lations may be seen in Table III. Pinna pair number varied from 2-4 and leaflet pair number from 1-2 for all populations.

Number of pinna pairs varies from two to four, although three are found most frequently. On some herbarium specimens all leaves may have four pinna pairs whilst on leaves from another specimen off the same plant only two or three pairs may be present. The two rachillae of a pinna pair commonly do not leave the rachis at opposite points so that leaves tend to be asymmetric. Furthermore, one rachilla

TABLE II

Mean morpholcgical parameters for populations of *Acacia nigrescens* sampled in Natal

| Populations sampled | Petiole length in mm | Rachis length in mm | Leaf length in mm | Rachilla length in mm | Leaflet length in mm | Leaflet width in mm |
|---|---|---|---|---|---|---|
| Ndumu Game Reserve | 19.9 | 42.3 | 62.2 | 9.5 | 22.9 | 18.7 |
| Mkuze . . . . . | 17.1 | 40.8 | 57.9 | 8.0 | 21.3 | 17.3 |
| Ngotshe . . . . . | 14.8 | 38.2 | 53.0 | 6.6 | 20.9 | 15.6 |
| Mkuzi Game Reserve | 14.4 | 37.2 | 51.6 | 8.3 | 20.7 | 17.1 |
| Mkuzana River . . . | 14.4 | 29.9 | 44.3 | 10.8 | 22.7 | 17.1 |
| Umfolosi Game Reserve | 13.7 | 28.8 | 42.5 | 7.5 | 18.0 | 14.6 |

may have one leaflet pair whereas the opposite member may have two leaflet pairs. Leaflet shape varies tremendously on a single plant and often on a single leaf: when two leaflet pairs are present the lower ones frequently differ in size and in shape from the upper ones.

As so much information is lost in the calculation of population means, scatter diagrams for mean parameters for individual plants for all populations were constructed. Use of plant means also results in loss of information, but the numbers of measurements involved precluded use of individual statistics. The variation within, and among, populations is clearly evident from Figs. 5 and. 6.

In *A. nigrescens* there is a tendency for a decrease in leaf length from Ndumu in the north to the Umfolosi Game Reserve in the south. Owing to inadequate information there is at present no single, or group of, environmental

TABLE III

Extreme and modal morphological parameters for populations of *Acacia nigrescens* sampled in Natal

| Populations sampled | Petiole length in mm | | Rachis length in mm | | Leaf length in mm | | Rachilla length in mm | | Leaflet length in mm | | Leaflet width mm | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Extremes | Mode | Extremes | Mode | Extremes | Mode | Extremes | Mode | Extremes | Mode | Extremes | Mode |
| Ndumu Game Reserve | 6-40 | 20.4 | 16-93 | 44.5 | 22-134 | 64.9 | 3-33 | 8.3 | 13-41 | 23.7 | 9-40 | 18.9 |
| Mkuzi | 7-35 | 18.3 | 13-98 | 39.4 | 20-134 | 57.7 | 2-32 | 7.4 | 10-50 | 21.2 | 9-49 | 18.0 |
| Ngotshe | 7-21 | 14.3 | 11-72 | 37.8 | 19-94 | 52.1 | 2-30 | 5.8 | 14-32 | 21.1 | 9-26 | 15.5 |
| Mkuzi Game Reserve | 7-24 | 15.4 | 14-58 | 35.8 | 21-82 | 51.2 | 4-23 | 8.2 | 14-30 | 21.6 | 12-31 | 17.4 |
| Mkuzana River | 8-28 | 15.6 | 10-55 | 31.6 | 18-83 | 47.2 | 3-18 | 8.8 | 11-32 | 23.4 | 9-27 | 16.0 |
| Umfolosi Game Reserve | 5-24 | 14.2 | 10-60 | 30.6 | 16-85 | 44.3 | 4-33 | 6.8 | 11-41 | 18.4 | 8-34 | 14.6 |

characters that can be clearly correlated with the observed morphological parameters within the species.

Pod size, although fairly uniform on a single plant, varies considerably from plant to plant within a population and from one population to another. Pod width does not appear to be closely correlated with pod length as both

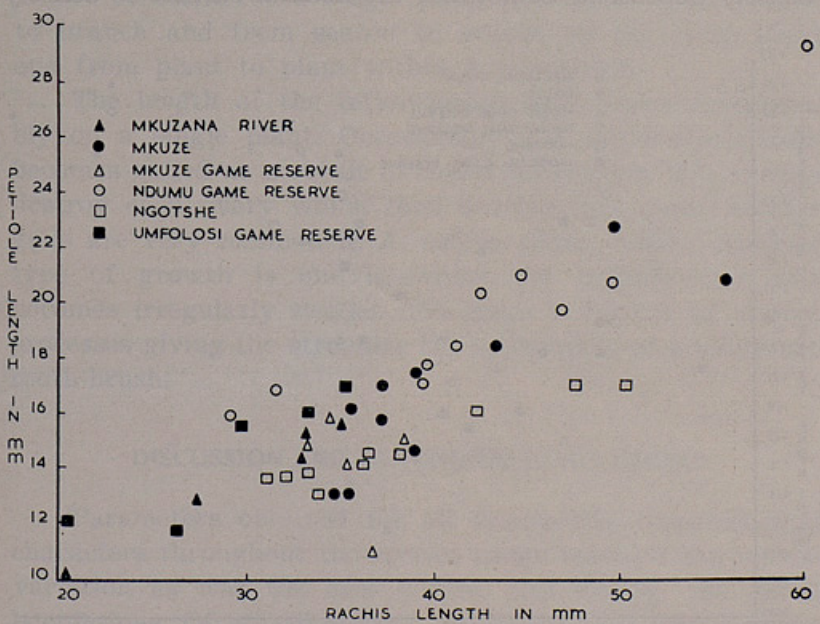


Fig. 5. — Scatter diagram showing the variation in petiole length and rachis length within, and among, the Natal populations of *A. nigrescens*.

the narrowest and the broadest pods within a single population frequently have the same length. Pod length and pod width show no apparent correlation with any of the other morphological characters. The seeds often lie transversely within the pods.

b) *Non-measurable characters*

The degree of pubescence of the branchlets, with the exception of coppice shoots, is fairly uniform on a single plant, but varies from plant to plant within a population

and from one population to another. Branchlets may be subglabrous to sparingly or densely pubescent.

The degree of pubescence of the ab- and adaxial leaflet surfaces varies considerably, even on a single plant. Conspicuous marginal cilia are invariably absent while the ab- and adaxial surfaces may be glabrous to sparingly or densely pubescent. Sometimes the abaxial surface is densely

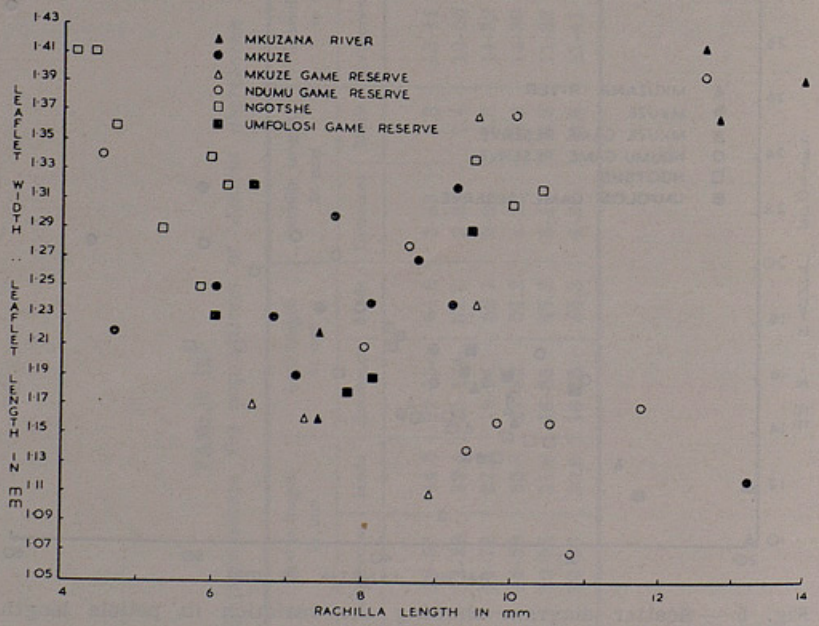


Fig. 6. — Scatter diagram showing the variation in rachilla length and the ratio of leaflet width to leaflet length within, and among, the Natal populations of *A. nigrescens*.

pubescent and the adaxial surface glabrous whilst in other instances the adaxial surface alone is pubescent. Occasionally the leaves are so densely pubescent as to impart a silvery hue.

There is usually a single, sometimes slightly raised, petiolar gland although occasionally two may be present. The position of the gland, which may be at any point between the apex of the pulvinus and the first pinna pair varies on leaves from a single plant. Gland size also varies considerably.

A small gland is usually present at the point of attachment of each leaflet pair but there is no rachidial gland at the point of attachment of a pinna pair.

Inflorescences are borne in axillary fascicles, crowded into irregular terminal panicles, or very occasionally produced singly. The arrangement and density of inflorescences is not constant for a single plant but varies from branch to branch and from season to season on the same plant and from plant to plant within a population.

The length of the inflorescence axis varies considerably on a single plant. Occasionally the inflorescence axis becomes galled as a result of insect infestation. The insects destroy each ovary which then develop into galls. Similar galls are very common in *A. caffra* (Ross, 1965). Another type of growth is one in which the inflorescence axis becomes irregularly swollen and bears a number of orange processes giving the structure the appearance of a miniature tooth-brush.

## DISCUSSION AND TAXONOMIC CONCLUSIONS

Parameters obtained for all measurable morphological characters throughout the species range revealed continuous variation as was the case within, and among, the Natal populations. Of all characters, leaflet size and leaflet shape appear the most variable.

Detailed knowledge of *A. nigrescens* is lacking in many parts of Africa but an examination of available specimens throughout the entire area of distribution revealed a tendency for the occurrence of a greater number of pubescent specimens, and more densely pubescent specimens, in the southern part of the species range namely Botswana, the Transvaal, Swaziland and Natal. An increase in the degree of pubescence of specimens in the southern area of distribution was also noted in *A. ataxacantha* (Ross, 1966).

No infraspecific categories are recognised within *A. nigrescens*. The alleged differences between var. *nigescens* and var. *pallens* are due in large measure to differences in the age of the shoots constituting the type specimens;

it is to be expected that the leaflets and recurved prickles would be smaller in young than in older specimens.

Before considering the relationship of *A. nigrescens* to a number of closely related species a description of *A. nigrescens* seems desirable.

Tree to 30 m with rounded crown or branches ascending and spreading slightly in mature trees, often cylindrical in younger plants, trunk to 0.75 m in diameter. Bark pale or dark yellowish-, grey- or reddish-brown, sometimes almost black, rough, fissured, typically with persistent prickles arising from swollen knobs, up to 6.3 cm long, irregularly scattered on the bole and larger branches; slash pink to deep red. Young branchlets pale or dark yellowish-, grey- or reddish-brown to black, flaking minutely, often with numerous somewhat transversely elongated reddish- or grey-brown lenticels, glabrous or subglabrous to densely pubescent. Prickles in pairs below nodes, strongly recurved, grey- or reddish-brown to black, yellowish when young, up to 7.0(4.0 ± 2.0) mm long. Leaf: petiole 0.5-4.3(2.2 ± 0.7) cm long, glabrous or subglabrous to densely pubescent, adaxial gland often absent, variable in position when present, usually slightly raised, rounded to oval, reddish-brown to black, 0.3-0.7 mm long, 0.1-0.4 mm wide; rachis 0.8-10.2(3.8 ± 1.8) cm long, glabrous or subglabrous to densely pubescent, abaxial surface usually without recurved prickles, gland usually absent between each pinna pair; pinnae 2-4 (usually 3) pairs; rachillae 0.3-3.7(1.6 ± 0.8) cm long, glabrous or subglabrous to densely pubescent, thickened into a pulvinule at their junction with main rachis; leaflets grey-green when mature, 1-4 pairs, usually 1 or 2, 6.5-50.0(10.5-26.0) mm long, 5.3-49.8(7.5-22.0) mm wide, very variable in shape, obovate or obliquely-obovate to obovate- orbicular, to broadly obovate-elliptic, apex rounded, frequently emarginate, coriaceous, veins prominent abaxially, glabrous ab- and adaxially or sparingly to densely appressed-pubescent ab- and/or adaxially. Stipules in pairs above nodes, inconspicuous, linear, 1.0-3.0 mm long, 0.2-0.6 mm wide, caducous. Inflorescence spicate, fascicled or crowded into an irregular terminal panicle, occasionally solitary; flowers sessile, yellowish-white to pale

cream; spikes 1.0-10.2(5.0 ± 1.6) cm long; peduncle 0.3-2.4 (1.0 ± 0.5) cm long, terete, reddish-brown, glabrous or subglabrous, occasionally pubescent; calyx yellowish-white, often tinged with pink, campanulate, glabrous, tube 0.7-1.75(1.0± 0.2) mm long, lobes 5, triangular, 0.3-0.8(0.5 ± 0.1) mm long; corolla yellowish-white, campanulate, glabrous, tube 1.5-2.0 (1.7 ± 0.1) mm long, lobes 5, triangular, up to 0.75(0.5 ± 0.1) mm long, alternating with calyx lobes; stamen filaments free, to 6.0 mm long, yellowish-white; anthers 0.1 across, with deciduous apical gland; ovary glabrous, very shortly stipitate, 0.6-1.5 mm long; style glabrous or subglabrous, up to 6.0 mm long, yellow. Legume olive- or dark reddish-brown to black, oblong, usually linear, 6.1-17.8(11.4 ± 2.2) cm long, 1.4-2.7(1.9 ± 0.4) cm wide, acuminate at both ends, or apex rounded and slightly beaked, dehiscing longitudinally, coriaceous, brittle, slightly umbonate over the seeds, glabrous, margin ridged, ridge up to 0.8 mm wide. Seeds olive-green to olive-brown, subcircular-lenticular, up to 12.0-13.0 mm × 12.0-13.0 mm; central areole distinct, large, 7.0-8.0 mm × 7.0-8.0 mm, horse-shoe shaped.

