 1

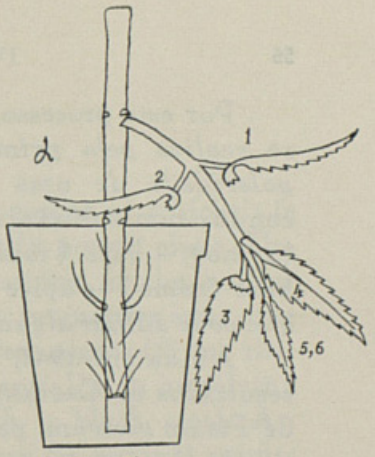


Fig. 2

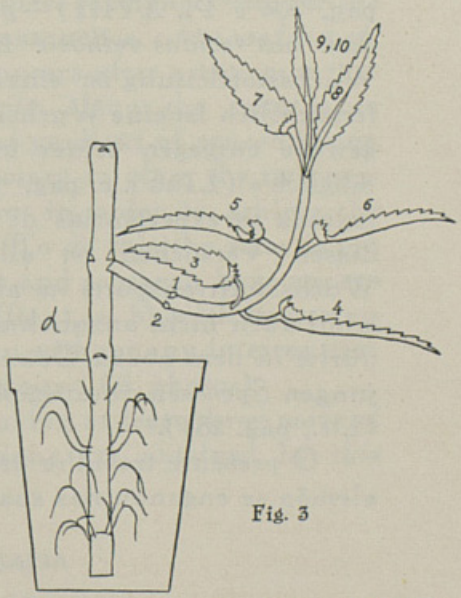


Fig. 3

Bryophyllum Daegremontianum (R. Hamet et Perrier) Berg.

Fig. 1. Representação semi-esquemática duma planta onde uma zona obscurecida do caule bastou para determinar uma inversão de polos. As setas *a* e *b* indicam os pontos do corte da região de polos invertidos. Esta região, ou zona, da planta é designada com a letra grega α. A zona inferior, com o sistema radicular normal, que depois rebenta com dois ramos no nó superior (comp. foto 2) designo-a pela letra β. Estas designações teem apenas por fim a melhor compreensão das fotografias

Fig. 2. A zona α depois de separada da planta-mãe e de se terem colocado os polos na sua posição física normal. Imediatamente o vértice vegetativo do ramo começa a levantar-se, devido a um geotropismo negativo, e assim nos aparece o que representa a Fig 3.

Os algarismos numeram as folhas deste ramo da base para o vértice. *A maior parte destas folhas morrem no voltar do ramo* (comp. fotos 1, 2, 3).

Por este processo, que podemos considerar natural, (1) *se realiza pela primeira vez em fisiologia a inversão da polaridade de uma planta adulta:* tecidos velhos que conduziram substâncias de crescimento (2) no sentido ápice (ramo) → base (raiz) passaram a conduzir no sentido base (*ramo*) → ápice (*raiz*) e isto numa *extensão de caule que pode atingir alguns decimetros de comprimento* (foto. 3).

Ainda em 1944, LANG, ao considerar críticamente os resultados de CASTAN, — que, em plantas novas e estioladas de *Pisum sativum*, parecia ter conseguido inverter a polaridade de alguns centímetros de epicótilo (CASTAN 1940, pag. 304 e Pl. XVIII) — *pensa que a inversão de polaridade nos tecidos velhos é impossível:* «Die Polarität der Wuchsstoffleitung ist eine feststehende Tatsache ... Offensichtlich ist eine Wuchsstoffleitung im alten Stecklingsgewebe entgegen seiner ursprünglichen Polarität nicht möglich» (LANG l. c. pag. 283 e 284). LANG descreve em seguida as experiências de CASTAN e conclui: «Auch in diesen Versuchen ist allerdings eine Umkehrung des Wuchsstofftransports im alten Gewebe nicht erwiesen und wohl auch nicht anzunehmen; der umgekehrte Transport dürfte in dem neuen Gewebe (dessen Produktion in den jungen Sprossen vorausgesetzt werden darf) statttfinden (l. c., pág. 284).

O presente trabalho prova que este grande fisiologista alemão se enganou nas suas previsões. (3)

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(1) Sem qualquer intervenção humana, uma diferença de iluminação do caule destas plantas, produzida espontaneamente, poderá determinar a inversão de polos.

(2) Além da inversão de sentido no transporte das substâncias de crescimento (= substâncias rizógenicas), dá-se também uma inversão de sentido no transporte das seivas. Com a inversão de polaridade está ligado, porém, apenas o conceito da inversão de transporte das substâncias de crescimento (LANG l. c.).

(3) Para o sr. GOMES AMARAL, do jardim botanico de Lisboa, vão, neste lugar, os meus melhores agradecimentos, pelo zelo, amor e competência com que, tanto antes como depois da minha jubilação, tem tratado das plantas, que são o material deste trabalho.

SUMMARY

A method has been devised by means of which it is possible to invert the polarity of a fully grown plant. The method is based on previous observations of the author (1946) on the action of different light intensities upon the conductive power of the stem of succulent plants (1) for rhizogenic substances, and consists essentially in involving any desired region of the stem with a black cloth. An accumulation of rhizogenic substances (= auxins) results from difficulty of circulation of these substances through the region in darkness and, as a consequence, roots are formed. Below this region a branch appears after a few months.

When inversion of polarity along the stem is so obtained, by modification of the gradient of concentration of the auxins, it is only necessary to place the two new poles in their natural position in order to achieve the complete inversion of polarity. To do this the stem is cut between the points where roots and a branch have appeared, and a new inverted plant (fig. 1, a, b), with its geotropically negativ branch, grows up without any interruption, after the roots are laid in the ground (cf. photos).

In plants with branches having at least three pairs of leaves 100 per cent of inversions are abtained by this method.

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(1) Now I have also stated the same behaviour in other plants, e. g. *Solanum Lycopersicum* Lin. The polarity of adult plants of this species can also be inverted by means of the same method. (Note added to proofs).

ESTAMPAS

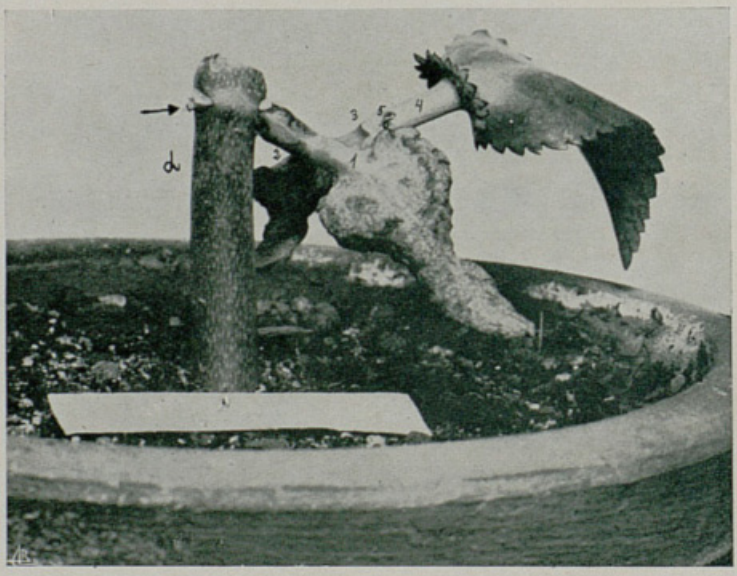


Foto. 1

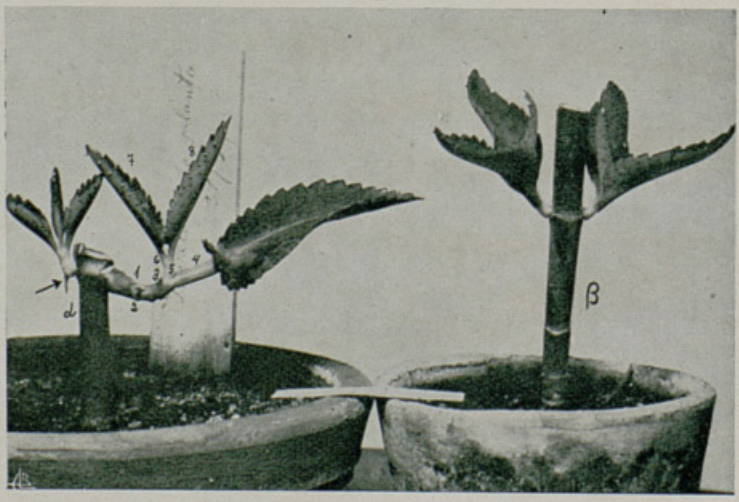


Foto. 2

Bryophyllum Daegremonteanum (R. Hamet et Perrier) Berg.

Foto. 1. Zona cortada e colocada na terra no dia 31-5-1947. Esta fotografia foi feita no dia 11-6-1947: nesta data (12 dias depois) já as duas folhinhas (5, 6) do vértice vegetativo estavam voltadas para cima e também a folha 4. A folha 3 morreu durante a rotação em volta do pecíolo. As folhas 1 e 2 morreram (comp. foto 2) antes de rodarem. A seta indica o início dum novo ramo.

Foto. 2. Fotografia em conjunto das zonas α e β (comp. desenhos) tirada no dia 5-7-47. O ramo voltado mostra-se já sem as folhas 1, 2, 3, 5 e 6. Enquanto a folha 4 continua a viver perfeitamente, depois da

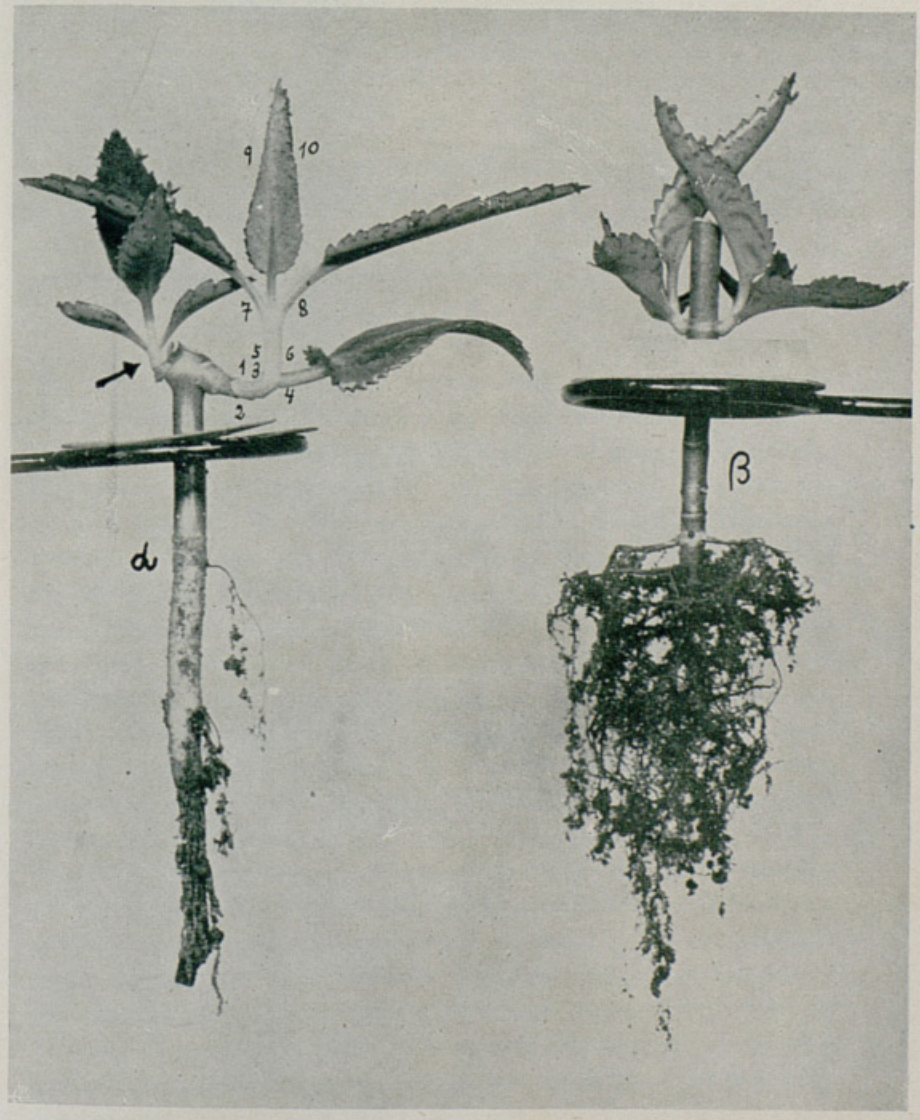


Foto. 3

rotação, as folhinhas 5 e 6 secam sem se desenvolverem ; são substituidas, porém, pelas folhas 7 e 8, *sem que o vértice vegetativo interrompa o seu desenvolvimento.*

O ramo, que a foto 1 mostra em início, já se encontra, nesta data, em pleno desenvolvimento com 4 folhas já desenvolvidas. Este ramo, ao contrário do ramo da direita, forma constantemente raizes na base, cortadas umas, veem outras.

Foto. 3. Fotografia das duas plantas α e β, tirada no dia 21-7-47. *O desenvolvimento tanto da planta invertida como da planta direita é pràticamente o mesmo.*

A foto 1 mostra a planta em tamanho natural. As outras estão reduzidas. A régua colocada entre os vasos, em foto 2, e colocada por cima do suporte de β, em foto 3, mede 5 cm..

UMA NOVA ESPÉCIE DE *NARCISSUS* L.

por

J. GOMES PEDRO

Estação Agronómica Nacional

Recebido para publicação em 1 de Setembro de 1947.

EM uma primeira e curta visita que, na segunda quinzena de Fevereiro de 1943, tivemos ocasião de fazer a algumas turfeiras da charneca de Samora Correia, Ribatejo, em reconhecimento da sua vegetação, ao deixarmos o núcleo do Monte da Adema, encontramos uma pequena colónia de *Narcissus* sp. (Sect. *Jonquillæ* DC. ap. Red.), da qual colhemos alguns indivíduos.

O material em questão afigurou-se-nos de especial interesse, dadas as suas características morfológicas e também as particulares condições ecológicas do seu habitat. Assim, observámos que a colónia se desenvolvera em solo arenoso, um tanto compactado e encharcado, dentro de uma formação graminoide rasteira, num local que nos pareceu susceptível de ser atingido pelas cheias do Tejo, e, dada a sua difícil drenagem, de permanecer encharcado até meados da primavera. Esta especial situação do habitat levou-nos a pensar que a colónia proviesse de algum bolbo carreado pelas águas do Tejo, depois de arrancado a montante, e ali depositado, permanecendo como vaza, no início do refluxo da cheia. Não possuimos, contudo, elementos suficientes para provar cabalmente este fenómeno hidrocórico.

Depois de havermos procurado determinar os exemplares, verificámos que nem a bibliografia nem os espécimes que pudemos observar em alguns herbários nos davam elementos satisfatórios para incluir as nossas plantas dentro de qualquer das espécies conhecidas. Sendo assim, passamos a admitir como provável que se tratasse de uma

espécie de *Narcissus*, ainda desconhecida, a filiar na secção *Jonquillæ* DC. ap. Red.

Considerada esta hipótese, renovamos a colheita de material, e alguns bolbos foram então enviados pela Estação Agronómica Nacional ao Prof. A. FERNANDES, a fim de a nossa planta ser estudada cariològicamente.

Mais tarde, deslocamo-nos a Coimbra, para consultar o Herbário de WILLKOMM, e, graças à aquiescência daquele ilustre professor, director do Instituto Botânico Dr. Júlio Henriques, tivemos a oportunidade de verificar que o nosso *Narcissus*, se bem que afim de um exemplar de *Narcissus gaditanus* existente no referido herbário, não lhe correspondia inteiramente.

Desde então, consideramos esta forma como uma nova espécie, que dedicamos ao Prof. Dr. ABÍLIO FERNANDES, a quem se devem valiosos e numerosos trabalhos sobre a cario-sistemática de *Narcissus*:

Narcissus *(Sect. Jonquillæ DC. ap. Red.)* **Fernandesii** nob.

Bulbus ovatus, 12-15 mm longus, 10-12 mm latus, squamis fuscis vestitus; *folia* 2-3, erecto-recurvata, scapo longiora, anguste linearia (1-1,5 mm lata), semicylindrica, supra leviter canaliculata, dorso leviter striata, nervis obsoletis; *scapus* tenuis (versus basin ca. 1,5 mm), cylindricus, erectus, ca. 10 cm altus, inferne plenus, superne fistulosus; *spatha* scariosa, biflora, 3-4 cm longa, longe acuminata, sub anthesi pedicellis altior, his vero inæqualibus, cylindrico-trigonis, quorum maximus tubum floris excedit; *perigonium* simul cum ovario 25-27 mm longum, *Narcissi Jonquillæ* odore fragrans; *ovarium* obovato-trigonum; *perigonii tubus* luteo-virescens, cylindrico-trigonus, leviter incurvatus 14-18 mm longus; *perigonii laciniæ* primum stellato-patentes, postea plus minusve reflexæ, clare imbricatæ, luteæ, retrorsum apiculatæ, externæ late obovatæ, internæ paulo angustius obovatæ, 9-11 mm longæ, tubo circiter dimidio breviores; *corona* truncata, crenulata, cyathiformis, concolor, laciniis firmior eisque fere dimidio

brevior (4,5-5 mm alta, 6 mm lata); *stamina* recta, inæqualia, duplici serie disposita, inferiore coronæ insertionem non excedente, superiore paulo infra coronæ insertionem nascente; *antheræ* 3-4 mm longæ; *stylus* in corona inclusus; *fructus* in typo nondum formatus. (Tab. I et II).

Ut in speciminibus in eodem loco postea collectis (Bento Rainha 903: LISE, COI) apparet, planta haec variat statura robustiore, bulbo ad 15 mm lato, foliis ad 45 cm longis et versus basin latioribus (2-3,5 mm), scapo altiore (16-20 cm), crassiore (3-4,5 mm prope basin), spatha ad 4-floram, perigonio 24-30 mm longo. (Tab. III).

A *N. juncifolio* Lag. differt foliis cum nervis obsoletis scapo longioribus, scapo superne fistuloso, spatha longe acuminata, tubo leviter incurvato, et corona concolori fere mediam longitudinem laciniarum æquante; a *N. gaditano* Bss. et Reut. foliis aliquanto latioribus, perigonii tubo minus incurvato, et corona breviore (laciniarum mediam longitudinem fere æquante); a *N. Jonquilla* L. tubo perigonii breviore et leviter incurvato, laciniis distinctius imbricatis, corona altiore; a *N. jonquilloide* Willk. pedicellis sub anthesi spatha brevioribus, perigonii tubo leviter incurvato, laciniis longioribus, et corona aliquanto breviore.

Habitat ad margines graminosas fossarum, in solo quidem arenoso, sed primo vere inundato, ideoque aliquantum spisso, in Lusitania, ad ripas Tagi, prope Zamora Correia, in prædio vulgo dicto Monte da Adema, in loco Pé de Galinha nominato (Gomes Pedro 1, 1943-Feb. 24, *Typus:* LISE; Bento Rainha 903, 1946-Mart. 7, LISE, COI), ubi tamen videtur rarissimus.

Floret Febr. et Mart.

Speciem hanc novam Doctori perillustri Abilio Fernandes dedico, caryologiæ generis *Narcissi* investigatori solertissimo.

AGRADECIMENTOS

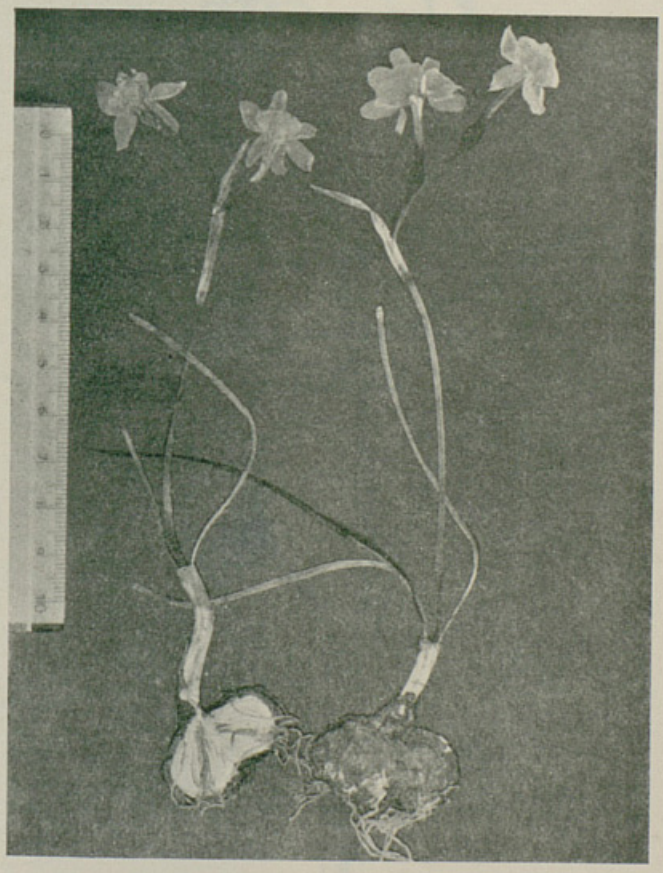
O arranjo final do manuscrito deste nosso trabalho, porque temos permanecido desde alguns anos fora de Portugal metropolitano e portanto sem a possibilidade de

o acompanhar de perto, muito deve aos auxílios que amàvelmente nos prestaram, sob diversas formas, os Ex.mos Senhores Pe. Dr. Alphonse Luisier e Prof. Dr. Abílio Fernandes e o meu colega A. R. Pinto da Silva A todos sinceramente agradecemos, assim como ao Sr. J. Santos Figueira, autor dos desenhos que ilustram este artigo.

TABULARUM EXPLICATIO

TAB. I

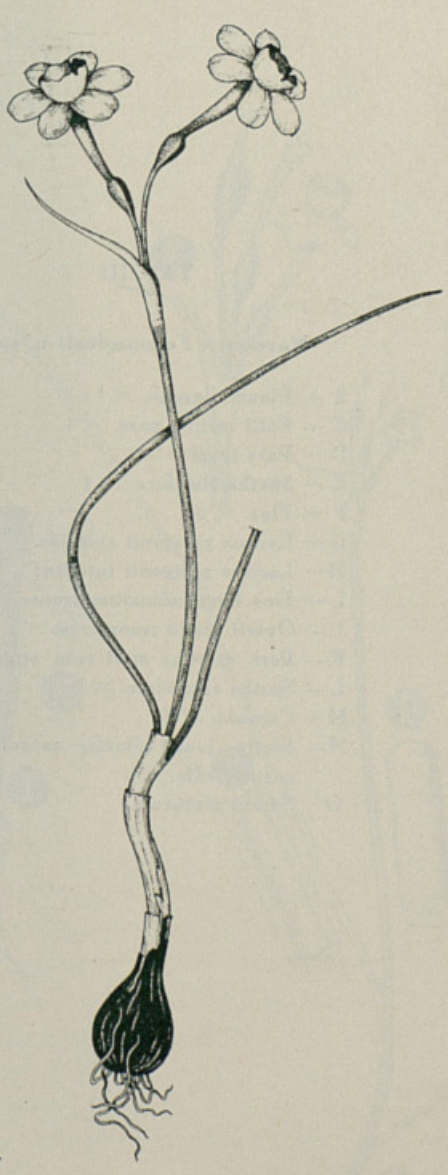
Narcissus Fernandesii n. sp.
Typus.



TAB. II

Narcissus Fernandesii n. sp.

Habitus typi. × 1.

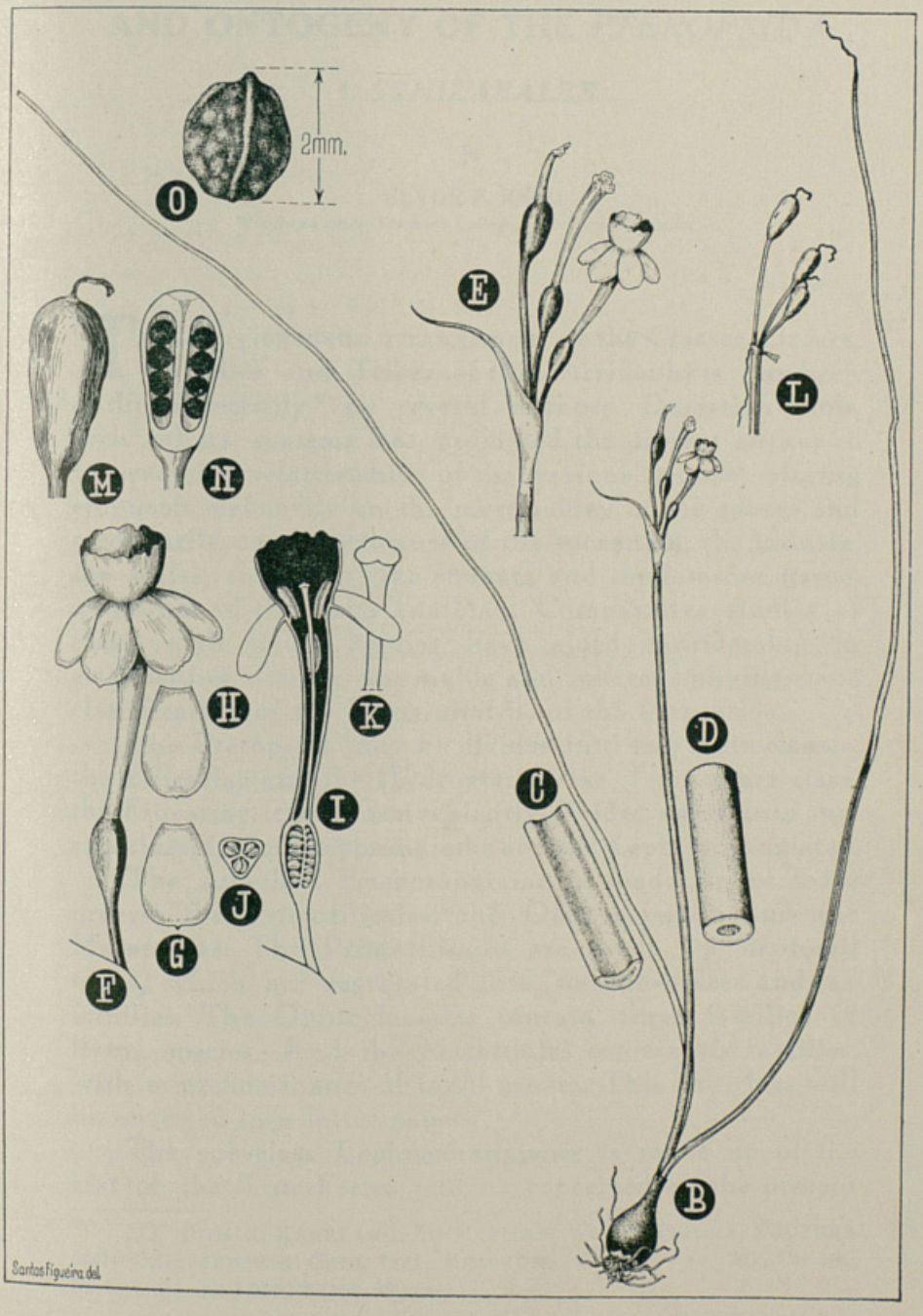


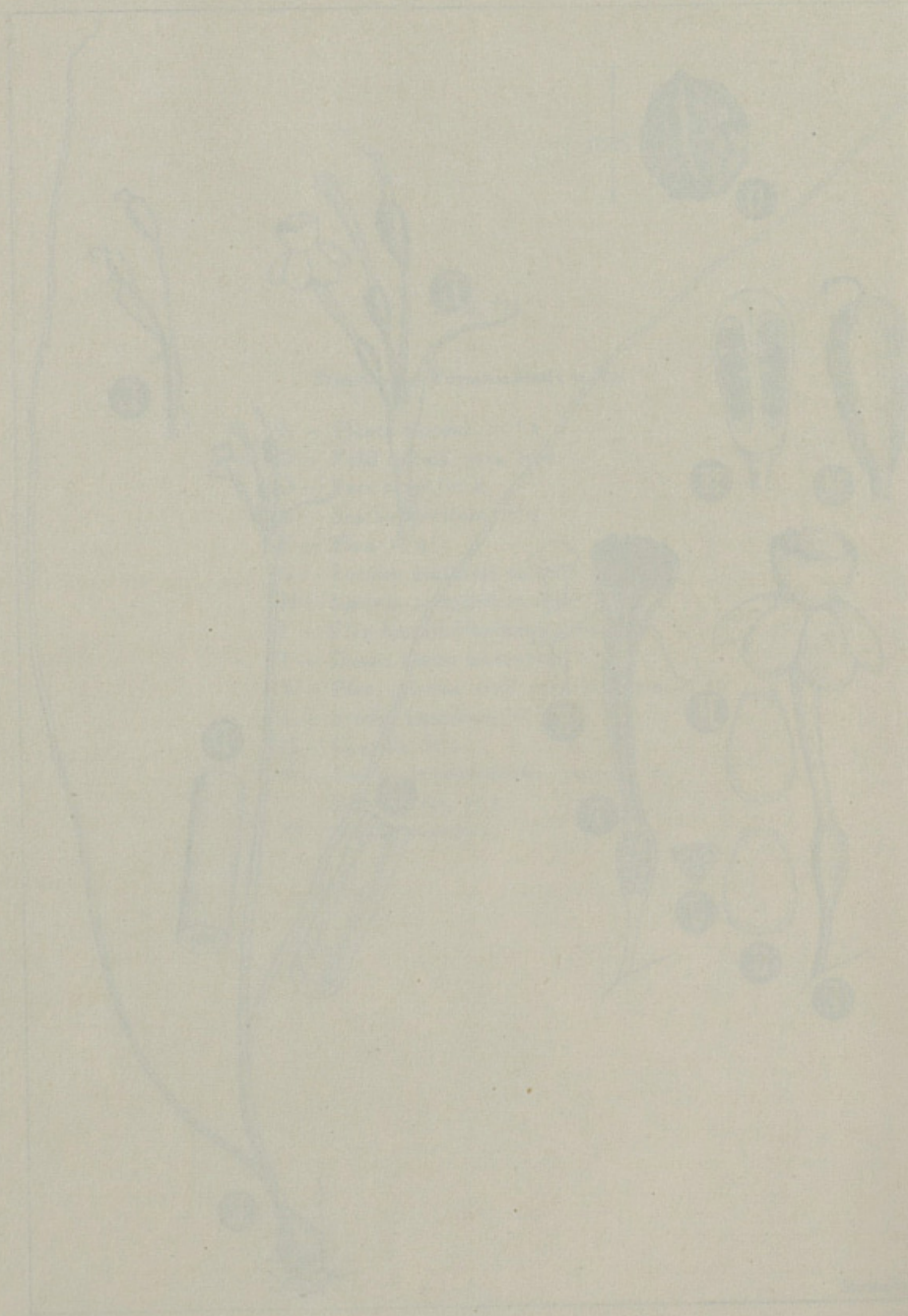
Santos Figueira del.

TAB. III

Narcissus Fernandesii n. sp.

B — Planta florens. × 1/2
C — Folii infima pars. × 4
D — Pars scapi. × 4
E — Spatha florifera. × 1
F — Flos. × 2
G — Lacinia perigonii exterior. × 2
H — Lacinia perigonii interior. × 2
I — Flos longitudinaliter sectus. × 2
J — Ovarii sectio transversa. × 2
K — Pars extrema styli cum stigmata. × 12
L — Spatha fructifera. × 1/2
M — Capsula. × 2
N — Sectio longitudinalis capsula in parte media. × 2
O — Semen maturum.





THE PHYLOGENY AND ONTOGENY OF THE *PTEROPSIDA*

I. *SCHIZAEALES*

by

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THE phylogenetic arrangement of the Classes, Orders, Families and Tribes of the Pteridophyta has been outlined recently* by several authors. Deviation from each others systems has prompted the present author to resurvey the relationships of the various groups, placing emphasis primarily on the morphology of the spores and secondarily on the structure of the sporangia, the indusia, the scales, the hairs, the stomata and the laminar tissue, as well as of the stelar anatomy. Comparative studies of fossil with living species have aided considerably in establishing a more reasonable and coherent phylogenetic classification of the Ferns, that is, of the Pteropsida.

The Pteropsida may be divided into two main classes, the Filicariae and the Hydropteridariae. The former class, the Filicariae, can be conveniently divided again into two sub-classes, the Eusporangiatae and the Leptosporangiatae.

The sub-class Eusporangiatae is made up of three orders: the Primofilicales, the Ophioglossales and the Marattiales. The Primofilicales are made up of fossil types, which are segregated into six sub-orders and ten families. The Ophioglossales contain three families of living species. And the Marattiales contain six families, with a predominance of fossil genera. This sub-class will be reviewed in a latter paper.

The sub-class Leptosporangiatae is made up of the rest of the True-Ferns, and as conceived by the present

(*) DOMIN, KAREL (*19*); ZIMMERMAN, W. (*69*); OGURA, YUDZURA (*42*); CHRISTENSEN, CARL (*17*); KOIDZUMI, GEN'ITI (*32, 33*); CHING, R. C. (*15*); and JONGMANS, W. (*27*).

author, consists of seven orders. These orders will be presented in the following series of papers.

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I. CLASSIFICATION OF THE SCHIZAEALES

One of the orders of the Leptosporangiate Pteropsida which has had a long geological history, as well as a wide recent distribution, is the Schizaeales, herein recognized as new. In order to correlate the fossil and living plants with known Schizaeaceous affinities, a survey of the morphology of the Mesozoic representatives will help to provide the reader with the geological background upon which the author has drawn his reasons for incorporating the genera into various families. Also it has been necessary to review the historical development of thought regarding the relationships of the Schizaeaceous Ferns to the other fern-like plants and regarding the organization of the genera within the families. Consequent upon the studies in morphology has followed the necessity for a taxonomic revision of the families, genera and species.

GEOLOGICAL SIGNIFICANCE OF THE SCHIZAEALES

The luxuriant growing periods during the Carboniferous Age afforded all types of climatic conditions for vegetative modification. Later, the various periods of the Jurassic Age also had helped to stabilize the various vegetative types in the Pteridophyta. So that by the Lower Cretaceous Age enumerable modifications in growth habit and form had appeared in the Schizaeales, making the representatives of this widely distributed group appear to be unrelated. Upon discovery of fertile material of the several form-genera which had been based upon sterile frond parts, it became evident that the character which had «timed» the evolution of the Schizaeales

was the thickening of the apical end of the sporangium, the annular cap.

During the Middle Upper Carboniferous, in the group believed to be the earliest representatives of the order Schizaeales, the family **Senftenbergiaceae,** here recognized as new, the sporangia, the primitive condition of which was probably a solid annular capsule similar to those of the Marattiaceous types of the time, began to show a thinning of the cell-walls in the lower portion of the sporangium.

Stur (60) treats both genera *Hapalopteris* and *Senftenbergia* as Marattiaceous types. Likewise, Solms-Laubach (*59*) placed *Senftenbergia* in the Marattiaceae, admitting that in so doing the limits of the Marattiaceae would have to be considerably widened. Scott (*52*) points out that *Senftenbergia* may be placed among the Primofilices of Arber (*2*). Seward (57) remarks that the genus may be a generalized type, such as occurs frequently in Palaeozoic floras. The family Senftenbergiaceae undoubtedly stands at the «cross-roads» between the Marattiales and the Schizaeales.

Placing these genera in the family Senftenbergiaceae as the earliest group of the Schizaeales affords one a foundation upon which to build: the multi-pinnate fronds; the decreasing number of rows of thick-walled cells in the annulus; the solitary sporangium (monangium) or the sporangia variously clustered into groups that might be considered sori in more advanced types; the variously situated sporangia, near the margin in arcs *(Hapalopteris)*, a condition which could lead to the higher ferns with marginal sori, or back from the margin, uniseriately arranged in two rows on the pinnules of the ultimate segments *(Senftenbergia)*, a condition which could terminate in the typical Dryopteroid families of higher ferns, which have circular shaped sori, or in definite sori along the lateral veins *(Cladotheca)*, a condition found in the Blechnaceae Ching and Aspleniaceae Presl. In *Hapalopteris* and *Senftenbergia* the plants were perhaps even tree-ferns,

with very large bipinnate to tri- to quadri-pinnate fronds. Frond characters in *Cladotheca* are not clear.

In HALLE's genus *Cladotheca* (*25*, p. 13) of Jurassic Age, the sporangia are short-stalked and pear-shaped. The apical cap of thick-walled cells definitely places it among the forms of probable Schizaeaceous affinity, paralleling the same structure in representatives of the Senftenbergiaceae of the Mid-Upper Carboniferous. *Cladotheca* was originally based on the difference in sporangial symmetry between it and *Todites*, and HALLE (*24*, p. 9) commented that the sporangia of *Cladotheca* were found to differ markedly from the structure regarded as characteristic of *Todites* Sew. The sporangia of *Cladotheca* show radial symmetry, which offers a strong contrast to the dorsiventral structure of the Osmundaceous sporangium. THOMAS' (*63*) observations of the sporangia of *Todites williamsoni* of England showed that the sporangia were not of the true Osmundaceous type, as was formerly supposed. The sporangia examined by THOMAS are stated by him to show the same general structure as those of *Cladotheca*. ZEILLER's (*67*) account of the sporangia of *Cladophlebis (Todea) roesserti* (Presl) Sap. would seem to indicate that it has a closer resemblance to the Osmundaceous type than THOMAS' English material of *Todites*. It is quite probable from this discussion of the sporangia that *Todites williamsoni* belongs among the Ferns with Schizaeaceous affinities, and that the material of ZEILLER belongs with the Osmundaceous Ferns.

HALLE (*25*, p. 14) makes the observation about another fossil species that the sporangia of *Asplenites cladophleboides* MÖLLER (*37*) from the Liassic of Bornholm also show the characteristic apical cap of thick-walled cells with sufficient distinctness to place it near or probably even referable to *Cladotheca undans*.

During Jurassic and Cretaceous time more of the variability potentialities manifest themselves in a group of genera called the family **Klukiaceae**, here recognized as new. In this group the apical annulus has only one row of thick-walled cells, a condition which would

warrant their being designated as the origin of the living genera of the Anemiaceae and Mohriaceae. The sporangium is still radially symmetrical. However, the position of the sporangia on the frond is more variable: in *Klukia* the sporangia are situated in two rows, one on each side of the midvein of the ultimate segments, a character carried over from *Senftenbergia* and further developed in Anemiaceae; in *Naktongia* there are two positions of the sporangia, one near the base of each lobe, and one at the summit of the uppermost branch of the vein, a character which will be very prominent in later ferns, as in the Aspidiaceae Presl, emend. Ching; in *Schizaeopteris* the sporangia are massed along the veins, a character to be found in *Cladotheca* and later in various groups, as the Gymnogrammaceae Ching and Lindsaeaceae Ching; in *Ruffordia* the sporangia are scattered all over the undersurface of the fertile pinnules, this character to be modified further in the recent groups Polypodiaceae (sensu strict.) and Acrostichaceae Presl, emend. Ching.

About this same time, i. e. the Lower Cretaceous and the Upper Jurassic, the sporangia were in some groups becoming massed into naked sori, some in rows close together along the veins, as in *Schizaeopteris*, and others into specialized fertile areas which are contracted into rounded or elliptical segments, as in the family **Acrostichopteridaceae,** here recognized as new. This was probably the side-track that ultimately resulted in the living representatives of the Schizaeales which possess modified fertile segments: Schizaeaceae, Lygodiaceae and Anemiaceae. Up to this time no marked dimorphism was apparent between the sterile and fertile portions of the frond, except the slight dimorphism in *Ruffordia* described by Halle (25, p. 11). The pronounced flabellate development of the lamina during this time initiated the patterns terminating in the Schizaeaceae, as emended. The very long flexuous rachises of the fronds with probably a creeping rhizome (*Acrostichopteris*) and the flabellately diverging, dichotomously forking veins of the decurrent pinnules laid down the pattern for the Lygodiaceae which

began in the Upper Cretaceous of North America and Europe. Out of this same complex probably developed the groups *Odontosoria*, *Sphenomeris* and *Lindsayopsis*, regarded as aberrant by the author in the Lindsaeaceae. These genera will be more carefully studied in the future, but there are indications that their origin was back in this region.

Schizaeopsis of the Lower Cretaceous is certainly the earliest fossil form with sufficient characteristics of the Schizaeaceae, as emended by REED herein, to be tagged the ancestral type of this group. However, *Schizaeopsis* has retained the trilete spores of the Klukiaceae, as well as the striate spores of *Ruffordia*. Although the spores are trilete and are sphaeric-tetrahedral in shape showing a triradiate crest and thus differing from the spores of the genera of the Schizaeaceae emend. Reed, which are monolete and bilateral (except in *Microschizaea* Reed, where they are monolete, but subglobose) with no triradiate crest, the leaf-form and probable habit link them with the Schizaeaceae.

A stem form-genus *Tempskya*, which was modified after fertile material was discovered, has received extensive discussion by KIDSTON and GWYNNE-VAUGHAN (*28*. p. 16-17),by SEWARD (*56*, p. 485-503) and later by READ and BROWN (*48*) who established a new family Tempskyaceae from the Mesozoic ferns of this genus. These discussions more conclusively clinch the argument that the Schizaeales during the Upper Jurassic and Lower Cretaceous represented a critical group. The solenostelic vascular system is one of the chief characters of this genus. KIDSTON and GWYNNE-VAUGHAN (*28*) state that «the affinities of the Tempskyas appear to lie with the leptosporangiate ferns. For instance, stems with a solenostelic vascular system are known to occur in the Schizaeaceae, Gleicheniaceae, the *Dipteris - Matonia* series, in *Loxsoma*, the Cyatheae, the Dennstaedtineae, and in certain series in the Polypodiaceae».

In order to familiarize the reader with the material presented by SEWARD and by READ and BROWN, the author

will repeat their discussions of the affinities of the Tempskyaceae.

READ and BROWN: U. S. Geol. Surv., Prof. PAPER 186-F: 120-124. 1937.

«Although siphonostelic axes occur in the Leptosporangiate Ferns, the characteristic features of *Tempeskya* tend to narrow down the possible affinities: for example, the probable absence of spiral protoxylem, the exarch or very slightly immersed position of the protoxylem, the shape of the leaf trace and its mode of origin, and the outline of vascular system of the petiole.

«**Schizaeaceae:** This family as generally considered includes four living genera — *Schizaea, Lygodium, Aneimia* and *Mohria*, all except the last-named have numerous species. Their distribution is widespread, but chiefly tropical. In habit there is a pronounced tendency toward dorsiventrality, although the radial condition persists in some species of *Schizaea* and *Mohria*, and in most species of *Aneimia*. Repeated dichotomy of the stem characterizes all the dorsiventral representatives.

«In the internal structure of the axis there is considerable diversity in the family, ranging from protostely to siphonostely and dictyostely. Among the siphonostelic members are encountered features that indicate an affinity with *Tempskya*.

«The section *Aneimiorrhiza* of *Aneimia* forms a natural group of at least seven species, all having siphonostelic stems. BOODLE has published an authoritative treatise on the anatomical features of these species and of *Aneimia mexicana* in particular. The stems are highly sclerotic and show a thin ring of xylem bounded without and within by phloem, pericycle and endodermis. The protoxylem is usually scalariform and appears diffuse exarch, although this point is not made clear. In some species, however, the spiral elements of the protoxylem in the leaf trace may continue downward into the central axis for a short distance. The petiole of this species has not been studied in detail, but in the related *Aneimia aurita* an inverted narrowly U-shaped leaf trace passes out in a manner similar to that in *Tempskya*. A median and two lateral areas of protoxylem are present. The phloem and endodermis conform to the outline of the xylem but are absent in the deeper portions of the concavity. The protoxylem is confined to the inner surface. A hypodermal layer of sclerenchyma is present, but the petiole is not prevailing sclerotic.

«The xylem presents certain features that militate somewhat against a very close comparaison with *Tempskya*. According to BOODLE, parenchyma intermingled with the tracheids is rare. If comparisons were being drawn only between this family and species of the type *Tempskya knowltoni* Seward, the point might be made that the occurrence of parenchyma is too sporadic to be worthy of serious consideration. However, its abundance in *Tempskya rossica* Kidston et Gwynne-Vaughan and in *Tempskya grandis* makes the difference worthy of note. Another feature upon which

BOODLE lays particular stress is the occurrence of sclerosed sieve tubes in the phloem of representatives of all the genera except *Mohria*. Such fibres have not been observed by the writers in *Tempskya*, nor has any record of such an occurrence been brought to their attention.

« Another character that may be of some value in discussing the affinities of *Tempskya* is the prevalence of diarch roots in the Schizaeaceae similar to those characteristic of the fossil.

« **Gleicheniaceae:** This family includes two genera — the monotypie *Stromatopteris* and *Gleichenia* — with about 80 species. Their distribution is chiefly tropical and south temperate. *Gleichenia* has been divided into three subgenera — *Mertensia*, *Eu-Gleichenia* and *Platyzoma*. In species of *Mertensia* characters are seen that suggest a comparison with *Tempskya*. In most species of the genus a protostele characterizes the vascular axis, but in *Gleichenia pectinata* of the subgenus *Mertensia* there is a very interesting solenostele of a type highly suggestive of that in *Tempskya*.

« In *Gleichenia pectinata* the stem is sclerotic. The solenostele carries numerous groups of slightly immersed protoxylem. Outer and inner phloem, pericycle and endodermis are present. The central area is occupied by sclerenchyma. The stem is markedly dorsiventral, giving off leaves above and roots below. At the node a band of tissue destined to pass into the leaf begins to separate from the xylem ring, the outer portion contributing more than the inner, in such a manner that the central sclerotic mass has a two-armed upward and lateral extension filling the concavity of the trace. The strand then splits off and gradually assumes an inverted U-shape with strongly recurved and somewhat swollen ends. The stele is left open for a time after the departure of the trace, so that there is free communication between central and cortical tissues.

« In the petiole there is a prominent protoxylem group at each of the terminal hooks, and between lie an indeterminate number of groups derived from a centrally located protoxylem in the early stages of the leaf trace. A considerable amount of sclerenchyma is included in the convexity of the petiole, and the phloem and endodermis are continuous within as well as without the xylem.

« In this plant there are several points of disagreement with the observed facts of structure in *Tempskya*, chief among which are the definite and slightly mesarch protoxylem, which is spiral, and the mode of origin of the leaf trace.

« Evidence of spiral protoxylem has not been noted in *Tempskya*, and its presence in slightly mesarch groups in *Gleichenia pectinata* is a significant point of difference. However, such protoxylem may exist in *Tempskya* but may have been obliterated during the course of silicification. This feature is in the writers' opinion an indecisive one.

« The origin of the leaf trace plainly presents considerable differences between *Gleichenia pectinata* and *Tempskya* species. However, some question may be raised as to the systematic value of this feature.

«Certain characters of the xylem necessitate the careful consideration of the Gleicheniaceae in this discussion. In its parenchymatous nature the ring is strongly suggestive of the stele of Tempskyas of the group *Tempskya rossica*. Likewise, the outline of the petiole bundle and the distribution of the tissues in general in *Gleichenia pectinata* as well as in other species of the genus is strongly suggestive of *Tempskya*.

«**Loxsomaceae:** This family of ferns of the tropics and the Southern Hemisphere includes two genera —*Loxsoma* and *Loxsomopsis*, the former being monotypic. The anatomy of *Loxsoma cunninghami* has been fully investigated by GWYNNE-VAUGHAN, and it is therefore possible to draw a rather careful comparison with *Tempskya*. The stem is a typical solenostele, a complete ring of xylem being invested on both sides by phloem, pericycle and endodermis. The groundmass of the stem is chiefly sclerenchyma, although a thin layer of parenchyma adjacent to the inner and outer endodermis is similar to the feature that the writers have called the inner cortex. Scattered «islets» of parenchyma occur in sclerotic tissue of the groundmass, being abundant in the vicinity of the stele and disappearing farther away. The xylem is only a few cells thick and may be parenchymatous.

«The closed stele is interrupted periodically along the upper side by the departure of leaves. At each node a portion of the ring separates and passes slowly outward as an inverted U-shaped meristele. Through the gap thus formed in the central cylinder there is free communication of medullary and cortical tissues. This gap may continue for some distance but never overlaps the succeeding one.

«The vascular strand in the petiole thus developed is horseshoe- or inverted U-shaped, with the extremities enlarged and incurved. The protoxylem lies in several groups on the adaxial surface of the thin strand, one group occupying the bay of each of the incurved hooks and an indeterminate number being situated along the dorsal curve. The phloem, pericycle and endodermis follow closely the contour of the xylem, although they may thin along the convex surface. The groundmass of the petiole is sclerenchymatous in the proximal portions but becomes more parenchymatous higher up. The roots are diarch and similar to those in *Tempskya*.

«*Loxsoma cunninghami* presents a number of features that suggest comparison with *Tempskya*. The exarch siphonostele with scalariform protoxylem, the sclerotic cortex, the dorsiventrality of the stem, the modified triarch, endarch leaf traces, and the diarch roots are all characters that are shared with *Tempskya*. However, the leaves are very nearly one-ranked, instead of two-ranked as in *Tempskya*, and the leaf trace is broader and flatter in outline. In *Loxsoma* islets of parenchyma related to the inner cortex are scattered in the sclerotic tissue for some distance from the stele, whereas in *Tempskya grandis* there are numerous islets and, in fact, an irregular sheet of sclerenchyma near the inner margin of the inner cortex. This feature may be taken as evidence of a trend toward sclerification of the parenchymatous cortex, with the possibility not remote

of isolation of the softer tissue as islands. It is, of course, impossible to say how far this sclerification proceeded ».

In summarizing the evidence of the « false» stem, one of the characteristics of *Tempskya*, READ and BROWN discuss the situation in the following notes.

« There appears to have been considerable diversity of habit in the genus. *Tempskya rossica* Kidston et Gwynne-Vaughan and *T. grandis* certainly show a radial symmetry that may be linked with an upright habit. The exact height to which a false stem might rise is, of course, uncertain, but it could not have been very efficient. The basal portions were probably much enlarged by the concentration of roots, so that the mass tapered upward. Of course, there must have been a downward taper also in the extreme basal region. In *T. knowltoni* Seward and *T. minor* dorsiventrality is very pronounced. The explanation may lie in the fact that the plant was subterranean and obliquely ascending. There is much evidence in favor of this assumption, but it is difficult to explain the course of the roots parallel to the stems if this is true. The writers offer as an alternative the suggestion that the plant was a liana but do not urge it, because it may present some fundamental difficulties ».

BROWN (*14*) had published a short paper in 1936, in which he presented the distinguishing characteristics of *T. knowltoni*. And more recently, ARNOLD (*3*) described two new species of *Tempskya* (namely, *T. wesselii* and *T. wyomingensis*) from the western part of the United States with radially symmetrical false-stems, thus closely relating these species to *T. grandis*.

Returning to the notes of READ and BROWN, one finds the following.

« The false-stemmed or 'tempskyoid' condition is by no means peculiar to *Tempskya*. Several examples are known, both living and fossil, and SAHNI (*51*) in 1928 summarized the facts concerning them.

« The best-known living ferns that possess false stems are *Todea barbara* Moore and *Hemitelia crenulata* Mettenius. In *Todea barbara* the trunk is rather massive but low. The individual stems are radially constructed and arise both through repeated bifurcation and by lateral branching. In *H. crenulata* the stems are entirely the result of lateral branching of a central axis. These branches grow horizontally at first but turn upward on reaching the surface. The size attained is considerable.

« In SAHNI's paper there is described a very interesting zygopterid fern, *Clepsydropsis australis* Sahni, of Westphalian Age, from localities

in New South Wales. SAHNI has clearly shown that this plant produced a false stem of numerous repeatedly forked leaf-forming axes and relatively stout, erect petioles, the stems and petioles being all bound together by and embedded in a packing of adventitious roots and aphlebeae.

« The false stem shows a distinct radial organization both in the individual stems and the complete mass. It is likewise suggested that *Clepsydropsis antiqua* and *C. kingisica* may have had false stems, although this has not yet been demonstrated.

« These comparisons cannot be carried very far, for a number of reasons. In the first place, even though the systematic position of *Tempskya* is not definitely established, yet it is certainly quite distinct from any member of the Osmundaceae, Cyatheaceae or Coenopteridaceae. The false stem of *Tempskya* is therefore the result of independent development and can be expected to differ in many significant respects from those developed in only distantly related families. Secondly, it is the only genus at present known to produce a false stem in which the individual axes are dorsiventral. Thirdly, it differs from other genera in that the aggregate is one of roots and stems with only a few petioles. In the other forms cited the petioles are notable constituents of the false stems ».

Additional comparisons were made by SEWARD (*56*, p. 500). In the Protocyatheaceae C. Chr. there are two genera, *Lophosoria* and *Metaxya*. The fern *Lophosoria quadripinnata* (Gmel.) C. Chr.. (*L. pruinata* Bower (*10*)) has a solenostele in which there are no protoxylem strands, but the rhizome is often bulky and the fully developed leaf trace is unlike that of the Tempskyas. Also *Metaxya rostrata* Bower (*11*) has a solenostele, but the meristele is not as simple as that of the fossil genus, and the stem of the recent fern is stouter.

GWYNNE-VAUGHAN (*23*) listed the solenostelic ferns known at that time, and points out that some of them differ from *Tempskya* in the greater diameter of the rhizome, and in many of the species studied the xylem--parenchyma is a conspicuous portion of the stele. Also Prof. MCLEAN THOMPSON (*64*) mentions several solenostelic ferns, but none of them provide the resemblance to *Tempskya* that the solenostele of *Anemia* does.

The possibility of affinities among the fossil species found in the formations of the Lower Cretaceous connecting the false stem of *Tempskya* with them is pertinent at this point. Among the widely distributed species foun-

ded on fronds from geological formations from which *Tempskya* has been recorded there are *Weichselia reticulata* (= *W. mantelli*), *Klukia browniana* (*Cladophlebis browniana*), *Onychiopsis psilotoides* and *O. elongata*, *Ruffordia goepperti*, *Schizaeopsis* and *Acrostichopteris* species, besides species of *Gleichenites*, *Hausmannia*, *Sphenopteris* and *Taeniopteris*. The stem and petiole of *Weichselia* (*8*) differ considerably from those of *Tempskya*; SEWARD states that there is clearly no real affinity. The fronds known as *Cladophlebis browniana* are usually sterile, but specimens have been discovered in the Peruvian Wealden described by ZEILLER (*68*) which are identical in habit with the Northern Hemisphere forms bearing sporangia of the Schizaeaceous type, and hence the species was transferred to *Klukia*, which genus includes another species, *Klukia zeilleri* Berry (*2*) from the Jurassic of Peru, as well as the more familiar *Klukia exilis* of Jurassic floras, a species hardly distinguishable from *K. browniana*. SEWARD states that it may be that *Klukia* fronds were borne on *Tempskya* stems, but the smaller rachises of the species of *Ruffordia* and the meager evidence of forking limit the possibilities of relating that genus with *Tempskya*.

SEWARD (*56* pl. XVI, fig. 5 and 8) figures the annuli of sporangia found associated with the roots of *Tempskya knowltoni* in Montana, showing the characteristic thick-walled cells. BOODLE (*9*) had already described spores found in the false stem of *Tempskya erosa*. The position of these sporangia and spores in the root mass about the false stem probably indicate that the frond that bore them must not be far away, and definitely had Schizaeaceous affinities.

In beds presumably of Lower Cretaceous Age, S. ENDO (*20*) describes specimens of *Tempskya* found in the vicinity of Yuasa, Kii, as being very closely related to *T. rossica* of KIDSTON et GWYNNE-VAUGHAN and the other species of the Lower Cretaceous. The genera *Klukia* and *Ruffordia* have also been found on the islands of Japan.

No sporangia of the widely distributed genus *Onychiopsis* were known to SEWARD (*56*, p. 502). That generic

name was substituted for the formgenus *Sphenopteris* because of the discovery of fertile pinnae in Japan, England and elsewhere similar to those of the Polypodiaceous genus *Onychium*. It is difficult to distinguish between the pinnae of *Onychiopsis* and *Ruffordia* without fertile specimens, and the polymorphism of *Ruffordia goepperti* makes the task more difficult. BERRY (*6*, p. 267-284), in describing different forms of sterile fronds of *Onychiopsis* from the Potomac Formation of Maryland and Virginia, includes both *O. psilotoides* and *O. goepperti*. In passing, the author wishes to clarify the fact that *Ruffordia goepperti* and *Onychiopsis goepperti* are not identical specific epithets: the former is based on *Cheilanthites goepperti* Dunker (1844) and the latter is based on *Sphenopteris goepperti* Schenk (1871, partim). In *Ruffordia* the fertile pinnae are considerably reduced with scattered sporangia and in *Onychiopsis* the fertile pinnules are elongated with a linear terminal 'sorus' on both sides of the midrib. The genus *Onychiopsis* is, in the opinion of the present author, one of the links between the Schizaeales and the higher Polypodiaceous groups.

The name *Ruffordia* SEWARD (*54*) was first suggested to replace *Sphenopteris* for *Sp. goepperti* because the habit of the sterile and fertile pinnae indicated an affinity with various species of the Anemiaceae. Later, SEWARD (*55*) found Schizaeaceous spores in the English specimens, and confirmation was presented by HALLE (*25*, pl. II, fig. 1-8), who found numerous impressions of sporangia with apical annuli, associated with the pinnae of *Ruffordia goepperti* in Manchuria, in beds presumably Lower Cretaceous. The habit of the fronds of *R. goepperti* agrees very closely with those of recent species of the Anemiaceae, such as *Ornithopteris adiantifolia*, one of the solenostelic groups in the family. The fronds of the recent species of the Anemiaceae are crowded, and leave no free surface of stem between them, a feature also present in *Tempskya*. Also, the occurrence of several small cells at the distal end of the annulus in the sporangia of *Tempskya knowltoni* is a feature consistent with its affinity with the

Anemiaceae, rather than with the Schizaeaceae, emend. or Lygodiaceae, the sporangia in these last two families having a very much smaller distal region (*12*). Fronds agreeing closely in habit with *Ruffordia goepperti* occur in the Kootanie Formation of Western North America, in the Wealden of England, and in the Lower Cretaceous of Bohemia, in association with *Tempskya*.

Fossil representatives of all the existing families of the Schizaeales, except Mohriaceae, have been found. In the Schizaeaceae, as emended herein by the author, fossil species are known in the genus *Actinostachys* from the Palaeocene and Eocene of Germany; and in the genus **Microschizaea,** herein described as new, from the Lower Miocene of Germany and the Quaternary of the Hawaiian Islands. In Lygodiaceae there are about fifteen species of *Lygodium* (sometimes called *Lygodites*) known from the Upper Cretaceous, the Eocene, the Miocene, the Palaeocene and the Tertiary. In Anemiaceae there have been several species described as species of the recent genus *Anemia*. Morphologically these species are more closely related to the genus *Ornithopteris* and therefore have been placed in a new genus **Protornithopteris.**

HISTORICAL SURVEY OF THE PHYLOGENY OF THE SCHIZAEACEOUS FERNS FROM 1801 TO 1947

Prior to 1801, the names of the Ferns known to belong to the Schizaeales had originated under the generic names *Acrostichum, Ophioglossum, Osmunda* or *Polypodium*. The species originally described under the generic name *Acrostichum* (namely, *A. pectinatum* L., 1753; *A. dichotomum* L., 1753; *A. elegans* Vahl, 1791) belong to the Schizaeaceae (*Schizaea*); those under *Ophioglossum* (namely, *O. circinnatum* Burm., 1768; *O. flexuosum* L., 1753; *O. japonicum* Thunb., 1784) to the Lygodiaceae (*Lygodium*); those under *Osmunda* (namely, *O. adiantifolia* L., 1753; *O. tomentosa* Sav., in Lam., 1797; *O. flexuosa* Sav., in Lam., 1797; *O. fulva* Cav., 1801; *O. oblongifolia* Cav., 1801; *O. humilis* Cav., 1801; *O. hirsuta* L.,

1753; *O. tenella* Cav., 1801; *O. filiformis* Sav., in Lam., 1797; *O. hirta* L., 1753; *O. phylitidis* L., 1753) to the Anemiaceae (*Ornithopteris, Hemianemia* and *Anemia*); and that under *Polypodium* (namely, *P. caffrorum* L., 1771) to the Mohriaceae (*Mohria*).

Throughout the earlier classifications of the Ferns with Schizaeaceous affinities, the genera are intermingled with such genera as *Osmunda, Todea, Angiopteris, Gleichenia* and *Mertensia.*

BERNHARDI, J. J. — Tentamen alterum Filices in genera redigendi. Schrad. Journ. Bot. 1800 (2): 1801.

II. Filices Agyratae.
A. Sporangiis unilocularibus.
a. Nudis .....
γ. Lineatim aggregatis.
22. Todea Willdenow? 23. Angiopteris Hoffm.
24. Odontopteris Bernh. 25. Ripidium Bernh.
B. Episporangiis tectis.
a. Solitariis.
26. Lycopodium Bernh. 27. Gisopteris Bernh.

SWARTZ, O. — Genera et species Filicum ordine sytematico redactarum adiectis synonymis et iconibus selectis, nec non speciebus recenter detectis, et demum plurimis dusiosis, ulterius investigandis. Schrad. Journ. Bot. 1800 (2) 1801.

A. Filices Annulatae.
Capsulae diverse aggregatae.
** Indusio (Willd. Involucrum Smith. Perisporangium Hedw.) vario modo velatae.
24. Schizaea.
B. Exannulatae.
Capsulis absque annulo medio dehiscentibus.
Capsulae confertae 1. solitariae.
* Uniloculares, bivalves.
25. Osmunda L. 26. Lygodium Swartz
27. Gleichenia Smith 28. Angiopteris Hoffm.

BERNHARDI, J. J. — Dritter Versuch einer Anordnung der Farrnkräuter. Schrad. Neues Journ. Bot. 1 (2): 6. 1806.

Subordo II. Pseudogyratae (Falschrädige).
II. Acrogyratae (Spitzenrädige).
25. Lygodium. 26. Schizaea. 27 Ornithopteris.

SWARTZ, O. — Synopsis Filicum earum genera et species sytematico complectens. Kiliae. 1806.

B. Spurie Gyratae s. Rimatae.

Schizaea, Lygodium, Anemia, Mohria, Osmunda, Todea, Mertensia, Gleichenia, Angiopteris.

WILLDENOW, C. L. — Species Plantarum, 5 (1): 1810.

IV. Schismatopterides.

Angiopteris, Gleichenia, Mertensia, Todea, Mohria, Hydroglossum, Schizaea, Anemia, Osmunda.

BROWN, R. — Prodromus Florae Novae Hollandiae. 1810.

III. Osmundaceae.

Schizaea, Lygodium, Osmunda Sw. (Todea Willd.).

KAULFUSS, G. F. — Enumeratio Filicum, quas in itinere circa terram legit clar. A. de Chamisso, etc. (April) 1824.

Osmundaceae R. Br.

Todea Willd., Osmunda L., Mohria Swartz, Lygodium Swartz, Schizaea Smith, Anemia Swartz

BORY DE SAINT-VINCENT. — Dictionnaire classique d'histoire naturelle, t. VI. (Sept.) 1824,

Osmundacées.

Anemia Sw.; Schizaea. (Lophidium Rich., Ripidium); Lygodium Sw. (Ugena Cav., Hydroglossum Willd.; Cteisium Rich. in Mich.); Mohria Sw.

DESVAUX. — Prodrome de la famille des Fougères. Ann. Soc. Linn. Paris, 6: (Mai). 1827.

OSMUNDACEAE

10. Ophioglossum L.
11. Botrychium Sw.
12. Ophiala Desv.
13. Carpanthus Raf. ?
14. Anemia Sw.
15. Osmunda Desv. in part.
16. Todea Willd.
17. Mohria Sw.
18. Platyzoma R. Br.
18. Gleichenia Sw.
20. Mertensia W.
21. Schizaea Smith
22. Lygodium Sw.

However, in 1810 R. BROWN introduced the family name Osmundaceae for the genera *Schizaea* and *Lygodium*, as well as for *Osmunda* and *Todea*. KAULFUSS (1824), BORY DE SAINT-VINCENT and DESVAUX introduced the rest of the genera, which had been seggregated by BERNHARDI, SWARTZ and WILLDENOW, to the Osmundaceae.

Later, in 1827, KAULFUSS realized the heterogeneity of

Brown's Osmundaceae and decided to separate those genera which up to the present time have constituted it, *Mohria, Lygodium, Schizaea* and *Anemia*, into the family Schizaeaceae.

From 1827 to 1842 there was a strong tendency to form families for this group of genera. As mentioned above Kaulfuss in 1827 set up the family Schizaeaceae. In 1828 Brongniart formed the group Lygodiées, placing in it all four genera. Later, Link (1829-1833) established the family Anemiaceae under the Filices. Presl in 1845 established a separate family or «sub-ordo» for each genus: namely, Eu-Schizaeaceae, Lygodiaceae, Anemiaceae and Mohriaceae.

Von Martius (1835), Endlicher (1836-40) and Hooker (1842) had used the family name Schizaeaceae under the larger group-name Filices. However, Meisner (1836-45) treated the Schizaeaceae as a subordinate group of the Polypodiaceae. This concept appeared in several different ways in later classifications. Lindley in 1845 formed the «tribe» *Schizaeae* (Mart.) under Polypodiaceae; Fée took up the Schizéacées and Lygodiacées under Polypodiacées in 1850-52; Payer in 1850 used Trib. 6. *Schizaeées* under Polypodiacées; John Smith in 1857 used Trib. IX. *Schizaeae* J. Sm. under Polypodiaceae, but later in 1866 placed Trib. *Schizaeae* and *Osmundeae* under Osmundaceae, a rather retrogressive tendency; Moore in 1857 used the order-name Filicales (a name also having been previously used by Lindley in 1845), placing the trib. *Schizaeineae* under Polypodiaceae, and forming two subtrib. *Lygodieae* and *Schizaeeae*.

After 1866, the general tendency was to return to Kaulfuss' proposal of keeping the Schizaeaceae as an independent group. Most of the taxonomic and phylogenetic works dealing with the Schizaeaceae since 1867 have centered upon division of the genera into subgenera, sections and subsections. Bommer in 1867 grouped as tribes of the Schizaeaceae, the Eu-Schizaeaceae, the Anemiaceae and the Mohriaceae, but kept the Lygodiaceae as an independent family, this classification being based on that of

Presl of 1845. Hooker and Baker in 1874, Prantl in 1881, Christ in 1897, and Diels in 1900, each presented his system of how the various genera should be divided up.

Hooker, W. J. and Baker, J. B. — Synopsis Filicum. Edition 2: 428-439. 1874.

Schizaeaceae.

1. Schizaea.
   - Euschizaea Hook.
   - Lophidium Rich.
   - Actinostachys Wall.
2. Anemia.
   - Euanemia.
   - Anemidictyon J. Sm.
   - Coptophyllum Gardn.
3. Mohria.
4. Trochopteris
5. Lygodium.
   - Eulygodium Hook.
   - Hydroglossum Presl.

Prantl, K. — Untersuchungen zur Morphologie der Gefässkryptogamen. Die Schizaeaceen. Leipzig. 1881.

Schizaeaceae Kaulf.

1. Lygodium Sw.
   - I. Sect. Palmata Prantl.
   - II. Sect. Flexuosa Prantl.
   - III. Sect. Volubilia Prantl.
2. Mohria Sw.
3. Aneimia Sw.
   - Subgenus I. Trochopteris (Gardn.) Prantl.
   - Subgenus II. Hemianeimia Prantl
     - Sect. 1. Gardnerianae Prantl.
     - 2. Tomentosae Prantl.
     - 3. Millefolia Prantl.
   - Subgenus III. Euaneimia Prantl.
     - Sect. 1. Oblongifoliae Prantl.
     - 2. Hirsutae Prantl.
     - 3. Collinae Prantl.
     - 4. Dregeana Prantl.
     - 5. Phyllitides Prantl.
   - Subgenus IV. Aneimiorrhiza Prantl.
     - Sect. 1. Coriaceae Prantl.
     - 2. Cuneatae Prantl.
4. Schizaea J. E. Sm.
   - Sect. 1. Digitatae Prantl.
   - 2. Pectinatae Prantl.

3. Bifidae Prantl.
4. Dichotomae Prantl.
5. Elegantes Prantl.

CHRIST, H. — Die Farnkräuter der Erde. Jena. 1897.

Monangia Prantl.

Schizaeaceae Mett.

1. Schizaea.
   a. Actinostachys.
   b. Euschizaea.
   c. Lophidium.
2. Aneimia.
   a. Rotundifoliae Christ.
   b. Caudatae Christ.
   c. Deltoideae Christ.
   d. Bipinnatae Christ.
   e. Cuneatae Christ.
   f. Coptophyllum Presl.
   g. Trochopteris Gardn.
3. Mohria.
4. Lygodium.
   a. Palmata Prantl ex parte.
   b. Dichotoma Christ.
   c. Volubilia Prantl.
   d. Flexuosa Prantl.

DIELS. — in Nat. Pfl.-fam. 1 (4): 356-371. 1900.

Schizaeaceae.

I. Schizaeeae.
   1. Schizaea.
      Sect. a. Actinostachys Wall.
      b. Euschizaea Hook.
      c. Lophidium Rich.

II. Lygodieae.
   1. Lygodium Sw.
      Sect. a. Palmata Prantl.
      b. Volubilia Prantl.
      c. Flexuosa Prantl.

III. Aneimieae.
   1. Mohria.
   2. Aneimia.
      Subgen. 1. Trochopteris Gardn.
      Subgen. 2. Hemianeimia Prantl.
      A. Gardnerianae Prantl.
      B. Tomentosae Prantl.
      C. Millefoliae Prantl (Coptohyllum Gardn.).

Subgen. 3. Euaneimia Prantl.
- A. Oblongifoliae Prantl.
- B. Hirsutae Prantl.
- C. Collinae Prantl.
- D. Dregeanae Prantl.
- E. Phyllitides Prantl.

Subgen. 4. Aneimiorrhiza J. Sm.
- A. Coriaceae Prantl.
- B. Cuneatae Prantl.