*Relationship of* A. nigrescens *to closely related species*

*A. nigrescens* in its typical form is an easily recognised species but it exhibits a greater range of morphological variation than was previously imagined so that some specimens can only with difficulty be distinguished from a number of other species. The complex of closely related species to which *A. nigrescens* belongs contains amongst it species that are taxonomically perhaps the most perplexing within the genus. The relationship of some of these species to *A. nigrescens,* and to one another, is not clear. Included in the complex, in chronological order, are *A. burkei* Benth. (1846), *A. rovumae* Oliv. (1871), *A. welwitschii* Oliv. (1871), *A. goetzei* Harms (1900) and *A. delagoënsis* Harms (1914). Within this complex the degree of pubescence of the calyx is the character of prime importance in distinguishing two groups. *A. burkei* and *A. rovumae* alone have pubescent calyces, in all other species calyces are glabrous.

In their typical forms *A. nigrescens* and *A. burkei* are readily distinguishable; the former with its large leaflets and glabrous calyces and the latter with smaller leaflets and hairy calyces. In Natal *A. nigrescens* grows most commonly on hard loam whilst *A. burkei* favours sand. However, there are numerous plants with leaflets intermediate in shape and in size between those of *A. nigrescens* and those of *A. burkei*. These plants, which have characteristics of both species, usually share the same habitat as *A. nigrescens*. Leaflet size varies considerably and an entire range from those the size of *A. burkei* to those the size of *A. nigrescens* may be found on a single plant. However, these plants have hairy calyces and their relationship would therefore seem to be with *A. burkei* rather than with *A. nigrescens*. The subject will receive more detailed consideration in a later paper.

*A. nigrescens, A. welwitschii* and *A. goetzei* are very closely related and have a number of characters in common. *A. goetzei* differs from *A. nigrescens* in having a larger, more woody fruit and in general leaf characters. BRENAN (1956) recognised two subspecies within *A. goetzei* namely, subsp. *goetzei* and subsp. *microphylla,* the difference between the two being largely in leaflet size and shape. *A. goetzei* is very variable in the number of pinnae and leaflets and the shape of the latter so that intermediates between the two subspecies are very common. The status of the two subspecies is uncertain for subsp. *goetzei* in particular contains a very heterogeneous assemblage of plants. Extreme forms of subsp. *goetzei* are, apart from the fruits, almost indistinguishable from *A. nigrescens* and many specimens can only with difficulty be referred to *A. goetzei* or to *A. nigrescens*. For example, some of the sheets of *Boaler 668* (K) from Tanzania are extremely close to *A. nigrescens*. WHITE (1962) suggested that subsp. *microphylla* is a distinct species, in which case its correct name would be *A. ulugurensis* Taub., and that the plants placed in subsp. *goetzei* have been produced by hybridisation between *A. nigrescens* and *A. ulugurensis*. However, careful field studies are required to resolve this problem.

WHITE placed *A. welwitschii* under *A. goetzei* subsp. *goetzei* but during a subsequent treatment of the complex (ROSS and BRENAN, 1967) it was felt prudent to maintain *A. welwitschii* and *A. goetzei* as distinct species even though they are very closely related. *A. delagoënsis* was relegated to subspecific rank under *A. welwitschii* (ROSS and BRENAN). *A. welwitschii* subsp. *welwitschii* and *A. welwitschii* subsp. *delagoënsis* differ from *A. nigrescens,* and from one another, in having distinctive leaflet shapes and in general leaf characteristics. The two subspecies within. *A. welwitschii* are well separated geographically, subsp. *welwitschii* being recorded from Angola and subsp. *delagoënsis* from Mozambique, the eastern portion of Rhodesia and the eastern Transvaal.

*A. goetzei* has a larger, more woody fruit than *A. welwitschii.* In addition, leaflet shape is typically different in *A. welwitschii* although some specimens have leaflets that are intermediate in size and in shape between the two species so that positive identification may be difficult. It is hoped that the bey provided (ROSS and BRENAN) will be of assistance in delimiting the two species and the subspecies within each.

*A. nigrescens* Oliv., in F. T. A. 2: 340 (1871); Benth. in Trans. Linn. Soc. XXX: 517 (1875); Sim in For. and For. Fl. P. E. A.: 54 Plate XXXIIIB (1909); Marloth in Fl. S. Afr. 2: 52, fig. 31 (1925); Baker in L. T. A.: 829 (1930); Milne-Redhead in Kew Bull. Misc. Inf.: 417 (1937); T.T.C.L.: 329 (1949); Codd in Trees and Shrubs of Kruger N. Park: 47, figs. 40, 41, 42, 43c, d, e (1951); Miller in J. S. Afr. Bot. XVIII: 23 (1952); Wild, S. Rhod. Bot. Dict.: 48 (1953); Young in Candollea XV: 118-122 (1955); Consp. Fl. Angol. 2: 274 (1956); Coats Palgrave, Trees Centr. Afr.: 250-253 (1956); Brenan in F. T. E. A. Legum.-Mimos.: 85-86 (1959); Palmer and Pitman, Trees S. Afr.: 161, Pl. VIII (1961); Letty in Wild Flowers of Tvl.: 153, 77, 1 and 1a (1962); White, For. Fl. N. Rhod.: 82 (1962); Mitchell in The Puku 1: 104 (1963). De Winter et al, Sixty Six Transvaal Trees: 52-53 (1966). Type: Malawi

(Nyasaland), near Mitonde, 19 Sept. 1859, *Kirk s. n.* (K, holo.).

Syn.: *A. nigrescens* Oliv. var. *pallens* Benth. in Trans. Linn. Soc. XXX: 517 (1875). Type: Portuguese East Africa, Zambesia, opposite Pita, near Sena, Apr. 1860, *Kirk 201* (K, holo.).
*A. brosigii* Harms in N. B. G. B. 2: 194 (1898). Type: Tanzania (Tanganyika), Kilosa, *Brosig* (B, holo. †).
*A. perrotii* Warb. in N. B. G. B. 2: 249 (1898). Type: Tanzania (Tanganyika), Lindi, *Perrot* (B, holo. †).
*A. pallens* (Benth.) Rolfe in Kew Bull. Misc. Inf.: 361 (1907); Burtt Davy in Kew Bull. Misc. Inf.: 159 (1908); Glover in Ann. Bol. Herb. I: 145 (1915); Sim, Native Timbers S. Afr.: 35, Plates 35 and 36 (1921); Baker in L. T. A.: 829 (1930); Burtt Davy in Man. Fl. Pl. Tvl.: 339 (1932).
*Albizzia lugardi* N. E. Br. in Kew Bull. Misc. Inf.: 109 (1909). Type: Botswana, Okavango valley, about 3,000 ft., June 1898, *Lugard 246* (K, holo.).
*Acacia passargei* Harms apud Passarge in Engl. Pflanzenw. Afr. 3(1) (Engl. & Drude, Veg. der Erde, 9): 384 (1915); White, For. Fl. N. Rhod.: 88 (1962).
*A. schliebenii* Harms in N. B. G. B. 12: 507 (1935); T. T. C. L.: 329 (1949). Type: Tanzania (Tanganyka), Lindi District, Lake Lutamba, 30 Oct. 1934, *Schlieben 5565* (B, holo. †, BM, LISC, P iso., K, NU photo.).
*A. mellifera* Benth. sensu Henkel, Woody Pl. of Natal and Zululand: 232 (1934).

## SPECIMENS EXAMINED

Herbarium specimens from the entire distributional range of *A. nigrescens* in Africa were examined but in view of the number involved only one specimen from each magisterial district has been cited.

**Tanzania.** DODOMA DISTR.: Plain of Umeroke R. — tributary of Ruaha R., 64-65 miles S. of Dodoma, 26 Mar. 1932, *Lynes C. V. 2* (K). HANDENI DISTR.: ± 53 km from Korogwe on Handeni rd., 19 Nov. 1955, *Milne-Redhead & Taylor 7338* (K). IRINGA DISTR.: Pawaga, Jan. 1937, *Ward P8* (K). KILOSA DISTR.: Kimamba, 13 Sept. 1960, *Paulo 779* (K, PRE). LINDI DISTR.: Tendaguru, 4 June 1926, *Migeod 238* (BM). MASASI DISTR.: Nachingwea area, Aug. 1954, *Hubbert 2028* (K). MOROGORO DISTR.: N. Uluguru Reserve, hill above Morningside, May 1953, *Semsei 1193* (K, PRE). MPWAPWA DISTR.: near Gulwe, 21 Oct. 1936, *Hornby 689* (K). NACHINGWEA DISTR.: Nachingwea, 18 Dec. 1962, *Ross 27* (NU). NZEGA DISTR.: Mpumbulya, 3 Apr. 1958, *Howard 32* (K). SHINYANGA DISTR.: Shinyanga, Mar. 1936, *Burtt 5625* (BM). SINGIDA DISTR.: near Matelele, 25 Sept. 1927, *Burtt 727* (BM, K).

**Angola.** CUANDO-CUBANGO DISTR.: Missão de Santa Cruz do Cuando, nas galerias do Rio Cuando, 22 Nov. 1949, *Teixeira 142* (BM). Regio Baixo, proximum flumen Luiana, 19 Nov. 1949, *Teixeira 87* (BM).

**South West Africa.** Okavango Reserve, Nyangana, ± S. E. of Runtu, 17 Jul. 1952, *Maquire 1659* (PRE); Okavango Reserve, between Sambio and Masari, 5 Jan. 1956, *de Winter 4078* (K, PRE).

**Botswana.** NGAMILAND: ± 15 miles S. of Nokanene on rd. to Tsau, 24 Jun. 1937, *Erens 289A* (K, PRE). Moremi Wildlife Reserve, Kwaai drainage north of Okavango Swamp, Jul. 1964, *Tinley 1056* (NH, NU). CHOBE DISTR.: between Kasane and Serondela, 2 Aug. 1950, *Robertson & Elffers 89* (K, PRE, SRGH). SOUTH EASTERN PROV.: Palla Ranch, between Mahalapye and Gaberones, *Pole Evans 3181(31)* (PRE). KGATLA DISTR.: Mathkwane, 5 miles N. of Sikwane, 5 Sept. 1955, *Reyneke 405* (K, PRE). MAHALAPYE DISTR.: near Mahalapye, 15 Oct. 1959, *de Beer 782* (K, PRE, SRGH).

**Zambia.** BAROISE PROV.: SENANGA DISTR.: Kaunga, Mashi R., 8 Oct. 1962, *Reynolds B184* (SRGH). SESHEKE DISTR.: Sesheke Boma, 100 yds. from Zambesi R., 31 Jan. 1952, *White 1986* (FHO, K). SOUTHERN PROV.: GWEMBE DISTR.: Gwembe, Sept. 1955, *Bainbridge 109/55* (FHO, K, LISC, SRGH). LIVINGSTONE DISTR.: Game Park, Victoria Falls, 28 Apr.

1947, *Brenan & Greenway 7780* (K, NDO). MAZABUKA DISTR.: between Kalama and Moonzwe R., near Singumba village, 28 May 1963, *v. Rensburg K. B. S. 2235* (K).

**Malawi.** CHIKWAWA DISTR.: Lower Mwanza R., 4 Oct. 1946, *Brass 17951* (K, SRGH). DOWA DISTR.: Chitala to Domira Bay, 29 Oct. 1941, *Greenway 6377* (K, PRE).