Although several fossil genera and species known before 1891 had been suggested as belonging to the Schizaeaceae, it was SEWARD, RACIBORSKI and POTONIÉ who began to associate and interweave the fossil and extant species and genera within this family. In 1900 POTONIÉ (in Nat. Pfl.-fam. 1 (4): 371-372. 1900) listed the genera *Senftenbergia* Corda from the Upper Cretaceous, *Klukia* Raciborski from the Jurassic Age and species of *Lygodium* Sw. from the Cretaceous. BERRY (in Maryland Geological Survey, Lower Cretaceous, 1911) included in the Schizaeaceae the genera *Schizaeopsis, Ruffordia, Klukia, Senftenbergia, Acrostichopteris, Schizaea, Anemia* and *Lygodium.* BOWER, in the Ferns (vol. 2, pp. 153-175. 1926), discussed the genera *Senftenbergia, Klukia, Ruffordia, ?Kidstonia, Tempskya,* and then *Schizaea, Lygodium, Anemia* and *Mohria.* DOMIN (Pteridophyta, 1929) placed the family Schizaeaceae under the group Euleptosporangiatae, and listed the genera *Senftenbergia, Klukia, Schizaeopteris, Norinbergia, Schizaeopsis,* and *Lygodites,* as genera represented by fossil plants.

In 1937 NAKAI (Jap. Journ. Bot. 13: 139-154. 1937) re-established as various separate families the subordinal names suggested by PRESL in 1845, recognizing the Schizaeaceae, the Lygodiaceae and the Anemiaceae, but leaving *Mohria* in the last named family. Also numerous genera were used in his work, as indicated in the brief outline of this work below.

I. Schizaeaceae.
- 1. Actinostachys.
- 2. Schizaea.

II. Lygodiaceae.

1. Lygodium.
2. Lygodictyum.
3. Gisopteris.
4. Odontopteris.

III. Anemiaceae

1. Aneimia.
2. Anemidictyon.
3. Anemiaebotrys.
4. Coptophyllum.
5. Mohria.
6. Trochopteris.

COPELAND (*18* a, p. 23-25), in his new Genera Filicum (1947), treats the Schizaeaceae in a most conservative manner, calling attention to the fact that several groups of species might be maintained as being genericly separable from the four conventional genera of this very diversified family. These genera would be *Actinostachys* and *Coptophyllum*. In the opinion of the author the classification set forth, as well as the suggested modifications, by COPELAND do not clearly represent the phylogenetic tendencies presented by the known fossil and extant species.

The classification introduced herein by the present author is the result of his studies of the recent and fossil genera and species of known representatives of the fern-like plants with Schizaeaceous affinities. Below is an outline of this system, and the reasoning for establishing it will be discussed in a later part of this paper.

Order Schizaeales Reed, ord. nov.
Fam. 1. Senftenbergiaceae Reed, fam. nov.
Genus a. Senftenbergia Corda.
b. Hapalopteris Stur.
c. Cladotheca Halle.
Fam. 2. Klukiaceae Reed, fam. nov.
Genus a. Klukia Raciborski.
b. Naktongia Oishi.
c. Ruffordia Seward.
d. Schizaeopteris Stopes et Fujii.
Fam. 3. Tempskyaceae Read et Brown.

Genus 1. Tempskya Corda, emend. Kidston et Gwynne-Vaughan.

Fam. 4. Acrostichopteridaceae Reed, fam. nov.

Genus a. Acrostichopteris Fontaine.

b. Schizaeopsis Berry.

c. Pelletieria Seward.

Fam. 5. Schizaeaceae Kaulf., emend. Presl.

Genus a. Schizaea J. E. Smith, emend. Reed.

Subgenus A. Eu-Schizaea Reed.

B. Lophidium (L. C. Rich.) Reed.

C. Paraschizaea Reed.

Genus b. Actinostachys Wall.

Sect. 1. Digitatae (Prantl) Reed.

a. Striatae Reed.

b. Laeves Reed.

2. Pennulae Reed.

Genus c. Microschizaea Reed, gen. nov.

Sect. 1. Laeves Reed.

2. Alveolatae Reed.

Fam. 6. Lygodiaceae Presl.

Genus a. Lygodium Swartz.

Subgenus A. Gisopteris (Bernh.) C. Chr.

1. Eu-Gisopteris Reed.

2. Arthrolygodes (Presl) Reed.

B. Eu-Lygodium Hook., emend. Reed.

C. Odontopteris (Bernh.) Reed.

Fam. 7. Anemiaceae (Presl) Reed, stat. nov.

Genus a. Protornithopteris Reed, gen. nov.

b. Ornithopteris Bernh.

1. Eu-Ornithopteris Reed.

2. Cicutariae Reed.

c. Hemianemia (Prantl) Reed stat. nov.

Subgenus A. Trochopteris (Gardn.) Reed.

B. Aneimiaebotrys (Fée) Reed.

C. Coptophyllum (Gardn.) Reed.

1. Eu-Coptophyllum Reed.

2. Rutaefoliae Reed.

D. Eu-Hemianemia Reed.

1. Gardnerianae (Prantl) Reed.
2. Tomentosae (Prantl) Reed.

d. Anemia Swartz, emend. Reed.

Sect. 1. Oblongifoliae Prantl.
2. Hirsutae Prantl.
3. Collinae Prantl.
4. Phyllitides Prantl.

Fam. 8. Mohriaceae (Presl) Reed, stat. nov.

Genus a. Mohria Swartz.

SCHIZAEALES Reed, ord. nov.

Syn.: *Pseudogyratae* II. *Acrogyratae* Bernh., Schrad. Neues Journ. Bot. 1 (2): 6. 1806; *Spurie Gyratae* s. *Rimatae* Swartz, Syn. Fil., p. 6 (partim). 1806; *Schismatopterides* Willd., Sp. Pl. 5: XLII et XLVI (partim). 1810; Osmundaceae R. Brown, Prodr. Fl. Nov. Holl., p. 161 (partim). 1810; Kaulf., Enum., p. 42 (partim). April, 1824; Bory de Saint-Vincent, Dict. Class. d'hist. nat. VI: (partim). Sept., 1824; Desvaux, Ann. Soc. Linn. Paris VI: (partim). Mai, 1827; *Schizaeaceae* Kaulf., Wesen d. Farrenkräuter, 119. 1827; Mart., Ic. Crypt. Bras., 112. 1828; Mett., Fil. Hort. Lips., p. 12 et 113; Sturm in Mart., Fl. Bras., fasc. XXIII, p. 167; Hook. et Baker., Syn. Fil., 428--439. 1874; Prantl, Schiz., 58. 1881; Christ, Farnkräuter der Erde, 1897; Diels, in Nat. Pfl.-fam. 1 (4): 356-371. 1900; Potonié, in Nat. Pfl.-fam. 1 (4): 371-372. 1900; Berry, Maryland Geol. Survey, Lower Cret., 1911; Bower, The Ferns, 2: 153-175. 1926; Domin, Pteridophyta. Systematic Survey of Living and Extinct Fern-like Plants, 1929; C. Chr., Manual Pteridology, 528-529. 1938; *Lygodiées* Brongn., Hist. Veg. Foss., Paris. 1828; *Aneimiaceae* Link, Fil. Hort. Berol., p. 23; *Schizaeinae* Moore, Ind. Fil., p. XII et CXII. 1857; *Schizaeae* J. Smith, Hist. Fil., p. 350.

Sporangia obovoidea vel pyriformia, sessilia, in origine marginalia, sed mox in externo loco coacta, non soros veros constituentia, sed quoque monangium, annulo completo transverso apice instructa, stomio definito in formis extantibus aperientia, verticali scissura varie constructa in

formis fossilibus aperientia; *sporae* tetraedrae et triletes, vel subglobosae, sphaericae vel obovoideae et monoletes, sine exospora, cum per spora crassa varie sculpta, numerosae (128-256) per sporangium, ad 512 in generibus fossilibus.

Habit terrestrial and xerophilous, rarely semi-aquatic; rhizome horizontal or erect, clothed with simple hairs or with several-celled flattened trichomes, or rarely with scales; fronds erect or twining, simple or dichotomously or pinnately divided, or diverse form, the veins free, mostly dichotomously branched, rarely reticulate; fertile pinnae modified into sporangiophores, except in some of the families of fossils and Mohriaceae; sporangia obovoid or pyriform, large and sessile, or short-stalked, marginal in origin but soon forced into a superficial position by various outgrowths of the fertile segment, not forming real sori, but each a monangial sorus (monangium), provided with a complete transverse annulus at the apical end with a definite stomium in the recent forms, opening by a vertical slit, variously constructed in fossil groups; spores tetrahedral and trilete, or subglobose to spherical or bilateral and monolete, without an exospore, with a thick variously sculptured perispore, rather numerous, (128-256) per sporangium, up to 512 in fossil genera.

Key to the Families of the Schizaeales

1. Indusium of any type absent; fossils.
   2. Sporangia scattered, or solitary in rows.
      3. Annulus of sporangia made up of more than one row of cells. . . 1. *Senftenbergiaceae.*
      3. Annulus of sporangia made up of a single row of cells.
         4. Frond form-genera . . 2. *Klukiaceae.*
         4. Stem form-genus . . 3. *Tempskyaceae.*
   2. Sporangia massed into fusiform bodies, ordinarily borne toward the distal ends of the ultimate divisions of the frond . . 4. *Acrostichopteridaceae.*
1. Indusium formed as a revolute or recurved margin or

outgrowth from the pinnal lobe, sometimes absent; living and fossils.

2. Prothallium (in living genera) filamentous with some swollen pale green cells with micorrhiza (the simplest and most primitive of all known prothallia); rhizome of an advanced protostelic structure; sporangiophores terminal at the apices of the stipes, digitate or pinnate; spores monolete . . . . . 5. *Schizaeaceae.*

2. Prothallium (in living genera) flat with a lateral cushion, green; rhizome solenostelic or dictyostelic; spores trilete.

3. Fronds twining, of indefinite growth, dichotomously, palmately, or pinnately divided; sporangia in two rows, each borne near the ends of the veins and enveloped in a pocket formed by outgrowths from the lobe . . . . . 6. *Lygodiaceae.*

3. Fronds not twining, pinnately divided.

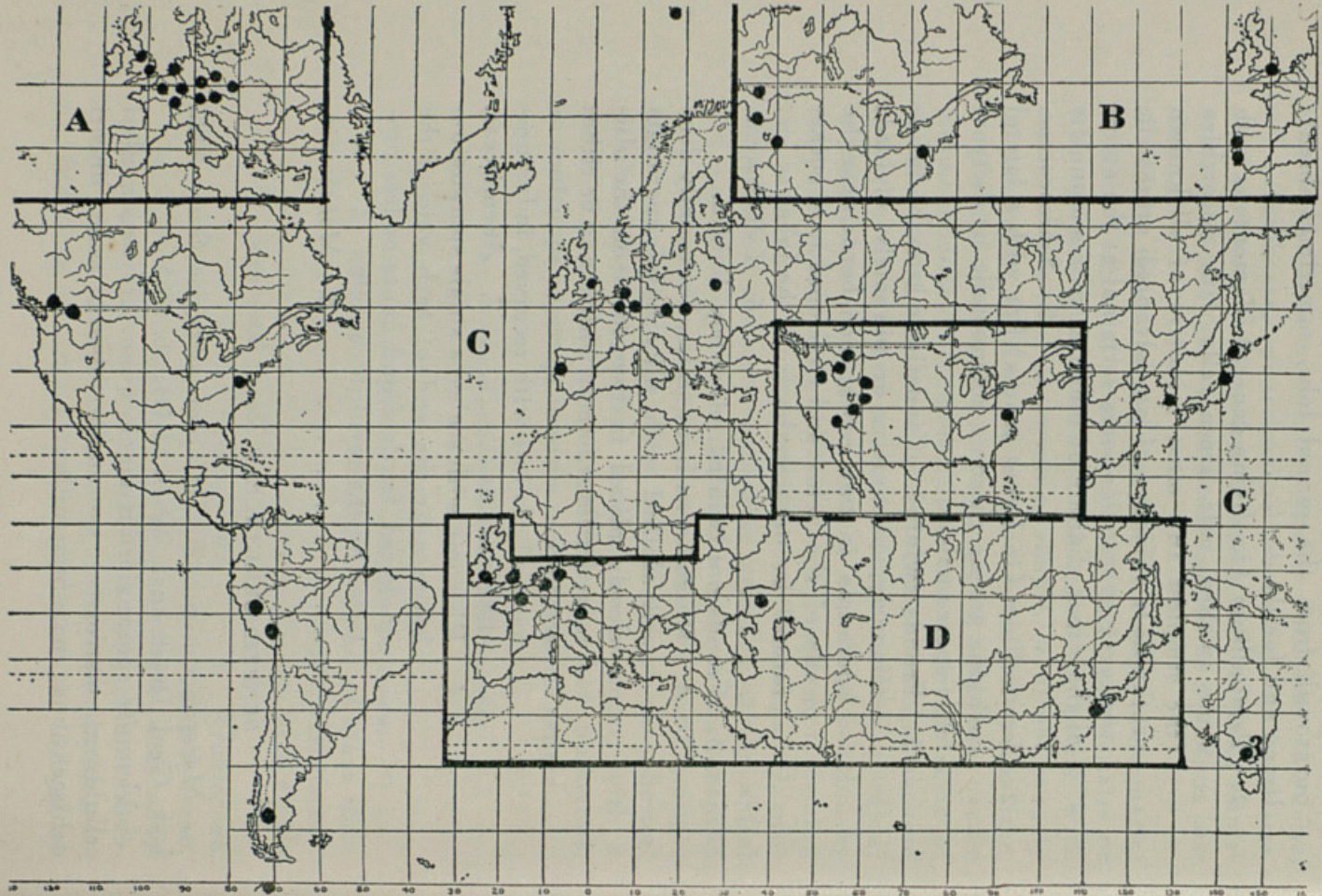
4. Rhizome without scales, but usually densely clothed with silky hairs; sporangia closely placed in two rows on the ultimate fertile segments which may be either semiterete without spurious indusium or narrowly foliose with recurved, indusium-like margins . . . . 7. *Anemiaceae.*

4. Rhizome with scales; a single sporangium borne near the end of each vein of the unaltered fertile frond, more or less protected by the revolute margins . . . . . 8. *Mohriaceae.*

SENFTENBERGIACEAE Reed, fam. nov.

Marattiaceae subord. III. *Senftenbergiae* Stur, Abh. k.-k. Geol. Reichsanst. Wien 11 (1): 26. 1885.

Annulis sporangiorum magis quam ordine singulari cellularum instructis; *sporangiis* liberis, rima lineari dehiscentibus; *indusium* nullum.



Map. A. Distribution of the Family Senftenbergiaceae.
Map. B. Distribution of the Family Acrostichopteridaceae.
Map. C. Distribution of the Family Klukiaceae.
Map. D. Distribution of the Family Tempskyaceae.

Fossil ferns, one of the ancestors of the recent families of the Schizaeales; sporangia free, dehiscing by means of a linear ridge; annulus rudimentary or well-defined, made up of four or five rows of thick-walled cells, apically arranged; indusium none; spores trilete. Known from the Mid-Upper Carboniferous and Jurassic Ages. Map. A.

Key to the genera of the Senftenbergiaceae

1. Sporangia disposed in groups along the lateral veins.
   2. Sporangia arranged in lunulate arcs, usually in interrupted groups along the margin; annulus rudimentary . . . . . 1. *Hapalopteris.*
   2. Sporangia arranged in definite sori along the lateral veins; annulus not well differentiated . . . . . 2. *Cladotheca.*
1. Sporangia disposed singly on lateral veins, near the margins; annulus well-defined . 3. *Senftenbergia.*

1. **Hapalopteris** Stur,

Anz. Akad. Wiss. Wien Nr. 12: 96. (mai 10) 1883; Sitzungsb. Akad. Wiss. Band 88, I. Abth. (Juli-Heft): (28) 660, tf. 8. (Dec.) 1883; Abh. k.-k. Geol. Reichsanst. Wien 11 (1): 26-52. 1885.

Renaultia Zeiller, Ann. Sci. Nat. VI. Bot. 16: 185. (Aug.) 1883; Kidston, Mem. Geol. Surv. Gr. Britain., Palaeon., 2 (5): 310. 1924; non Stur.

Frond medium to large sized; lamina tri- or quadri--pinnatifid, or more often pinnatisect in the segments; segments rarely entire, dentate, serrate, pinnati-lobate or pinnatisect, thin or rigid, smooth or striolate, paleaceo--pilose; rachis delicate and very thin, glabrous or with trichomes; sporangia ellipsoid, rarely subglobose, superficial, sessile, rarely solitary or in twos, more often in threes or fours or more numerous, arranged in lunulate arcs, usually in interrupted groups along the margin; annulus apical, rudimentary.

Genotype: *Hapalopteris typica* Stur.

1. *H. microscopica (Crep.) Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 29, t. 43, fig. 1-3, tf. 9. 1885. (*Sphenopteris microscopica* Crep., msc.). Schatzlarer Schichten: Belgium.
2. *H. rotundifolia (Andr.) Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 31, t. 44, fig. 1-5, t. 41, fig. 9. 1885. (*Sphenopteris rotundifolia* Andrae, Vorwelt. Pfl., 37, t. 12.). Schatzlarer Schichten: Inde Bassin; Belgium; Great Britain.
3. *H. laurentii (Andr.) Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 36, t. 44, fig. 5-6. 1885. (*Sphenopteris laurentii* Andrae, Vorwelt. Pfl., 39, t. 13,fig. 1-3 (apicales et medias partes folii sistens). Schatzlarer Schichten: Inde Bassin (prope Aquisgranum); Kronprinzhalde in Eschweiler-Pumpe.
4. *H. villosa (Crep.) Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 39, t. 43, fig. 4-6. 1885. (*Sphenopteris villosa* Crep., in Mourlon, Geol. de la Belgique, 2: 60. 1881). Schatzlarer Schichten: Charbonniere du Levant du Flenu.
5. *H. westphalica Stur. Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 42, t. 43, fig. 7a-b, tf. 10. 1885. Schatzlarer Schichten: Westphalen.
6. *H. schwerini Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 43, t. 41, fig. 8-8a. 1885. Schatzlarer Schichten: Moravia-Upper Silesia.
7. *H. grosseserrata Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 44, t. 42, fig. 5. 1885. Schatzlarer Schichten: Belgium.
8. *H. typica Stur, Sitzungsb. Akad. Wiss. Wien, Band 88, Abth 1: 660 (28), fig. 8. 1883; Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 46, t. 42, fig. 3, 3a, 4, tf. 8. 1885. Schatzlarer Schichten: Belgium.
9. *H. bella Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 49, t. 42, fig. 1-2. 1885. Schatzlarer Schichten: Belgium.
10. *H. amoena Stur, Abh. d. k.-k. Geol. Reichsanst. 11

(1): 52, t. 41, fig. 7-7a. 1885. Schatzlarer Schichten: Bohemia-Silesia; Belgium.

11. *H. crepini Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 54, t. 41, fig. 5-6. 1885. Schatzlarer Schichten: Belgium, Great Britain.
12. *H. schützei Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 56, t. 41, fig. 1-4. 1885. Schatzlarer Schichten: Moravia-Upper Silesia; Bohemia-Silesia.
13. *H. schatzlarensis Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 58, t. 40, t. 39, fig. 7-7a, tf. 11. 1885. Schatzlarer Schichten: Moravia-Bohemia-Silesia.
14. *H. aschenborni Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 63, t. 39, fig. 6, tf. 12 a-b. 1885. Schatzlarer Schichten: Moravia-Bohemia-Silesia.
15. *H. chaerophylloides (Bgt.) Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 29. 1885. (*Pecopteris chaerophylloides* Bgt., Hist. veg. Foss., 357, t. 125, fig. 1-2. 1835; Gr.-Eury, Fl. Carb. du Dep. de la Loire, 60, t. 7, fig. 1a). Upper Carboniferous: Great Britain; France.

2. **Cladotheca** Halle,

Ark. för Bot. 10 (15): 4. 1911.

Pinnules closely set, attached to rachis by the whole of the base, almost linear and obtusely pointed at the apex, 4 mm. in breadth at the base; margin faintly undulating; secondary veins running from the midrib to the margin, simple; sporangia very densely crowded, partly concealing each other, the apices of the sporangia of each two adjacent veins touching each other in the middle of the intervening segment; sporangia short-stalked (rarely up to one-third the length of the sporangium), cells of the upper apical half thick-walled, those of the lower-half thin-walled; annulus not definite, nor a stomium; sporangium occasionally splitting radially across the apex and continuing down the side; spores spherical, about 30 mu in diameter, with typical triradiate markings, otherwise smooth.

Genotype: *Cladotheca undans* (Lindl. et Hutt.) Halle.

1. *C. undans (Lindl. et Hutt.) Halle, Ark. för Bot. 10 (15): 4, 1 tf., 2 pl. 1911. Jurassic: Great Britain.

Halle (*24*, p, 7-8) asserts that the nearest analogy as regards the sporangial structure among the fossil ferns is found in *Senftenbergia*. Like the genus *Senftenbergia*, *Cladotheca* forms a transitional stage connecting the two orders Schizaeales and Marattiales, coming nearer to the Marattiales than does *Senftenbergia*. In character of the frond, *Cladotheca undans* is quite similar to *Pecopteris australis*, referred to *Todea* by Renault. However, the sporangia in the *Pecopteris* species occupy a narrow zone on each side of the vein, not a wide area as in *Cladotheca*.

3. **Senftenbergia** Corda,

Beiträge zur Flora der Vorwelt, 91, t. 57, fig. 1-6. 1845; Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 8 (2): 293-301 (187-195). 1877; 11 (1): 64-103. 1885.

Dactylotheca Zeiller, Ann. Sci. Nat. VI. 16: 184, 207. 1883; Flore foss. Bassin houil. d. Valenciennes, p. 30, fig. 16. 1888; Kidston, Trans. Geol. Soc. Glasgow 9: 27. 1891; *Dyotheca* Hartung, Abhandl. Sächs. Geol. Landesamts, Heft 18: 92. 1938.

Frond bipinnate, rachis thin, smooth, canaliculate; sporangia oval, sessile, superficial, single in two rows on the pinnules of the ultimate divisions, uniseriate on each side of the midvein, with a cone-shaped cap (annulus) of thick-walled cells at the apex, dehiscing by a vertical slit running from this annulus down one side; annular cap made up several (4-5) rows of cells; indusium none.

Genotype: *Senftenbergia elegans* Corda.

1. *S. elegans Corda, Beiträge zur Flora der Vorwelt (Fl. Protogaea), 91, t. 57, fig. 1-6. 1845 (1867); Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 62, tf. 13.

1885. Upper Carboniferous (Radnitzer Schichten): Stradonitz.

2. *S. setosa (Ett.) Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 8 (2): 293 (187), 298 (192). 1877; 11 (1): 72. 1885. (*Cyatheites setosus* Ett., Abh. d. k.-k. Geol. Reichsanst. Wien 2 (3): 44, t. 17, fig. 2-3. 1855). Radnitzer Schichten: Böhmen.
3. *S. exigua (Ren.) Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 68 et 71, tf. 14 a. c. 1885. (*Pecopteris exigua* B. Ren., Cours de Bot. Fossile 3: 115, t. 19, fig. 13-18. 1883).
4. *S. crenata (Lindl. et Hutt.) Stur, Morph. Syst. d. Culm und Carbonfarne, p. 44, 1882; Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 72, t. 45, fig. 1-3; t. 46, fig. 1-3. 1885. (*Sphenopteris crenata* Lindl. et Hutt., Fossil Flora of Great Britain 1: t. 39. 1830-32; 2: t. 100-101. 1833-35). Schatzlarer Schichten: Saarbecken; Westphalen; England; Moravia; Bohemia.
5. *S. stipulosa Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 80, t. 47, fig, 1-2; t. 46, fig. 4-5. 1885. Schatzlarer Schichten: Belgium; Moravia.
6. *S. brandauensis Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 83, t. 48, fig. 1-2. 1885. Schatzlarer Schichten: Brandau.
7. *S. boulay Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 85, t. 50, fig. 1. 1885. Schatzlarer Schichten: France.
8. *S. ophiodermatica (Goepp.) Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 87, t. 49; t. 50, fig. 2-3, tf. 15 auf p. 70. 1885. (*Asplenites ophiodermaticus* Goepp., Foss. Farne 280, t. 17, fig. 1-2. 1836). Bensham Coal Seam, Jarrow Colliery, Great Britain; Schatzlarer Schichten: Moravia, Bohemia, Saarbecken.
9. *S. plumosa (Artis) Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 8 (2): 298 (192) et 293 (187). 1877; 11 (1): 92, t. 51, fig. 1-3. 1885. (*Filicites plumosus* Artis, Antediluvian Phytology, t. 17. 1825). Schatzlarer Schichten: Germany, Belgium, France, England.
10. *S. acuta (Bgt.) Stur, Abh. d. k.-k. Geol. Reichsanst.

Wien 11 (1): 96, t. 51, fig. 4-5. 1885. (*Pecopteris acuta* Bgt., Hist. Veg. Foss. 1: 350, t. 119, fig. 3. 1828). Schatzlarer Schichten: Bohemia, Saarbrucken, Moravia.

11. *S. schwerini Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 99, t. 48, fig. 3-5. 1885. Schatzlarer Schichten: Bohemia, Moravia.
12. *S. spinulosa Stur, Abh. d. k.-k. Geol. Reichsanst. Wien 11 (1): 101, t. 48, fig. 6. 1885. Schatzlarer Schichten: Moravia.
13. *S. aspera (Bgt.) Stur, Abh. d. k.-k. Geol. Reichsanst. Wien. 8: 299 (193), t. 11, fig. 10-10 a. 1877. (*Pecopteris aspera* Brongn., Hist. Veg. Foss. 1: 339, t. 120, fig. 1-4. 1828). Ostrauer Schichten: Ida-Schachte bei 130 m. Teufe.
14. *S. larischi Stur, Abh, d. k.-k. Geol. Reichsanst. Wien 8: 300 (194), t. 11, fig. 11 a, b, c. 1877. Ostrauer Schichten: Peterswald.

KLUKIACEAE Reed, fam. nov.

Annulis sporangiorum ordine singulari cellularum instructis; *sporangiis* liberis; *indusio* nullo.

Fossil ferns, indicating perhaps the origin of the living genera of the Anemiaceae and Mohriaceae, especially the latter; position of the sporangia much as in *Senftenbergia*, but the apical annular cap with only a single row of cells; indusium none; spores trilete. Known from the Jurassic and Cretaceous Ages, widely distributed. Map C.

Key to the genera of Klukiaceae

1. Sporangia arranged uniseriately on each side of pinna-axis.
   2. Sporangia medial to submarginal, each on a separate simple secondary veinlet . 1. *Klukia.*
   2. Sporangia near the base of each lobe and one at the summit of the uppermost branch of the vein . . . . . 2. *Naktongia.*
1. Sporangia numerous, variously arranged.

2. Sporangia massed together along the veins . . . . . 3. *Schizaeopteris.*
2. Sporangia scattered all over the undersurface of the fertile pinnules . . . . . 4. *Ruffordia.*

1. **Klukia** Raciborski,

Engl. Bot. Jahrb. 13: 5. 1890 (non 1891).

Sporangia biseriate, one row on each side of the mid-vein of the ultimate segments, the fertile and sterile frond parts being situated similar to those of the living genera *Mohria* and *Hemianemia*, subgenera *Trochopteris* and *Aneimiaebotrys;* sporangia naked as in *Senftenbergia*, and naked and exindusiate as in the living *Eu-Anemia* and *Hemianemia*, subgenera mentioned above. Several species found in the Jurassic and Lower Cretaceous, widely distributed.

Genotype: *Klukia exilis* (Phillips) Raciborski.

1. *K. exilis (Phillips) Racib., Engl. Bot. Jahrb. 13: 5-6, t. 1, fig. 17-19. 1890. Jurassic: Russia, Kamenka; Sutherland.
2. *K. phillipsii (Brongn.) Racib., Engl. Bot. Jahrb. 13: 6, t. 1, fig. 16. 1890.
3. *K. acutifolia (Lindl. et Hutt.) Racib., Engl. Bot. Jahrb. 13: 7. 1890.
4. *K. yokoyamae Ôishi, Journ. Fac. Sci., Hokkaidô Imp. Univ., Ser. IV. 4 (3-4): 305. tf. 1. 1939; 5 (2-4): 199. 1940. Ryôseki Series: Japan (Haginotani and Katazi, Koti Pref.).
5. *K. zeilleri Berry, Johns Hopkins Univ., Studies in Geol. No. 4: 55. 1922; No. 13: 84. 1939. Mesozoic (Jurassic): Peru.
6. *K. browniana (Dunker) Seward (*), Ann. Bot. 38: 501. 1924. (*Pecopteris browniana* Dunker, Mon. Nord-

(*) This is the earliest published account of the combination, but there is no indication in SEWARD's article that this is the original publication.

deutsch. Wealdenbildung, p. 5, pl. 8, fig. 7. 1846). Late Jurassic and Lower Cretaceous: Portugal, Spitzbergen; Neocomian: Japan; Wealden: England, Germany, Austria; Shasta Form.: Horsetown; Chico Form.: Pacific Coast; Kootanie Form.: Montana, British Columbia: Wealden: Peru; Lower Cretaceous (Patuxent Form.): Virginia and Maryland; (Arundel Form.): Maryland; (Patapsco Form.): Virginia and Maryland.

7. ***K. koraiensis** (Yabe) Reed, comb. nov. (*Cladophlebia (Klukia) koraiensis* Yabe. Journ. Coll. Sci., Imp. Univ. Tokyo, 20 (Art. 8): 32, pl. 2, fig. 1; pl. 3, fig. 12-13. 1905). Rakutô Bed: Butudôken and Ryûsindô, Japan.

Nathorst (*38*) in 1890 described the genus *Dicksoniopteris* for a fruiting bipinnate frond from the Ryôseki Series of Haginotani, Koti Prefecture, the species having been named, *D. naumanni*. Yokoyama (*66*) later described some fossil plants of this same series from various localities in the Japanese Islands and identified a fruiting bipinnate frond from Katazi in the Ryôseki District, Koti Prefecture, with *D. naumanni*. However, Ôishi (*43*, p. 301), after examining Yokoyama's specimen in the Geological Institute of the Tokyo Imperial University, found that the specimen represented a new species belonging to the genus *Klukia*, and proposed the name *Klukia yokoyamae*. Ôishi had been advised by Dr. Halle of Stockholm that the *D. naumanni* of Nathorst was an obscure species, and that better preserved material should not be identified with it.

While discussing the validity of *Klukia* and *Dicksoniopteris* as generic names, Ôishi (*44*) states: «If Nathorst's specimen were revealed in any way to bear the sporangia of *Klukia*-type, then Nathorst's generic name *Dicksoniopteris* (1890) should be substituted for *Klukia* which was founded a year later than the former». This statement seems to be valid, since the generally accepted citation for the generic name *Klukia* reads: «*Klukia* Raci-

borski, Engl. Bot. Jahrb. 13: 5. 1891». However, the reverse side of the title page of Vol. 13 reads: «Vol. 13: 1-272. 1890; 273-606, Lit. 1-159, Beibl. 29. 1891». Evidently, Ôishi was not aware of this note. Consequently, both generic names appeared early in their respective volumes in 1890, *Klukia* on page 5 and *Dicksoniopteris* on page 13. Since *Klukia* has been taken up and used for several species, some of which possess very good fruiting material, that generic name remains to represent the Schizaeaceous ferns discussed above. Whether *Dicksoniopteris* be valid or not, in the opinion of the author, *Klukia* need not lose its validity on the basis of publication priority. In fact, if *D. naumanni* of Nathorst proves to possess sporangia of the *Klukia*-type, then it may eventually be placed in that genus.

On the basis that *Klukia* is the earliest described genus in this complex of genera of fossil ferns having Schizaeaceous affinities, characterized by the apical annular cap having only a single row of cells, the name **Klukiaceae** has been assigned to the family thus represented.

However, it should be kept in mind that the generic name *Klukia* had been used by Andrz. in DeCandolle (System. II. 1812) for a Cruciferous group of species of the Mediterranean Region. This group is now referred to the genus *Malcolmia* (*'Malcomia'*) R. Br., in Aiton (Hort. Kew, ed. 2, IV: 121. 1822; *vide* Dalla-Torre et Harms, p. 190, 3032. 1900-07).

2. **Naktongia** Ôishi,

Journ. Fac. Sci., Hokkaidô Imp. Univ., Ser. IV. 4 (3-4) : 310. 1939.

Sporangia arranged in a single row on each side of pinna-axis, each sporangium corresponding with a single pinnule; annulus apical, uniserial, with a broad distal face. Known from the Upper Jurassic.

Genotype: *Naktongia yabei* Ôishi.

1. *N. yabei Ôishi, Journ. Fac. Sci., Hokkaidô Imp. Univ., Ser. IV. 4 (3-4): 310, pl. 35, fig. 3, tf. 2. 1939. Upper Jurassic: Korea (Naktong).

Ôishi (*43*, p. 310) states: « Among fossil Schizaeaceous ferns the present specimen *(Naktongia yabei)* resembles *Ruffordia* in respect to the Sphenopteroid habit of the frond, but in the latter the sporangia are scattered all over the surface of the fertile pinnules ».

However, the arrangement of the sporangia in a single row on each side of the pinna-axis suggests a closer affinity to *Klukia* than to *Ruffordia* in my opinion.

3. **Schizaeopteris** Stopes et Fujii,

Proc. Roy. Soc. Lond. 81 B: 560. 1909 (Abstract); Phil. Trans. Roy. Soc. Lond. 201 B: 6, 10, tf. 1-3, t. 2, fig. 1. 1911; International Cat. Sci. Liter. Palaeont. 9: 192 *(Schizoecopteris)*. (1909) 1911.

Sporangia numerous, arranged closely together along the veins, each standing separately on a broad base, sessile; annulus apical, the widest portion, consisting of a single row of 12-14 cells, symmetrical, the walls of the annular cells being very much thickened; indusium none; spores tetrahedral, trilete, 0.04 mm. in diameter; epidermal cells possessing straight walls.

Genotype: *Schizaeopteris mesozoica* Stopes et Fujii.

1. *S. mesozoica Stopes et Fujii, Phil. Trans. Roy. Soc. Lond. 201 B: 6, 10, tf. 1-3, t. 2, fig. 1. 1911. Upper Cretaceous: Japan.

Schizaeopteris differs from the living genera in the relative massiveness of its annular cap, which appears to be the widest part of the sporangium, unlike the living

genera (except *Hemianemia* subgenus *Trochopteris)*, in which it usually narrows down at the apex. The position of the sporangia on the veins is characteristic of the extant members of the order: in Lygodiaceae and Mohriaceae there is only a single sporangium on each vein; in Schizaeaceae a double row lies along the single central vein of the reduced sporangiferous segment; and in Anemiaceae the sporangia are irregularly placed on either side of the branching veins of the specialized vegetative portion.

In *Schizaea* and several species of *Anemia* the epidermal cellwalls are straight, whereas in the other genera they are irregularly curved and fitted into each other. The fossil has straight-walled cells, which character supports the view, based on the characters of the sporangia, that this genus is connected with *Anemia* and *Hemianemia*. The stalkless base of the sporangium in *Schizaeopteris* is shared with the simpler species of *Schizaea*, as pointed out by Stopes and Fujii. They suggest that the sporangia were arranged thickly along the veins, so that a tangential section cutting the veins would show a mass of sporangia, as their illustrations indicate.

Regarding the validity of the publication of the generic name *Schizaeopteris*, the following notes are pertinent. In Stopes and Fujii, Proc. Roy. Soc. Lond. 81 B; 560. 1909, are mentioned the following: « *Schizaeopteris Tansleii* gen. et spec. nov. The sorus and sporangia of a Schizaeaceous Fern. *Fasciostelopteris mesozoica* gen. et spec. nov. The stem and petiole of a fern, with a dictyostelic anatomy. Probably allied to the Dicksoniaceae ». Then, in Phil. Trans. Roy. Soc. Lond. 201 B: 10. 1911, the same authors published: « *Schizaeopteris* gen. nov. and *S. mesozoica* sp. nov. » Also on page 15: « *Fasciostelopteris* gen. nov. and *F. Tansleii*, sp. nov. ». The species were interchanged by the authors themselves, and since the earlier published names were mere 'nonima', and since the later citations are accompanied by lengthy descriptions and figures, the names published in 1911 are used here to establish the genera and species.

4. **Ruffordia** Seward,

Wealden Fl., pt. 1 : 75 1894;
Berry, Maryland Geol. Surv., Lower Clet., 2s0--233, t. 23. 1911; Halle. Ark. för Bot. 17 (1) : 11, t. 2, fig. 1-8, tf. 1. 1921.

Fronds tri-quadripinnate, triangular in outline; rachis frequently flexuous; pinnae alternate, broadly triangular to ovate-lanceolate; pinnules delicate, decurrent somewhat variable, with linear acuminate ovate cuneate ultimate divisions, dentate or denticulate; veins flabellate, repeatedly forked; ferti'e pinnae considerably reduced, with scattered sporangia (*6*, p. 230). Spores tetrahedral, striate; sporangia with apical annulus. Related to the Anemiaceae: scattered sporangia occur in *Hemianemia*, subgenus *Trochopteris*; the most reduced annulus occurs in *Hemianemia*, subgenus *Coptophyllum*.

Genotype: *Ruffordia goepperti* (Dunker) Seward.

1. *R. goepperti (Dunker) Seward, Wealden Fl., pt.: 76-77, t. 4-5, 10, fig. 1-2. 1894. (*Cheilanthites goepperti* Dunker, Norddeutsch, Wälderthon, Program der hoheren Gewerbschule in Cassel, 1843-44: 6. 1844). Neocomian, Wealden, Barremian or Albian Age in England, Germany, Belgium, Russia, Portugal, Austria and Japan; Lower Cretaceous (Patuxent Form.): Fredericksburg, Dutch Gap and Trents Reach, Virginia; Mesozoic (Jurassic and Lower Cret.): Peru, Piñonate; Cretaceous: Patagonia; Jurassic: Hope Bay, Graham Land.
2. *R. acrodentata (Font.) Berry, Maryland Geol. Surv., Lower Cret. 230, t. 23, fig. 5-6. 1911. (*Sphenopteris acrodentata* Font., Mon. U. S. Geol. Surv. 15 (1889); 90, t. 34, fig. 4. 1890). Lower Cretaceous (Patuxent Form.): Dutch Gap, Virginia; (Patapsco Form.): Federal Hill (Baltimore), Maryland.

Another species, *Ruffordia mortoni*, has been described from the Upper Cretaceous of Australia. Also there are several species in the form-genus *Sphenopteris* which might be placed here after more fertile material has accumulated and been carefully studied. Also, many of the species generally placed in the form-genus *Cladophlebis* may be transferred to *Klukia* or *Ruffordia*.

Seward (*55*, p. 91, fig. 2 A) describes the spores of *Ruffordia goepperti* from the Hastings District of England: «the spores are .05 mm. in diameter, and have a rounded triangular form, the surface being characterized by the presence of numerous ridges (text-fig. 2 A): they agree in shape and sculpturing with those of certain recent Schizaeaceous ferns, and are similar to the spores of Mr. Berry's Potomac fern *Schizaeopsis americana*».

Halle (*25*, p. 11-12, tf. 1) describes the annulus in the sporangium of *Ruffordia goepperti* as tranverse, apically situated, 0.25 to 0.30 mm. in diameter, constructed of about 25 elongated cells. Concerning the spores of this specimen from Russian Manchuria (near the village of Konstantinovskaja in the Ussuri District) Halle describes them: «the spores are of the tetrahedral type, with a diameter of 0.035 to 0.050 mm. Their surface shows the tetrad scar and a distinct sculpture of fine dense ridges, which is more prominent on the side facing outward in the tetrad».

TEMPSKYACEAE Read et Brown,

U. S. Geol. Surv., Prof. Paper 186-F: 108. 1937.

Vascular system of stem a solenostele; roots diarch. A stem form-family, with its affinities nearest Klukiaceae and Acrostichopteridaceae. Map D. A single genus.

1. **Tempskya** Corda, emend. Kidston et Gwynne-Vaughan,

Russ. k. Min. Gesell. Verh. 48: 13, pl. 1-3. 1911.

Stems of small diameter, erect, dichotomous, and embedded in a felted mass of their own adventitious roots.

Dorsiventral, with the leaves in two rows on one side of the stem and roots alone on the opposite side. Vascular system of stem a solenostele. Leaf trace departs as a single strand. Roots diarch (*28*, p. 13). Known from the Cretaceous, about 14 species.

Genotype: *Tempskya rossica* Kidston et Gwynne-Vaughan.

1. *T. rossica Kidst. et Gwynne-Vaughan, Russ. k. Min. Gesell. Verh. 48: 13, pl. 1-3. 1911. Upper Cretaceous: Basin of Karaganda River, west of Mugodjar Mountains, Russia; Japan? (Kii, according to ENDO).
2. *T. knowltoni Seward, Ann. Bot. 38 (151): 485-507, pl. 16-17. 1924; Read et Brown, U. S. Geol. Surv., Prof. Paper 186-F: 112-114, pl. 28, fig. 1-3; pl. 29, fig. 3; pl. 30, fig. 1-2; pl. 31, fig. 1-2; pl. 23, fig. 1; pl. 42, fig. 4; pl. 43, fig. 2-3. 1937. Upper Cretaceous (Colorado Shale): Southeast of Harlowton, Montana.
3. *T. grandis Read et Brown, U. S. Geol. Surv., Prof. Paper 186-F: 114-117, pl. 29, fig. 2; pl. 32, fig. 2-5; pl. 33, fig. 1-3; pl. 43, fig. 1, 4-7. 1937. Upper Cretaceous (Aspen Shale): Afton Quadrangle (sec., T. 35 N., R. 115 W.), Wyoming; (Aspen Shale): Lincoln Co., (sec. 14, T. 13 N., R. 115 W.), Wyoming.
4. *T. minor Read et Brown, U. S. Geol. Surv., Prof. Paper 186-F.: 117-119, pl. 29, fig. 1; pl. 36, fig. 1-4; pl. 37, fig. 1-4; pl. 38, fig. 1-4; pl. 39. fig. 1-4; pl, 40, fig. 1-3; pl. 41, fig. 1-3; pl. 42, fig. 5. 1937. Upper Cretaceous (Aspen Shale): Wyoming; (Wayan Formation): Idaho.
5. *T. whitei Berry, Maryland Geol. Surv., Lower Cretaceous, 295-299, pl. 37-38. 1911. Lower Cretaceous (Patapsco Form.): Stony Run and Deep Run, near Severn, Anne Arundel Co., Maryland.
6. *T. pulchra Corda, A. J. Flora Protogaea, Beiträge zur Flora der Vorwelt, 81. 1845. Cretaceous: Bohemia (along Elbe River, east of Neupaka).
7. *T. macrocaula Corda. A. J. Flora Protogaea, Beiträge zur Flora der Vorwelt, 81. 1845. Cretaceous: Bohemia (along Elbe River, east of Neupaka).

8. *T. schimperi Corda, A. J. Flora Protogaea, Beiträge zur Flora der Vorwelt, 81. 1845. Hils Beds (Hastings Sands): Neundorf, near Hannover, Germany; Wealden: Glageon and Fourmies, France.
9. *T. microrrhiza Corda, A. J. Flora Protogaea, Beiträge zur Flora der Vorwelt, 81. 1845. Cretaceous: Bohemia (along Elbe River, east of Neupaka).
10. *T. cretacea Hosius et von der Marck, Palaeontographica 26: 192 (68), pl. 39, fig. 161-163. 1880. Senonian: Haltern in Westphalia, Germany.
11. *T. varians (Corda) Velenovsky, K. Böhm. Gesell. Wiss. Abh., Folge 7. 2: 23. 1888. Cenonomian (Perucer Beds): Bohemia.
12. *T. wesselii Arnold, Papers Mich. Acad. Sci., Arts and Lett. 30 (1944): 26, pl. 7-9. 1945. Kootanie Form.: Great Falls, Montana; Greenhorn, Oregon.
13. *T. wyomingensis Arnold, Papers Mich. Acad. Sci., Arts and Lett. 30 (1944): 30, pl. 10; pl. 11, fig. 1. 1945. Morrison Form.: Greybull, Wyoming.
14. *T. erosa (Stokes et Webb) Stopes, Catalogue Mesozoic Pl. in Brit. Mus. (Nat. Hist.), 9-12, tf. 2-5. 1915. (*Endogenites erosa* Stokes et Vebb, in Mantell, Geol. Soc. Lond. Trans., II. 1: 423, pl. 46, fig. 1-2; pl. 47, fig. 5 a-b. 1824). Wealden: England (Sussex, Tilgate Forest and Isle of Wight); Lower Greensand (Aptian): Potton, near Woburn in Bedford; also in Ireland.

An extensive discussion of this group and its relationships to the other families in the order Schizaeales is found in the forepart of this paper.

ACROSTICHOPTERIDACEAE Reed, fam. nov.

Pterides fossiles; *sporangia* in soros nudos in latere inferiore ultimarum segmentorum frondium aggregata; *segmenta fertilia* scortim, rotunda, elliptica vel sphaerica; *venulae* tenues sed distinctae, flabellatim furcantes; *indusium* nullum; *sporae* triletes, striatae.

Fossil ferns; sporangia massed in naked sori on the

lower side of the ultimate divisions of the fronds; fertile segments leathery, rounded, elliptical or sphaerical; veinlets slender but distinct, flabellately divergent; indusium none; spores trilete. Known from the Cretaceous of Maryland, Virginia, Montana, Wyoming; England (Wealden); Portugal (Albian, Aptian, and Upper Jurassic). Map. B.

Key to the genera of the Acrostichopteridaceae

1. Spore-masses or sporangia on rounded or elliptical lobes of the ultimate segments.
   2. Ultimate fertile pinnae modified into leathery rounded or elliptical segments . . . . . 1. *Acrostichopteris.*
   2. Ultimate fertile pinnae bearing nearly spherical spore-masses near the tips. . . 2. *Pelletieria.*
1. Spore-masses or sporangia on spindle-shaped ultimate segments . . . . . 3. *Schizaeopsis.*

Acrostichopteris Fontaine,

Mon. U. S. Geol. Surv. 15 : 106. 1890: Berry, Proc. U. S. Nat. Mus. 38 : 625-627, 627-632. 1910; Maryland Geol. Surv., Lower Cret., 220-222. 1911; Jongmans Palaeobot. Lit., 47. 1913.

Fronds probably creeping, with very long, often flexuous rachises, which seem to have been more or less succulent; pinnae oblique, long and apparently slender; ultimate pinnae or pinnules subopposite to alternate, comparatively short, and cut nearly to the rachis into more or less cuneate-flabellate pinnules, these generally divided into cuneate-flabellate segments, which in turn are separated into oblong segments, ending in oblong, or ovate-obtuse, or acute teeth; pinnules decurrent and forming a wing; nerves slender but distinct, flabellately divergent, forking dichotomously, and ending in the teeth; fructification occurring on the basal segments of the pinnules, in the upper portions of the frond on the upper one alone, in the lower portions on the upper and lower ones, the

fructified segments closely appressed to the principal rachis; fertile segments leathery, rounded or elliptical, covered on the lower side by the nacked sori.

Genotype: *Acrostichopteris longipennis* Fontaine.

1. *A. longipennis Fontaine, Mon. U. S. Geol. Surv. 15: 107, t. 10, fig. 10, t. 171, fig. 1, 5, 7. 1890; emend. Berry, U. S. Nat. Mus. Proc. 38: 627. 1910. Lower Cretaceous (Patapsco Form.): Virginia, Mount Vernon; Federal Hill, Maryland.
2. ***A. debilior** (Sap.) Reed, comb. nov. *(Sphenopteris debilior* Sap., Fl. Foss. Portugal, 161, t. 28, fig. 5-5a. 1894). Albian Form.: Portugal.
3. *A. adiantifolia (Fontaine) Berry, Proc. U. S. Nat. Mus. 38: 629. 1910. *(Baieropsis adiantifolia* Fontaine, Mon. U. S. Geol. Surv., 15: 211, t. 92, fig. 8-9; t. 93, fig. 1-3; t. 94, fig. 2-3. 1890). Lower Cretaceous (Patuxent Form.): Fredericksburg, Virginia, Potomac Run; (Arundel Form.): Arlington, Maryland; (Patapsco Form.): Fort Foote, Maryland; Chinkapin Hollow, Virginia.
4. *A. cyclopteroides Fontaine, Mon. U. S. Geol. Surv. 15 (1889): 109, t. 94, fig. 8. 1890; emend. Berry, Proc. U. S. Nat. Mus. 38: 630. 1910. Lower Cretaceous (Patuxent Form.): Dutch Gap, Virginia.
5. ***A. flabellina** (Sap.) Reed, comb. nov. *(Sphenopteris flabellina* Sap., Fl. Foss. Portugal, 160, t. 28, fig. 3, 6. 1894). Albian Form.: Portugal.
6. *A. parvifolia Fontaine, Mon. U. S. Geol. Surv. 15 (1889): 108, t. 94, fig. 5, 9, 10, 12; t. 171, fig. 3-4; t. 172, fig. 4. 1890 (partim); non Font. in Ward, 1906. Lower Cretaceous (Patuxent Form.): Dutch Gap, Fredericksburg, Trents Reach, Potomac Run, Virginia.
7. *A. fimbriata Knowlton, Smiths. Misc. Coll. 1: 110, t. 11, fig. 3-3a. 1907. Kootanie Form.: Montana.
8. *A. ruffordii Seward, Wealden Fl. pt. 1: 61, t. 6, fig. 3. 1894; Knowlton, Smiths. Misc. Coll. 1: 110, t. 11, fig. 3-3a. 1907. Wealden Form.: England; Kootanie: Montana.

9. *__A. tenellisecta__ (Sap.) Reed, comb. nov. (*Sphenopteris tenellisecta* Sap., Fl. Foss. Portugal, 25, t. 13, fig. 1. 1894). Upper Jurassic: Portugal.
10. *__A. flabellisecta__ (Sap.) Reed, comb. nov. (*Sphenopteris flabellisecta* Sap., Fl. Foss. Portugal, 69, t. 15, fig. 14-15. 1894). Aptian Form.: Portugal.
11. *A. pluripartita (Font.) Berry, Proc. U. S. Nat. Mus. 38: 631. 1910. (*Baieropsis pluripartita* Font., Mon. U. S. Geol. Surv. 15 (1889): 208, t. 89, fig. 4; t. 90, fig. 2-5; t. 91, fig. 1, 3, 4, 7; t. 102, fig. 1, 2, 6. 1890). Lower Cretaceous (Patuxent and Patapsco Form.): Maryland, Virginia; (Lakota and Fuson Form.): Black Hills, Wyoming.
12. *__A. cuneifida__ (Sap.) Reed, comb. nov. (*Sphenopteris cuneifida* Sap., Fl. Foss. Portugal, 69, 127, t. 16, fig. 11; t. 23, fig. 5. 1894). Urgonian-Aptian Form.: Portugal.
13. *__A. dissectiformis__ (Sap.) Reed, comb. nov. (*Sphenopteris dissectiformis* Sap., Fl. Foss. Portugal, 68, t. 15, fig. 18; t. 16, fig. 12-13. 1894). Aptian: Portugal.
14. *__A. tenuifissa__ (Sap.) Reed, comb. nov. (*Sphenopteris tenuifissa* Sap., Fl. Foss. Portugal, 161, t. 28, fig. 4. 1894). Albian: Portugal.
15. *A. expansa (Font.) Berry, Maryland Geol. Surv., Lower Cret., 229, 1911. (*Baieropsis expansa* Font., U. S. Geol. Surv. Mon. 15: 207, t. 89, fig. 3; t. 90, fig. 2; t. 92, fig. 5 (non t. 89, fig. 1 = *Schizaeopsis americana*). 1890). Patuxent Form.: Fredericksburg, Dutch Gap, Trents Reach, Virginia.

2. **Pelletieria** Seward,

Quart. Journ. Geol. Soc. Lond. 69 : 91. 1913.

Fertile fronds consisting of a slender main axis, giving off lateral branches at an acute angle which fork repeatedly, the ultimate ramifications being very thin and divergent; nearly spherical carbonized bodies (presumably masses of sporangia) borne at the tips of the fertile bran-

ches; spores tetrahedral, numerous, 60-70 mu in diameter, characterized by well-defined surface-ridges, trilete. Known from the Wealden of England.

Genotype: *Pelletieria valdensis* Seward.

1. *P. valdensis Seward, Quart. Journ. Geol. Soc. Lond. 69: 91, pl. 12, fig. 12a-b; pl. 14, fig. 5; tf. 2B, 3-4. 1913. Cretaceous (Wealden): England.

The form of sculpturing on the spores of *Pelletieria* is much like that found in recent species of Anemiaceae and Mohriaceae, as well as in the tropical water-fern *Ceratopteris:* the spores in *Mohria caffrorum* measuring 80 mu in diameter; those of *Anemia tomentosa*, 110 mu; as compared to those of *Pelletieria*, 60-70 mu. Boodle (*9*, p. 137) described the spores found with the Wealden fern *Tempskya* as 65 mu in diameter. Seward states that these spores of *Tempskya* bear a very close resemblance to those of *Pelletieria*. Also the spores of *Schizaeopsis* are very close in structure to those of *Pelletieria*, having a diameter of 100 mu. Berry (*5*) regarded the spore-masses of *Schizaeopsis*, which are spindle shaped bodies, as consisting of many closely arranged sporangia. The Sussex specimens of *Pelletieria* show no evidence as to the nature of the sporangium.

3. **Schizacopsis** Berry,

Ann. Bot. 25 : 194. 1911: Maryland Geol. Surv., Lower Cret., 214-219, t. 22, fig. 1-9, tf. 2. 1911.

Fossil ferns with repeatedly dichotomous fan-like fronds made up of ribbon-like coriaceous segments; veins thin and parallel, forking dichotomously at intervals; fructifications massed in fusiform bodies of relatively large size, and consisting of numerous closely packed sporangia, whose structure and detailed arrangement is unknown; fructifications borne at the distal ends of certain of the veins at varying heights, usually along the

margins, but occasionally on the face of the lamina, ordinarily massed toward the distal ends of the ultimate divisions of the frond, as in the recent *Schizaea elegans*, the ultimate ones appearing as continuations of the ultimate teeth which terminate the distal laciniae: spores spheric--tetrahedral, thich-walled, massively striated, trilete. Known from the Lower Cretaceous of Virginia.

Genotype: *Schizaeopsis americana* Berry.

1. *S. americana Berry, Maryland Geol. Surv., Lower Cret., 216. 1911. Lower Cretaceous (Patuxent. Form.): Fredericksburg, Virginia.

Although BERRY points out the generally accepted fact that the spores in *Anemia* and *Lygodium* are spheric--tetrahedral in shape, but apparently not in *Schizaea*, the author may comment that the spores of the fossil as well as of the recent species of the genus *Microschizaea* are subglobose, but monolete, instead of trilete. Also *Schizaeopsis* offers a combination of characters, each of which has predominated in one of the genera of the Schizaeaceae, as emended: the coriaceous dichotomous blade of *Schizaea (Lophidium)*, the spindle-shaped sporangiophores of *Actinostachys* and the subglobose spores of *Microschizaea*.

OF DOUBTFUL AFFINITY

Teilhardia Seward (Quart. Journ. Geol. Soc. Lond. 69: 96. 1913) was described a few pages following the genus *Pelletieria*, as one of doubtful affinity. The description of the species is as follows:

Teilhardia valdensis Seward, Quart. Journ. Geol. Soc. Lond. 69: 96, pl. 11, fig. 7a-9b. 1913. Frond tripinnate; pinnae linear, alternate; pinnules on the smaller branches more or less deltoid, with obtuse apices; other pinnules linear and relatively narrower, entire or crenulate, and attached almost at right angles to the pinna-axis; venation very imperfectly preserved; no sporangia; no spores. Wealden: Fairlight Clay, Ecclesbourne, near Hastings, England.

SEWARD comments that the longer and narrower type of fertile pinnule reminds one of *Cladophlebis browniana* and *Klukia exilis;* but that the size of the elliptical patches on each side of the midrib suggests sori rather than single sporangia of *Klukia.* In the opinion of the present author I think that this genus, although imperfectly known, belongs in the family Acrostichopteridaceae rather than in the Klukiaceae.

SCHIZAEACEAE Kaulf.,

Wesen d. Farnkr., 119 (partim). 1827; emend. Presl. Abh. K. Böhmischen Ges. Wissensch., V. 4 : 332. 1845 (*) (Suppl. Tent. Pterid., 72 (partim). 1845); Prantl, Schiz, 58 (partim). 1881.

Schizaeaceae subord. I. *Euschizaeaceae* Presl, Suppl. Tent. Pterid., 72. 1845; *Schizaeaceae* subfam. *Schizaeaceae* Diels, in Nat. Pfl.-fam. 1 (4): 362-363. 1900.

Fronds polystichous, simple or forked, unicostate, grass- or rush-like, or flat and repeatedly dichotomous with uni- or pluricostate divisions; sporangiophores terminal on the costae, spuriously digitate in a penicillate tuft with the sporangia apparently in four rows or pinnate with the sporangia in two distinct rows, partly protected by the indusium-like recurved margins; spores subglobose or bilateral, smooth, verrucose or reticulate, monolete. Maps E, F, G.

Key to the genera of the Schizaeaceae

1. Sporangiophores digitate in a penicillate tuft with the sporangia apparently in 4 rows; spores bilateral; fronds simple . . . . . 2. *Actinostachys*
1. Sporangiophores pinnate in a terminal spike with the sporangia in two rows.

(*) Suppl. Tent. Pterid. is a reprint, with changed pagination, from Abh. K. Böhmischen Ges. Wissensch. V. 4: 261-380. 1845.

2. Spores bilateral; fronds simple or repeatedly dichotomous, the divisions usually numerous, linear or broader and rather leafy, unicostate or multicostate, forming a flabellate blade . . 3. *Schizaea.*
2. Spores ovoid to subglobose; fronds simple, sterile ones grayish-green, shorter than the fertile ones; rarely semiaquatic plants; blades linear . . . . . 3. *Microschizaea.*

1. **Schizaea** J. E. Smith, emend. Reed.

(J. E. Smith, Mem. Acad. Turin 5 : 419 (partim). 1793).

Sporangiophores pinnate; spores bilateral, verrucose; fronds varying from simple to simply forked to repeatedly dichotomous with barely to extensively expanded blades, the fertile segments being simple or dichotomous; sporangia borne in only two rows. About 14 species of the tropics and subtropics. Map G.

Genotype: *Schizaea dichotoma* (L.) J. E. Smith (*Acrostichum dichotomum* L.)

Key to the subgenera of Schizaea

1. Sterile blades expanded.
   2. Blades only narrowly expanded, the fronds dimorphic, several times dichotomous with the segments not fused together, the main vein of each segment terminating in a sporangiophore . . . . . A. *Eu-Schizaea.*
   2. Blades various, ranging from nearly simple to merely forked to several times dichotomous, then the segments fused to form a flabellate blade, the numerous veins terminating each in a sporangiophore . . . . . B. *Lophidium.*
1. Sterile blades apparently absent; the fronds rush-like, simple or forked . . . . . C. *Paraschizaea.*

Subgenus A. **Eu-Schizaea** Reed, nom. nov.

Schizaea sect. III. *Lophidium* (Rich.) Diels. A. *Dichotomae* (Prantl) Diels, in Nat. Pfl.-fam. 1 (4): 363. 1900; *Schizaea* sect. 4. *Dichotomae* Prantl, Schiz., p. 129. 1881; *Ripidium* Bernh., Schrad. Journ. 1800 (2): 127. 1801.

Frondes steriles expansae; *vena prima* singuli segmenti in sporangiophorem terminans.

In this subgenus the sterile blades are expanded into numerous dichotomously divided segments which are not fused together, the main vein of each segment terminating in a sporangiophore. The P:E value for the spores varies from 0.63-0.64.

Type: *Schizaea dichotoma* (L.) J. E. Smith

1. S. dichotoma (L.) J. E. Smith, Mem. Acad. Turin 5: 422, t. 9, fig. 9. 1793. (*Acrostichum dichotomum* L., Sp. Pl. 2: 1068. 1753). New Caledonia, Fiji, New Hebrides, Aneityum Island, New Guinea, tropical Polynesia to Madagascar and Mascarene Islands.*
2. S. poeppigiana Sturm, Fl. Bras. 1 (2): 181. 1859. Cuba, Venezuela.

Subgenus B. **Lophidium** (L. C. Rich.) Reed, comb. nov.

Schizaea sect. III. *Lophidium* (L. C. Rich.) Diels, B. *Elegantes* (Prantl) Diels, in Nat. Pfl.-fam. 1 (4): 363. 1900; *Schizaea* sect. 5. *Elegantes* Prantl, Schiz., p. 129. 1881; *Lophidium* L. C. Rich., Act. Soc. Hist. Nat. Paris 1: 114. 1792.

Frondes steriles expansae; venae numerosae singulae in sporangiophores terminantes.

The sterile blades in this subgenus are also expanded, ranging from nearly simple to merely forked to nume-

* Specimens of this species vary considerably, probably representing several varieties. Also there must be more species to connect this with the next species in South America.

rously dichotomous, and then the segments are fused to form a flabellate blade with the numerous veins, each terminating in a sporangiophore. The P : E value for the spores varies from 0.59-0.63 in the species studied.

Type: *Schizaea elegans* (Vahl) Swartz.

3. S. elegans (Vahl) Swartz, Schrad. Journ. 1800 (2): 103. 1801. (*Acrostichum elegans* Vahl, Symb. 2: 104, t. 50. 1791). Trinidad, Mexico to Peru, Brazil, Colombia.
3a. S. elegans var. angustior R. Bonap., Notes Pterid. 1: 172. 1915. Trinidad, Santa Cruz.
4. S. fluminensis Miers ex Sturm, in Mart. Fl. Bras. 1 (2): 184, t. 15, fig. 2. 1859. Brazil, Grenada.
5. S. sprucei Hooker ex Baker, in Hook., Ic. Pl. t. 1016. 1867. Amazonas, Rio Negro.
6. S. pacificans Mart., Ic. Cr. Bras., 116, t. 56, fig. 1. 1834. Brazil.
7. S. biroi Richter, Math. Termesz. Ertesito, Budapest 29: 1083, t. 1-4. 1911. New Guinea.
8. S. copelandica Richter, Math. Termesz. Ertesito, Budapest 29: 1084, t. 1-4. 1911. Borneo, Malaysia.
9. S. forsteri Spreng., Anleit. 3: 157. 1804. New Caledonia.
10. S. cristata Willd., Sp. Pl. 5: 88. 1810. Society Islands, Borneo (Sarawak).

Subgenus C. **Paraschizaea** Reed, subgen. nov.

Schizaea sect. II. *Eu-Schizaea* Hook., B. *Bifidae* (Prantl) Diels, in Nat. Pfl.-fam. 1 (4): 363. 1900; *Schizaea* sect. 3. *Bifidae* Prantl, Schiz., p. 129. 1881; *Schizaea* set. II. *Eu-Schizaea* Hook., A. *Pectinatae* (Prantl) Diels, in Nat. Pfl.-fam. 1 (4): 363 (partim). 1900; *Schizaea* sect. 2. *Pectinatae* Prantl, Schiz., p. 129 (partim). 1881.

Frondes steriles ut videtur desunt; *frondes fertiles* simplices vel bifurcatae.

The sterile blades are apparently absent in this subgenus. The fronds are rush-like, being either simple or forked. The P : E value of the spores varies from 0.63-0.65.

Type: *Schizaea pectinata* (L.) Swartz.

11. S. pectinata (L.) Swartz, Schrad. Journ. 1800 (2): 102. 1801. (*Acrostichum pectinatum* L., Sp. Pl. 2: 1068. 1753). South Africa, St. Helena, Madagascar.
12. S. incurvata Schkuhr, Kr. Gew. 1: 138, t. 137. 1809. Brazil, British and Dutch Guiana.
13. S. bifida Willd., Schrift. Akad. Erf. 1802: 30, t. 3, fig 3. 1802. Australia, New Zealand, New Caledonia, Tasmania.
14. S. kikuzatonis Ogata, Journ. Jap. Bot. 11: 36, fig. 6. 1935. Liukiu (Ins. Kume-sima).

A brief survey of the taxonomy and nomenclature of the genus *Schizaea* from the time J. E. Smith originally described it up to the present time may serve to clarify some of the reasons for separating the genus, as it has been considered conservatively, into three genera, and for dividing these three genera into various subgenera or sections.

The original description of the genus *Schizaea* by J. E. Smith (58) reads:

> « Fructif. in appendiculo frondis, ejusdemque dorsum tegentes. Involucra e marginibus appendiculi inflexis, continuis, confer. Fig. 9. Obs. Genus habitu distinctissimum, charactere obscurum. Namen a schizo, findo.
>
> Ex Gen. Acrostichum pectinatum Linn.
> Acrostichum dichotomum ejusd.
> Acrostichum elegans Vahl, Symb. 2, t. 50.
> Acrostichum spicatum Linn., Smith, Pl. Ic. t. 49 ».

Then, on page 422, describing figure 9, Smith writes: « *Schizaea dichotoma.* aa. Apex frondis fructicantis. bb. Aucta. cc. Involucr. »

No type is explicitly designated, but he figures *Schizaea dichotoma* as the species illustrating the newly described genus. However, he includes *Acrostichum pectinatum*, but does not explicitly transfer it to the genus *Schizaea*. The Greek word *schizo*, or Latin *findo*, means cleave, separate, split or divide; here alluding to the dichotomous character of the fronds in *Schizaea dichotoma*.

Not until 1801 was the combination *Schizaea pectinata* explicitly made by SWARTZ (*61*). Besides the four species mentioned by J. E. SMITH, SWARTZ also mentions *Acrostichum digitatum* Linn.

In the same publication BERNHARDI (*4*) on page 127 describes a new genus *Ripidium*, as follows:

> « *Ripidium* mihi T. 2, f. 3.
> Sporangia subturbinata, supra concentrice striata, rima latere dehiscentia.
> E. g. *Ripidium dichotomum* (*Acrostichum dichotomum* Forster *Osmunda* Sprengel) ».

Then on page 128, BERNHARDI writes: « — 2. *Acrostichum dichotomum* L et Forst. species valde diversae. Illud Cl. Smith ob gyri praesentiam ad Schizaeam retulit, hoc a Cl. Sprengel, ab illo non differre putante, perperam Osmundae generi adscriptum est ».

In order to clarify what BERNHARDI meant, both descriptions of *Acrostichum dichotomum*, are included below.

> *Acrostichum dichotomum* sensu Forst. (*21*), non L., reads: « 415. *A. dichotomum*, nudum dichotomum, spicis secundis adscendentibus reflexis. M. S. V. p. 929, n. 12. Societatis insulae ».
>
> Likewise, in Linnaeus' Species Plantarum, p. 1524, one finds: « *dichotomum*. 8. *Acrostichum* nudum dichotomum, spicis secundis adscendentibus reflexis compressis. Filix cochin. Pet. Gaz. t. 70, f. 12. Habitat in China. Refert *A. pectinatum* caule et spica, at caulis est pluries dichotomus totidem spicis ».

Even though the descriptions of *A. dichotomum* read practically identical BERNHARDI states, not that FORSTER and LINNAEUS had different phrase-names, but that they had different plants. The present author does not want to state definitely whether the plants are identical or not, as he has not seen the material upon which the remarks were based. As his reference to MURRAY shows, FORSTER was merely applying LINNAEUS' *Acrostichum dichotomum* to a collection of his own. Hence, since the genus *Ripi-*

dium was based upon a plant, which judging from BERNHARDI's figure is a *Schizaea*, *Ripidium* becomes a generic synonym of *Schizaea*.

For consideration of a genotype for *Schizaea*, as emended herein, we must go back to J. E. SMITH's description of the genus. As stated above the description and the figures definitely agree most clearly with *Schizaea dichotoma*. However, other species were also included. The *Acrostichum spicatum* L. is attributed to *Hymenolepis* by CHRISTENSEN (*17*), with doubt. That leaves *A. pectinatum* L. and *A. elegans* Vahl. Although SMITH lists these species, he does not make the actual combinations; SWARTZ made them in 1801. In regard to the type of the genus, MAXON, in BRITTON and BROWN (*36*), mentions *Schizaea dichotoma* (L.) J. E. Smith, as genotype. This selection is in keeping with the reasoning above of the present author.

In 1792, one year before J. E. SMITH described *Schizaea*, L. C. RICHARD (*49*) described a new genus *Lophidium* as follows:

> « *Lophidium*. Frons digitato-pedata: fructificatio marginalis, sub pedicillata, cristata. *L.* (*latifolium*) digitis latospathulatis, bifidis et simplicibus: spicibus fructiferis sub aequaliter rotundatis ».

According to CHRISTENSEN (*17*, p. 409), *Lophidium latifolium* Richard is synonymous with *Schizaea elegans*. Although *Acrostichum elegans* had been suggested as belonging to *Schizaea* by SMITH, and actually combined in that genus by SWARTZ, it was not until 1845 that *Schizaea elegans* was placed in *Lophidium* by PRESL (*46*) along with *Lophidium flabellum* (*S. elegans* var.), *Lophidium pacificans* and *Lophidium spectabile* (*S. elegans* var.).

FOSBERG (*22*) has discussed *Schizaea* J. E. Smith versus *Lophidium* L. C. Richard, and has proposed that *Schizaea* J. E. Smith be added to the list of Nomina Generica Conservanda, and that *Lophidium* be rejected.

The last member of the original group of species of *Schizaea* is *Acrostichum pectinatum* Linn. In 1801 SWARTZ made the combination *Schizaea pectinata* (L.). This is an

aberrant member in the *Schizaea-Lophidium* complex, and is here placed, along with other species of *Schizaea* having the sterile blades apparently absent, in the new subgenus *Paraschizaea.*

Fosberg (*22*) clearly states that «there is no obvious break in the series of species between the 'curly-grass type' of *Schizaea*, such as *S. pusilla*, with unbranched, strongly dimorphic fronds and the type with flabellately branched fronds, such as are seen in *S. dichotoma*, which type is sometimes called *Lophidium*». On the basis of the single character, namely the width of the blades, it must be remembered that the species placed in *Schizaea* as emended herein vary considerably and range from simple-bla-

	Actinostachys	Schizaea	Microschizaea
Sporangiophores . . .	digitate	pinnate	pinnate
Sporangia	4-rowed	2-rowed	2-rowed
Spores	bilateral	bilateral	subglobose to ovoid
Blades	simple	simple to flabellate	simple
P : E of Spores . . .	0.57-0.71	0.59-0.65	0.66-0.76

ded to broadly flabellate-bladed fronds. The simple--bladed groups are segregated herein in the genera *Actinostachys* and *Microschizaea.* When other morphological characters are taken into consideration, the following table results, showing the similarities and differences of the three genera.