**Rhodesia.** BEITBRIDGE DISTR.: Beitbridge, between Customs Post and Limpopo R., 25 Mar. 1959, *Drummond 6010* (K, SRGH). BELINGWE DISTR.: 5 miles W. of Shabani, Sept. 1956, *Miller 3661* (SRGH). BIKITA DISTR.: West end of Moodies Pass, 21 Aug. 1955, *Chase 5736* (BM, LISC, SRGH). BULAWAYO DISTR.: 25 miles from Bulawayo, Sept. 1959, *Armitage 86/59* (SRGH). CHIBI DISTR.: Lundi R., Hippo Pools, 30 Dec. 1962, *Moll 430* (SRGH). DARWIN DISTR.: Chimanda Reserve near Winda Pools on Mazoe R., 4 Sept. 1958, *Phipps 1299* (K, PRE, SRGH). GWANDA DISTR.: Farvie Mine, 18 miles S. of Gwanda, Sept. 1952, *Henderson H29677* (PRE). INYANGA DISTR.: Sabie valley, Honde Dip, 26 Sept. 1947, *Whellan 253* (SRGH). LOWER SABIE DISTR.: E. bank, 28 Jan. 1948, *Wild 2339* (K, SRGH). MATOBO DISTR.: Three Sisters, foot of Sedyman's Hill, 15 Sept. 1948, *West 2788* (SRGH). MELSETTER DISTR.: Devuli R., 6 miles W. of Birchenough Bridge, 6 Sept. 1961, *Methuen 190a* (K, LISC), *190b, 190c* (K). MTOKO DISTR.: Tsetse Fly Control Gate, 16 Apr. 1951, *Lovemore 6* (K, SRGH). NDANGA DISTR.: Ndanga, beyond riverine belt of Sabie R., Chitsa's Kraal, 5 Jun. 1950, *Chase 2301* (BM, SRGH). NUANETSI DISTR.: Nov. 1952, *Rail R3* (SRGH). NYAMANDHLOVU DISTR.: Pasture station, 25 Sept. 1953, *Plowes 1632* (K, PRE, SRGH). SEBUNGWE DISTR.: Oct. 1952, *Vincent 92* (PRE). UMTALI DISTR.: banks of Odzi R., near hotel grounds, I Jan. 1949, *Chase 1511* (BM, LISC, SRGH). WANKIE DISTR.: 28 miles S. of Victoria Falls, 12 Sept. 1935, *Galpin 14958* (PRE).

**Mozambique.** LOURENÇO MARQUES PROV.: Lourenço Marques, 18 Jan. 1920, *Borle 272* (PRE); 90 km S. of Lourenço Marques, 2 Sept. 1947, *Gomes e Sousa 3607* (K); entre Moamba e Ressano Garcia, 4 Dec. 1940, *Torre 2227* (LISC). MANICA E SOFALA PROV.: entre os rios Mucuze e Vila Machado, 20 Apr. 1948, *Garcia 935* (LISC). NIASSA PROV.: Cabo Delgado entre Porto Amélia e o Missão de S. Paulo de

Mahate, 27 Oct. 1942, *Mendonça 1100* (BM, LISC, PRE). SUL DO SAVE PROV.: Inhambane, entre Vilanculos e Mabote, 1 Sept. 1944, *Mendonça 1941* (BM, K, LISC). TETE PROV.: 7 miles E. of Msusa on Tete rd., 22 Jul. 1950, *Chase 2693* (BM, K, LISC). ZAMBESIA PROV.: Mopeia, estrada para Morrumbala, 27 Sept. 1949, *Andrada 1936* (LISC).

**Transvaal.** BARBERTON DISTR.: Hyslop Creek, near Barberton, Nov. 1907, *Thorncroft 678* (BM, NH). LETABA DISTR.: Kruger National Park, 11 miles E. of Letaba Rest Camp, 30 Sept. 1948, *v. Zinderen Bakker 207* (BLFU). NELSPRUIT DISTR.: Kruger National Park, Lower Sabie, 12 Sept. 1952, *v. d. Schyff 806* (K). PIET RETIEF DISTR.: 1 mile S. of Gollel on Candover rd., 26 Oct. 1964, *Ross 1554* (NU). PILGRIMS REST DISTR.: Kruger National Park, 12 miles from Satara on Rabelais rd., 1 Nov. 1950, *Story 3978* (GRA). ZOUTPANSBERG DISTR.: 5 miles E. of Punda Maria, 16 Mar. 1949, *Codd 5385* (K, PRE).

**Swaziland.** LUBOMBO DISTR.: Ingwavuma Poort, bank of Ingwavuma R., 9 miles from Ingwavuma on Nsoko rd., 26 Oct. 1964, *Ross 1547* (NU). SHISELWENI DISTR.: 20 miles from Gollel on Hluti rd., 13 Oct. 1964, *Ross 1429* (NU).

**Natal.** HLABISA DISTR.: Corridor between Hluhluwe and Umfolosi Game Reserves, 28 Mar. 1964, *Ross 919* (NU). INGWAVUMA DISTR.: Ndumu Game Reserve, W. area, 24 Feb. 1964, *Ross 667, 668* (NU). LOWER UMFOLOSI DISTR.: Umfolosi Game Reserve, 15 Apr. 1923, *Swynnerton 4041* (K). MAHLABATINI DISTR.: 6 miles N. of Mahlabatini, 16 Aug. 1945, *Acocks 11665* (NH, PRE). NGOTSHE DISTR.: 3 miles N. of Mkuze on Candover rd., 12 Oct. 1964, *Ross 1382* (NU). NONGOMA DISTR.: Mkuzana R., ± 14 miles from Magudu on Nongoma rd., 26 Oct. 1964, *Ross 1090, 1092, 1093, 1094* (NU). UBONBO DISTR.: Mkuzi Game Reserve, 25 Aug. 1954, *Ward 2393* (GRA, NH, NU, PRE).

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## SUMMARY

The history of *Acacia nigrescens* Oliv. and the distribution of the species in Africa were considered. Population sampling was carried out in Natal. Parameters for all measurable morphological characters revealed the presence of continuous variation within, and among, these populations. Herbarium specimens from the species range in Africa were examined and the nature of the morphological variation presented. The relationship of *A. nigrescens* to several closely related species was considered. No infraspecific categories are recognised within *A. nigrescens*.

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# *ACACIA SENEGAL* (L.) WILLD. IN AFRICA, WITH PARTICULAR REFERENCE TO NATAL. *

*by*

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*Mimosa senegal* was described by LINNAEUS in 1753. Subsequently, WILLDENOW (1806) transferred the species to the genus *Acacia*. Although the whereabouts of the type specimens is unknown, the species is identified by LINNAEUS' reference to the three recurved prickles, the median one curving downward and the two laterals upward. LINNAEUS' comment that *M. senegal* was easily distinguished by its white bark has, in the past, led to the confusion of this species with *A. albida* Del. which frequently has white or ashen bark. However, whereas *A. albida* has two straight or only slightly curved stipular spines, *A. senegal* has three, or less frequently one, strongly curved prickles. The illustration of *A. senegal* in ENGLER & PRANTL (1894: 112, Fig. 68), and which was subsequently reproduced in ENGLER & DRUDE (1915: 380, Fig. 221), is incorrect in that all prickles curve downward.

*A. senegal* forms part of a complex of closely related species, each of which shares the distinctive armature of *A. senegal* in having the recurved prickles either singly or in threes. The species, in chronological order, include amongst others *A. asak* (Forsk.) Willd. [= *A. glaucophylla* Steud. ex A. Rich.] (1806), *A. hamulosa* Benth. (1842), *A. oliveri* Vatke (1880), *A. hunteri* Oliv. (1881), *A. dudgeoni* Craib

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ex Holl. [= *A. samoryana* A. Chev.] (1911), *A. thomasii* Harms (1914) and *A. condyloclada* Chiov. (1915). With the exception of *A. dudgeoni,* which occurs in tropical west Africa, the remaining species occur in tropical north east Africa. This complex of species including *A. senegal* becomes exceedingly difficult taxonomically in north east tropical Africa, an area which is mostly poorly known floristically. The relationship of some of these species to *A. senegal,* and to one another, is unclear and it is frequently difficult to assign a specimen to any one species with certainty.

In addition to the typical form of *A. senegal,* four infraspecific categories have been recorded. SCHWEINFURTH (1896) recognised var. *kerensis* basing the description on his own specimens from Keren in Eritrea. Variety *kerensis* was said to differ from the typical form in having linear, sub-entire, tomentellous pods. SCHWEINFURTH also mentioned that in the type locality plants exhibited only a shrubby growth form.

CHIOVENDA (1916) described var. *pseudoglaucophylla* from Italian Somaliland. BAKER (1930) noted under this variety: «Leaves small, pinnae 2-4, leaflets small, glaucescent. Racemes much longer than leaves. Young fruit adpressed, hairy, mature, sparsely pilose, stipitate». Unfortunately this description does not identify the variety positively and no later workers shed any light on its identity. Regrettably no authentic specimens of var. *pseudoglaucophylla* have been available for examination and, as material and information are so difficult to obtain from north east tropical Africa at present, it has reluctantly been necessary to exclude further reference to the taxon in this paper. This is particularly unsatisfactory since it is unknown whether var. *pseudoglaucophylla* is a valid variety of *A. senegal,* whether it is a synonym of another variety of *A. senegal,* or whether it is a synonym of a species closely related to *A. senegal.*

ROBERTY's (1948) treatment of *A. senegal* as an «omnibus» species in which he included as subspecies the quite distinct species *A. laeta* [R. Br. ex] Benth. and *A. mellifera*

(Vahl.) Benth. is at variance with that of all other workers and is best disregarded.

BRENAN (1953) based his description of var. *leiorhachis* on a specimen collected by *Greenway* in Tanzania. This variety differed from var. *senegal* and from var. *kerensis* in having a glabrous or subglabrous inflorescence axis.

BRENAN (1959) considered this glabrous inflorescence axis as no more than «a minor variation» and merged var. *leiorhachis,* including the type, with var. *senegal* except for two specimens, *Hornby 140* and *Burtt 3845,* which were referred to *A. circummarginata* Chiov. *A. senegal* was maintained as a species distinct from *A. circummarginata,* the latter differing in having longer pinnae and «smooth, purplish twigs whose internodes are often longer than in *A. senegal*». Further, it was suggested that the Transvaal specimens cited under *A. senegal* var. *leiorhachis* in Kew Bulletin 1953: 98-9 (1953) would be better placed under *A. circummarginata.*

BRENAN (1953) also described var. *rostrata* within *A. senegal* basing the variety on a specimen from the Transvaal collected by *Verdoorn.* As in var. *senegal* and in var. *kerensis,* but unlike var. *leiorhachis,* the inflorescence axis in var. *rostrata* is densely pubescent. However, the apices of the pods in var. *rostrata* are typically strongly beaked or rostrate in contrast to those of var. *senegal* and var. *kerensis* where pod apices are said to be rounded to acute or acuminate but not strongly rostrate.

As mentioned by BRENAN (1959) the present delimitation of infraspecific categories within *A. senegal* is far from satisfactory. Difficulty is frequently encountered whilst attempting to assign a specimen to any one variety with certainty. For example, many specimens collected in north east tropical Africa and referred to var. *kerensis* carry the comment «correctly named if a shrub» or words to that effect. Consequently it was felt necessary to attempt to evaluate the range of infraspecific variation within *A. senegal* and to attempt to explain the relationship of *A. senegal* to some of the other species in the complex.

## DISTRIBUTION, HABIT AND HABITAT

### a) *In Natal*

The known distribution of *A. senegal* in Natal is shown in Fig. 1.

Populations extend from near the border of Mozambique in the north to a little further south than the Tugela River mouth, and inland as far as Middledrift and a little west of Nongoma. Two populations occur south of the Tugela River, in both instances within the Lower Tugela district. One is located some three hundred yards from the Tugela

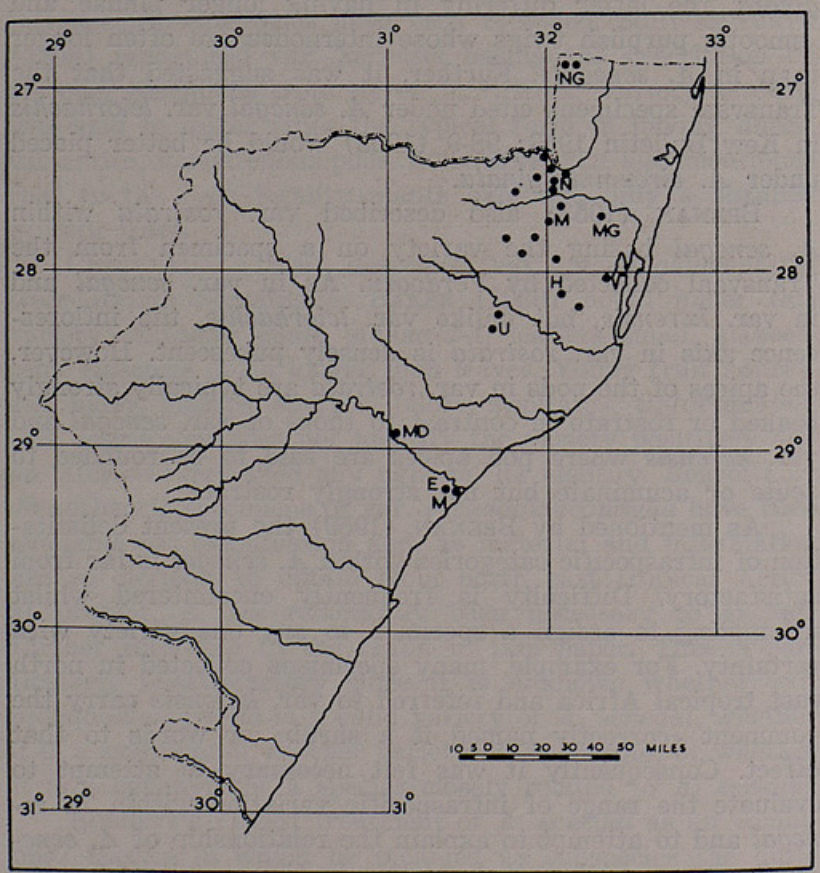


Fig. 1. — The known distribution of *A. senegal* in Natal.

river a few miles south of Mandini, whilst the other is on the 'Essiena' farm opposite the confluence of the Nembe and Tugela rivers. As far as is known the species does not cross the Tugela at Middledrift. The small Middledrift population is isolated from all others.

Fig. 2. — Tree 4 m high with somewhat flattened spreading crown growing in heavily overgrazed, boulder strewn, grey loam. *A. tortilis* (Forsk.) Hayne subsp. *heteracantha* (Burch.) Brenan, *A. nilotica* (L.) [Willd. ex] Del. subsp. *kraussiana* (Benth.) Brenan, *A. luederitzii* Engl. var. *retinens* (Sim) Ross & Brenan and *Dichrostachys cinerea* (L.) Wight & Arn. in background. Natal, Ngotshe Distr., W. foothills of Lebombo Mts., May 1963.

Growth form varies from a small shrub to a tree, the latter seldom attaining a height of as much as 5 metres in Natal. The crown in arborescent forms is typically flattened and spreading or slightly rounded although some specimens with a markedly rounded crown have been observed. In smaller trees the crown is frequently irregularly open and lax.

Populations generally occur in dry thornveld or in valley scrub, tending to avoid the more mesic situations. Plants may form fairly dense stands; especially is this the case on abandoned kraal sites within the Ndumu Game Reserve. These thickets, which may be pure stands of *A. senegal* or of this species in association with *A. grandicornuta* Gerstner and *A. luederitzii* Engl. var. *retinens* (Sim) Ross & Brenan, are frequently quite impenetrable (see Fig. 3). *A. senegal* is greatly relished by the black rhinoceros (*Diceros bicornis*

Fig. 3. — Dense impenetrable thicket of *A. senegal* 3 m high growing on old kraal site. *Sporobolus capensis* (Willd.) Kunth., *S. pyramidalis* Beauv., *Pogonarthria squarrosa* (Licht.) Pilg. and *Cassia petersiana* Bolle in foreground. *A. luederitzii* var. *retinens* in background. Natal, Ingwavuma Distr., Ndumu Game Reserve, Feb. 1964.

*bicornis* L.) and in the Hluhluwe, Mkuzi and Umfolosi Game Reserves these beasts sometimes do considerable damage to plants whilst browsing.

The bark, which varies in colour from pale to dark yellowish- or grey-brown is rough, somewhat cork-like, and typically flaking. The outer brownish layer sometimes exfo-

Fig. 4. — Close up of pale to dark yellowish or grey-brown, rough, irregularly flaking, cork-like bark of *A. senegal*. Natal, Ngotshe Distr., W. foothills of Lebombo Mts., Apr. 1966.

liates revealing a powdery, sulphur coloured inner bark. Trees may be found on which patches of the bark are quite smooth but this is usually the result of animals having rubbed against the trunk. Crystal clear gum exudations from the trunk or main branches are frequently encountered.

Plants are armed with recurved prickles that occur either singly, or more commonly in threes, at the nodes. Prickles seldom, if ever, occur in pairs. When only one prickle is present it is the median downward curved one, the two laterals being absent. No other *Acacia* species in Natal has ternate prickles.

Inflorescences are borne mainly in spring and in early summer, the peak flowering period depending upon local climatic conditions. Unlike most other species, plants invariably continue flowering intermittently for several months so that flowers and the same season's pods, in various stages of development, including those containing mature, viable seeds, may be found together. With the exception of the mid-winter months it is usually possible to find a flowering specimen within a population. Inflorescences are not always borne peripherally; a number are often produced in the axils of the previous season's leaves or on older wood. As with most species, weevils, of the family Bruchidae, destroy vast quantities of seed.

b) *Remainder of Africa*

The known distribution of *A. senegal* in Africa is shown in Fig. 5.

*A. senegal* is one of the most widespread species in Africa extending from Senegal in the north west across to Eritrea and the Somali Republic in the north east, and southwards to Natal. Although no specimens have been examined from the Ivory Coast, the occurrence of the species there is reported by AUBRÉVILLE (1950).

Plants grow as small, spreading, many stemmed shrubs branching from near the base or, as trees. Trees, which seldom attain a height of more than 13 metres, have flattened and spreading or rounded crowns, or may even exhibit a lax, irregular mode of branching.

## DIAGNOSTIC CRITERIA AND SAMPLING TECHNIQUE

In the recognition of infraspecific categories within *A. senegal* attention was paid by previous workers (SCHWEINFURTH, 1896; CHIOVENDA, 1916; BRENAN, 1953, 1959; ROSS & BRENAN, 1967) to leaf size, number of pinna and leaflet pairs, leaflet size and colour; nature of the armature of the rachillae and the rachides, degree of pubescence of the inflorescence axes, pod shape, especially pod apices, growth form and the nature of the bark. These characters are also

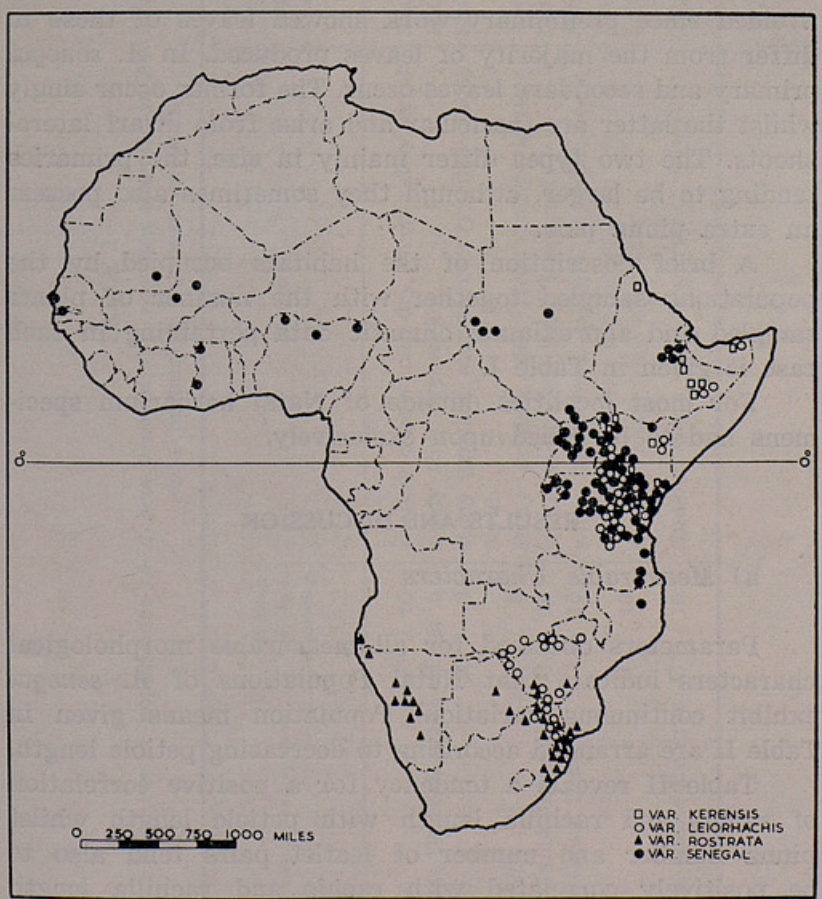


Fig. 5. — The known distribution of *A. senegal* in Africa.

important in delimiting *A. senegal* from a number of closely related species.

The characters selected for measurement or qualitative estimation were those adopted in similar studies of *A. brevispica* Harms (Ross & Gordon-Gray, 1966a), of *A. caffra* (Thunb.) Willd. (Ross & Gordon-Gray, 1966b) and of *A. ataxacantha* DC. (Ross, 1966). Thus, all morphological features previously regarded of taxonomic value within the species were considered.

Individual plants were sampled uniformly according to the method of Gordon-Gray (1965). Coppice shoots were avoided since preliminary work showed leaves of these to differ from the majority of leaves produced. In *A. senegal* primary and secondary leaves occur. The former occur singly whilst the latter are fascicular and arise from dwarf lateral shoots. The two types differ mainly in size, the primaries tending to be larger, although they sometimes also possess an extra pinna pair.

A brief description of the habitats occupied by the populations sampled together with the number of plants sampled and approximate climatic data pertaining in each case is given in Table I.

For most localities outside of Natal herbarium specimens had to be relied upon exclusively.

## RESULTS AND DISCUSSION

### a) *Measurable Characters*

Parameters obtained for all measurable morphological characters indicate that Natal Populations of *A. senegal* exhibit continuous variation. Population means given in Table II are arranged according to decreasing petiole length.

Table II reveals a tendency for a positive correlation of rachis and rachilla length with petiole length whilst pinna number and number of leaflet pairs tend also to be positively correlated with rachis and rachilla length respectively.

TABLE I

Habitats of populations of *Acacia senegal* var. *rostrata* sampled in Natal and approximate climatic data pertaining in these habitats

| Populations and symbols | Number of plants sampled | Habitat | Aproximate Climatic Data | | | |
|---|---|---|---|---|---|---|
| | | | Nearest weather station | Altitude in metres | Mean Annual Rainfall in mm | Mean Annual Temp. in °C. |
| Essiena E | 10 | shallow stony soil; dry river valley scrub | Stanger | 46 | 800-1000 | 21.4 |
| Hluhluwe Game Reserve H | 5 | sandy soil; dry scrub | Hlabisa | 512 | 1126.2 | 19.9 |
| Mandini M | 5 | stony ground; margin of dry river valley scrub | Stanger | 46 | 800-1000 | 21.4 |
| Middledrift MD | 5 | stony ground; dry river valley scrub | Nietgedacht | 792 | 660.9 | 18.0 |
| Mkuzi Game Reserve MG | 10 | white sandy soil; dry thornveld | Mkuze | 122 | 500-600 | 21.6 |
| Ndumu Game Reserve NG | 10 | white sandy soil; margin of dense impenetrable thicket, dry scrub | Ndumu | 75 | 638.6 | 22.7 |
| Ngotshe N | 10 | reddish loam; dry thornveld | Pongola Settlement | 274 | 718.8 | 22.0 |
| Umfolosi Game Reserve U | 10 | shallow stony soil; dry valley scrub | Hlabisa | 512 | 1126.2 | 19.9 |

Population extremes and modes are given in Table III.

As so much information is lost in the calculation of population means, scatter diagrams for mean parameters for individual plants for all Natal populations were constructed. Use of plant means also results in loss of information but the numbers of measurements involved precluded use of individual statistics.

The variation within, and among, populations is clearly evident from Figs. 6 and 7.

Although not readily apparent from the rainfall figures, observations suggest that there is a morphological gradient in relation to moisture; plants growing in moister environments tending to have larger leaves than those growing in drier situations, a relationship with environment also shown by *A. ataxacantha*. The approximate annual rainfall figures

TABLE II

Mean morphological parameters for populations of *Acacia senegal* var. *rostrata* sampled in Natal

| Populations sampled | Petiole length in mm | Rachis length in mm | Leaf length in mm | Rachilla length in mm | Number of pina pairs | Number of leaflet pairs |
|---|---|---|---|---|---|---|
| Mandini . . . | 12.9 | 44.9 | 57.8 | 26.4 | 8.2 | 18.8 |
| Hluhluwe . . . | 10.5 | 31.4 | 41.9 | 18.4 | 7.6 | 17.1 |
| Ngotshe . . . | 10.1 | 35.4 | 45.5 | 17.4 | 7.5 | 15.5 |
| Essiena . . . | 9.6 | 30.6 | 40.2 | 18.7 | 6.9 | 17.0 |
| Umfolosi . . . | 9.0 | 28.4 | 37.4 | 18.2 | 6.7 | 15.5 |
| Middledrift . . | 8.7 | 31.9 | 40.6 | 17.1 | 7.5 | 14.4 |
| Ndumu . . . | 8.4 | 23.2 | 31.6 | 14.6 | 6.1 | 13.7 |
| Mkuze . . . . | 7.8 | 19.1 | 26.9 | 12.6 | 6.3 | 14.0 |

given in Table I serve only as a rough indication for in no instance was a weather station located within the limits of a population and, in some instances, were many miles removed. Further, mean annual figures do not include precipitation in the form of mist which is important in some areas, nor do they indicate the season of rainfall, length of the dry season, the extremes, nor the effectiveness of the precipitation. Thus, although rainfall figures given for the Mandini and the Essiena populations, and for the

TABLE III

Extreme and modal morphological parameters for populations of *Acacia senegal* var. *rostrata* sampled in Natal

| Populations sampled | Petiole length in mm | | Rachis length in mm | | Leaf length in mm | | Rachilla length in mm | | Number of pinna pairs | | Number of leaflet pairs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Extreme | Mode | Extreme | Mode | Extreme | Mode | Extreme | Mode | Extreme | Mode | Extreme | Mode |
| Mandini . . . . . | 5-21 | 13.2 | 29-68 | 44.1 | 34-89 | 55.7 | 18-40 | 26.3 | 5-11 | 8.9 | 12-24 | 19.1 |
| Hluhluwe . . . . . | 6-20 | 11.4 | 18-52 | 31.8 | 24-72 | 44.3 | 12-27 | 20.2 | 5-11 | 8.9 | 13-21 | 18.3 |
| Ngotshe . . . . . | 5-20 | 10.1 | 17-48 | 32.0 | 22-68 | 42.1 | 10-24 | 18.6 | 4-10 | 8.7 | 12-21 | 15.4 |
| Essiena . . . . . | 3-20 | 9.6 | 16-59 | 30.2 | 19-79 | 46.2 | 11-39 | 19.7 | 4-10 | 7.6 | 13-21 | 17.2 |
| Umfolosi . . . . . | 2-17 | 9.2 | 18-50 | 29.5 | 20-67 | 39.0 | 10-28 | 18.4 | 4-9 | 7.5 | 11-21 | 16.7 |
| Middledrift . . . . . | 4-16 | 7.9 | 17-49 | 33.2 | 21-65 | 41.3 | 10-23 | 16.3 | 5-10 | 7.4 | 12-19 | 14.8 |
| Ndumu . . . . . | 4-17 | 8.0 | 15-37 | 23.4 | 19-54 | 30.5 | 9-25 | 14.3 | 4-8 | 6.7 | 10-17 | 14.4 |
| Mkuze . . . . . | 5-13 | 8.2 | 13-34 | 18.1 | 18-47 | 28.9 | 9-19 | 12.2 | 5-7 | 6.6 | 10-18 | 14.3 |

Hluhluwe and Umfolosi populations, are the same respectively this is due to the absence of other weather stations. The Mandini population definitely has a more mesic habitat than that of the Essiena population, whilst the Umfolosi plants grow in a drier habitat than do the Hluhluwe ones. It is evident from Table II that leaf length is shortest within the Ndumu and Mkuze populations which are those in which least rainfall occurs, and longest in the Mandini and Hluhluwe populations which experience a considerably higher rainfall.