Nomenclaturally, it should be remembered, while considering selection of types of the various subgenera and sections of the three genera, that *Schizaea pusilla* Pursh was placed in the genus in 1814: after *Schizaea dichotoma* had been described as representing the type of plant to be included in the genus by J. E. Smith (1793); after *Schizaea digitata* representing another type, herein

referable to *Actinostachys*, had been added by SWARTZ (1801); after *Schizaea elegans* (= *Lophidium latifolium* L. C. Richard, 1792) was added in 1801 by SWARTZ (based upon *Acrostichum elegans* Vahl, 1791) representing a complex of species close to *Schizaea dichotoma*; after *Schizaea pectinata* (L.) Swartz (1801) was made representing those species without sterile blades; after all these complexes of species had been added to the original concept of *Schizaea* J. E. Smith, then *Schizaea fistulosa* in 1806 and *S. pusilla* in 1814 were added to confuse the true relationships of the morphologically distinct generic segregates present, as listed above in the table.

To return to the contention of FOSBERG regarding the conservation of the genus *Schizaea*, in the opinion of the present author, the genus *Schizaea* of J. E. SMITH should be conserved as it was originally described by SMITH, to include those complexes of species originally referred by SMITH to the genus: namely, *Acrostichum dichotomum* L. representing subgenus *Eu-Schizaea; Acrostichum pectinatum* L., subgenus *Paraschizaea;* and *Acrostichum elegans* Vahl, subgenus *Lophidium.* (There are nomenclatural objections to the use of *Lophidium* (1792) as a subgenus of *Schizaea* (1793), but one must remember that *Acrostichum elegans* Vahl (1791) antedates *Lophidium latifolium* Rich. (1792), and that *Schizaea elegans* stands as representing *Lophidium* through synonomy).

The brief diagnostic characters recited along with each generic and subgeneric division are sufficient to substantiate the present treatment given for the various species which have made up the *Schizaea*-complex, these characters being based upon morphological variability in the dimorphism of the fronds, the rhizome characters, the structure of the sporangiophores, the spore characters and the ecological adaptations.

Recently (1944), SELLING (*53*) presented an excellent «Study in the Recent and Fossil Species of *Schizaea*, with Particular Reference to their Spore Character». Due to the fact that SELLING followed PRANTL's classification (1881) of the genus *Schizaea*, an equally confused classification

of the segregates within this genus has resulted. SELLING's use of the ratio of the polar to the largest equatorial diameter of the spores, P : E, and the actual values tabulated for the species studied are quite significant. Since SELLING's paper has had a very limited circulation (an original copy belonging to Prof. M. L. FERNALD has been turned over to the Gray Herbarium Library, Harvard University, and a photostatic copy is in my library, Baltimore, Maryland), his table giving the P : E values is reproduced below. Using SELLING's P : E ratios, it is interesting to note that, although my classification set forth in this paper was proposed in my unpublished doctorate thesis in 1942 and was of course unknown to SELLING, there are, aside from the generic, subgeneric and sectional segregations, many striking similarities in the two studies. The data set forth by SELLING actually accentuate the classification proposed by me. SELLING's observations and consequent discussion of the spores of the genus *Schizaea*, in the broad sense, are excellent, and space permitting, his paper should be republished for wider circulation. The following material and table are taken from his article. The present author has added his own classification in a parallel column to that of SELLING and has thus correlated the two systems. In the following table the spore sizes and the appearance of the exospore surfaces of each species are summarized. In single spores the extremes are 16 (-57) — (26-) 88 × 28 (-84) — (44-) 110 mu. Also the ratios of polar to largest equatorial diameters (P : E) are introduced, the average being just over 0.6. The significance of this ratio is discussed by SELLING. It is immediately noticeable that the ratio is fairly constant in large groups of species. In one group of the largest spores the ratio is about 0.75.

Reed	Selling	Exospore	Average Size in mu	P : E
1. *Schizaea* J. E. Smith emend. Reed	*Schizaea* J. E. Smith			
Subgen. A. *Eu-Schizaea* Reed	Sect. III. *Lophidium* (Rich.) Diels			
	Subsect. 1. *Dichotomae* Prantl			
1. *S. dichotoma* (L.) J. E. Smith	22. *S. dichotoma* (L.) J. E. Smith	Smooth	27 × 42 (17-38 × 28-60)	0.64
2. *S. poeppigiana* Sturm	25. *S. poeppigiana* Sturm	Smooth	29 × 46	0.63
Subgen. B. *Lophidium* (L. C. Rich.) Reed				
7. *S. biroi* Richt.	23. *S. biroi* Richt.	Probably smooth	18 × 30 ?	0.60
8. *S. copelandica* Richt.	24. *S. copelandi*(ca) Richt.	Probably smooth	—	
	26. *S. orbicularis* (Baker) C. Chr. (misplaced)	Probably smooth		
	Subsect. 2. *Elegantes* Prantl			
3. *S. elegans* (Vahl) Swartz	30. *S. elegans* J E.Sm.	Smooth	29 × 46 (22-38 × 35-60)	0.63
4. *S. fluminensis* Miers; Sturm	27. *S. fluminensis* Sturm	Smooth	23 × 39 (21-26 × 35-60)	0.59
5. *S. sprucei* Hook.	28. *S. sprucei* Hook.	Smooth	27 × 44 (23-30 × 38-48)	0.61
6. *S. pacificans* Mart.	29. *S. pacificans* Mart.	Shallow pitted ?	—	—
9. *S. forsteri* Spreng.	—	—	—	—
10. *S. cristata* Willd.	—	—	—	—
Subgen. C. *Paraschizaea* Reed	Sect. *Eu-Schizaea* Hook.			
	Subsect. 2. *Bifidae* Prantl			
12. *S. incurvata* Schkuhr	10. *S. incurvata* Schkuhr	Minutely tuberculate	39 × 60 (30-47 × 47-70)	0.65

Reed	Selling	Exospore	Average Size in mu	P : E
13. *S. bifida* Willd.	9. *S. bifida* Swartz	Minutely tuberculate	32 × 49 (24-41 × 39-60)	0.65
14. *S. kikuzatonis* Ogata	—	—	—	0.63
	Subsect. 1. *Pectinatae* Prantl			
11. *S. pectinata* (L.) Swartz	2. *S. pectinata* (L.) Sm.	Smooth (or rarely with shallow pits)	51 × 78 (42-64 × 66-95)	0.65
3. *Microschizaea* Reed				
Sect. 1. *Laeves* Reed				
1. *M. fistulosa* (Labill.) Reed	6. *S. fistulosa* Labill.	Smooth	62 × 82 (48-79 × 69-104)	0.76
2. *M. robusta* (Baker) Reed	5. *S. robusta* Baker	Smooth	67 × 88 (48-88 × 70-110)	0.76
4. *M. malaccana* (Baker) Reed	7. *S. malaccana* Baker	Smooth	47 × 65 (43-50 × 60-80)	0.72
3. *M. australis* (Gaud.) Reed	—	Smooth	—	—
5. *M. rupestris* (R. Br.) Reed	4. *S. rupesttis* R. Br.	Smooth	53 × 70 (48-58 × 60-80)	0.76
6. *M. tenella* (Kaulf.) Reed	3. *S. tenella* Kaulf.	Smooth (sometimes minutely tuberculate)	58 × 78 (52-65 × 72-85)	0.74
7. *M. hallieri* (Richt.) Reed	8. *S. hallieri* Richt.	Smooth	45 × 61 (40-50 × 57-60)	0.74
Sect. 2. *Alveolatae* Reed				
8. **M. miocenica* (Sell.) Reed	* *S. miocenica* Sell.	Alveolate	48 × 67.5	0.71
9. **M. skottsbergii* (Sell.) Reed	* *S. skottsbergii* Sell.	Alveolate	78 × 114 (70-90 × 96-132)	0.68
10. *M. pusilla* (Pursh) Reed	1. *S. pusilla* Pursh	Alveolate	57 × 86 (44-72 × 68-106)	0.66
2. *Actinostachys* Wall.	Sect. II. *Actinostachys* (Wall.) Diels			
Sect. 1. *Digitatae* (Prantl) Reed				
Subsect. a. *Striatae* Reed				
1. *A. digitata* (L.) Wall.	16. *S. digitata* (L.) Swartz	Obliquely striate	24 × 42 (16-32 × 29-56)	0.57

Reed	Selling	Exospore	Average Size in mu	P : E
2. *A laevigata* (Mett.) Reed	15. *S. laevigata* Mett.	Obliquely striate	50 × 79 (40-61 × 64-92)	0.63
3. *A. intermedia* (Mett) Reed	18. *S. intermedia* Mett.	Faintly striate and minutely tuberculate	38 × 64 (31-46 × 56-74)	0.59
4. *A. spirophylla* (Troll) Reed	17. *S. spirophylla* Troll	Obliquely striate	22 × 35	0.63
5. *A. boninensis* Nakai	—	—	—	—
6. *A. melanesica* (Sell.) Reed	14. *S. melanesica* Sell.	Iregular striate	34 × 60 (30-38 × 51-68)	0.57
7. **A. palaeocenica* (Sell.) Reed	* *S. palaeocenica* Sell.	Striate	— × 60	—
8. **A. eocenica* (Sell.) Reed	* *S. eocenica* Sell.	Striate	38 × 60	0.63
Subsect. b. *Laeves* Reed				
9. *A. balansae* (Fourn.) Reed	11. *S. balansae* Fourn.	Smooth	63 × 88 (57-71 × 84-97)	0.70
10. *A. plana* (Fourn.) Reed	13. *S. plana* Fourn.	Smooth	27 × 44 (23-33 × 39-48)	0.61
11. *A. tenuis* (Fourn.) Reed	12. *S. tenuis* Fourn.	Smooth	48 × 68 (40-53 × 54-81)	0.71
Sect. 2. *Pennulae* Reed				
12. *A. pennula* (Swartz) Hook.	20. *S. pennula* Swartz	Pitted (simple narrow pits)	38 × 65 (28-48 × 52-84)	0.58
13. *A. germani* Fée	21. *S. germani* (Fée) Prantl	Pitted (simple narrow pits)	33 × 54 (26-39 × 46-61)	0.61
14. *A. orbicularis* (Baker) Reed	26. (*S. orbicularis* (Baker) C. Chr.)	—	—	—
15. *A. penicillata* (Willd.) Maxon	19. *S. penicillata* Kunth	Pits faint, longitudinally striate	36 × 63 (33-40 × 58-66)	0.57

2. **Actinostachys** Wall., Cat.n. 1. 1828; Hook., Gen. Fil., t. 111 A. 1842. *Schizaea* sect. 1. *Actinostachys* (Wall.) Diels, in Nat. Pfl.-fam. 1 (4) : 362. 1900; C. Chr., Ind. Fil. LV. 1905.

Fronds simple, erect or rigidly ascending; blades narrowly linear, more or less grass-like, triquetrous or flattish, arising from a dark, terete or semiterete base, prominently unicostate; sporangiophores terminal, spuriously digitate, in a penicillate tuft from a very short inconspicuous prolongation of the costa; sporangia in two rows, appearing to form 4 rows, caused by the bending of the sporangia to left or right; indusium continuous, formed by the narrowly reflexed margins of the simple segments; spores bilateral, monolete, smooth, striate or punctate. About 13 species, tropical and subtropical, and two fossil species. Map. F.

Genotype: *Actinostachys digitata* (L.) Wall.

Section 1. **Digitatae** (Prantl) Reed, comb. nov.

Schizaea sect. 1. *Digitatae* Prantl, Schiz., p. 129. 1881.

Perisporae oblique striatae, vel laeves. Asiatic tropics, Pacific Islands from the Bonin Islands to New Guinea and Fiji, east to Ceylon, southern India and Madagascar.

Subsection a. **Striatae** Reed. subsect. nov.

Perisporae oblique striatae.

1. A. digitata (L.) Wall., List n. 1. 1828. Southern Asia from British India and Ceylon to the Bonin Islands and south to New Guinea; Madagascar; the Seychelles; Fiji; New Caledonia; Isle of Pines; the Tonga Islands and New South Wales.
2. **A. laevigata** (Mett.) Reed, comb. nov. (*Schizaea laevigata* Mett., Ann. Sci. Nat. IV. 15: 85. 1861). New Caledonia.

2a. **A. inopinata** (Selling) Reed, comb. nov. (*Schizaea inopinata* Selling, Svensk Bot. Tidskr. 40 (3): (273-283). 1946). Malay Peninsula; Philippine Islands.

3. **A. intermedia** (Mett.) Reed, comb. nov. *(Schizaea intermedia* Mett., Ann. Sci. Nat. IV. 15: 86. 1861). New Caledonia.

3a. **A. wagneri** (Selling) Reed, comb. nov. *(Schizaea wagneri* Selling, Svensk Bot. Tidskr. 40 (3): (273-283). 1946). Bismarck Archipelago; Admiralty Islands.

4. **A. spirophylla** (Troll) Reed, comb. nov. *(Schizaea spirophylla* Troll, Flora 128: 343, fig. 1933). Amboina.

5. A. boninensis Nakai, Journ. Jap. Bot. 13: (139-154). 1937. Bonin Islands.

6. **A. melanesica** (Selling) Reed, comb. nov. *(Schizaea melanesica* Selling, Sv. Bot. Tidskr. 38 (3): 207-225. 1944; Medd. Goteb. Bot. Tradg. 16: 31, t. 3, fig. 21-23. 1944). New Caledonia, Fiji.

7. ***A. palaeocenica** (Selling) Reed, comb. nov. *(Schizaea palaeocenica* Selling, Medd. Goteb. Bot. Tradg. 16: 64, t. 4, fig. 42-43. 1944). Palaeocene: Hannover, Germany.

8. ***A. eocenica** (Selling) Reed, comb. nov. *(Schizaea eocenica* Selling, Medd. Goteb. Bot. Tradg. 16: 66, t. 4, fig. 44-45. 1944). Eocene: Geiseltal, Germany.

Subsection b. **Laeves** Reed, subsect. nov.

Perisporae Laeves

9. **A. balansae** (Fourn.) Reed, comb. nov. *(Schizaea balansae* Fourn., Ann. Sci. Nat. V. 18: 353. 1873). New Caledonia.

10. **A. plana** (Fourn.) Reed, comb. nov. *(Schizaea plana* Fourn., Ann. Sci. Nat. V. 18: 353. 1873). New Caledonia.

11. **A. tenuis** (Fourn.) Reed, comb. nov. *(Schizaea tenuis* Fourn., Ann. Sci. Nat. V. 18: 353. 1873). New Caledonia.

Section 2. **Pennulae** Reed, sect. nov.

Perisporae punctatae, rare longitudinaliter striatae et punctatae. Central and South America, West Indies.

12. A. pennula (Swartz) Hook., Gen. Fil., t. 111 A. 1842, *(Schizaea pennula* Swartz, Syn. 150, 379. 1806). Tro-

pical America, Porto Rico, Guadeloupe, Trinidad, Costa Rica to Dutch Guiana, Brazil and Uruguay.

13. A. germani Fée, Mem. Foug. 11: 123, t. 29, fig. 3. 1866. Florida. Guadeloupe. British Honduras, Colombia.
14. **A. orbicularis** (Bak.) Reed, comb. nov. *(Schizaea digitata* var. *orbicularis* Bak., Journ. Bot. 1881: 208. 1881; *Schizaea orbicularis* (Bak.) C. Chr., Ind. Fil. 617. 1906). Colombia.
15. A penicillata (Humb. & Bonpl. ex Willd.) Maxon, Proc. Biol. Soc. Wash. 46: 139. 1933 (as *penicellata).* Amer. Austr. trop., Trinidad.

The generic name *Actinostachys* was given to this group of species, which is sometimes considered as being congeneric with *Schizaea*, by Wallich (*65*), whose original treatment reads as follows:

«1. *Actinostachys digitata* Wall. *(Schizaea* Sw.)

Genus novum, dubiè a Brownio in Prod. Nov. Holl. 1. 161 propos. (1810). Singapore et insula vicina, 1822».

Then in Brown (*13*) we find on page 162 (161 by error):

Obs. *Schizaea digitata*, Sw. (in Herb. Herm. et Linnei visa) a congeneribus differt appendice digitata nec pinnata, capsulis confertis nec biseriatis nec extus dehiscentibus: an ideo separando?»

The treatment by Linnaeus (*35*) reads:

«*digitata*. 8. *Acrostichum* caulibus nudis triquetris, fronde digitata lineari integerrima aequali. Fl. Zeyl. 379. 1747. Amoen. Acad. 3rd. Edit., p. 269. 1787; 1. st. Edit., p. 153, fig. 1 on plate 190. 1749. Planta pluribus foliis triquetris instar graminis cyperini summitate foliorum in plurima folia biuncialia divisis. Herm. Zeyl. 27. Habitat in Zeylona».

Referring to Brown's description of *Schizaea digitata* Swartz, and stating that Brown had seen the material in the herbarium of Linnaeus (Linnaeus had described and

illustrated the material as *Acrostichum digitatum*, as pointed out above), WALLICH transfers this species to the new genus *Actinostachys*, even though he does not describe the genus.

In HOOKER's Genera Filicum, t. 111 A. 1842, is illustrated *Actinostachys pennula*, with the brief generic description, «sporangia subquadriserialia, appendicibus digitatis. Caeterum ut in *Schizaea*». As shown in HOOKER's drawing the spores of all species of *Actinostachys* are bilateral. However, on Plate XIX in HOOKER, are drawn tetrahedral spores, with the inference that they belong to *Schizaea dichotoma*. My own observations, as well as those of RICHTER (*50*) and SELLING (*53*, p. 5-12), indicate that spores of the subgenera *Eu-Schizaea* and *Lophidium* (as the subgenera are considered herein) have bilateral monolete spores, with no indication of a subglobose aspect. Further, the sporangiophore drawn by HOOKER in Plate XIX is not that of *Schizaea dichotoma*.

3. **Microschizaea** Reed, gen. nov.

Schizaea sect. II. *Eu-Schizaea* Hook., A. *Pectinatae* (Prantl) Diels, in Nat. Pfl.-fam. 1 (4): 363 (partim). 1900; *Schizaea* sect. 2. *Pectinatae* Prantl, Schiz., p. 129 (partim). 1881.

Frons simplicissima, nuda, filiformis, teretiuscula; *pares* appendiculorum secundae, subduodenae; *stipites* baseos setis fistulosis vel elongatis multicellularibus pilis, radiculis elongatis, vix pilosis; *frondes* numerosae, congestae, filiformes; *sporae* subglobosae, alveolatae vel laeves, minute tuberculatae. Map E.

Genotype: *Schizaea fistulosa* Labill.

Microschizaea Reed: A very distinct group of species having subglobose spores, alveolate or smooth on the surface, rather large in size; fronds of two types, the shorter sterile ones usually linear, flattened or subterete, grayish-green and the taller fertile ones bearing the pin-

nate sporangiophores; bases of the stipes having fistulose, terete, stiff brownish unicellular setae in Sect. *Laeves* and flattened several-celled trichomes in Sect. *Alveolate*.

Section 1. **Laeves** Reed, sect. nov.

Setae fistulosae; *sporae* laeves, aliquando minute tuberculatae.

Type: *Schizaea fistulosa* Labill.

1. **M. fistulosa** (Labill.) Reed, comb. nov. (*Schizaea fistulosa* Labill., Nov. Holl. Pl. Spec. 2: 103, t. 250, fig. 3. 1806). New Caledonia, Tasmania, New Zealand, Antarctic America, West Australia, (Viti), Madagascar, Borneo.
2. **M. robusta** (Baker) Reed, comb. nov. (*Schizaea robusta* Baker, Syn. Fil. 429. 1868). Hawaii, Society Islands.
3. **M. australis** (Gaud.) Reed, comb. nov. (*Schizaea australis* Gaud., Ann. Sci. Nat. 5: 98. 1825). Chile (Valdivia). Auckland Island, New Zealand.
4. **M. malaccana** (Baker) Reed, comb. nov. (*Schizaea malaccana* Baker, Syn. Fil. 428. 1868). Burma, New Guinea, Malesia, Philippine Islands.
5. **M. rupestris** (R. Brown) Reed, comb. nov. (*Schizaea rupestris* R. Brown, Prod. Fl. N. Holl., 162. 1810). Australia.
6. **M. tenella** (Kaulf.) Reed, comb. nov. (*Schizaea tenella* Kaulf., Enum. 50, t. 1, fig. 7. 1824). South Africa.
7. **N. hallieri** (Richter) Reed, comb. nov. (*Schizaea hallieri* Richter, Meded. Rijks Herb. Leiden 28: 24, t. 1-5. 1916). Borneo.

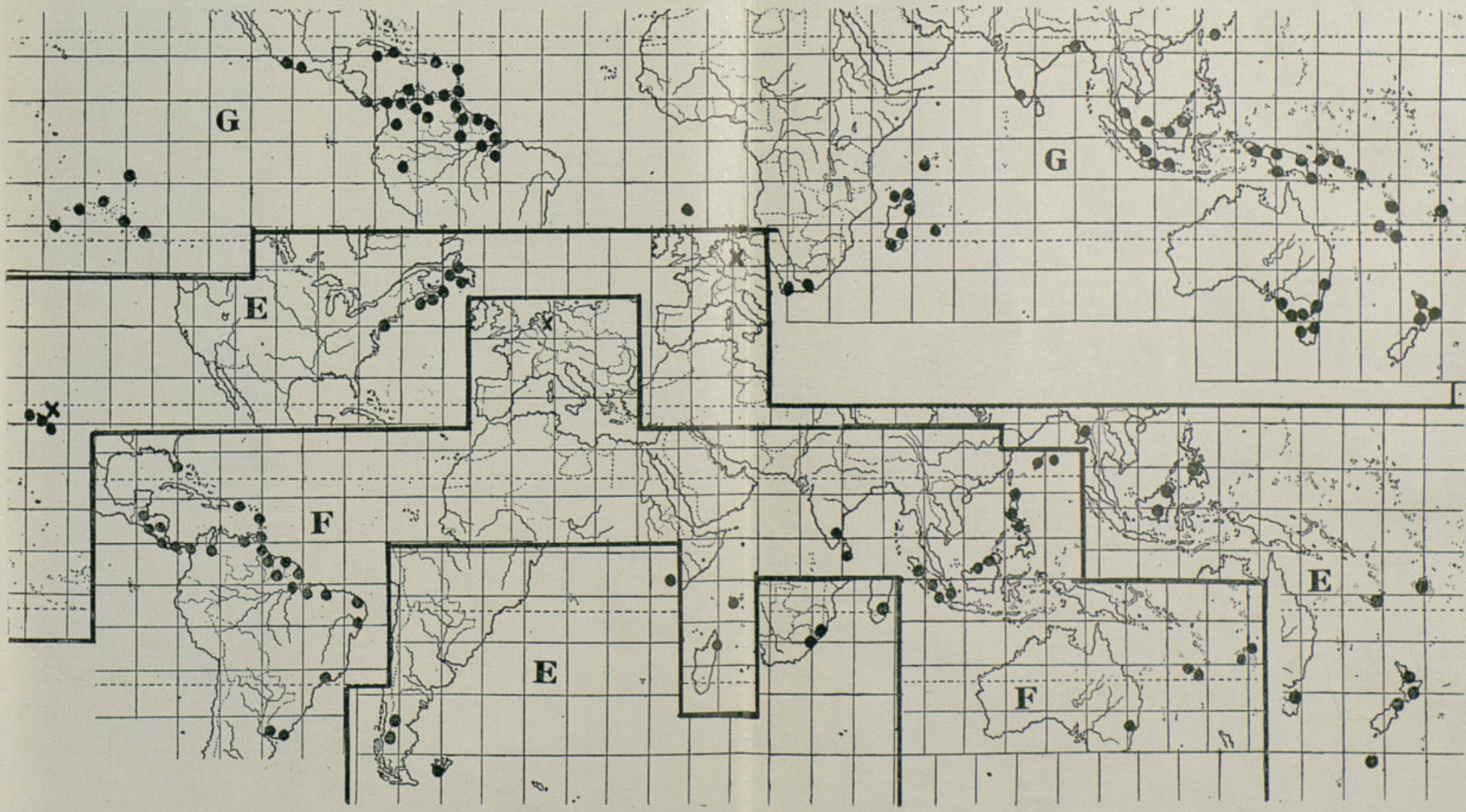
Section 2. **Alveolatae** Reed, sect. nov.

Pili multicellulares elongati; *sporae* alveolatae.

Type: *Schizaea pusilla* Pursh.

8. ***M. miocenica** (Selling) Reed, comb. nov. (*Schizaea miocenica* Selling, Medd. Goteb. Bot. Tradg. 16: 68,

Distribution of the Family Schizaeaceae



Map. E. Distribution of the Genus Microschizaea. Dots indicating living species, crosses the fossil species.

Map. F. Distribution of the Genus Actinostachys. Dots indicating living species, crosses the fossil species.

Map. G. Distribution of the Genus Schizaea.

t. 4, fig. 46. 1944) Lower Miocene: Senftenberg, Germany.

9. ***M. skottsbergii** (Selling) Reed, comb. nov. *(Schizaea skottsbergii* Selling, Medd. Goteb. Bot. Tradg. 16:71, t. 5, fig. 48-51. 1944). Quaternary: Hawaiian Islands (Kauai, 1300 m. alt., in Alakai swamp; Molokai, 1200 m. alt., in Pepeopae Bog.).

9a. ***M. skottsbergii** var. **mauiensis** (Selling) Reed, comb. nov. *(Schizaea skottsbergii* var. *mauiensis* Selling, Medd. Goteb. Bot. Tradg. 16: 73, t. 5, fig. 52--56. 1944). Late Quaternary: Hawaiian Islands (Maui, 1700-1750 m. alt., bogs).

10. **M. pusilla** (Pursh) Reed. comb. nov. *(Schizaea pusilla* Pursh, Fl. Amer. Sept. 2: 657. 1814). New Jersey, Nova Scotia, Newfoundland, Ontario?

This the third main group of species to be considered has globose to ovoid spores. The earliest described species of the group is *Schizaea fistulosa* Labillardière (*34*), whose figures are excellent, showing the terete fistulose setae at the base of the stipes and the subglobose spores. The spores are smooth in all the species referable to this group, except those species of the sect. *Alveolate*, which have alveolate subglobose spores and lack the stiff terete setae on the rhizome. These characters mark a definite group, which has been treated as the section *Pectinatae* of *Schizaea* by Prantl (*45*). The spores of *Schizaea pectinata* are bilateral and verrucullose, and the rhizome possesses flattened elongated trichomes, which characters place it in *Schizaea* subgenus *Paraschizaea*, along with *Schizaea bifida* and *S. incurvata*. With *S. pectinata* removed, the *fistulosa-pusilla* complex becomes naturally one.

The «Curly-grass Fern», *Schizaea pusilla*, occurs geographically quite apart from the other members of this genus, and differs from all the other extant species by the alveolate spores, a character observed in several of the spores from the bogs of Hawaii of Quaternary Age. It is interesting that these fossil spores, which have been described and illustrated by Selling (*53*, p. 68-73, t. 4-5),

should be found so far away from the present distribution of *Schizaea pusilla*, which is found in pine barrens from New Jersey, Nova Scotia and Newfoundland, and perhaps in Ontario. PURSH described the species originally (*47*) from the barren sandy but moist pine lands of New Jersey.

The peculiar geographic distribution of the members of the genus *Microschizaea* — New Jersey to Newfoundland for *M. pusilla;* the Hawaiian Islands at 3000' for *M. robusta*, and perhaps Tahiti; South Africa for *M. tenella;* New Zealand, Tasmania, New Caledonia, South and Southwest Australia, Southern Chile for *M. fistulosa* (incl. *Schizaea chiliensis* and *Schizaea valdiviana*); Falkland and Auckland Islands for *M. australis;* Australia for *M. rupestris;* Burma to North Borneo and the Philippines for *M. malaccana;* and Borneo for *M. Hallieri* — recalls in some respects the distributions of other species and genera of plants which are found in Newfoundland and on the Auckland and Falkland Islands, or southern South America. Some such plants are the following:

1. *Carex macloviana* D'Urville — in scattered areas in Greenland; Labrador; Gaspé Peninsula of Quebec; northwest Canada, with several allied forms in the mountains of Colorado, Utah and California; Mount Orizaba, Mexico; Kamtchatka and the Kurile Islands; and then the Falkland Islands and Tierra del Fuego northward into southern Argentina and Chile. FERNALD, Rhodora 44 (518): 71. 1942.

2. *Antennaria chilensis* Remy — Patagonian species with a close relationship to a series of localized species of cordilleran North America, Greenland, north Labrador, west Newfoundland and the Gaspé region. FERNALD, Rhodora 35: 335. 1933.

3. *Empetrum rubrum* Vahl — of subantarctic islands and the Andes of Chile, Islands of Tristan da Cunha, with the nearest relatives centering in the Gulf of St. Lawrence. FERNALD, Rhodora 35: 335. 1933; Mem. Amer. Acad. Arts and Sci. 15: 261-263. 1925.

4. *Primula decipiens* Duby — of the Falkland Islands and Patagonia, the only representative in the southern hemisphere of the complex boreal *Primula* sect. *Farinosae*. Fernald, Rhodora 35: 335. 1933; Rhodora 30: 77. 1928.

5. *Polystichum mohrioides* (Bory) Presl — of the subantarctic islands and Fuegia, with varieties in the Andes, in the cordilleran region of North America and on the Gaspé Peninsula. Fernald, Rhodora 35: 336. 1933.

6. *Ophioglossum vulgatum* — varieties *pycnostichum* and *pseudopodum* occur from Quebec to Washington, south to North Carolina, Arizona and Mexico; and variety *valdivianum* is isolated in Valdivia, Chile. Fernald, Rhodora 41: 494. 1939; Lichtenst., Darwiniana 6: 405. 1944.

7. *Botrychium matricariaefolium* — the typical variety occurs from Labrador to Maryland, Ohio, South Dakota, Idaho; England, Sweden, Italy, Germany; Korea (Mt. Paiktusan), while an isolated variety *patagonicum* is known only from Patagonia, Argentina.

8. *Rumex maritimus* var. *fueginus* (Phil.) Dusen — with a broad range in interior and western North America; on Tierra del Fuego and Patagonia; the Pacific coast from Lower California to British Columbia; and on the eastern coast from Rhode Island to the Gulf of St. Lawrence. Fernald, Amer. Journ. Bot. 5: 232. 1918.

9. *Psilocarya* — of tropical Australia and tropical eastern South America and Cuba, southern Massachusetts and Rhode Island, and near the head of Lake Michigan.

10. *Erechtites* — highly developed in Australia, New Zealand, eastern and northern South America, Central America, tropical Mexico and the Antilles, eastern North America and southern Cape Cod.

11. *Junci thalassii* — a section of *Juncus* of saline and subsaline habitats — various species being found: *J. acutus* in the Atlantic and Mediterranean regions of Europe and North Africa, the coasts and steppes of southeastern Asia, the Atlantic Islands (Madeira, the Azores, Bermuda), Cape of Good Hope, the coast of California, southern Brazil, southward to Juan Fernandez off the coast of Chile; *J. Cooperi* only in saline regions of California

and Nevada; *J. Roemerianus* along coast of Virginia to Texas; *J. austerus* from Chile; *J. Kraussi* from South Africa; *J. maritimus* on the Atlantic and Mediterranean coasts of Europe, southwest Asia, northeast Africa, Cape of Good Hope, the Azores, Bermuda, Brazil, Australia, Tasmania, New Zealand, Coney Island; *J. pervetus* on Cape Cod.

12. *Lilaeopsis* — occurs along the Atlantic Coast of the United States and southwest Nova Scotia with representatives in the Andes of southern South America, Falkland Islands, New Zealand, Tasmania and Australia. FERNALD, Rhodora 26: 93-94. 1924.

13. *Puccinella, Saxifraga, Euphrasis, Agoseris, Taraxacum* — occur along the cordilleran North America or about the Gulf of St. Lawrence and have isolated Magellanic or Falkland allies. Other species of plants with distributions similar to the foregoing ones are *Carex capitata* L., *Carex incurva* Lightf., *Carex microglochin* Wahlenb., *Draba magellanica* Lam. and *Plantago juncoides* Lam.

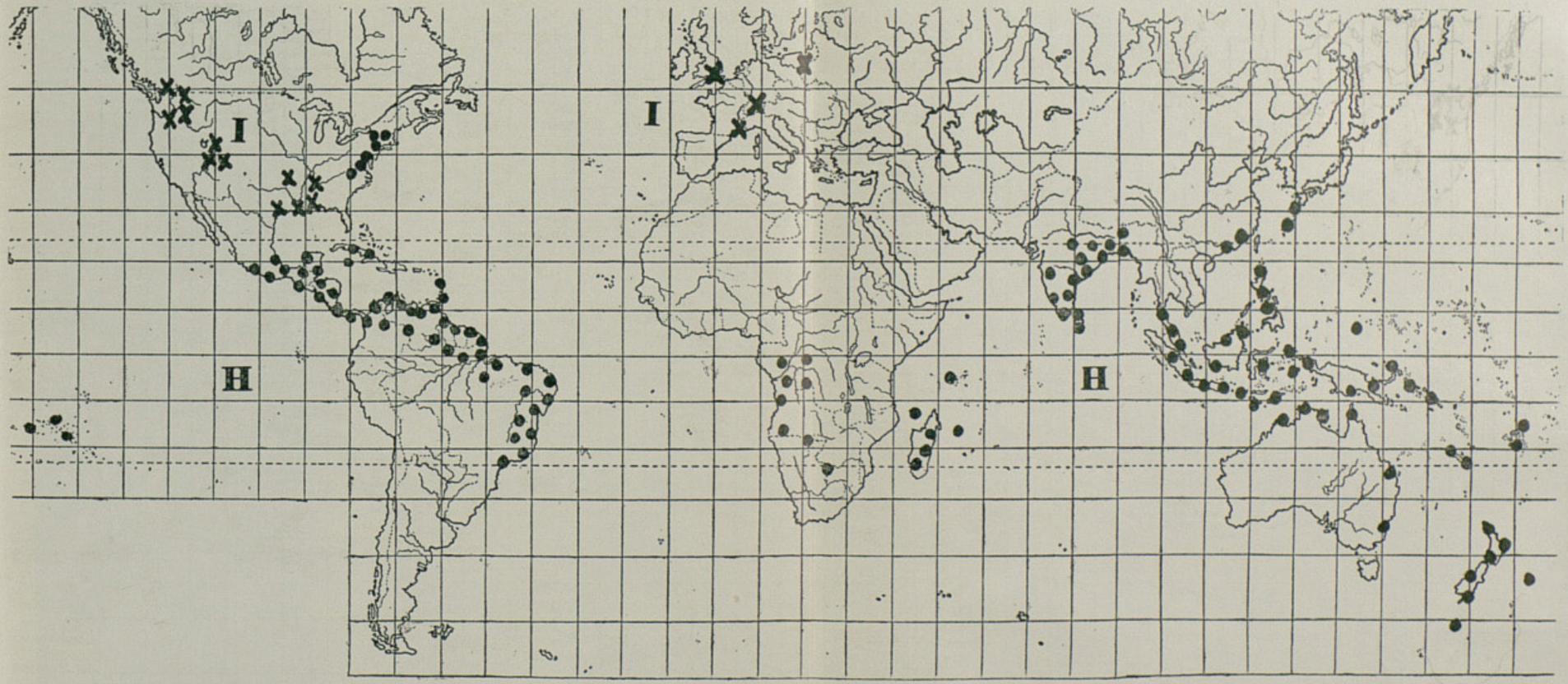
LYGODIACEAE Presl,

Abh. K. Bohmischen Ges. Wissensch. V. 4: 358. 1845 (Suppl. Tent. Pterid., p. 98. 1845); Fée, Gen. Fil., 5e Mem. 1850-52; Bommer, Monogr. Clas. Fougères, p. 91. 1867: Nakai, Journ. Jap. Bot. 13: (139-154). 1937; Momose, Journ. Jap. Bot. 17: 667. 1941.