Rachilla length, number of pinna pairs and number of leaflet pairs are also greatest in those populations in mesic habitats and smallest for those in drier situations.

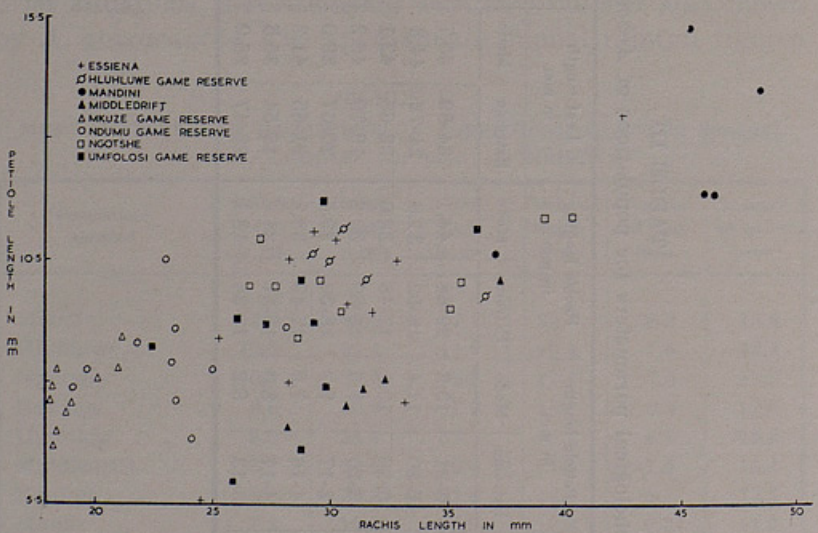


Fig. 6. — Scatter diagram showing the variation in petiole length and rachis length within, and among, the Natal populations of *A. senegal.*

The morphological gradients in relation to distribution in Natal, which were so evident in *A. caffra* (Ross & Gordon-Gray) are not so obvious in *A. senegal.* In *A. caffra* leaf length was found to decrease from north to south along the coast, and to increase inland from the coast. In *A. senegal* leaf length is longest within the Mandini populations, which

represents almost the southern limit of the species in Natal, and shortest within the Mkuze and Ndumu populations, the latter being the northernmost. However, apart from the correlation between leaf length and moisture mentioned earlier, there is no positive correlation between leaf length and distribution in Natal. For example, the Ngotshe population, which lies north of Mkuze, has larger leaves than the latter, whilst the Essiena population further south has smaller leaves than the Mkuze population.

Pod size, although fairly uniform on a single plant, varies quite considerably from plant to plant within a population and from one population to another. Pod width does not appear to be closely related to pod length as both the longest and the shortest pods within a single population frequently have the same width. Pod length and width

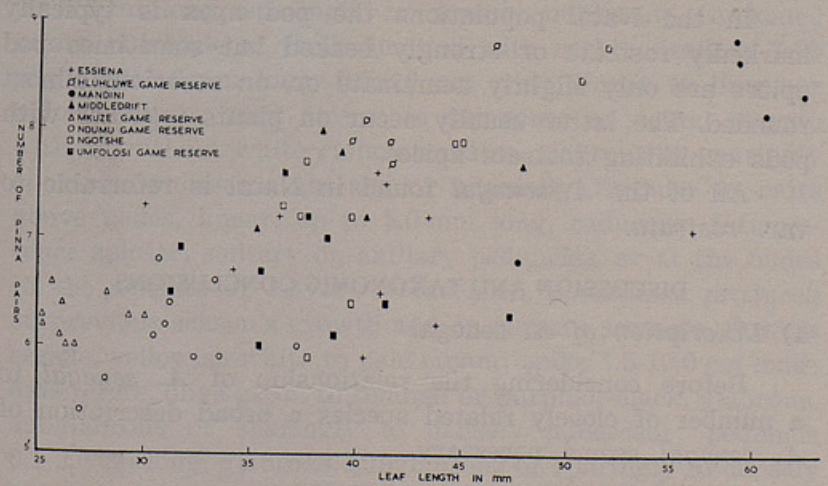


Fig. 7. — Scatter diagram showing the variation in leaf length and number of pinna pairs within, and among, the Natal populations of *A. senegal.*

show no apparent correlation with any other morphological characters.

b) *Non-measurable Characters*

The degree of pubescence of the young branchlets is fairly uniform on a single plant but varies from plant to

plant within a population. Abaxial leaflet surfaces may be glabrous or sparingly appressed-pubescent on a single plant. Likewise, marginal cilia may be present on some leaflets but absent from others.

There is usually a single petiolar gland although occasionally two are present. The position of the gland, which may be at any point between the apex of the pulvinus and the lowest pinna pair, varies on leaves of a single plant. Gland size also varies considerably.

The number of rachidial glands, each of which lies at the point of attachment of a pinna pair, varies on a plant. There is usually a gland between the distal one to six pinna pairs although in some instances there may be one between every pinna pair. Often two glands are crowded between a single pinna pair.

In the Natal populations the pod apex is typically markedly rostrate or strongly beaked but sometimes pod apices are only slightly acuminate or, on occasion, almost rounded. The latter usually occur on plants together with pods exhibiting rostrate apices.

All of the *A. senegal* found in Natal is referrable to var. *rostrata.*

## DISCUSSION AND TAXONOMIC CONCLUSIONS

a) *Description of* A. senegal

Before considering the relationship of *A. senegal* to a number of closely related species a broad description of *A. senegal* seems necessary.

Shrub or spreading bush branching from the base, or a tree to 13 m high with flattened and spreading or rounded crown, or straggling and irregularly branched, trunk to 0.5 m in diameter. Bark pale to dark yellowish- or greyish-brown to purplish black, rough, often corklike and flaking or, papery and peeling. Young branchlets pale to dark yellowish- or greyish-brown to purplish black, or as though whitewashed over a purplish background, smooth with numerous minute somewhat transversely elongated lenticels, or flaking minutely, or rough and somewhat corklike or

powdery, exfoliating to reveal yellow inner bark, glabrous, subglabrous or sparingly to densely pubescent. Prickles typically in threes below the nodes, the central one pointing down and the laterals upward, or singly with the laterals absent, seldom if ever in pairs, strongly curved, reddish or purplish-black, yellowish when young, up to 10 mm long. Leaf: petiole 0.2-3.0 cm long, sparingly to densely pubescent, rarely subglabrous, adaxial gland usually present, sometimes two, variable in position, rounded or oval, 0.5-0.75 mm in diameter, yellow or reddish-brown to purplish-black; rachis 0.7-6.9 cm long, sparingly to densely pubescent, abaxial surface with or without recurved prickles, up to 1.5 mm long, glands oval, reddish-brown to black, between top pinna pair only, or between each pinna pair, or absent from some, sometimes two between one pinna pair; pinna 2-12 pairs; rachillae 0.5-6.5 cm long, sparingly to densely pubescent, thickened into a pulvinule at their junction with rachis; leaflets 7-25 pairs, 1.0-9.0 mm long, 0.5-3.0 mm wide, linear to linear-or elliptic-oblong, apex obtuse to sub-acute or acute, margin with or without white cioliolate hairs, glabrous or sparingly appressed-pubescent ab- and/or adaxially. Stipules in pairs above nodes, linear, up to 5.0 mm long, caducous. Inflorescence spicate, solitary on axillary peduncles, or at the nodes in the absence of leaves, or fascicled, sometimes produced on previous season's growth and on current season's, flowers sessile, yellowish-white to pale cream; spike 1.5-10.0 cm long; axis terete, olive-green to reddish or purplish-black, glabrous, subglabrous or sparingly to densely pubescent; peduncle 0.1-2.0 cm long, glabrous, subglabrous or sparingly to densely pubescent; calyx greenish-yellow or yellowish-white, sometimes tinged with red, cupulate, glabrous or sometimes pubescent, tube 0.9-2.9 mm long, lobes 5, triangular, 0,2-0.8 mm long; corolla yellowish-white, tubular, glabrous or subglabrous, tube 2.4-3.5 mm long, lobes 5, triangular, up to 0.9 mm long, alternating with calyx lobes; stamen filaments up to 7.0 mm long, free, yellowish-white; anthers up to 0.25 mm across, with a deciduous apical gland; ovary glabrous, very shortly stipitate; style glabrous, yellowish-white. Legume olive- green to yellowish- or greyish-brown or chestnut,

linear, oblong, sometimes somewhat constricted between seeds, 1.8-19.0 cm long, 1.2-3.4 cm wide, apex rounded to subacute, acute or markedly rostrate, dehiscent, venose, coriaceous or chartaceous, sparingly to densely appressed-pubescent or puberulous. Seeds olive-green to light or dark brown, subcircular-lenticular, 8.0-12.0 mm in diameter; areole impressed, horse-shoe shaped, 2.5-6.0 mm × 2.5-5.0 mm.

b) *Relationship of* A. senegal *to closely related species*

Although the relationships of the closely related species to one another and to *A. senegal* are not fully understood, and although it is sometimes difficult to assign a specimen to any one species with certainty, it seems desirable, in the absence of further information, to maintain each of the following as a distinct species.

*A. dudgeoni* was distinguished from *A. senegal* by CRAIB (1911, 1912) in having 8-16 pinna pairs and up to 24 leaflet pairs as opposed to the 6 pinna pairs and 15 leaflet pairs found in *A. senegal* in west Africa. HUTCHINSON & DALZIEL (1928) made no mention of *A. dudgeoni* and included it in *A. senegal.* The differences between the two species were amplified by KEAY & BRENAN (1949) and it was stated that «The geographical distributions in West Africa of *A. senegal* and *A. dudgeoni* are quite distinct...» KEAY (1958) reported that *A. dudgeoni* occurs in much moister regions than *A. senegal.*

In Natal up to 12 pinna pairs and 24 leaflet pairs were recorded within *A. senegal* var. *rostrata* so that when viewed on a continental basis these two characters provide no clear discontinuity between *A. dudgeoni* and *A. senegal.* In Natal highest number of pinna and leaflet pairs were recorded on plants growing in the more mesic habitats which is interesting since *A. dudgeoni,* which grows in moister regions than *A. senegal,* has a higher number of pinna and leaflet pairs than *A. senegal* in west Africa. However, in *A. dudgeoni* the pinnae tend to be more crowded on the rachis, giving the leaf a somewhat different 'look' to the *A. senegal* leaf. Further, in Natal largest leaflets of *A. senegal* var. *rostrata* were found on plants in mesic habitats whereas in west

Africa *A. dudgeoni,* which occurs in moister areas than *A. senegal,* has smaller leaflets than *A. senegal.* In west Africa *A. senegal* may be differentiated from *A. dudgeoni* on the characters defined by KEAY & BRENAN (1949) and by KEAY (1958).

*A. condyloclada* and *A. thomasii* resemble *A. senegal* var. *leiorhachis* in having inflorescence axes which are glabrous or subglabrous apart from a small basal tuft of hairs. *A. condyloclada* differs from both in having 3-4 pinna pairs and large leaflets up to 20 mm long and 9 mm wide, whilst *A. thomasii* has typically one or two, sometimes three, pinna pairs and large flowers in which the calyx is up to 4.5 mm long and the corolla up to 7 mm long. *A. thomasii* is only recorded from Kenya. *A. asak* has glaucous foliage, reddish to purplish-black young branchlets, fruits and inflorescence axes, the latter being sub-glabrous or sparingly pubescent.

*A. hamulosa* is characterised by having a single recurved prickle on the abaxial surface either at, or just below, the apex of each rachide. There is sometimes a recurved prickle terminating the rachis in the other species but not the rachides. In addition the pod in *A. hamulosa* is broad, up to 3.7 cm wide, somewhat papery and light yellowish-brown. *A. hunteri,* which has frequently been confused with *A. hamulosa* in the past, differs in the absence of the small recurved prickle terminating each rachide. From. *A. senegal* and the other species it differs in having tiny pods 2-3 cm long and only up to 0.9 mm wide.

The relationship of *A. senegal* to a number of other species for example, *A. cheilanthifolia* Chiov., *A. impervia* Gilliland and *A. oliveri* Vatke has been omitted owing to lack of information. Clearly the relationship of *A. senegal* to its numerous allies needs further investigation.

c) *Infraspecific Categories within* A. senegal

**A. senegal** (L.) Willd., Sp. Pl. **4**: 1077 (1806); DC., Prodr. **2**: 459 (1825); Benth. in Trans. Linn. Soc. **30**: 516 (1875); Hutch. & Dalz., F. W. T. A., ed. 1, **1**: 361 (1928), pro parte; Bak. f., L. T. A.: 827 (1930), pro majore parte; T. S. K.: 69 (1936); Eggeling, Indigenous Trees of Uganda

Protectorate: 212, Pl. 9 (1940); T. T. C. L.: 330 (1949); Bogdan in Nature in E. Afr., ser. 2, No. 1: 12 (1949); Aubréville, Fl. Soud.-Guin. 266, t. 52, 5, t. 54, 1 (1950); Gilb. & Bout. in F. C. B. 3: 149 (1952); I. T. U., ed. 2: 212, fig. 47g, t. 10 (1952); Keay in F. W. T. A., ed. 2, 1: 498, fig. 159 (1958); Brenan in F. T. E. A. Legum.-Mimos. 92-93 (1959); Dale & Greenway, Kenya Trees and Shrubs: 293, Pl. 17 (1961). Whereabouts of type unknown.

Syn.: *Mimosa senegal* L., Spec. 1506 (l., 521) excl. syn. (1753).
*M. senegalensis*, Lam. Encycl. Bot. **1**: 19 (1784).
*Acacia verek* Guill. & Perr., Fl. Seneg. Tent. **1**: 245, t. 56 (1832); Schweinf. in Linnaea XXXV: 374 (1867); Oliv., F. T. A. **2**: 342 (1871); Crowfoot, Fl. Pl. Northern and Central Sudan, fig. 73(1): (1928). Type: from Senegal (P. syn.).
*A. rupestris* Stocks in Fl. Or. **2**: 638 (1872).
*A. virchowiana* Vatke & Hildebr. in Oesterr. Bot. Zeitschr. **30**: 275 (1880), pro parte. Type; Kenya, Teita district. Voi R. and elsewhere, *Hildebrandt 2486* (K, iso.).
*A. campanulata* Hochst., T. S. K.: 69 (1936).
*A. somalensis* sensu T. T. C. L.: 330 (1949), non Vatke.
*A. thomasii* sensu T. T. C. L.: 330 (1949), non Harms.
*A. senegal* (L.) Willd. subsp. *senegalensis* (Houtt.) Roberty var. *verek* (Guill. & Perr.) Roberty in Candollea **11**: 156 (1948).

Variety *senegal* grows typically as a tree up to 13 m in height with a somewhat variable crown from flat and spreading to lax or rounded. The bark is pale or dark yellowish- to greyish-brown, fissured and rough, sometimes flaking off. In the Nachingwea district of Tanzania bark on the trunks of many trees was deep reddish-brown as a result of red dust accumulating, and from earth deposited by termites.

The inforescence axis in var. *senegal* is typically pubescent although occasionally it may be glabrous or subglabrous. Pod apex is rounded to acute or acuminate.

The known distribution of var. *senegal* in Africa is shown in Fig. 5. The variety is widespread in tropical west, north-east and east Africa, extending as far south as Mozambique. BRENAN (1959) mentioned that the variety extended «southwards to Zululand» but no trace of it in Zululand has yet been found.

In view of the number of herbarium specimens examined only one from each magisterial district has been cited.

**Senegal:** no locality, *Perrottet 276* (BM); M. Bidjam, between St. Louis and Dakar, May 1865, ? *Heudelot* (K).

**Gambia:** *Heudelot* (K).

**Mauritania.** Néma — Bassikounou, 29 July 1959, *Popov 85* (BM).

**French Sudan:** Toguerè de Banguita, 30 Jan. 1952, *Davey 13* (K); Goumal (Dioura), 8 Jan. 1955, *Davey 238* (K). Timbuktu, 11 Aug. 1927, *Olufsen 261* (BM).

**Ghana:** Ashanti, Wenchi-Sunyani Distr., 25 Mar. 1958, *Hepper & Morton A 3200* (K). 9 miles from Wa on Han rd., 3 Apr. 1956, *Adams 4010* (K).

**Nigeria:** BORNU PROV.: Sudan zone, ± ¾ mile from Lantewa on Geidam rd., 24 June 1947, *Onochie FHI 23373* (K). KANO PROV.: Dawaki-Kudu Distr., near the Kano-Dawaki Kudu old motor rd., 18 Aug. 1949, *Onwudinjoh FHI 24017* (K). KATAGUM DISTR.: 20 July 1907, *Dalziel 55* (K). SOKOTO PROV.: ± 7 ½ miles E. of Zurmi and ¾ miles N. of R. Farfara, 20 Apr. 1946, *Keay FHI 16169* (BM, K).

**Sudan:** DARFUR PROV.: between Guldu and Nyuringya, on W. side of Marra Mts., 3 Jan. 1934, *Dandy 40* (BM). EQUATORIA PROV.: between Kiliu and Ngarama, Katire-Torit rd., 12 June 1961, *Jackson 4228* (K). KORDOFAN: Shambat, 31 Dec. 1930, *Aylmer 95* (K).

**Ethiopia.** HARAR PROV.: highway W. of Dire Dawa (to Addis Ababa) nr. R. just W. of Dire Dawa, 4 Aug. 1961, *Burger 452* (K). Erer R. area 60 km. W. of Dire Dawa on highway to Addis Ababa, hillside S. W. of Erer village,

24 Aug. 1961, *Burger 675* (K). MESSANANO: nr. Awash R. bridge, 25 Apr. 1957, *Mooney 7072* (K).

**Congo.** ORIENTALE PROV.: Plaine du Lac Albert (Mahagi Port), 2 Dec. 1959, *Deville 551* (K).

**Ruanda-Urundi.** RUANDA PROV.: Territ. Biumba, Kakoli, N. E. Mutara, 13 Feb. 1954, *Christiaensen 360* (K).

**Uganda.** ACHOLI DISTR.: Kitgum, Chua, 10 Nov. 1945, *Thomas 4338* (K). BUGISHU DISTR.: Mbale, Cheptui N., 10 Oct. 1933, *Tothill 2241* (K). BUNYORO DISTR.: Butiaba escarpment, 2 July 1951, *Trapnell 2147* (K). KARAMOJA DISTR.: Kakumongole, Karamoja, 6 Jan. 1937, *Thomas 2194* (K). LANGO DISTR.: *Kennedy 8* (K). MENGO DISTR.: Burulo, Lwabiyata, 8 July 1933, *Johnston 182* (K). NORTH MENGO DISTR.: Lwampanga, North Mengo site 42, 13 Sept. 1954, *Langdale-Brown 1259* (K). WEST NILE DISTR.: Ajugopo, East Madi, May 1932, *Hancock 745* (K).

**Kenya.** KAJIADO DISTR.: 23 miles S. of Kajiado on Arusha rd., 30 Jan. 1952, *Trapnell 2204* (K). KARASUK DISTR.: Kacheliba-Lodwar rd., 70 miles N. of Kitale, 12 Oct. 1957, *Knight 126* (K). KILIFI/KWALE DISTR.: Mazeres, Aug. 1929, *Graham 620* (K). KITUI DISTR.: Kitui Reserve, 16 Mar. 1953, *Trump 53* (K). KWALE DISTR.: Kwale, *Elliot 1373* (K). LAMU DISTR.: Kiyangwe, Sept. 1929, *Abdula 2203* (K). MACHAKOS DISTR.: Plot 4, Mwita Siana area, southern Yatta Plain, 30 Jan. 1938, *Edwards 120* (K). MASAI DISTR.: new Magadi rd., Ngong, *Bally 7134* (K). MERU DISTR.: Isiolo, game office, 3 Mar. 1944, *Bally 3507* (K). NAIROBI DISTR.: Nairobi, National Park, 6 Aug. 1948, *Bogdan 1868* (K). NAKURU DISTR.: Nakuru to Eldama ravine rd., near Molo R. (Esageri Bush clearing scheme), 14 Sept. 1948, *Bogdan 2060* (K). NAROK DISTR.: Narosura R. valley below Loita Hills, S. of Narok, 22 Jan. 1957, *Knight 118* (K). NORTHERN FRONTIER PROV.: Moyale, 12 Aug. 1952, *Gillett 13714* (K). RIFT VALLEY PROV.: Lake Baringo, W. side, Feb. 1962, *Tweedie 2298* (K). TANA RIVER DISTR.: Tana R., 5 Apr. 1919, *Battiscombe* 255 (K). TEITA DISTR.: Wallis Camp, Voi, 2 Feb. 1952, *Trapnell 2211* (K). TURKANA DISTR.: desert between Lokitaung and Lodwar, 1 Aug. 1938, *Pole Evans & Erens 1601* (PRE). WEST SUK

DISTR.: foot of Kapenguira Escarpment, 35 miles N. of Kitale, 28 Mar. 1958, *Knight 139* (K).

**Tanzania.** ?HANDENI DISTR.: Korogwe-Handeni rd., 25 July 1954, *Faulkner 1474* (K). KARAGWE DISTR.: S. of Nyabiyonza, Feb. 1958, *Proctor 846* (K). KILOSA DISTR.: Kilosa, 1922, *Swynnerton 305, 306* (BM). KONDOA DISTR.: Kikori, Kondoa-Irangi, 5 June 1931, *Scott s. n.* (K). LINDI DISTR.: Tendaguru, 16 Feb. 1926, *Migeod 87* (BM). LUSHOTO DISTR.: Mwule to Kerenge, 21 Oct. 1915, *Zimmermann A 13* (K, PRE). MOROGORO DISTR.: 3 Feb. 1932, *Wallace 356* (K). MOSHI DISTR.: North side Hill, 20 Dec. 1951, *McCoy-Hill 24* (PRE). MPWAPWA/ /KILOSA DISTR.: Chakwale, 15 June 1938, *Hornby 945* (K). MUSOMA DISTR.: Seronera to Banagi, mile 1, 30 Mar. 1961, *Greenway 9929* (K, PRE). MWANZA DISTR.: 15 miles S. of Nyegezi on Nyambiti rd., 5 July 1949, *Doggett 110* (K). NACHINGWEA DISTR.: Nachingwea, 12 Dec. 1962, *Ross 4* (EA, NU). NZEGA DISTR.: Mwanhala, 12 miles S. of Nzega, 20 July 1949, *Doggett 118* (K). SHINYANGA DISTR.: Samui Bush, Mar. 1936, *Burtt 5646* (BM, K). SINGIDA DISTR.: Singida, 11 May 1945, *v. Rensburg 14* (K). TABORA DISTR.: 13 May 1924, *Swynnerton 4037* (K). TANGA DISTR.: Ngomeni, 25 Aug. 1944, *Greenway 7033* (K).

**Mozambique.** LOURENÇO MARQUES PROV.: between Umbelusi and Boane, 27 Apr. 1947, *Pedro & Pedrógão 646* (PRE). NIASSA PROV.: Cabo Delgado, entre Balama e Alide 1 Sept. 1948, *Barbosa 1952* (LISC).

*A. senegal* var. *kerensis* Schweinf. in Bull. Herb. Boiss. 4, app. 2: 216 (1896); Baker, L. T. A.; 828 (1930); Brenan in F. T. E. A. Legum-Mimos.: 93 (1959). Types: Eritrea, Keren, *Schweinfurth 745* (B, syn. †, K, isosyn.) and Bogu valley, *Schweinfurth 741* (B, syn. †) and near Djuffa, *Schweinfurth* 998 (B, syn. †).

As stated by BRENAN (1959) application of the name var. *kerensis* is uncertain and reliance is placed mainly on SCHWEINFURTH's reference to the shrubby growth form as opposed to the arborescent growth form in var. *senegal*. At present all shrubby forms of *A. senegal* in north east

Africa are referred to var. *kerensis* which is most unsatisfactory since it is not known whether var. *kerensis* represents a true taxon or whether it is merely a collection of bushy and shrublike forms. Although shrubs occur typically in drier habitats than the arborescent forms in north east Africa, the two forms co-exist in many areas (GILLETT, pers. comm.). There is the question of naming correctly young trees, which on being heavily browsed, assume and retain a bushy habit although genetically capable of becoming trees. Occasional specimens described by collectors as «a spreading bush or sometimes a small tree» cannot be referred to a variety with certainty whilst other specimens, which are morphologically almost indistinguishable from typical var. *kerensis,* but which have been described as «small straggling trees», are often hesitantly referred to var. *senegal.* Clearly detailed field observations are required in an attempt to evaulate the significance of growth form in delimiting infraspecific categories within *A. senegal.*

SCHWEINFURTH drew attention to the frequent presence of a small abaxial recurved prickle terminating, or almost terminating, the rachis even when the rachis is otherwise without prickles. This character, however, is often found in var. *senegal* and in var. *rostrata.* The young branchlets in var. *kerensis* usually appear «as though whitewashed over a purplish background» (BRENAN, 1959). The leaves are small with up to four pinna pairs while leaflets are also small. Pod apex is acute to acuminate or rostrate.