Lygodiées Brongn., Hist. Veg. Foss., partim, 1828; *Schizaeaceae* 1. *Lygodieae* Moore, Ind. Fil. 1857; *Schizaeaceae* subfam. II. *Lygodieae* (Moore) Diels, Nat. Pfl.-fam. 1 (4): 363-366. 1900.

Rhizomes creeping, solenostelic, without scales; fronds monostichous, twining, of indefinite growth, dichotomously, palmately or pinnately divided; veins free, rarely reticulate; sporangia in two rows on marginal sporangiophores or specialized lobes of otherwise unaltered pinnules,

Distribution of the Family Lygodiaceae



Map. H. Distribution of the Genus Lygodium, living species

Map. I Distribution of the Genus Lygodium, fossil species.

each borne near the end of the vein and enveloped in a pocket formed by outgrowths from the lobes; spores tetrahedral, very large, striate or verrucose with rounded papillae, or reticulate or smooth, trilete. A family of about 39 species, found in the American and East Indian tropics, with several fossil species known from Europe and North America. Maps I and H.

Unique for the Schizaeales is the gemmiferous bud between the pair of primary pinnae. This phenomenon is found also in the Gleicheniaceae and Phanerosorus of the Matoniaceae. Incidentally, the apex of the frond of *Anemia radicans* and *A. wurmingii* is gemmiferous.

1. **Lygodium** Swartz,
Schrad. Journ. 1800 (2): 106. 1801.

Ugena Cav., Icon. Descr. Pl. 6: 73. 1801; Anal. Cienc. 4: 249. 1801; *Ramondia* Mirbel, Bull. Soc. Philom. 2: 179. 1801; *Hydroglossum* Willd., Schr. Akad. Wiss. Erfurt 1802: 20. 1802; *Vallifilix* Thouars, Nov. Gen. Madagascar. 1: —; in Römer, Collect. Bot. 195. 1809.

The living species of this genus *Lygodium* grade into one another to the extent that no sharp lines can be drawn. However, *L. reticulatum* and *L. scandans* have reticulate or alveolate spores, unique for this genus, just as those of *Microschizaea* sect. *Alveolatae* in the Schizaeaceae are unique there with their alveolate spores. The majority of the species of *Lygodium* have verrucose spores; a very few are smooth. The veins are free and forking dichotomously, or reticulate. The reticulation of the veins in various species is not correlated with other characters. Likewise, in the cut of the fronds the gradations are gradual and again not correlated with spore or venation characters. This group offers a very good example of 'reticulate evolution' and incremental segregation of characters. There are several species of *Lygodium* recorded

among the fossils, some of them under the generic name *Lygodites*. Map I (fossils) and Map H (extant).

Christensen (*16*, p. LV) has suggested the subgeneric or sectional names *Gisopteris* Bernh., *Volubilia* Prantl and *Flexuosa* Prantl. Since *Volubilia* and *Flexuosa* are not in proper form for subgeneric epithets, due to the fact they are not nouns, they must be replaced. *Ugena* Cav. included representatives of all the subgenera and sections of *Lygodium* and hence is a generic synonym of *Lygodium*, as a whole. *Ramondia* Mirbel included *L. flexuosum* and *L. scandans*, each representing a different subgenus of *Lygodium*.

Typical *Lygodium*, represented by *L. flexuosum*, is here treated as subgenus *Eu-Lygodium* Hooker emended by Reed, replacing the name *Flexuosa*. Likewise, the portion of *Lygodium*, represented by *L. volubile*, and called heretofore *Volubilia*, becomes subgenus *Odontopteris* (Bernh.) Reed. The remaining group of species is treated under the subgeneric name *Gisopteris*, this subgenus having two sections recognized herein as new, *Eu-Gisopteris* Reed represented by *L. palmatum* and *Arthrolygodes* (Presl) Reed represented by *L. articulatum* A. Rich.

Genotype: *Ophioglossum flexuosum* L.

Key to the Subgenera and Sections of Lygodium

1. Secondary segments, at least the sterile ones, with repeatedly dichotomous costae, mostly dichotomously pedate, rarely radiating from the apex of the tertiary petiole . . . . . Subgen. A. *Gisopteris*.
   2. Sterile secondary segments with pedate costae, the fertile ones repeatedly pinnate . . . . . Sect. 1. *Eu-Gisopteris*.
   2. Sterile and fertile segments dichotomous and the primary segments distinctly petiolate, or the primary segments mostly sessile and the secondary segments pedate, radiating or repeatedly pinnate . . . . . Sect. 2. *Arthrolygodes*.

1. Secondary segments, both sterile and fertile, pinnate.
   2. Tertiary segments antrorsely smaller; costae basally throwing off costules in the basal laciniae, or pinnate . . . . Subgenus B. *Eu-Lygodium.*
   2. Tertiary segments mostly of same size; none with costules or basal laciniae, rarely the inferior ones pinnate . . . . . Subgenus C. *Odontopteris.*

Subgenus A. **Gisopteris** (Bernh.) C. Chr.,

Ind. Fil. LV. 1905.

Lygodium sect. I. *Palmata* Prantl, Schiz., p. 60. 1881; Diels, in Nat. Pfl.-fam. 1 (4): 364. 1900.

Segmenta secundaria saltem sterilia costis repetito-dichotomis, plerumque dichotomo-pedatis, rarius ex apice petioli tertiarii radiantibus. (Prantl).

Type: *Gisopteris palmata* Bernh.

Section 1. **Eu-Gisopteris** Reed, sect. nov.

Gisopteris Bernh., Schrad. Journ. 1800 (2): 129. 1801; *Cteisium* Michx., Fl. Bor. Amer. 2: 275. 1803.

Segmenta secundaria sterilia costis pedatis, fertilia repetito-pinnata. (Prantl).

This section of the subgenus *Gisopteris* contains the Eastern North American species *L. palmatum* which lacks the apical bud between the pairs of pinnae. The primary segments are distinctly petiolate, the secondary segments are wholly sterile with pedate costae. The fertile segments are repeatedly pinnate The spores are minutely verrucose. There are two known fossil species in the section.

Type: *Gisopteris palmata* Bernh.

1. L. palmatum (Bernh.) Swartz, Syn. 154. 1806. (*Gisopteris palmata* Bernh., Schrad. Journ. 1800 (2): 129, t. 2, fig. 1. 1801). U. S. A. atlant.

2. *L. pumilum R. W. Brown, Journ. Wash. Acad. Sci. 33 (5): 141-142, fig. 1-5. 1943. Cretaceous: Wyoming.
3. *L. binervatum (Lesq.) Berry, U. S. Geol. Surv., Prof. Paper 91: 165, t. 10, fig. 3-8. 1916. Wilcox: Mississippi. Louisiana.

Section 2. **Arthrolygodes** (Presl) Reed, stat. nov.

Arthrolygodes Presl, Suppl. Tent. Pterid. 101. 1845.

Segmenta sterilia fertiliaque dichotoma et segmenta primaria distincte petiolata, vel segmenta primaria fere sessilia et segmenta secundaria pedatis, radiantibus vel repetito-pinnata. (PRANTL).

This section contains several species in which the primary segments are more deeply cut, but not completely divided. Included are transitional species which have the first segments separated but not the second. The spores are very verrucose or tuberculate, varying from small to large in size.

Type: *Lygodium articulatum* A. Rich.

4. L. articulatum A. Rich., Fl. N. Zel., 96, t. 15. 1832. New Zealand, Auckland.
5. L. trifurcatum Baker, Syn. 437. 1868. Melanesia, Banka Island.
6. L. circinnatum (Burm.), Swartz, Syn. 153. 1806. (*Ophioglossum circinnatum* Burm., Fl. Ind. 228. 1768). Asia trop., Queensland.
7. L. versteegii Christ, Nova Guinea 8: 161. 1909. New Guinea, Luzon.
8. L. digitatum Presl, Rel. Haenk. 1: 73. 1825. Philippine Isl., Malacca.
9. L. merrillii Copel., Philip. Journ. Sci. Bot. 2: 146, t. 4. 1907. Mindoro.
10. L. matthewii Copel., Philip. Journ. Sci. Bot. 3: 36. 1908. Luzon.
11. L. semihastatum (Cav.) Desv., Mem. Soc. Linn. Paris 6: 203. 1827. (*Ugena semihastata* Cav., Ic.

Descr. Pl. 6: 74, t. 594, fig. 1. 1801). Philippine Islands, Mariana Islands.

12. L. moskowskii Brause, Engl. Bot. Jahrb. 49: 57. 1912. New Guinea.
13. L. dimorphum Copel., Philip. Journ. Sci. Bot. 6: 67. 1911. New Guinea.
14. L. derivatum v. A. v. R., Bull. Buit. III 5: 213. 1922. Lingga Islands (Malesia).
15. L. basilanicum Christ, Philip. Journ. Sci. Bot. 2: 179. 1907. Philippine Islands.
16. L. hians Fourn., Ann. Sci. Nat. V. 18: 355. 1873. New Caledonia.
17. L. mearnsii Copel., Philip. Journ. Sci. Bot. 3: 37. 1908. Batan.
18. L. borneense v. A. v. R., Bull. Jard. Bot. Buit. II (nr. XX): 29. 1915. Borneo.
19. L. teysmannii v. A. v. R., Bull. Dept. Agric. Ind. Neerl. 18: 5. 1908. Pulo Pisang.
20. L. radiatum Prantl, Schiz. 66. 1881. Guatemala—Colombia. (This species is probably misplaced. Reed).

Subgenus B. **Eu-Lygodium** Hook., emend. Reed.

Lygodium sect. II. *Flexuosa* Prantl, Schiz., p. 67. 1881 Diels, in Nat. Pfl.-fam. 1 (4): 366. 1900; C. Chr., Ind Fil; LV. 1905; *Lygodium* § *Eulygodium* Hook., Syn. Fil., ed. 2: 436-439 (partim). 1874.

Segmenta secundaria sterilia fertiliaque pinnata, ambitu ovata vel deltoidea, tertiaria antrorsum minora, costa prope basin costulas in lacinias basales emittente vel pinnata. (Prantl).

The fronds are usually 2- to 4-pinnate with the fertile portions around the margins.

Type: *Lygodium flexuosum* (L.) Swartz.

21. L. flexuosum (L.) Swartz, Schrad. Journ. 1800 (2): 106 (partim). 1801; Syn. 153. 1806. (*Ophioglossum*

flexuosum L., Sp. Pl. 2: 1063. 1753) China austr. Malesia-Ins. Philippine, Queensland.

21a. L. flexuosum var. accidens Chou, Bull. Torr Bot. Club, 74: 374, 7 fig. 1947. China (Prope Chowshang, Pref. Changfeng, Prov. Kweichow).

22. L. colaniae Tard.-Bl. et C. Chr., Not. Syst. 5 (3): 168. 1936. Tonkin.

23. L. japonicum (Thbg.) Swartz, Schrad. Journ. 1800 (2): 106. 1801. (*Ophioglossum japonicum* Thbg., Fl. Jap. 328. 1784). Japan, China, Asia, tropical Australia.

24. L. subareolatum Christ, Bull. Geogr. Bot. Mans. 1907: 151. 1907. China.

25. L. conforme C. Chr., Bull. Mus. Paris II. 6: 104. 1934. Tonkin, Hongkong.

26. L. brycei Baker, Kew Bull. 1901: 138. 1901. Rhodesia.

27. L. kerstenii Kuhn, Fil. Deck. 28. 1867. Eastern tropical Africa, Comor Islands, Madagascar.

28. L. mexicanum Presl, Rel. Haenk. 1: 72. 1825. American tropics.

29. L. venustum Swartz, Schrad. Journ. 1801 (2): 303. 1803. American tropics to Paraguay.

30. L. cubense HBK., Nov. Gen. et Sp. 1: 31. 1815. Cuba.

31. L. heterodoxum Kunze. Farnkr. 2: 32, t. 113. 1849. Mexico-Venezuela.

32. L. polymorphum (Cav.) HBK., Nov. Gen. et Sp. 1: 31. 1815. (*Ugena polymorpha* Cav., Ic. Descr. Pl. 6: 75. 1801). American tropics.

33. L. oligostachyum (Willd.) Desv., Prod. 205. 1827. (*Hydroglossum oligostachyum* Willd., Sp. Pl. 5: 81. 1810). West Indies.

34. L. pedicellatum C. Chr. et Maxon, Sv. Vet. Akad. Handl. III. 16 (2): 85, t. 19. 1936. Haiti.

35. *L. marvinei Lesq., U. S. Geol. & Geogr. Surv. Terr., Bull. 1: 383. 1875 (1876). Laramie: Colorado.

Subgenus C. **Odontopteris** (Bernh.) Reed, comb. nov.

Odontopteris Bernh., Schrad. Journ. 1800 (2): 127. 1801; *Lygodictyon* J. Smith, in Hook., Gen. Fil. t. 111 B. 1842;

Hydroglossum Willd., emend. Presl, Suppl. Tent. Pterid. 113. 1845; *Lygodium* sect. III. *Volubilia* Prantl, Schiz. 76. 1881; Diels, in Nat. Pfl.-fam. 1 (4): 366. 1900; C. Chr., Ind. Fil. LV. 1905.

Segmenta secundaria sterilia fertiliaque pinnata, ambitu oblonga, tertiaria fere aequilonga, costulis laciniisve basalibus nullus, rarius postrema pinnata. (Prantl).

The fronds are bipinnate, the pinnules elongated. The fertile portions are situated around the margins of the lamina. Some species have reticulate spores, others smooth ones; a few have verrucose spores.

Type: *Lygodium volubile* Swartz.

36. L. volubile Swartz, Schrad. Journ. 1801 (2): 304. 1803. American tropics.
37. L. micans Sturm, Fl. Bras. 1 (2): 178. 1859. West Indies.
38. L. salicifolium Presl, Suppl. Tent. Pterid. 102. 1845. India.
39. L. smithianum Presl, Suppl. Tent. Pterid. 112. 1845 (nomen); Prantl, Schiz. 80. 1881. Tropical West Africa.
40. L. boivini Kuhn, Fil. Afr. 168. 1868. Comor Islands.
41. L. lanceolatum Desv., Berl. Mag. 5: 307. 1811. Comor Islands, Madagascar.
42. L. kingii Copel., Philip. Journ. Sci. Bot. 6: 68. 1911. New Guinea.
43. L. scandens (L.) Swartz, Schrad. Journ. 1800 (2): 106. 1801. (*Ophioglossum scandens* L., Sp. Pl. 2: 1063. 1753). Africa, Asia, Polynesia, tropical Australia.
44. L. reticulatum Schkuhr, Kr. Gew. 1: 139, t. 139. 1809. Polynesia, Australia.

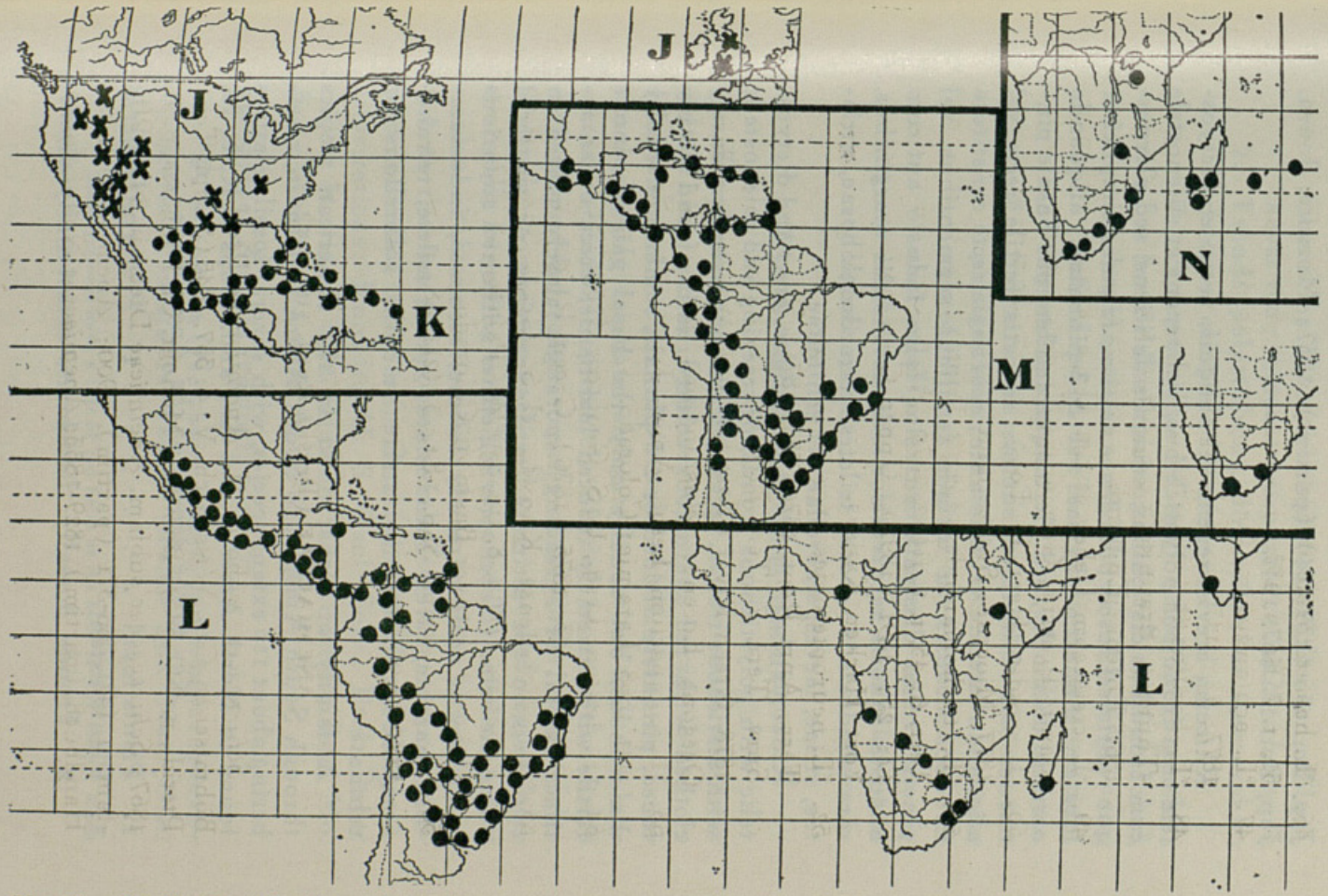
There are several fossil plants which have been described in the genus *Lygodium*, which are listed below without reference to the subgenera until additional notes on the material are made.

45. *L. trilobatum Berry, Geol. Surv. Prof. Paper 156: 50, t. 7, fig. 5. 1930. Eocene (Wilcox): Tennessee, Louisiana, Mississippi.

46. *L. hastataforme Berry, Geol. Surv. Prof. Paper 156: 50, t. 7, fig. 4. 1930. Eocene (Wilcox): Texas.
47. *L. acutangulum Heer, Fl. Helv. 1: 42, t. 13, fig. 3. 1877; 3: t. 117, fig. 25b. Tertiary: Switzerland.
48. *L. kaulfussii Heer, Beitr. z. nähern Kennt. Sachs.--Thüring. Braunkolhe, p. 409, t. 8, fig. 21; t. 9, fig. 1. 1861. Eocene: England.
49. *L. cretaceum Debey et Ett. Upper Cretaceous (Senonian): Prussia; Germany (Niederschoena).
50. *L. gaudini Heer, Fl. Foss. Helv. 1: 41, t. 13, fig. 5-15. 1877. Miocene: Switzerland.
51. *L. trichomanoides Lesq., Rept. U. S. Geol. Surv. Terr. 6: 45, t. 1, fig. 2. 1874; U. S. Geol. Surv., Mon. 17: 25; 1891 (1892). Upper Cretaceous (Dakota): Fort Harker, Kansas.
52. *L. neuropteroides Lesq., U. S. Geol. & Geogr. Surv. Terr., Ann. Rept. 1870: 384. 1871; Rept. U. S. Geol. Surv. Terr. 7 (Tert. Fl.): 61, t. 5, fig. 4-7; t. 6, fig. 1. 1878. Green River (Fort Union): Wyoming; Clarno: Oregon; Eocene: Washington; British Columbia.
53. *L. compactum Lesq., Amer. Journ. Sci., Ser. 2, 16: 206. 1868. Laramie: Colorado.
54. *L. dentoni Lesq., U. S. Geol. & Geogr. Surv. Terr., Bull. 1: 383. 1875 (1876). Green River: Wyoming.
55. *L. coloradense Knowl., U. S. Geol. Surv., Prof. Paper 155: 30, t. 8, fig. 8. 1930. Palaeocene (Dawson Arkose): Denver Basin of Colorado.
56. *L. exquisitum Sap., Et. 3 (2): 88, t. 1, fig. 13. Gypses of Aix.

ANEMIACEAE (Presl) Reed, stat. nov.

Schizaeaceae subord. II. *Aneimiaceae* Presl, Abh. K. Böhmischen Ges. Wissensch. V. 4: 337. 1845 (Suppl. Tent. Pterid., p. 77. 1845); Bommer, Monogr. Cl. Fougères, p. 91. 1867; *Schizaeaceae* subfam. *Aneimieae* Diels, in Nat. Pfl.--fam. 1 (4): 366-371 (partim). 1900; *Anemiaceae* Link, Handbuch, (partim). 1829-1833; *Anemiaceae* Nakai, Journ,



Map. J. Distribution of the Genus Protornithopteris.
Map. K. Distribution of the Genus Ornithopteris.
Map. L. Distribution of the Genus Hemianemia.
Map. M. Distribution of the Genus Anemia.
Map. N. Distribution of the Genus Mohria.

Jap. Bot. 13: (139-154) (partim). 1937; Momose, Journ. Jap, Bot. 17: 667. 1941.

Rhizoma brevis, repens vel obliquis, recta et dictyostele cum frondibus polystichibus, vel repens et solenostele cum frondibus distichibus, squamis deficiens, sed plerumque rubris vel fuscis pilis dense vestita; *frondes* simpliciter lobatae, pinnatim divisae vel 2-3-pinnatae, aliquando omnino dissimiles, sed plerumque tandem par basale pinnarum cum folii-textu summe reductis fertile recte vel aliquando laterale vel dilatante; *sporangia* tecte constituta in duos ordines in ultimis fertilibus segmentibus, vel praeter venas dissipata, aut sine falso indusio aut cum angustis foliosis recurvatis similibus indusii marginibus, rare exindusiatis; *sporae* triletes, tetraedroglobosae, striatae, striae, laeves, scabrellae vel echinatae.

Rhizome short, creeping or oblique, erect and dictyostelic with polystichous fronds, or creeping and solenostelic with distichous fronds, lacking scales but usually densely clothed with red to fuscous colored hairs; frond simply lobed, pinnately divided or 2-3-pinnate, sometimes wholly dimorphous, but usually only the basal pair of pinnae fertile with extremely reduced leaf-tissue, erect or sometimes lateral or spreading; sporangia closely placed in two rows on the ultimate fertile segments, or scattered along the veins (*Trochopteris*), either without a supurious indusium or with narrowly foliose, recurved, indusium-like margins, rarely exindusiate; spores trilete, tetrahedralglobose, striate, the striae smooth, scabrellous or echinate.

A family of ferns found in the American tropics through South America to South Africa and India, numbering about 115 extant species, with several fossil relatives found in North America and England. Maps J, K, L, M.

Key to the genera of the Anemiaceae

1. Plants fossil . . . . . 1. *Protornithopteris.*
1. Plants extant.
   2. Fronds dorsally distichous, occasionally dimor-

phous; hairs on the rhizome dark brown or black, never red; rhizome creeping . 2. *Ornithopteris.*

2. Fronds polystichous, dimorphic, or isomorphic; rhizome oblique or horizontal.
   3. Stomata close to each other or suspended; fronds dimorphic or isomorphic, simply lobed, or pinnate-pinnatifid to tri- or quadripinnate; tuft of red hair at base of stipes; spores striate, the striae smooth . . . 3. *Hemianemia.*
   3. Stomata free; fronds isomorphic, pinnate, the pinnae incised or entire, never again pinnate; tuft of hairs at base of stipe reduced in size and usually fuscous brown*; spores mostly echinate or echinulate at the triangular-tetrahedral apices . . . . . 4. *Anemia.*

Protornithopteris Reed, gen. nov.

Frond once-pinnate, bipinnate or tripinnate, narrowly deltoid in outline; *pinnae* alternate, ovate-oblong to linear-lanceolate; *pinnules* sessile, subdecurrent or sometimes slightly stipitate, elongate-lanceolate or linear-lanceolate, acuminate, pinnately divided to near the rachis into oblong-lanceolate, mostly acute, lobes; *lower lobes* distantly, sometimes rather sharply, toothed; *upper lobes* gradually becoming crenulate or sometimes entire; *rachis* narrow; *texture* coriaceous; *veins* forking, free, running out to the margin; *spores* tetrahedral, trilete; sporangiophores similar to those in *Ornithopteris.* Map J (crosses). Illustrations: Knowlt., U. S. Geol. Surv., Prof. Paper 108: t. 31, fig. 6; t. 32, fig. 1-3. 1917; Andrews, Ann. Mo. Bot. Gard. 28: fig. 1-12, 33, 36-38. 1941.

Genotype: *Anemia fremonti* Knowlt.

1. *__P. elongata__ (Newberry) Reed, comb. nov. *(Sphenopteris elongata* Newberry, Boston Soc. Nat. Hist.

* Some sections have a tuft of red hairs at the base of the stipes, along with striate nearly non-echinulate spores.

Journ. 7: 511. 1863). Cretaceous: Wyoming, Colorado, New Mexico, Utah, Montana; Eocene: England; Gelinden: Sézanne.

2. ***P. eocenica** (Berry) Reed, comb. nov. (*Anemia eocenica* Berry, U. S. Geol. Surv., Prof. Paper 91: 164, t. 9, fig. 7; t. 10, fig. 2; t. 11, fig. 1-2. 1916). Wilcox Age: Tennessee, Arkansas, Louisiana, Texas (Upper Claiborne deposits of Texas Coastal Plain).
3. ***P. fremonti** (Knowlton) Reed, comb. nov. (*Anemia fremonti* Knowlt., U. S. Geol. Surv., Prof. Paper 108: 84-85, t. 31, fig. 6; t. 32, fig. 1-3. 1917; *Anemia fremonti* forma *fertilis* Andrews, Ann. Mo. Bot. Gard. 28: 168, fig. 1-12, 33, 36-38. 1941). Frontier Form.: Wyoming.
4. **P. gracillima** (Lesq.) Reed, comb. nov. (*Adiantites gracillimus* Lesq., Rept. U. S. Geol. Surv. Terr., 8: 137, t. 21, fig. 8, 1883). Miocene: Florissant, Colorado.
5. **P. grandifolia** (Knowlt.) Reed, comb. nov. (*Anemia grandifolia* Knowlt., U. S. Geol. Surv., Prof. Paper 134: 78, t. 5, 1924). Animas Form.: Colorado; Fruitland Form.: New Mexico.
6. **P. hesperia** (Knowlt.) Reed, comb. nov. (*Anemia hesperia* Knowlt., U. S. Geol. Surv., Prof. Paper 98: 332, t. 84, fig. 3. 1916). Fruitland Form.: New Mexico.
7. **P. lanceolata** (Knowlt.) Reed, comb. nov. (*Anemia lanceolata* Knowlt., U. S. Geol. Surv., Prof. Paper 155: 29, t. 8, fig. 10. 1930). Middle Park Form.: Colorado.
8. **P. mosbyensis** (Knowlt.) Reed, comb. nov. (*Anemia mosbyensis* Knowlt., U. S. Geol. Surv., Prof. Paper 155: 28, t. 8, fig. 9. 1930). Dawson Arkose: Colorado.
9. **P. occidentalis** (Knowlt.) Reed, comb. nov. (*Anemia occidentalis* Knowlt., U. S. Geol. Surv., Prof. Paper 101: 285, t. 54, fig. 2. (1917) 1918). Eocene (Raton Form.): Colorado, New Mexico.
10. **P. robusta** (Hollick) Reed, comb. nov. (*Anemia robusta* Hollick, Torreya 2: 145, t. 3, fig. 1. 1902). Vermejo Form.: Colorado.
11. **P. supercretacea** (Hollick) Reed, comb. nov. (*Ane-*

mia supercretacea Hollick, Torreya 2: 145, t. 3, fig. 6-7. 1902). Upper Cretaceous (Laramie Form.): Colorado, New Mexico.

Hollick (*26*, p. 3) proposed a new name, *Anemia perplexa*, to replace *Sphenopteris* (*Asplenium*) *elongata* Newberry (*39*), because *Asplenium elongatum* Swartz (*62*) antedated Newberry's name (*41*). «*Asplenium elongatum*», so far as I have been able to track down, never has appeared as such for the fossil species, and it might be well contended the combination *Anemia elongata* (Newb.) Knowlt., based on *Sphenopteris elongata* Newb., is valid. Of course, *Sphenopteris* is a 'form-genus', and acknowledging that the species properly belongs in *Asplenium*, might be a legitimate excuse for renaming the plant. *Anemia perplexa* is a *nomen abortivum*.

Other specific epithets confuse the issue. Saporta, who first applies the name *Asplenium subcretaceum* to plants from Sézanne, was quite certain his plant was the same as those from Bournemouth (Eocene, England). Further, Lesquereux considered the English specimens and his *Gymnogramma haydenii* from Wyoming as identical. Newberry (*40*) considered the British and American material as at least varieties, if specifically identical. However, due to the fact that all this material has been sterile, and at times quite fragmentary, the exact relationship of the British and American material to each other is a matter of conjecture, until fertile material of both is found.

Knowlton (*29*, p 20) takes up *Anemia subcretacea* (Sap.) Gard. et Ett. (1880), based on *Asplenium subcretaceum* Sap. (1868), and includes *Gymnogramma haydenii* Lesq. (1873) as a synonym. However, later Knowlton (*30*); (31) took up *Anemia elongata* (Newb.) Knowlt., and reduced *Anemia subcretacea* (Sap.) Gard. et Ett., *Anemia haydenii* (Lesq.) Cockerell (*18*) and *Anemia perplexa* Hollick to synonyms. If the specific epithet *elongata* were invalid due to Swartz's *Asplenium elongatum*, then *haydenii* is proper, it being an older epithet than *perplexa*.

However, if *subcretacea* (1868) should prove identical with *haydenii* (1873), then *subcretacea* must become the proper epithet to use.

Most of the species referable to the genus *Protornithopteris* have been founded on sterile material. Of *Anemia fremonti* Knowlt., there has been abundant fertile material discovered by Andrews (*1*). This species will be used to typify this new genus of fossil ferns, which genus in habit, frond-texture, venation and spore characters shows much similarity to *Ornithopteris*. The genus *Protornithopteris* has a wide geographical range in the late Mesozoic and early Cenozoic, being found in the Eocene, Miocene and Cretaceous of Western United States and South Central United States; also in the Eocene of England. The forms that approach *Hemianemia* and *Anemia* occur in geologically more recent formations than those that resemble *Ornithopteris*, indicating that *Ornithopteris* is more closely related to the progenitor of this complex. It is significant that the distribution of *Protornithopteris* is just north of the northern boundary of the living members of the Anemiaceae, in that so often the fossil members of a group are rather far removed spatially from the present day distribution of their living descendents.

2. **Ornithopteris** Bernh.,

Schrad. Neu Journ. 1 (2): 40. 1806.

Anemirhiza J. Smith, in Seeman Bot. Herald Voy., 243 (in nota). 1854; *Aneimia* subgenus IV. *Aneimiorrhiza* (J. Smith) Prantl, Schiz., p. 88 et 121, 1881, incl. sect. I. *Coriaceae* Prantl et sect. 2. *Cuneatae* Prantl, Schiz., p. 88. 1881; Diels, in Nat. Pfl.-fam. 1 (4): 371. 1900.

Fronds distichous, distant and produced in a single series from an elongating creeping on axis; fronds dimorphic, or, if only the basal pinnae fertile, these quite often remote from the sterile lamina; veins always free; indusium narrow; spores semi-globose to tetrahedral-

-globose, striate, the striae smooth, the ridges undulate. This genus consists of ferns that live in calcareous (rarely serpentine) soils in the West Indies and Central America. Map K.

Genotype: *Ornithopteris adiantifolia* (L.) Bernh.

Section 1. **Eu-Ornithopteris** Reed, sect. nov.

Frondes similes, tandem basales pinnae fertiles; *lamina sterilis* simpliciter pinnata, ad pinnato-pinnatifidam ad plene bipinnato-pinnatifidam in pinnis inferioribus; *textura* rigide herbacea ad crassim coriacea.

Fronds similar, with the basal pinnae fertile; sterile lamina simply pinnate, to pinnate-pinnatifid to fully bipinnate-pinnatifid in the lower pinnae; texture rigidly herbaceous to thick coriaceous.

Type: *Osmunda adiantifolia* L.

1. O. adiantifolia (L.) Bernh., Schrad. Neu Journ. 1 (2): 50, t. 3, fig. 15 a. 1806 (*Osmunda adiantifolia* L., Sp. Pl. 2: 1065. 1753). Florida, tropical Americas.
2. **O. coriacea** (Griseb.) Reed, comb. nov. (*Anemia coriacea* Griseb., Cat. Pl. Cub. 272. 1866). Eastern Cuba. Pl. 1. fig. 4.
3. O. mexicana (Klotzsch) Underw., Our Nat. Ferns, ed. VI, 76. 1900. (*Anemia mexicana* Klotzsch, Linnaea 18: 526. 1844). Texas, Mexico. Pl. 1, fig. 1.
4. **O. speciosa** (Presl) Reed, comb. nov. (*Anemia speciosa* Presl, Suppl. Tent. Pterid. 89. 1845). Western Mexico, Cuba. Pl. 1, fig. 2.
5. **O. makrinii** (Maxon) Reed, comb. nov. (*Anemia makrinii* Maxon, Journ. Wash. Acad. Sci. 8: 199. 1918). Mexico. Pl. 1, fig. 3.
6. **O. cuneata** (Kunze) Reed. comb. nov. (*Anemia cuneata* Kunze; Spr., Syst. 4: 32. 1827; Kunze, Anal. 8, t. 8, fig. 1. 1837). Cuba.

Section 2. **Cicutariae** Reed, sect. nov.

Frondes semper dissimiles; *textura* membranacea vel rigide coriacea; *frons fertilis* distincte distichis; *venae* liberae, pinnatae vel flabellatae.

Fronds always dimorphic, of finely membranaceous or rigidly coriaceous texture, the fertile distinctly distichous; veins free, pinnate or flabellate.

Type: *Anemia cicutaria* Kunze.