For the purpose of compiling the distribution of var. *kerensis* in Fig. 5, only specimens with adequate habit notes indicating a bush or a shrubby growth form have been taken as referrable to var. *kerensis.* Specimens without detailed collector's notes and which could therefore be referred to var. *senegal* or to var. *kerensis* have been omited.

**Eritrea.** Vallée de l'Afbaron près Keren, 3 Mar. 1891 *Schweinfurth* 745 (K).

**Ethiopia.** Highway W. of Dire Dawa (to Addis ababa) 22 Sept. 1962, *Burger 2135* (K). Plateau N. of Fich, 4 Nov. 1962, *Burger 2324* (K). Gobelli, 1 Mar. 1933, *Gillett 5261*

(K). Ogaden, Danot Mersin rd., 3 Apr. 1956, *Simmons* 15 (K).

**Somali Republic.** N. region, 30 miles from Erigavo on Mait rd., 20 Oct. 1960, *Hemming 2041* (K).

**Uganda.** MENGO DISTR.: Beruli, Nakasongola, Nov. 1932, *Eggeling* 706 (K).

**Kenya.** KITUI DISTR.: Mutha Plains, 24 Jan. 1942, *Bally 1637* (K). NORTHERN FRONTIER PROV.: Wajir, Jan. 1955, *Hemming 459* (K). TURKANA DISTR.: Lokitaung, Feb. 1943, *Daie 306* (K).

**Tanzania.** MOSHI DISTR./TEITA DISTR.: Crater edge of Lake Chala, 21 Jan. 1936, *Greenway 4438* (K).

*A. senegal* var. *leiorhachis* Brenan in Kew Bull. **1953**: 98 (1953); Young in Candollea **15**: 95 (1955); v. Breitenbach in Indigenous Trees of S. Afr. **2**: 271 (1965); Ross & Brenan in Kew Bull. 1967: 68-70. Type: Tanzania, Tanga Province, Pare District, Same, 7 Feb. 1930, *Greenway 2192* (K holo., EA iso.).

Syn: *A. circummarginata* Chiov. in Ann. Bot. Roma 13: 394 (1915); Baker in L. T. A.: 834 (1930); Brenan in F. T. E. A. Legum.-Mimos.: 94 (1959); Dale & Greenway in Kenya Trees and Shrubs: 286 (1961). Types: Ethiopia, Ogaden, *Paoli 794, 913 bis, 920, 1010* (Fl syn.).

*A. thomasii* sensu T. T. C. L.: 330 (1949), non Harms.

*A. glaucophylla* sensu T. T. C. L.: 330 (1949), non Steud. ex A. Rich.

*A. kinionge* sensu T. T. C. L.: 330 (1949), non De Willd.

*A. senegal* Willd. sensu Codd in Trees and Shrubs of Kruger N. Park: 50 (1951).

*A. senegal* var. *senegal* [non (L.) Willd. sens. strict.] Brenan in F. T. E. A. Legum.-Mimos.: 93 (1959), pro parte, quoad syn. var. *leiorhachis*.

*A. sp. 1* sensu White in For. Fl. N. Rhod.: 88 (1962), quoad *Allen 399* (K).

Subsequent to BRENAN's (1959) treatment of *A. senegal* the alleged differences between *A. senegal* and *A. circummarginata* were found (ROSS & BRENAN, 1967) not to be as distinct as at first believed. It is now clear that the Transvaal plants cited by BRENAN under *A. senegal* var. *leiorhachis* in Kew Bull. **1953**: 98-9 (1953) are not taxonomically separable from *A. circummarginata* and that *A. circummarginata* itself is not specifically distinct from *A. senegal.* This taxon seemed best treated as a variety of *A. senegal* for which the correct name appeared to be var. *leiorhachis, A. circummarginata* being placed under *A. senegal* var. *leiorhachis* (ROSS & BRENAN, l. c.).

Variety *leiorhachis* is characterised chiefly in having an inflorescence axis which is normally glabrous apart from a small basal tuft of pubescence, although on occasional specimens the axis may be sparingly pubescent throughout. The inflorescence axis is typically deep reddish- purple with yellow mottling in contrast to the olive-greenish axes in the other varieties. Plants often flower when in a leafless state or when in young leaf in var. *leiorhachis,* whereas in other varieties flowers appear with, or after, the leaves. However, in var. *senegal* occasional specimens with subglabrous inflorescence axes occur in East Africa. The possibility does exist that the type specimen of var. *leiorhachis,* which is a flowering specimen with glabrous, olive-green inflorescence axes and which was of necessity chosen when little herbarium material was available, is an atypical specimen of var. *senegal* exhibiting glabrous inflorescence axes.

The pod of var. *leiorhachis* is linear with a rounded or acute apex, and is normally several times longer than it is broad.

Variety *leiorhachis* grows usually as a tree with a rounded crown or as a slender tree with a straggling, irregular mode of branching. However, shrubs also occur.

The distribution of var. *leiorhachis* is shown in Fig. 5, Specimens have been recorded from Ethiopia, Kenya, Tanzania, Zambia, Rhodesia, Mozambique and the Transvaal. An adequate selection of herbarium specimens has already been cited (ROSS & BRENAN, l. c.).

*A. senegal* var. *rostrata* Brenan in Kew Bull. **1953**: 99 (1953); Young in Candollea **15**: 96 (1955); v. Breitenbach, Indigenous Trees of S. Afr. **2**: 271 (1965). Type: Transvaal, Zoutpansberg District, Dongola Reserve, 15 Mar. 1948, *Verdoorn 2264* (K, holo., PRE, iso.).

Syn.: *A. spinosa* Marl. & Engl. in Engl., Bot. Jahrb. **10**: 20 (1888); non E. Mey., Comm. Pl. Afr. Austr. **1**: 170 (1836); Miller in J. S. Afr. Bot. **18**: 24 (1952). Type: South West Africa, Hereroland, frequens in collibus pr. Usakos, May 1886, *Marloth 1257* (K, PRE, iso.).

*A. trispinosa* «Marl. et Engl.» ex Schinz in Mém. Herb. Boiss. **1**: 115 (1900); non Stokes in Bot. Mat. Med. **3**: 168 (1912); Dinter, Deutsch-Südwest-Afrika: 73 (1909); Pönninghaus in J. S. W. Afr. Sci. Soc. **6**: 16 (1933). Type: South West Africa, Hereroland, frequens in collibus pr. Usakos, May 1886, *Marloth 1257* (K, PRE, iso.). An earlier reference to *A. trispinosa* appears in a paper read by MARLOTH on 26 Oct. 1887 and subsequently published in 1893: Trans. S. A. Phil. Soc. **5**: 269 (1893). NOTE: *Marloth 1257* is the type specimen of *A. spinosa* Marl. et Engl. and of *A. trispinosa* «Marl. et Engl.».

*A. rostrata* Sim, For. Fl. P. E. A.: 55, t. 37A (1909); non Humb. & Bonpl. ex Willd., Sp. Pl. **4**: 1060 (errore typogr. 1054) (1806). Type: Lourenço Marques et Maputo, *Sim 6263,* whereabouts uncertain.

*A. senegal* Willd., Burtt Davy, Man. Fl. Pl. Tvl.: 337 (1932), pro parte; Henkel, Woody Pl. of Natal and Zululand: 231 (1934).

*A. senegal* Willd. subsp. *trispinosa* (Stokes) Rob. sensu Roberty in Candollea **11**: 155 (1948), quoad *Dinter 222*. ROBERTY recorded *Dinter 222* (BM, K) as having been collected in Tanganyika whereas it is from Okahandja in South West Africa.

*A. senegal* Willd. var. 'Geelhaak' sensu Codd, Trees and Shrubs of Kruger N. Park: 51 (1951). *A. volkii* Suesseng in Mitt. Bot. Staatssamml. **11**: 40 (1954); Walter & Volk, Grundlagen Weidewirtschaft Südwestafrika: 211, t. 68a (1954).

Variety *rostrata* differs from the other varieties in having pods with typically rostrate or strongly beaked apices, although on occasional specimens apices may be acute or even rounded. The latter are usually accompanied by pods with rostrate apices so that there is little difficulty in identifying the specimens. Variety *rostrata* allegedly has a southern distribution in Africa (see Fig. 5). However in north east tropical Africa specimens of var. *senegal* and of var. *kerensis* frequently have acute to acuminate or even rostrate pod apices. BRENAN (1953) mentioned a specimen from Somaliland, namely *Gillett 3954* (K), which agreed well with specimens of var. *rostrata* and which had «the pods rostrate at the apex as in var. *rostrata*». However, as it was so far removed from the next locality of var. *rostrata* in Rhodesia difficulty was encountered in attempting to name the specimen correctly. The identity of this, and other similar specimens, remains uncertain.

As mentioned earlier var. *kerensis* is characterised at present by having a shrubby growth form, pubescent inflorescence axes and pods with acute to acuminate or rostrate apices. In Natal plants that are shrubby, have pubescent inflorescence axes and pods with rostrate apices are referred to var. *rostrata*. Admittedly the young branchlets in var. *rostrata* are different from those described for var *kerensis* and up to 12 pinna pairs may be found in Natal as apposed to only four in var. *kerensis*, but in other parts of the distributional range of var. *rostrata* there are often as few as four pinna pairs.

A specimen from the Transvaal, namely *Codd 4087* (PRE), hesitantly referred to var. *rostrata*, but which might equally well be placed in var. *leiorhachis*, deserves comment. This specimen agrees with var. *rostrata* in having pubescent inflorescence axes and pods with rostrate apices whilst the

pods «look» typical of those of var. *leiorhachis*. Coupled with this is the collector's note on growth form «not as densely spreading as usual». The specimen is probably best considered as an intermediate between var. *leiorhachis* and var. *rostrata*.

**Angola.** MOÇAMEDES DISTR.: Vite-Viele, Lungo, 6 Mar. 1956, *Teixeira 741* (PRE).

**South West Africa.** GIBEON DISTR.: in depression in Kalkveld, 13.3 miles E. N. E. of Mariental on rd. to Witbooisvlei, 14 May 1955, *de Winter 3542* (K, PRE). KAOKOVELD RESERVE. Etanga, 8 Apr. 1957, *de Winter & Leistner 5445* (K, PRE). KARIBIB DISTR.: Karibib, 30 Jan. 1934, *Dinter 6926* (BM, BOL, K, PRE). MARIENTAL DISTR.: 31 miles W. of Mariental on ?Maltahoe rd., 10 Mar. 1965, *Hardy 1952* (PRE). OKAHANDJA DISTR.: Okahandja, Nov. 1906, *Dinter 222* (BM, K). OKAVANGO TERRITORY: 25 miles W. of Ndola store on rd. to Ombalantu, 14 Nov. 1955, *de Winter 3635* (K, PRE). OTJIWARONGO DISTR.: Omatjeni, *Keet 1618* (PRE). OUTJO DISTR.: 20 miles W. of Outjo, June 1960, *Esterhuyse 449* (PRE). REHOBOTH DISTR.: farm Buellsport, Dec. 1947, *Strey 2314* (K, PRE).

**Botswana.** NGAMILAND: N. of Lake Dow, 40 km. E. S. E. of Rakops, 22 Mar. 1965, *Wild & Drummond 7223* (PRE, SRGH). SOUTH EASTERN PROV.: Dikhatlon Ranch, 14 Apr. 1931, *Pole Evans 3189* (39) (K, PRE).

**Rhodesia.** BEITBRIDGE DISTR.: Sashi-Limpopo R. confluence, 22 Mar. 1959, *Drummond 5936* (K, LISC, PRE, SRGH). GWANDA DISTR.: Shashi plain, 18 Dec. 1956, *Davies 2362* (K, LISC, SRGH). MELSETTER DISTR.: Birchenough Bridge, 30 Jan. 1948, *Wild 2458* (SRGH).

**Mozambique.** LOURENÇO MARQUES PROV.: Moamba, ao km. 5 de Sábiè, 7 June 1948, *Torre 7968* (K, LISC). SUL DO SAVE PROV.: Guijá, 2 July 1947, *Pedro & Pedrógão 1206* (K, PRE, SRGH).

**Transvaal.** BELFAST DISTR.: Machadodorp, Schoemans Kloof, 5 Aug. 1933, *Pole Evans H30008* (K, PRE). LYDENBURG DISTR.: Sekukuniland, farm Driekop, 11 Nov. 1935, *Barnard 435* (PRE). NELSPRUIT DISTR.: Kruger National Park, 5½ miles

E. of Skukuza on Lower Sabie rd. 5 Feb. 1949, *Codd & de Winter 5030* (PRE). PIET RETIEF DISTR.: 1 mile N. of Pongola R. on rd. to Gollel, 23 Apr. 1967, *Ross 1702* (NH, NU). POTGIETERSRUST DISTR.: 41 km. from Zebediela on rd. to Olifants R. via Gompies, 5 Dec. 1946, *Story 1582* (PRE). WATERBERG DISTR.: 4 miles S. of Ellisras, 24 Feb. 1954, *Codd 8489* (K, PRE). ZOUTPANSBERG DISTR.: Weipe, 12.2 miles from Dongola Camp, 15 Mar. 1948, *Verdoorn 2263* (K, PRE). **Swaziland.** LUBOMBO DISTR.: Stegi, 31 Mar. 1963, *Compton 31571* (PRE). SHISELWENI DISTR.: Hluti-Gollel, 9 Dec. 1931, *Pole Evans 3393* (2) (K, PRE).