7. **O. aurita** (Swartz) Reed, comb. nov. (*Anemia aurita* Swartz, Syn. 157. 1806). Jamaica. Pl. 1, fig. 5.
8. **O. portoricensis** (Maxon) Reed, comb. nov. (*Anemia portoricensis* Maxon, N. Amer. Fl. 16: 48. 1909). Porto Rico.
9. **O. abbottii** (Maxon) Reed, comb. nov. (*Anemia abbottii* Maxon, Proc. Biol. Soc. Wash. 35: 48. 1922). Hispaniola, Santo Domingo.
10. **O. nipeensis** (Benedict) Reed, comb. nov. *Anemia nipeensis* Benedict, Amer. Fern Journ. 1: 41, t. 2. 1911). Cuba.
11. O. cicutaria (Kunze) Underw., Mem. Torr. Bot. Cl. 12: 15. 1902. (*Anemia cicutaria* Kunze; Spr., Syst. 4: 31. 1827). Bahamas, Cuba, Yucatan. Pl. 1, fig. 6.
12. O wrightii (Baker) Millsp., Field Col. Mus. Bot. Ser. 3: 1 (14). 1903. (*Anemia wrightii* Baker, Syn. 435. 1868). Eastern Cuba. Pl. 1, fig. 7.

3. **Hemianemia** (Prantl) Reed, stat. nov.

Aneimia subgenus II. *Hemianeimia* Prantl, Schiz. 86 et 90. 1881; Diels, in Nat. Pfl.-fam. 1 (4): 368. 1900.

The most characteristic features of this genus and its several subgenera are the tuft of red hairs at the base of the stipes and the tetrahedral spores, striate, the striae always smooth. The fertile segments are rarely wholly sporangiferous. A reflexed pseudo-indusium is present. The

fronds may be simply lobed with uncontracted fertile pinnae (*Trochopteris*), variously pinnate with definite stipes but the lower two fertile pinnae not modified (*Aneimiaebotrys*), variously pinnate with the ultimate segments tending to be linear, dichotomously branching, dimorphous or isomorphous (*Coptophyllum*), or 2-3--pinnate with very hairy stipes and rachises (*Eu-Hemianemia*). The sporangia vary from those with a poorly developed annulus in subgenus *Coptophyllum* to a normally developed annulus covering one-third to one-fourth of the sporangium in subgenera *Eu-Hemianemia* and *Aneimiaebotrys*, finally expressing itself over one-half of the sporangium in subgenus *Trochopteris*.

This genus ranges from western Mexico southward along the Andes in South America to northern Argentina to southern Brazil, Paraguay and Uruguay and then northward in southeastern Brazil; also in Jamaica, Trinidad, Tobago and in Venezuela and British Guiana, and extending from Nigeria to Abyssinia and Guinea to South Africa, Madagascar and southern India. Map L.

Genotype: *Osmunda tomentosa* Sav.

Key to the subgenera of Hemianemia

1. Fertile pinnae not modified, lateral.
   2. Fronds simple, lobed, produced in a closely arranged rosette; stomata on upper side . . . . . A. *Trochopteris*.
   2. Fronds at least once-pinnate with the pinnae pinnatifid or incised, covered with hairs; stomata on lower side . . . B. *Aneimiaebotrys*.
1. Fertile pinnae modified, contracted and erect; stomata on lower side.
   2. Fronds dimorphic or isomorphic with linear or narrowly expanded ultimate segments, 2-3-pinnate . . . . . C. *Coptophyllum*.
   2. Fronds isomorphic, 2-3-pinnate and with very hairy stipes . . . . . D. *Eu-Hemianemia*.

Subgenus A. **Trochopteris** (Gardn.) Reed, comb. nov.

Trochopteris Gardn., Lond. Journ. Bot. 1: 74, t. IV. 1842; *Aneimia* subgen. I. *Trochopteris* (Gardn.) Prantl, Schiz., p. 86. 1881; Diels, in Nat. Pfl.-fam. 1 (4): 368 (part A). 1900.

Fronds very small (2-10 cm. long), sessile, produced in a rosette, rather hairy; tuft of red hair present at the bases of the extremely short stipes; fronds simple, usually about 5-lobed, the lower two fertile, not conspicuously contracted, with the sporangia irregularly placed on the underside; annulus covering nearly one-half of the sporangium; spores triangular-tetrahedral, striate, scabrellous. These xerophytic ferns are confined to central Brazil.

Type: *Trochopteris elegans* Gardn.

1. **H. elegans** (Gardn.) Reed, comb. nov. (*Trochopteris elegans* Gardn., Lond. Journ. Bot. 1: 74, t. 4. 1842). Goyas, Brazil.
2. **H. eximia** (Taubert) Reed, comb. nov. (*Anemia eximia* Taubert, Engl. Bot. Jahrb. 21: 422. 1896). Goyas, Brazil.

Subgenus B. **Aneimiaebotrys** (Fée) Reed, comb. nov.

Aneimiaebotrys Fée, Crypt. Vasc. Brés. 1: 267. 1869; *Aneimia* subgen. I. *Trochopteris* (Gardn.) Diels, in Nat. Pfl.-fam. 1 (4): 368 (part B). 1900; *Aneimia* subgen. II. *Hemianeimia* sect. 2. *Tomentosae* Prantl, b. *Catadromae* Prantl, Schiz. p. 87. 1881.

Lower pair of pinnae fertile but not contracted, on short petioles; stipes of the fronds usually possessing brownish-red (occasionally white) hairs, with a tuft of red hairs at their bases; fronds 2-3-pinnate; spores subtriangular to globose, striate, the striae smooth. These ferns ive at rather high altitudes up to 3000 m. in southwestern

Brazil, eastern Bolivia, with relatives in Mexico and Costa Rica and Guinea (Africa) and Madagascar.

Type: *Aneimiaebotrys aspera* Fée.

3. **H. aspera** (Fée) Reed, comb. nov. (*Aneimiaebotrys aspera* Fée, Crypt. Vasc. Brés. 1: 267, t. 78, fig. 2 1869). Brazil, Costa Rica.
4. **H. smithii** (Brade) Reed, comb. nov. (*Anemia smithii* Brade, Bol. Mus. Nac., Rio de Janeiro 5 (3): 95, t. 3. 1929). Brazil (Matto Grosso).
5. **H. brandegeea** (Davenp.) Reed, comb. nov. (*Anemia brandegeea* Davenp., Fern Bull. 13: 20. 1905), Mexico.
6. **H. intermedia** (Copel.) Reed, comb. nov. (*Anemia intermedia* Copel., ex M. E. Jones, Contrib. West. Bot. No. 15: 123. 1929). Mexico.
7. **H. trichorhiza** (Gardn.) Reed, comb. nov. (*Anemia trichorhiza* Gardn., in Hook., Ic. Pl. t. 876. 1852). Brazil (Matto Grosso).

7a. **H. trichorhiza** var. **paraguariensis** (Hassl.) Reed, comb. nov. (*Anemia trichorhiza* var. *paraguariensis* Hassl., Trab. Inst. Bot. Farm. Buenos Aires, No. 45: 83. 1928). Paraguay.

8. **H. myriophylla** (Christ) Reed, comb. nov. (*Anemia myriophylla* Christ, Bull. Herb. Boiss. II. 7: 793. 1907). Southern Bolivia.
9. **H. sessilis** (Jeanpert) Reed, comb. nov. (*Anemia tomentosa* var. *sessilis* Jeanpert, Bull. Mus. Nat. d'Hist. 1910: 403. 1910). Guinea (Africa).
10. **H. perrieriana** (C. Chr.) Reed, comb. nov. (*Anemia perrieriana* C. Chr., Cat. Pl. Mad. Pter. 65. 1931 (nomen); Dansk. Bot. Ark. 7: 178, t. 72, fig. 5-6. 1932). Madagascar.

Subgenus **C. Coptophyllum** (Gardn.) Reed, comb. nov.

Coptophyllum Gardn., Lond. Journ. Bot. 1: 133. 1842; *Aneimia* subgen. II. *Hemianeimia* Prantl, sect. 3. *Millefoliae* Prantl, Schiz., p. 87. 1881; Diels, in Nat. Pfl.-fam. 1 (4): 368. 1900.

Plants dimorphic or isomorphic, xerophytic, with a creeping rhizome; sterile frond several times divided into elongated, linear, dichotomous ultimate segments, or progressively widening ultimate segments with the loss of dimorphism; fertile fronds, or fertile portions, tripinnate, the pinnules sporangiferous, contracted; veins forked, free; indusium none; spores subtriangular to globose, striate, striae smooth. These ferns grow at high elevations in Colombia and Brazil, on rocks and in dry places.

Occasionally part of the fertile frond, in the dimorphic series, is barren, approaching, to a degree, *Mohria*, but differing from *Mohria* in its double row of sporangia, in its lack of the indusium-like inflexed margin and in its lack of true scales. The annulus is much less developed than in any of the other genera or subgenera in the Anemiaceae.

Type: *Coptophyllum buniifolium* Gardn.

Section 1. **Eu-Coptophyllum** Reed, sect. nov.

Frondes dissimiles, aliquando pars frondis fertilis sterilis, similis *Mohria*.

Type: *Coptophyllum buniifolium* Gardn.

11. **H. buniifolia** (Gardn.) Reed, comb. nov. (*Coptophyllum buniifolium* Gardn., Lond. Journ. Bot. 1: 133. 1842). Serra de Natividade, Brazil; Rio Guatiquia, Colombia. Pl. 1, fig. 8.

11a. **H. buniifolia** var. **tenuifolia** (Presl) Reed, comb. nov. (*Anemia tenuifolia* Presl, Abh. Böhm. Ges. V. 5: 327. 1848). Brazil.

11. **H. millefolia** (Gardn.) Reed, comb. nov. (*Coptophyllum millefolium* Gardn., Lond. Journ. Bot. 1: 133. 1842). Goyas, Brazil. Pl. 3, fig. 6.

13. **H. pyrenaea** (Taubert) Reed, comb. nov. (*Anemia pyrenaea* Taubert, Engl. Bot. Jahrb. 21: 422. 1896). Brazil.

Section 2. **Rutaefoliae** Reed, sect. nov.

Frondes similes omnes.

Type: *Anemia rutaefolia* Mart.

14. **H. dimorphostachys** (Baker) Reed, comb. nov. (*Anemia dimorphostachys* Baker, in Engl. Bot. Jahrb. 17: 522. 1893). Brazil.
15. **H. heterodoxa** (Christ) Reed, comb. nov. (*Anemia heterodoxa* Christ, Ann. Cons. Jard. Bot. Genève 3: 45. 1899). Brazil.
16. **H. rutaefolia** (Mart.) Reed, comb. nov. (*Anemia rutaefolia* Mart., Ic. Cr. Bras., 112, t. 55, fig. 1 1834). Brazil. Pl. 1, fig. 9.
17. **H. nana** (Baker) Reed, comb. nov. (*Anemia nana* Baker, in Engl. Bot. Jahrb. 17: 522, 1893). Brazil.

Subgenus D. **Eu-Hemianemia,** subgen. nov

Aneimia subgen. II. *Hemianeimia* Prantl, Schiz., 86 et 90. 1881; Diels, in Nat. Pfl.-fam. 1 (4): 368. 1900.

Frondes similes, 2-3-pinnatae, cum stipitibus hirsutissimis; *stomatae* in inferiore latere.

Tuft of red hairs at the base of the stipes; fronds pinnate with entire segments, or incised, or pinnatifid, or repeatedly pinnate; lower pair of pinnae fertile and erect; spores tetrahedral, striate, the striae smooth. The section *Gardnerianae* has its affinities with the subgenus *Trochopteris*, while the section *Tomentosae* is more closely allied with subgenera *Coptophyllum* and *Aneimiaebotrys*, these affinities being borne out by the spores and the hairs on the stipes and rhizome. These ferns are found from Mexico through northern South America, south to Paraguay and southern Brazil; and in Nigeria to Abyssinia, Madagascar and southern India.

Type: *Osmunda tomentosa* Sav.

Section 1. **Gardnerianae** (Prantl) Reed. comb. nov.

Aneimia subgen. II. *Hemianeimia* sect. 1. *Gardnerianae* Prantl, Schiz., p. 87. 1881: Diels, in Nat. Pfl.-fam. 1 (4): 368. 1900.

Fronds pinnately lobed or pinnate, with entire segments or only pinnatifidly incised.

Type: *Anemia gardneri* Hook.

18. **H. gardneri** (Hook.) Reed, comb. nov. (*Anemia. gardneri* Hook., Ic. Pl., t. 190. 1837). Brazil.
19. **H. glareosa** (Gardn.) Reed, comb. nov. (*Anemia glareosa* Gardn., in Field et Gardn., Sert. Pl., t. 70. 1844). Brazil, Colombia.
20. **H. lanuginosa** (Bongard; Sturm) Reed, comb. nov. (*Anemia lanuginosa* Bongard; Sturm, Fl. Bras. 1 (2): 210. 1859). Brazil.

Section 2. **Tomentosae** (Prantl) Reed, comb. nov.

Aneimia subgen. II. *Hemianeimia* sect. 2. *Tomentosae* Prantl, a. *Anadromae* Prantl, Schiz., p. 87. 1881; Diels, in Nat. Pfl.-fam. 1 (4): 368. 1900.

Fronds pinnate, the segments pinnatifid or repeatedly pinnate; lamina pilose; laminae of fertile pinnae pubescent, as in some species of the subgenus *Coptophyllum*; spores broadly striate, the striae smooth, yellowish; tuft of red hairs at base of stipes. There are indications in the South African species of filiform scales, linking this genus with the Mohriaceae.

Type: *Osmunda tomentosa* Sav.

21. **H. tomentosa** (Sav.) Reed, comb. nov. (*Osmunda tomentosa* Sav., in Lam., Encycl. 4: 652. 1797; *Anemia*

tomentosa (Sav.) Swartz, Syn. 157. 1806). Tropical South America.

21a. **H. tomentosa** var. **subsimplex** (Christ) Reed, comb. nov. (*Anemia tomentosa* var. *subsimplex* Christ, Bull. Herb. Boiss. II. 2: 695. 1902). Brazil, Venezuela.

21b. **H. tomentosa** var. **oblonga** (Sturm) Reed, comb. nov. (*Anemia oblonga* Sturm, Fl. Bras. 1 (2): 206. 1859). Brazil.

22. **H. ahenobarba** (Christ) Reed, comb. nov. (*Anemia ahenobarba* Christ, in Schwacke, Pl. Nov. Mineiras 2: 37. 1900; Bull. Herb. Boiss. II. 2: 696. 1902). Central Brazil.

23. **H. anthriscifolia** (Schrad.) Reed, comb. nov. (*Anemia anthriscifolia* Schrad. Gott. Gel. Anz. 1824: 865. 1824). Mexico-Paraguay. Pl. 2, fig. 4.

23a. **H. anthriscifolia** forma **nana** (Lindm.) Reed, comb. nov. (*Anemia anthriscifolia* forma *nana* Lindm., Ark. för Bot. 1: 258. 1903). Argentina, Bolivia.

23b. **H. anthriscifolia** var. **rotundata** (Lindm.) Reed, comb. nov. (*Anemia anthriscifolia* var. *rotundata* Lindm., Ark. för. Bot. 1: 258, t. 12, fig. 1. 1903) Brazil.

23c. **H. anthriscifolia** var. **simplicior** (Christ) Reed, comb. nov. (*Anemia anthriscifolia* var. *simplicior* Christ, in Fedde Repert. 6: 351. 1909). Paraguay.

24. **H. guatemalensis** (Maxon) Reed, comb. nov. (*Anemia guatemalensis* Maxon, N. Amer. Fl. 16: 46. 1909). Guatemala. Pl. 3, fig. 4.

25. **H. rosei** (Maxon) Reed, comb. nov. (*Anemia rosei* Maxon, N. Amer. Fl. 16: 46. 1909). Mexico.

26. **H. tripinnata** (Copel.) Reed, comb. nov. (*Anemia tripinnata* Copel., Univ. Calif. Publ. Bot. 17: 24, t. 1. 1932). Brazil. Pl. 3, fig. 1.

27. **H. flexuosa** (Sav.) Reed, comb. nov. (*Osmunda flexuosa* Sav., in Lam., Encycl. 4: 652. 1797; *Anemia flexuosa* (Sav.) Swartz, Syn. 156. 1806). Tropical Americas. Pl. 2, fig. 3.

27a. **H. flexuosa** forma **genuina** (Hieron.) Reed, comb. nov. (*Anemia flexuosa* forma *genuina* Hieron., Hedwigia 48: 290. 1909). Peru.

27b. **H. flexuosa** forma **transitoria** (Rosenst.) Reed, comb. nov. (*Anemia flexuosa* forma *transitória* Rosenst., Hedwigia 46: 158. 1907). Brazil.

28. **H. villosa** (H. et B.) Reed, comb. nov. (*Anemia villosa* Humb. et Bonpl. ex Willd., Sp. Pl. 5: 92. 1810). Tropical South America. Pl. 2, fig. 2.

29. **H. fulva** (Cav.) Reed, comb. nov. (*Osmunda fulva* Cav., Icon. 6: 70, t. 593, fig. 2. 1801). Tropical South America. Pl. 2, fig. 5.

30. **H. luetzelburgii** (Rosenst.) Reed, comb. nov. (*Anemia luetzelburgii* Rosenst., in Fedde Repert. 20: 94. 1924). Brazil.

31. **H. karwinskyana** (Presl) Reed, comb. nov. (*Anemia villosa karwinskyana* Presl, Suppl. Tent. Pterid. 83. 1845; *Amenia karwinskyana* (Presl) Prantl, Schiz. 99. 1881). Mexico.

32. **H. retroflexa** (Brade) Reed, comb. nov. (*Anemia retroflexa* Brade, Anais Prim. Reun. Sul-Am. Bot. Rio de Janeiro 2: 9, t. 5. 1940). Brazil.

33. **H. schimperiana** (Presl) Reed, comb. nov. (*Anemia schimperiana* Presl, Suppl. Tent. Pterid. 84. 1845). Nigeria to Abyssinia. Pl. 2, fig. 1.

33a. **H. schimperiana** var. **angustiloba** (R. Bonap.) Reed, comb. nov. (*Anemia schimperiana* var. *angustiloba* R. Bonap., Notes Pterid. 1: 133. 1915). Tanganika.

33b. **H. schimperiana** var. **wightiana** (Gardn.) Reed, comb. nov. (*Anemia wightiana* Gardn., Calc. Journ. 7: 10, t. 1. 1847). Southern India.

34. **H. lanipes** (C. Chr.) Reed, comb. nov. (*Anemia lanipes* C Chr., Cat. Pl. Mad. Pter. 65. 1931 (*nomen*); Dansk Bot. Ark. 7: 177. t. 71, fig. 1-3. 1932). Madagascar.

35. **H. madagascariensis** (C. Chr.) Reed, comb. nov. (*Anemia madagascariensis* C. Chr., Arch. de Bot. (Caen), 2 (Bull. mens.): 216. 1928; Dansk Bot. Ark. 7: 177, t. 72, fig. 1-4. 1932). Madagascar.

4. **Anemia** Swartz, emend. Reed

Anemia Swartz, Syn. Fil. 6, 155. 1806: *Aneimia* Kaulf., Enum. 51. 1824; *Aneimia* subgen. III. *Eu-Anei-*

mia Prantl, Schiz., p. 87. 1881; Diels, in Nat. Pfl.-fam. 1 (4): 369-370. 1900; *Aneimia* subgen. II. *Hemianeimia* sect. a. *Anemidictyon* J. Smith; C. Chr., Ind. Fil. LVI. 1905; *Anemia* Nutt., Amer. Nat. Hist. 1: 136. 1838 = *Anemiopsis* (*'Anemopsis'*) Hook. et Arn., Amer. Nat. Hist. 1: 136 (nota). 1838) Bot. Beecheys Voy., p. 390, t. 92. 1841 (Saururaceae).

Pinnae fertiles ad ultimam pinnulam fertiles, propinquae basim cum pinnarum sterilium primo pare; *stomatae* liberae, in inferiore latere; *sporae* tetraedrae, striatae, striae paucis echinulis ad profuse echinatis.

This genus, as emended, is separated from *Hemianemia* by having the following characters: the fertile pinnae to the very last pinnule fertile, contiguous at the base with the first pair of sterile pinnae; indusium wanting; stomata free, on the lower side. The sterile fronds are only once-pinnate with the pinnae entire, serrate or incised. The series of variations in this genus begins where those of the last genus left off. Sections *Oblongifoliae* and *Hirsutae* retain the red tuft of hairs at the base of the stipes, but, even though the spores are striate, at the corners of the tetrahedral-triangular faces there are indications of a few echinulae, in some becoming quite numerous. This character is carried farther in the section *Collinae* and finally all the members of the section *Phyllitides* possess long echinulae on the striae of the spores. Most of the genus *Anemia*, as emended, are found in Brazil, with a few species living in Central America and Mexico, as well as the West Indies; a single species lives in South Africa. Map M.

Genotype: *Anemia phyllitidis* Swartz.

Section 1. Oblongifoliae Prantl,

Schiz., p. 87. 1881; Diels, in Nat. Pfl.-fam. 1 (4): 369 1900.

Aneimia subgen III. *Eu- Aneimia* sect. 4. *Dregeanae* Prantl, Schiz., p. 87. 1881; Diels, in Nat Pfl.-fam 1 (4): 371. 1900.

Fronds pinnate, the pinnae entire; sterile lamina decreasing basally, the segments cut back to the base; petioles stramineous, sparsely hairy, with a red tuft of hair at the base of the stipes; spores striate, with a few species having short echinulae at the angles; usually two fertile sorophores, rarely one in *Anemia santae-martae*. This section is more closely related, according to spore characters and hairs, to the section *Tomentosae* in *Hemianemia*, but in vegetative habit and frond form it is closer to the other sections of the true Anemias.

Type: *Anemia oblongifolia* (Cav.) Swartz.

1. A. oblongifolia (Cav.) Swartz, Syn. 156. 1806. (*Osmunda oblongifolia* Cav., Icon. 6: 69, t. 592, fig. 2. 1801). Tropical Americas. Pl. 4, fig. 6.

1a. A. oblongifolia var. presliana (Prantl) Farwell, Amer. Midl. Nat. 12: 306. 1931. (*Anemia presliana* Prantl, Schiz. 104. 1881). Brazil, Guatemala-Colombia.

2. A. humilis (Cav.) Swartz, Syn. 156. 1806. (*Osmunda humilis* Cav., Icon. 6: 69, t. 592, fig. 3. 1801). Mexico to Colombia, Brazil. Pl. 4, fig. 1.
3. A. cornea Prantl, Schiz. 104. 1881. Mexico.
4. A. affinis Baker, Syn. 525. 1874. Mexico. Pl. 4, fig. 3.
5. A. santae-martae Christ. Bull. Herb. Boiss. II. 7: 791. 1907. Colombia. Pl. 4, fig. 2.
6. A. gomesii Christ, Bull. Herb. Boiss. II. 7: 791. 1907. Southern Brazil.
7. A. donnell-smithii Maxon, N. Amer. Fl. 16: 43. 1909. Honduras.
8. A. organensis Rosenst., in Fedde Repert. 20: 95. 1924. Brazil.
9. A. dregeana Kunze, Linnaea 10: 493. 1836. South Africa. Pl. 4, fig. 4.

Section 2. Hirsutas Prantl,

Schiz., p. 87 1881; Diels, in Nat. Pfl.-fam. 1 (4): 370. 1900.

Fronds pinnate, the pinnae sometimes elongate; sterile lamina decreasing antrorsely; segments incised to bipinna-

tifid, cuneate at the base; petioles fuscous, the tuft of hairs fuscous or dark brown, rarely red; spores striate, the striae usually smooth, a few species having variously sized echinulae.

Type: *Anemia hirsuta* (L.) Swartz.

10. A. hirsuta (L.) Swartz, Syn. 156. 1806. (*Osmunda hirsuta* L., Sp. Pl. 2: 1064. 1753; *Anemia hirsuta* forma *genuina* Hieron., in Engl. Bot. Jahrb. 34: 565. 1905). Tropical Americas. Pl. 3, fig. 5.
10a. A. hirsuta var. subfiliformis Christ, Bull. Herb. Boiss. II. 2: 695. 1902. Brazil.
10b. A. hirsuta var. humboltiana Hieron., in Engl. Bot. Jahrb. 34; 566. 1905. Colombia, Venezuela, Peru.
10c. A. hirsuta var. schwackeana Christ, Bull. Herb. Boiss. II. 2: 695. 1902. Brazil.
11. A. tenella (Cav.) Swartz, Syn. 156. 1806. (*Osmunda tenella* Cav., Icon. 6: 69, t. 592, fig. 1. 1801). Brazil.
12. A. jaliscana Maxon, N. Amer. Fl. 16: 44. 1909. Mexico, southern Lower California.
13. A. pulchra Pohl; Prantl, Schiz. 109. 1881. Brazil.
14. A. wettsteinii Christ, Denkschr. Akad. Wien 79: 48, t. 9, fig. 3-6. 1907. Southern Brazil. Pl. 3, fig. 3.
15. A. barbatula Christ, Denkschr. Akad. Wien 79: 48. 1907. Southern Brazil.
16. A. damazii Christ, Bull. Herb. Boiss. II. 7: 792. 1907. Southern Brazil.
17. A. laxa Lindm., Ark. för Bot. 1: 261, t. 13. 1903. Brazil.
18. A. proxima C. Chr., Sv. Vet. Akad. Handl. III. 16 (2): 86, t. 20, fig. 1-2. 1936. Haiti.
19. A. filiformis (Sav.) Swartz, Syn. 156. 1806. (*Osmunda filiformis* Sav., in Lam., Encycl. 4: 652. 1797). Jamaica, tropical South America.
20. A. obovata (Underw.) Maxon, N. Amer. Fl. 16: 42. 1909. Cuba.
21. A. pastinacaria Moritz ex Prantl, Schiz. 110. 1881. (*Anemia longistipes* (Liebm.) C. Chr., Ind. Fil. 53. 1905; *Anemia pilosa longistipes* Liebm., Vid. Selsk.

Skr. V. 1: 301 (seors. 149). 1849). Mexico, Venezuela, Trinidad. Pl. 3, fig. 2.

22. A. pallida Gardn., in Field et Gardn., Sert. Pl. ad t. 70. 1844. Brazil.

Section 3. Collinae Prantl,

Schiz., p. 87. 1881; Diels, in Nat. Pfl.-fam. 1 (4): 370. 1900.

Fronds pinnate, the sterile lamina decreasing antrorsely; segments rarely incised, often numerous, cut back to the base or completely cleft; petiole straminous: tips of the fronds rarely gemmiferous (*); spores echinate along the striae.

Type: *Anemia collina* Raddi.

23. A. rotundifolia Schrad., Gött. Gel. Anz.: 865. 1824. Brazil. Pl. 4, fig. 5.
24. A. radicans Raddi, Opusc. Sci. Bol. 3: 282. 1819. Brazil. Pl. 5, fig. 4.
25. A. warmingii Plantl, Schiz. 113. 1881. Brazil.
26. A. repens Raddi, Opusc. Sci. Bol. 3: 282. 1819. Colombia, Brazil, Venezuela.
27. A. palmarum Lindm., Ark. för Bot. 1: 261, t. 14. 1903. Brazil.
28. A. mandioccana Raddi, Opusc. Sci. Bol. 3: 282. 1819. Brazil. Pl. 5, fig. 5.
29. A. hirta (L.) Swartz, Syn. 155. 1806. (*Osmunda hirta* L., Sp. Pl. 2: 1064. 1753). West Indies, Costa Rica, Brazil.
30. A. ulei Christ, in Schwacke, Pl. Nov. Mineiras 2: 36. 1900; Bull. Herb. Boiss. II. 2: 694. 1902. Brazil.
31. A. ouroptretana Christ, in Schwacke, Pl. Nov. Mineiras 2: 36. 1900; Bull. Herb. Boiss. II. 2: 693. 1902. Brazil.
32. A. collina Raddi, Opusc. Sci. Bol. 3: 282. 1819. Brazil. Pl. 5, fig. 1.

(*) *Anemia radicans* and *A. warmingii*, both with a red tuft of hairs at the base of the stipes and with echinate spores.

33. A. herzogii Rosenst., Meded. Rijks Herb. Leiden nr. 19: 24. 1913. Bolivia.
34. A. diversifolia Schrad., Gött. Gel. Anz. 1824: 864. 1824. Brazil.
35. A. pohliana Sturm, Fl. Bras. 1 (2): 195. 1859. Brazil.

Section 4. **Phyllitides** Prantl,

Schiz., p. 88. 1881; Diels, in Nat. Pfl.-fam. 1 (4): 371. 1900.

Anemidictyon J. Smith, in Hook., Gen. Fil. t. 103. 1842; *Aneimidictyum* Presl, Suppl. Tent. Pterid. 91. 1845.

Fronds pinnate, the sterile lamina decreasing gradually antrorsely; segments entire, hardly equilateral to the base; petioles stramineous; veins anastomosing or connivent or totally free; spores striate, the striae densely echinate; hairs at the base of the stipes brown or fuscous.

Type: *Anemia phyllitidis* (L.) Swartz.

36. A. phyllitidis (L.) Swartz, Syn. 155. 1806. (*Osmunda phyllitidis* L., Sp. Pl. 2: 1064. 1753). Tropical Americas. Pl. 5, fig. 2.
36a. A. phyllitidis var. pygmaea Christ, Denkschr. Akad. Wien 79: 52, t. 7. 1908. Brazil.
36b. A. phyllitidis var. carytoidea Christ, Bull. Herb. Boiss. II. 2: 692. 1902. Brazil.
36c. A. phyllitidis var. langsdorffiana (Presl) C. Chr., Ind. Fil. 53, 54. 1905. (*Anemia langsdorffiana* Presl, Suppl. Tent. Pterid. 89. 1845). Brazil (Matto Grosso).
36d. A. phyllitidis var. obliqua (Schrad.) Krug, Engl. Bot. Jahrb. 22: 145. 1897; C. Chr., Ind. Fil. 53-54. 1905. (*Anemia obliqua* Schrad., Gött. Gel. Anz. 1824: 864. 1824). Brazil.
36e A. phyllitidis forma aurito-lobata Rosenst., Hedwigia 46: 159. 1907. Brazil.
36f. A. phyllitidis var. nervosa (Pohl; Sturm) Christ, Denkschr. Akad. Wien 79: 52. 1908. (*Anemia nervosa* Pohl; Sturm, Fl. Bras. 1 (2): 193. 1859). Brazil.
36g. A. phyllitidis var. tweedieana (Hook.) Hassl., Trab.

Inst. Bot. Farm. Buenos Aires, no. 45: 85. 1928. (*Anemia tweedieana* Hook., Ic. Pl., t. 906 1854) Uruguay, Southern Brazil.

36h. A. phyllitidis forma transitoria Rosenst., Hedwigia 46: 159. 1907. Brazil.

36i. A. phyllitidis forma transiens Rosenst. ex Hassl., Trab. Inst. Bot. Farm. Buenos Aires, no. 45: 85. 1928 (nulla descr.). Paraguay.

36j. A. phyllitidis forma subtripinnatifida Rosenst., Hedwigia 43: 233. 1904. Brazil.

36k. A. phyllitidis forma minor Rosenst. ex Hassl., Trab. Inst. Bot. Farm. Buenos Aires, no. 45: 85. 1928 (nulla descr.). Paraguay.

36l. A. phyillitidis var. longifolia (Raddi) Lansd. et Fiscch.; Hieron., Engl. Bot. Yahrb. 22: 411. 1897; Hassl., Trab. Inst. Bot. Farm. Buenos Aires, no. 45: 85. 1928. (*Anemia longifolia* Raddi, Pl. Bras. 1: 69, t. 8 bis. 1825). Brazil.

37. A. munchii Christ, Bull. Herb. Boiss. II. 7: 792. 1907. Mexico.

38. A. underwoodiana Maxon, N. Amer. Fl. 16: 40. 1909. Haiti, Cuba, Jamaica. Pl. 5, fig. 6.

39. A. lancea Christ, Bull. Herb. Boiss. II. 7: 791. 1907. Brazil (Matto Grosso).

MOHRIACEAE (Presl) Reed, stat. nov.

Schizaeaceae subord. III. *Mohriaceae* Presl, Abh. K. Böhmischen Ges. Wissensch. V. 4: 355. 1845 (Suppl. Tent. Pterid., p. 95. 1845); Bommer, Monogr. Class. Fougères, p. 91. 1867; *Schizaeaceae* subfam. *Aneimieae* Diels, in Nat. Pfl.-fam. 1 (4): 366-367 (partim). 1900.

Rhizoma brevis, dictyostele, squames obtecta; *frondes* polystiches, pinnatim divisae; *monangium* prope segmentium immutatarum fertilium terminum, plus minus ab marginibus revolutis protectum; *sporae* tetrahedrae, striatae.

Rhizome short, dictyostelic, clothed in scales, a unique character in the living Schizaeales; fronds polystichous,

pinnately divided, in habit like *Cheilanthes;* single sporangium (monangium) borne near the end of each vein of the unaltered fertile segments, more or less protected by the revolute margins; spores tetrahedral, striate, trilete.

1. **Mohria** Swartz,

Syn. Fil. 6, 159, t. 5. 1806.

Mohria Britton, Garden and Forest 6: 434. 1893 = *Halesia* L., Syst. ed. 10: 1044. 1759 (Styracaceae).

Characters of the family; distributed in Africa and the African Islands. Map N.

Genotype: *Mohria caffrorum* (L.) Desv.

1. M. caffrorum (L.) Desv., Prod. 198. 1827. (*Polypodium caffrorum* L., Mantissa, 307. 1771). Africa, south of the Equator and the African Islands, generally in damp places on the outskirts of the forests; Madagascar, Mascarene Islands. Pl. 5, fig. 3.

1a. M. caffrorum var. multisquamosa R. Bonap., Notes Pterid. IV: 85. 1917. Madagascar.

2. M. lepigera Baker, Ann. Bot. 5: 498. 1891. Zambesia.

3. M. vestita Baker, Trans. Linn. Soc. II. Bot. 2: 355. 1887. Kilimanjaro.

In 1940 Chiovenda (*15* a) described a new species, under the name *Mohria scioana*, collected in Southern Abyssinia in 1909 by Giovanni Negri. Pichi-Sermolli (44 a), after extensive studies of the plant, has come to the conclusion that the fern does not belong to the 'Schizaeaceae', but rather to the Cheilanthoid ferns, since it superficially resembles *Aleuritopteris farinosa* in its habit and in its fronds being covered with white farinose powder beneath. However, since it differs from all known ferns in several features of the sporangium, Pichi has established a new genus *Negripteris*, typified by the only known species, *N. scioana.*

The distinguishing characteristics of this genus are as follows: «The sori are gradate, terminal, superficial, consisting of one or two (rarely three) sporangia only, and protected by the modified, veinless, reflexed, indusioid leaf-margin. The sporangia are spheroidal, very large, almost sessile, archaic, and destitute of stomium. The annulus is dark-coloured, vertical, slightly displaced to one side relatively to the middle plane of the sporangium, very broad, not overelevated relatively to the walls, broadly interrupted at the base, consisting of 18-22 (rarely 24) cells, which are closely linear, placed parallel and transverse, with all the four walls, the outer one included, equally and strongly indurated.

«The dehiscence of the sporangium is very peculiar. Owing to the fact that the stomium is wanting, the rupture takes place in correspondence with the third-fifth inner cell of the annulus or between this and the base of the sporangium. Afterwards the broadest wall of the sporangium breaks transversally in the middle or along the line of union with the annulus. Simultaneously the annulus bends its free extremity on the side opposite to the broken wall, and this entails also the rupture of the outer and narrower wall. This peculiar mechanism of dehiscence is caused by the characteristic texture of the annulus, which is formed by cells having strongly indurated walls and hence cannot evert itself outwards. Therefore in *Negripteris* there is neither eversion nor forcible ejection of the spores, the dispersion of which occurs through a small slit by the simple action of gravity. However, afterwards the annulus and the upper part of the sporangium, having detached themselves, fall to the ground and assure in this way a complete dispersion of all the spores. Thus only the base of the sporangium remains attached to the frond.

«The sporangia arise from a superficial cell, back from the margin, though placed near it. The initial cleavages of the sporangium are like those of the gradate ferns. The spores are large, archaic, with indurated walls, wanting perispore. The spore-output per sporangium is 32.

«The rhizome is solenostelic and the stipe is monostelic; the stele is V-shaped with a small protoxylem placed in the phloem out of the xylematic bundle. The wood is represented chiefly by very long scalariforme tracheides». PICHI (44a, p. 166-167).

The conclusions of PICHI regarding the affinities of the genus *Negripteris* show that it should be regarded as a relatively primitive one. «The sorus consisting, as a rule, of one or two sporangia only, and the sporangia spheroidal, very large, massive, almost sessile, with thick walls and very broad, indurated, not prominent annulus, and destitute of stomium, are indeed primitive characters of *Negripteris* common to several Simplices or ancient ferns. The characteristic conformation of the annulus, the peculiar way of dehiscence, and, on the whole, the irregular and archaic conformation of the spore-producing members, not to mention the geographical isolation, all testify to the primitiveness of *Negripteris*.

«Together with these resemblances to the ancient ferns, *Negripteris* shows a clear affinity to Cheilantheae, particularly to *Sinopteris* and *Aleuritopteris*. Its frond covered beneath with white farinose powder, the anatomy of its stipe, the texture of its scales, the sorus consisting of one or two sporangia only, the reflexed and indusioid margin, the massive, large, globose, dark-coloured and sessile sporangia, and the very broad annulus, show how clearly *Negripteris* is related to *Sinopteris*. The habit of the frond, the fact that it is covered on the undersurface of the lamina with white mealy powder, the texture of capitate hairs (pili pulverulenti) which excrete it, the anatomy of the rhizome and stipe, the kind of venation, the texture of the scales, the position of the sorus, the indusioid and reflexed leaf-margin, and finally the shape and output of the spores prove clearly the relationship of *Negripteris* with *Aleuritopteris* and especially with the group of pinnate-pinnatifid species of this genus.

«Owing to the annulus consisting of cells with all the walls, including the outer one, equally and strongly indurated, and owing to the peculiar mechanism of dehis-

cence of the sporangium, *Negripteris* cannot be included in any known family; I (PICHI) have therefore established a new family which I have named Negripteridaceae. PICHI (44 a, p, 167).

NEGRIPTERIDACEAE Pichi-Sermolli,
Nuovo Giorn. Bot. Ital., n. s. 53: 160. 1946.

Sori gradati, superficiales, prope marginem frondis adfixi, terminales, 1-2 (raro 3) sporangis instructis, oris crenarum indusiformibus obtecti. Sporangia magna, sphaerica, subsessilia, annulo verticali, inaequilaterali, latissimo, non prominente, stomio indifferenti, rima transversa, irregulari dehiscentia. Annuli cellulae stricte lineares, parallele atque transverse dispositae, parietibus omnibus, etiam externa, valde incrassatis formatae. Sporae tetraedrico-globosae, magnae, structura rudes, perisporio destitutae.

Filix perennis herbacea. Frondes infra strato densissimo pulveris ceracei candidi tectae. Nervatio Neuropteridis.

Genus monotypicum tantum *Negripteris*, in Abissinia meridionali habitans, adhuc cognitum. PICHI-SERMOLLI (44 a, p. 160).

Negripteris Pichi-Sermolli,
Nuovo Giorn. Bot. Ital., n. s. 53: 130, Icon., t. XIV-XVI. 1946.

Characters of the family.

Genotype: *Mohria scioana* Chiov.

1. N. scioana (Chiov.) Pichi, Nuovo Giorn. Bot. Ital., n. s. 53: 131. 1946. (*Mohria scioana* Chiov., Atti R. Accad. d'Ital., Mem. Cl. Sci. Fis. Mat. Nat. 11: 66. 1940.). Abyssinia (Scioa).

COPELAND (18 a, p. 67) has reduced the genus *Sinopteris* C. Chr. et Ching to *Aleuritopteris*, since *Sinopteris* was originally regarded as an extraordinary fern because there were only 1 or 2 sporangia in a sours. However, COPELAND points out that many of the species of *Aleuritopteris* have a single or only a few (up to five) sporangia per sorus. Perhaps on this single character, *Negripteris* should be reduced to *Aleuritopteris*,

Furthermore, COPELAND has established the family Pteridaceae in the Genera Filicum (p. 45) in such a way as to include the Gymnogrammaceae of CHING (15, p. 227) and Sinopteridaceae of KOIDZUMI, as cited by CHING (15, p. 224), in which family belong *Cheilanthes*, *Pellaea* and *Notholaena*. However, COPELAND does state that one must look beyond the Miocene, perhaps into Cretaceous time for a type of fern, probably represented now by members of the Schizaeaceae or Loxsomaceae for the ancestor of the Pteridaceae.

A preliminary survey of the sporangial modifications, the spore characters, the cell structure of the scales and the solenostelic and dictyosletic rhizome systems in the Sinopteridaceae *(Cheilanthes*, *Pellaea* and *Notholaena)* and the Anemiaceae and Mohriaceae indicate that a rather close relationship probably exists between these groups. Further, various genera of the Lindsaeaceae, such as *Lindsayopsis* and *Sphenomeris*, perhaps play an important part in the continuity of this complex, especially with the Anemiaceae. Negripteridaceae seems to fill one of these gaps between the Schizaeaceous Ferns and the Cheilanthoid Ferns.

ADDENDUM

Actinostachys confusa (Selling) Reed, comb. nov. *(Schizaea confusa* Selling, Svensk Bot. Tidsk. 41 (4): 432-434, fig. 1-13. 1947). Madagascar, Ins. Seychelles.

SELLING places this species along with *A. melanesica*, *A. inopinata* and *A. laevigata* in a separate group, — the *melanesica*-group.

EXPLANATION OF PLATES

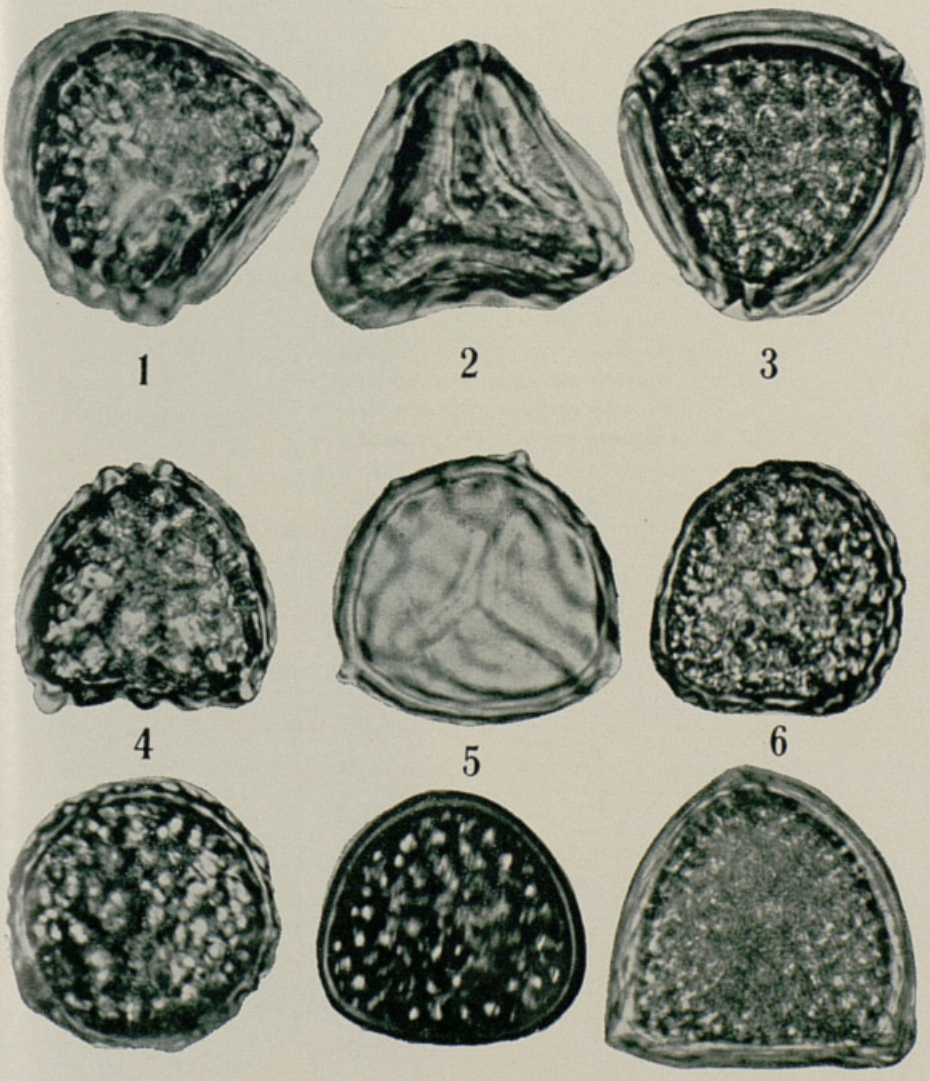
PLATE I

Spores of species in the Anemiaceae

1. *Ornithopteris mexicana* (Klotzsch) Underw.
2. *Ornithopteris speciosa* (Presl) Reed.
3. *Ornithopteris maktinii* (Maxon) Reed.
4. *Ornithopteris coriacea* (Griseb.) Reed.
5. *Ornithopteris aurita* (Swartz) Reed.
6. *Ornithopteris cicutaria* (Kunze) Underw.
7. *Ornithopteris wrightii* (Baker) Millsp.
8. *Hemianemia (Eu-Coptophyllum) buniifolia* (Gardn.) Reed.
9. *Hemianemia (Rutaefoliae) rutaefolia* (Mart.) Reed.

All photomicrographs magnified about × 450.

PLATE I



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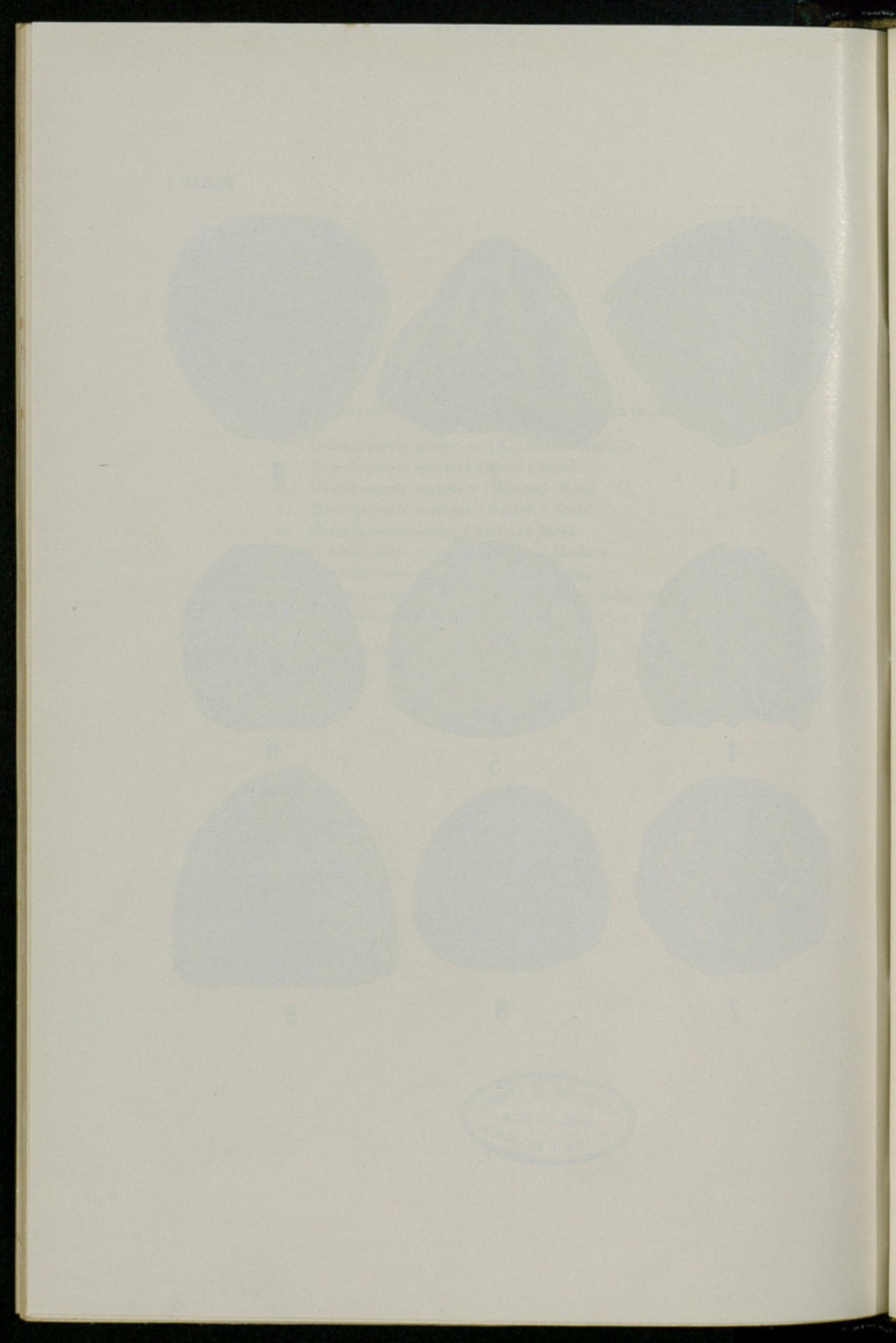


PLATE II

Spores of species of the Anemiaceae

1. *Hemianemia schimperiana* (Presl) Reed.
2. *Hemianemia villosa* (H. et B.) Reed.
3. *Hemianemia flexuosa* (Sav.) Reed.
4. *Hemianemia anthriscifolia* (Schrad.) Reed.
5. *Hemianemia fulva* (Cav.) Reed.

All photomicrographs magnified about × 450.

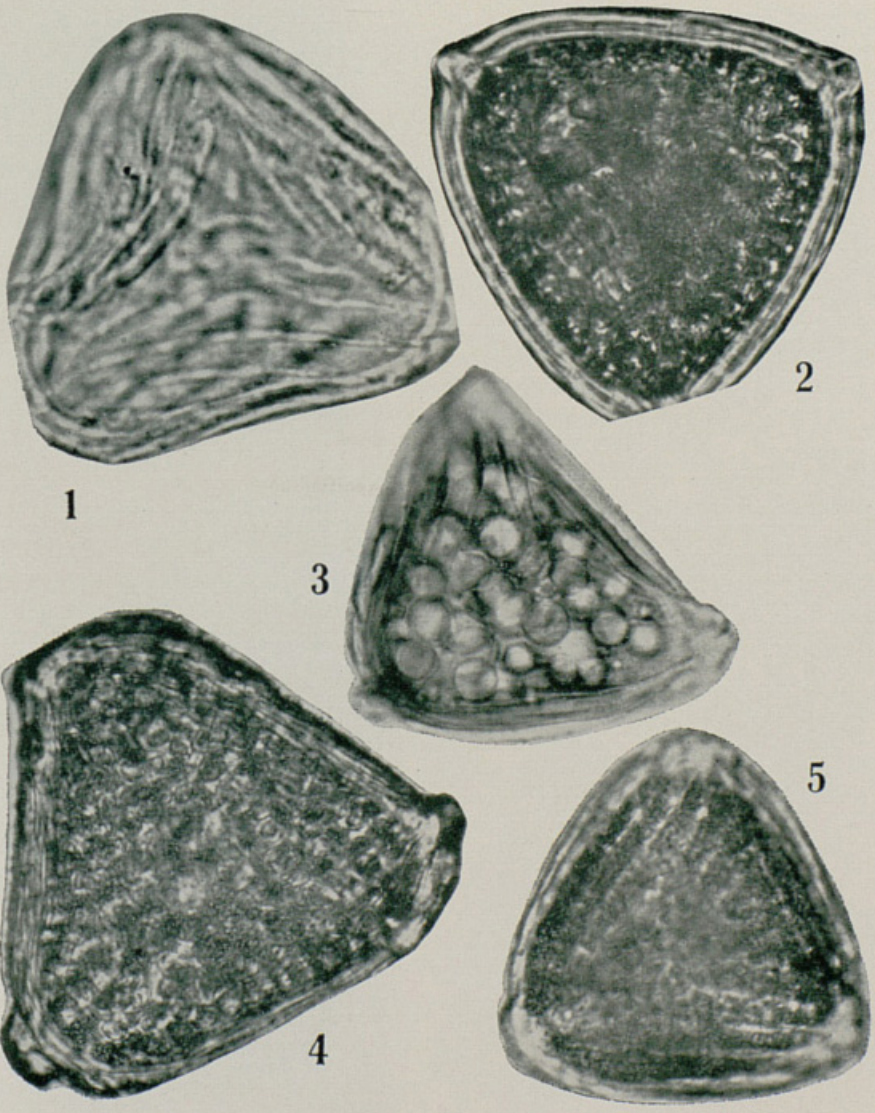
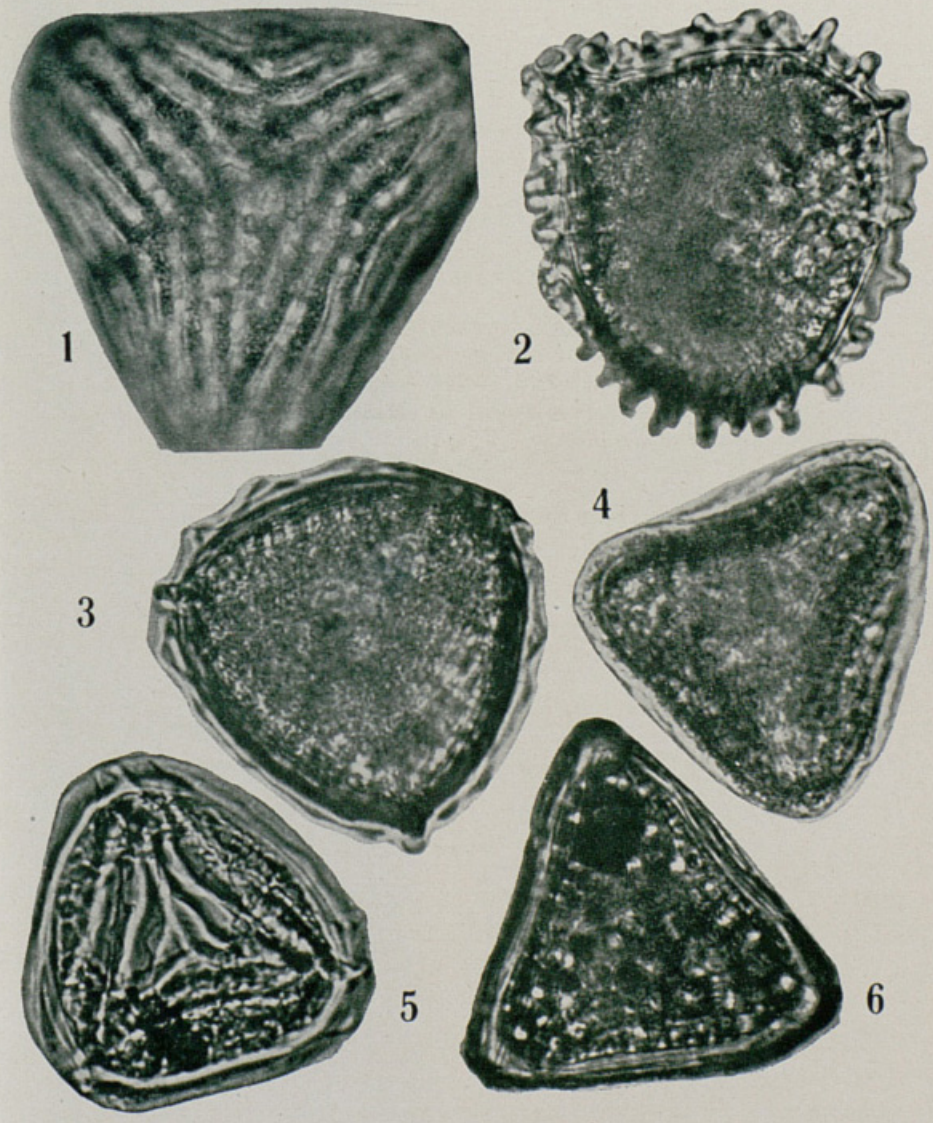


PLATE III

Spores of species of the Anemiaceae

1. *Hemianemia tripinnata* (Copel.) Reed.
2. *Anemia pastinacaria* Moritz ex Prantl.
3. *Anemia wettsteinii* Christ.
4. *Hemianemia guatemalensis* (Maxon) Reed.
5. *Anemia hirsuta* (L.) Swartz.
6. *Hemianemia millefolia* (Gardn.) Reed.

All photomicrographs magnified about × 450.



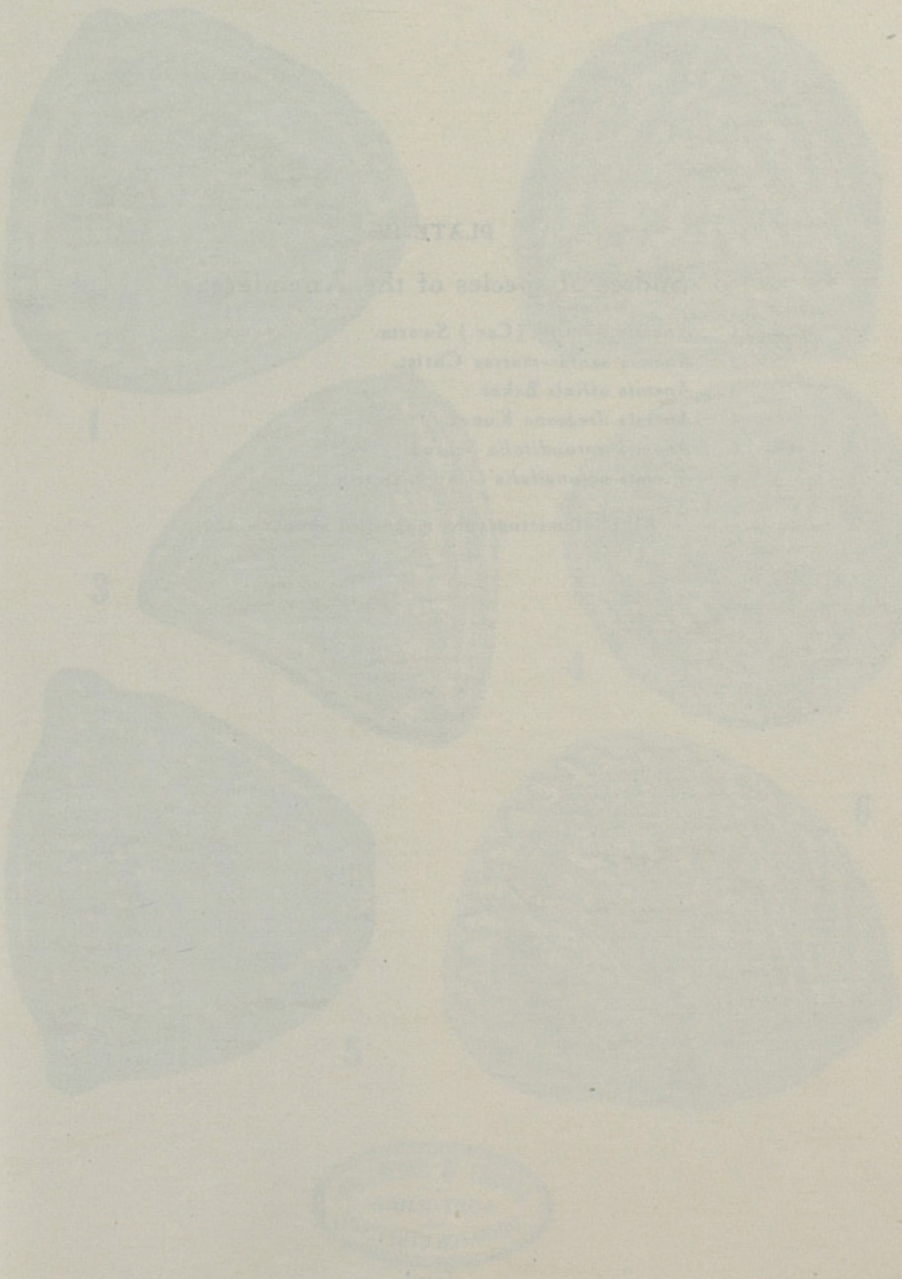


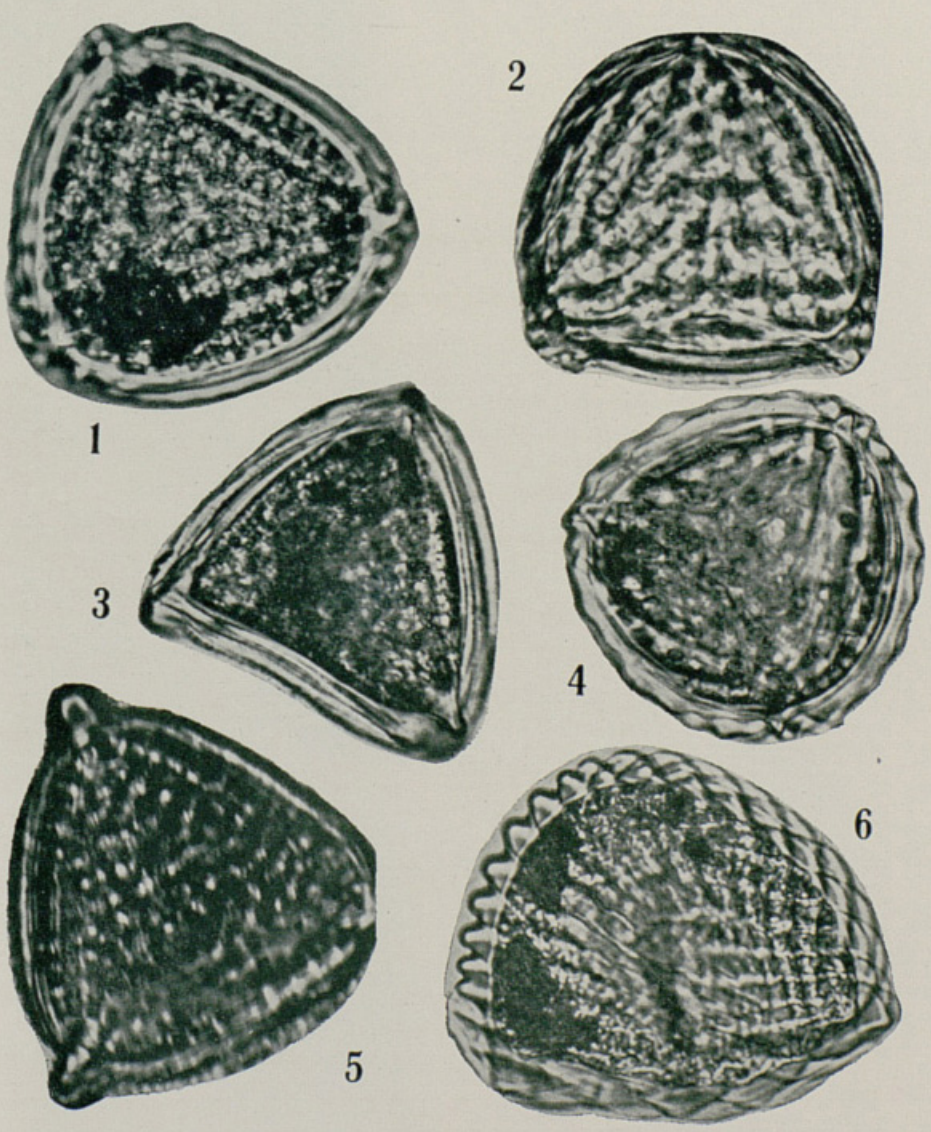
PLATE IV

Spores of species of the Anemiaceae

1. *Anemia humilis* (Cav.) Swartz.
2. *Anemia santae-martae* Christ.
3. *Anemia affinis* Baker.
4. *Anemia dregeana* Kunze.
5. *Anemia rotundifolia* Schrad.
6. *Anemia oblongifolia* (Cav.) Swartz.

All photomicrographs magnified about × 450.

PLATE IV



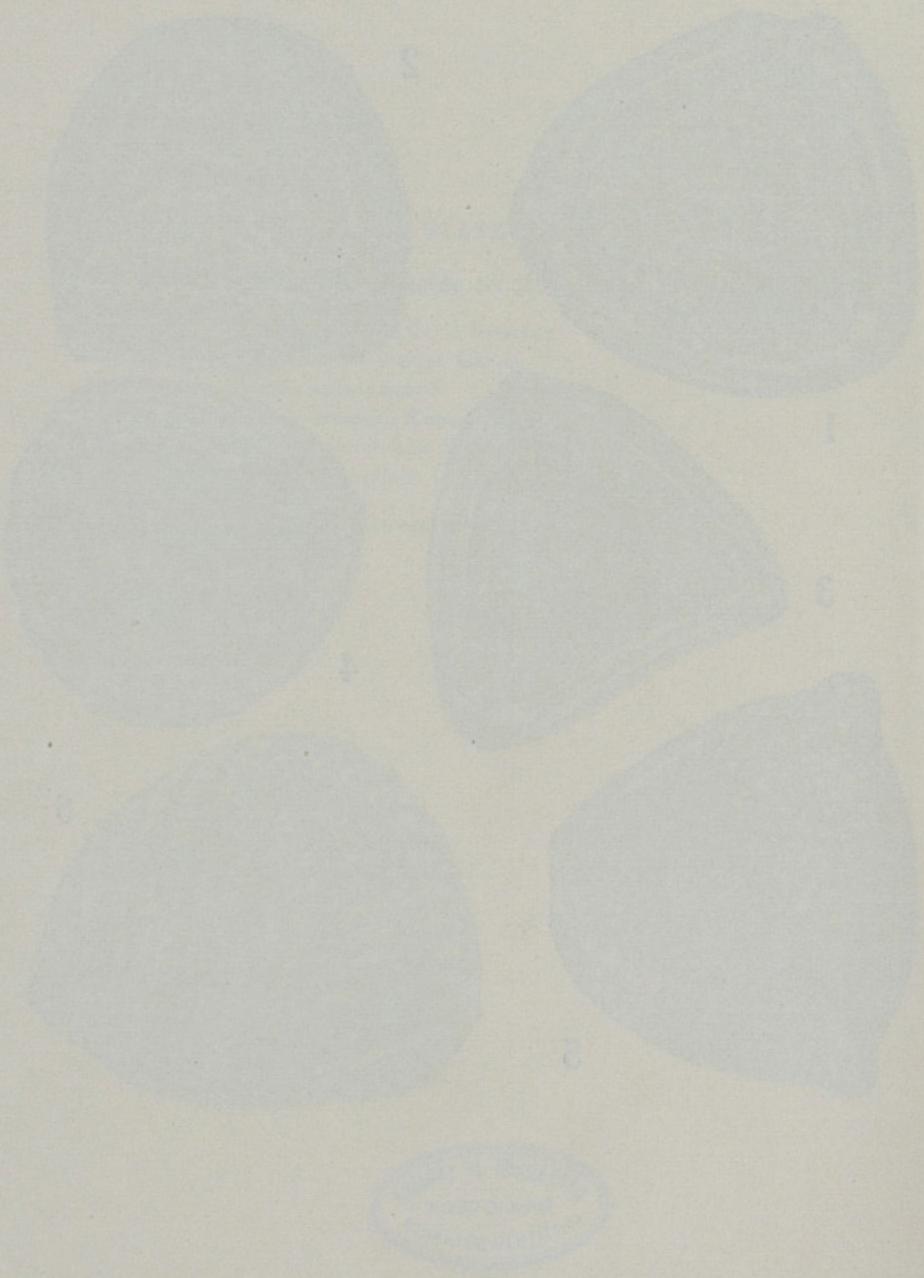


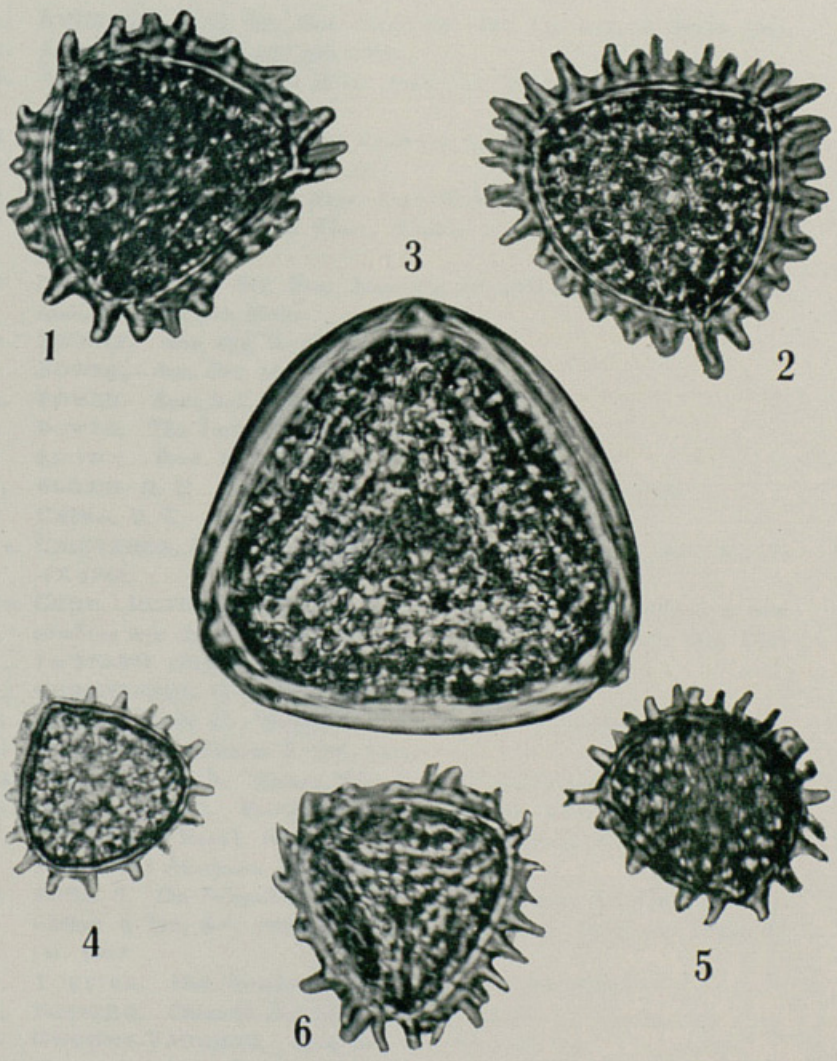
PLATE V

Spores of species of the Anemiaceae and Mohriaceae

1. *Anemia collina* Raddi.
2. *Anemia phyllitidis* (L.) Swartz.
3. *Mohria caffrorum* (L.) Desv.
4. *Anemia radicans* Raddi.
5. *Anemia mandioccana* Raddi.
6. *Anemia underwoodiana* Maxon.

All photomicrographs magnified about × 450.

PLATE V



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(*) Italics denote synonyms.

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