**Natal.** HLABISA DISTR.: Hluhluwe Game Reserve, 20 Apr. 1958, *Skead & Ward 17* (K, NH, NPGF, PRE). INGWAVUMA DISTR.: Ndumu Game Reserve, 9 Jan. 1954, *Ward 2022* (NH, NPGF, NU, PRE). LOWER TUGELA DISTR.: 3 miles S. of Mandini on old main rd., 21 Apr. 1963, *Ross 176* (NU). LOWER UMFOLOSI DISTR.: Umfolosi Game Reserve, W. area, 28 Mar. 1964, *Ross 910* (K, NU). NGOTSHE DISTR.: 1 ½ miles from turnoff to Jozinidam, 5 miles S. of Candover on Mkuze rd., 1 June 1963, *Ross 281* (K, NU). NKANDHLA DISTR.: Middledrift, 9 June 1956, *Edwards 1407* (K, NU, PRE). UBOMBO DISTR.: 1 mile S. of Mkuze on Nongoma rd., 11 Mar. 1964, *Edwards 3286* (K, PRE).

## GENERAL DISCUSSION

*A. senegal* is an extremely widespread and variable species that can sometimes only with difficulty be distinguished from a number of closely related species. In addition, the present delimitation of infraspecific categories within *A. senegal* is unsatisfactory since numerous specimens cannot be referred to any particular variety with certainty. The characters typifying each of the varieties are not necessarily correlated but appear as inconsistent tendencies so that intermediates possessing attributes of more than one variety are common. For example, some specimens of var. *senegal* have glabrous inflorescence axes as in var. *leiorhachis* and others pods with rostrate apices as in var. *rostrata,* whilst specimens of var. *leiorhachis* may have pubescent inflores-

cence axes as in the other varieties. Indeed, the difficulty is such that duplicates of the same specimen housed in different herbaria have occasionally been referred to different varieties by the same worker. In addition, the application of the name var. *kerensis* is not certain, whilst little is known of the identity of var. *pseudoglaucophylla.*

North east tropical Africa is an area of the utmost importance that must be investigated in any attempt to solve the many problems within *A. senegal* and those pertaining to the relationship of *A. senegal* to a number of closely related species. Regrettably this region is mostly poorly known floristically, some of the territories being represented in herbaria by only a few specimens. It seems desirable, in the absence of more precise information relating to the range of morphological variation within *A. senegal* in this region, to maintain the four varieties dealt with in this paper although this decision may ultimately have to be altered. Regrettably no decision can be reached regarding the identity of var. *pseudoglaucophylla.*

It is hoped that the accompanying key to the delimitation of infraspecific variants within *A. senegal,* which attempts to account for the most commonly encountered phenotypes, will be of assistance in identifying specimens.

## KEY TO INFRASPECIFIC VARIANTS

1. Inflorescence axes glabrous or subglabrous apart from basal pubescence . . . . . 2
   Inflorescence axes pubescent throughout . . . . . 3
2. Young branchlets purplish, smooth, glabrous or subglabrous; inflorescence axes purplish, often with yellow mottlings; flowers often produced before leaves or with young leaves . . . . . var. *leiorhachis*
   Young branchlets yellowish- to greyish-brown, sparingly to densely pubescent, inflorescence axes olive-green; flowers usually produced with mature leaves . . . . . var. *senegal*
   (for atypical specimens with glabrous inflorescence axes)

3. Young branchlets purplish, smooth, glabrous or subglabrous; inflorescence axes purplish, often with yellow mottlings; flowers often produced before leaves or with young leaves . . . . . var. *leiorhachis*
(for atypical specimens with sparingly pubescent inflorescence axes)
Young branchlets yellowish- to greyish-brown or appearing as though whitewashed over a purplish background, sparingly to densely pubescent; inflorescence axes usually olive-green, flowers produced with mature leaves . . 4
4. Shrub or bush . . . . . 5
Tree . . . . . 6
5 Brachlets typically smooth, flaking minutely, appearing as though whitewashed over a purplish background; leaves small with usually up to only 4 pinna pairs, apices of pods acute to acuminate or rostrate . . var. *kerensis*
Branchlets often corklike and exfoliating, yellowish- to greyish-brown, sometimes olive or even purplish, up to 12 pinna pairs although often as few as 4, apices of pods typically strongly beaked or rostrate . . . . . var. *rostrata*
6. Tree up to 13 m, branchlets yellowish- or greyish-brown, flaking minutely, up to 6 pinna pairs, apices of pods rounded to acute, seldom strongly beaked or rostrate . . . . . var. *senegal*
Tree up to 5 m, branchlets yellowish- to greyish-brown, sometimes olive or even purplish, often corklike and exfoliating, up to 12 pinna pairs although often as few as 4, apices of pods acute, acuminate, strongly beaked or rostrate . . . . . var. *rostrata*

## SUMMARY

The five varieties previously recognised within *Acacia senegal* (L.) Willd. were briefly discussed. Parameters for all measurable morphological characters revealed the presence of continuous variation within, and among, the Natal populations sampled. The relationship of *A. senegal* to several closely related species was discussed. Herbarium specimens

from the species range in Africa were examined and the nature of the morphological variation presented. As no specimens were available for examination no decision could be reached concerning the identity of var. *pseudoglaucophylla* Chiov. The four remaining varieties within *A. senegal* were maintained. A key to the identification of these varieties is given.

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# SOBRE A OCORRÊNCIA DO COMPLEXO *POLYPODIUM VULGARE* NOS AÇORES

*por*

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NAS ilhas dos Açores tem sido indicada a presença de *P. vulgare* L. (TRELEASE, Bot. Obs. Azores: 174, 1897; VALENTINE in Fl. Europaea, 1: 23, 1964); de *P. australe* Fée, quer considerado como espécie independente (VALENTINE, loc. cit.; PALHINHA, Cat. Pl. Vasc. Açores: 14, 1966), quer como variedade (var. *serratum* Willd.) de *P. vulgare* (SEUBERT, Fl. Azor.: 15, 1844; DROUET, Cat. Fl. Iles Açores: 130, 1866; MILDE, Fil. Eur.: 19, 1867); e de *P. macaronesicum* A. BOBROV (in Rev. Bot. URSS, 49, 4: 541, 1964), taxon que, na categoria de variedade (var. *Teneriffae* Fée ex Milde), fora anteriormente assinalado por MILDE (loc. cit.) para as nossas ilhas. Recentemente, o Prof. J. C. VASCONCELLOS (in Bol. Soc. Brot. sér. 2, 42: 159-160, 1968) referiu os exemplares dos Açores, arquivados em LISI, a um novo taxon que descreveu como subespécie (subsp. *azoricum)* de *P. vulgare*. O estudo destes espécimes, bem como o dos existentes em COI e LISU permitiu-nos verificar que todos os materiais dos Açores que se encontram nos herbários metropolitanos pertencem ao taxon descrito por VASCONCELLOS. É possível, todavia, que tanto *P. vulgare* como *P. australe* ou mesmo *P. macaronesicum* existam nessas nossas Ilhas. Mas só o exame de exemplares de outros herbários permitirá concluir se a indicação da ocorrência dessas três espécies se baseou ou não em falsas identificações.

De acordo com o nosso ponto de vista, porém, a entidade dos Açores descrita por VASCONCELLOS deve ser considerada

espécie independente. Atendendo a que a descrição desse autor é bastante sucinta, damos a seguir uma outra, ampliada.

**Polypodium azoricum** (Vasc.) R. Fernandes, stat. nov. *Polypodium vulgare* subsp. *azoricum* Vasc. in Bol. Soc. Brot. sér. 2, **42**: 159 (1968).

Descriptio clariss. J. C. VASCONCELLOS sic amplificanda: *Squamae* rhizomatis 6-13 mm longae, lanceolatae vel ovato-lanceolatae, longe subulatae, marginibus remote denticulato-spinulosae, tenues, fulvae vel fulvo-brunneae. *Petiolus* 2,3-24 (vel ultra?) cm longus. *Lamina* foliorum 5-27,3 × 6-18 (vel ultra?) cm, late triangularis vel ovato-triangularis, plerumque fere tam lata quam longa; segmenta generaliter satis lata (usque ad 20 mm), plerumque oblonga, basin versus ± constricta, in rachidem non vel paulo decurrentia, obtusa, raro paulo attenuata et ± acuta, marginibus obsolete usque distincte serrata vel crenata, contigua vel tegentia raro sinubus angustis disjuncta, rigida usque fere coriacea (in statu juvenili membranacea), sub angulo fere 90° raquide imposita, suprema abrupte minora; ramuli steriles secundariorum nervorum 3-5. *Sori* magni, ovales, maturitate tempore aurantiaci usque atrobrunnei, a margine segmentorum satis remoti. Variatio mediorum numeri cellularum sporangiorum annuli 11-16 (frequentia maxima 12).

A *P. vulgari* L. squamis rhizomatis majoribus, laminis foliorum pro ratione valde latioribus; segmentis latioribus; soris ovalibus; cellulis annuli sporangiorum latioribus praecipue differt.

A *P. australi* Fée denticulis marginis squamarum rhizomatis remotioribus et longioribus; laminis foliorum pro ratione latioribus; segmentis crassioribus, plerumque oblongis obtusisque neque longe attenuatis et acutis, saepissime contiguis neque sinubus ± latis disjunctis, cum latitudine maxima versus medianam partem neque ad basin, in raquidem non vel paulo decurrentibus; soris a margine segmentorum remotioribus; variatione mediorum numeri cellularum

sporangiorum annuli 11-16 (frequentia maxima 12) neque 7-15 (frequentia maxima 8) differt.

A *P. interjecto* Shivas squamis rhizomatis majoribus; laminis foliorum etiam latioribus, segmentis non attenuatis nec acutis sed plerumque oblongis obtusisque, saepissime contiguis neque distincte a sinubus ± latis disjunctis, mediis numeri cellularum sporangiorum annuli majoribus, etc. differt.

A *P. macaronesico* A. Bobrov forma laminae et segmentorum differt, sed praecipue squamis rhizomatis satis tenuioribus, fascia lata mediana atrofusca destitutis valde distinctum.

Icon. nostr.: Tab. I-III.

Os dados referentes aos exemplares que estudámos, com excepção de dois [1], nos quais as folhas ainda se não encontravam completamente desenvolvidas, constam do Quadro I, em que se seguiu a disposição empregada num trabalho anterior (cf. R. FERNANDES in Bol. Soc. Brot. sér. 2, 42: 80-83, 1968). O método aqui utilizado é também idêntico ao desse artigo. Os números relativos aos espécimes (1.ª coluna) são os das colecções particulares dos colectores, com excepção do de LISU, que indica o número da folha de herbário. Damos a seguir uma tabela com a variação dos caracteres analisados [2] e as respectivas médias, o que permite o seu confronto com a Tabela 13 do aludido trabalho (op. cit.: 128-129), na qual figuram os resultados que obtivemos relativamente a *P. australe, P. vulgare* e *P. interjectum*. Como o número de colheitas examinadas foi relativamente pequeno, acharam-se as médias respeitantes ao conjunto de todas as folhas, não se consi-

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[1] Esses dois espécimes são os seguintes: Angra do Heroísmo, 1878, *A. R. d'Abreu* s. n. (COI); S. Miguel, Giesta, freg. do Piso da Pedra, VIII-1950, *V. V. Freitas da Silva* s. n. (LISI). Nas folhas jovens, os segmentos, ainda membranáceos, têm a forma de um triângulo, que progressivamente se alonga. A forma oblonga e obtusa é alcançada quando a folha atinge as dimensões definitivas. Em *P. vulgare* e *P. australe* os segmentos começam também por ser triangulares.

[2] Para efeitos de medição, só foram consideradas folhas adultas.

derando isoladamente as folhas maiores e as menores, tendo-se medido também as dos duplicados de alguns espécimes (valores que não figuram no Quadro I, onde se registaram apenas as medidas da folha mais longa e da mais curta do total da colheita).

TABELA 1

| | |
|---|---|
| Variação do comprimento do limbo | 5-27,3 cm |
| Média do comprimento do limbo | 11,9 cm |
| Variação da largura do limbo | 6-18 cm |
| Média da largura do limbo | 10,5 cm |
| Variação do índice foliar [1] | 0,8-1,5 |
| Média do índice foliar | 1,1 |
| Variação do comprimento do pecíolo | 2,3-24 cm |
| Média do comprimento do pecíolo | 8,3 cm |
| Variação do índice peciolar | 0,6-2,6 |
| Média do índice peciolar | 1,7 |
| Variação das médias do número de células do anel [2] | 11-(12)16 |
| Média geral | 12,5 = 13 |

[1] Variação do índice foliar

| Valores | N.º de casos |
|---|---|
| 0,8 | 1 |
| 0,9 | 5 |
| 1,0 | 8 |
| 1,1 | 8 |
| 1,2 | 3 |
| 1,3 | 1 |
| 1,4 | 3 |
| 1,5 | 1 |

Faça-se a comparação entre estes resultados e os obtidos respectivamente para *P. vulgare*, *P. australe* e *P. interjectum* (cf. R. FERNANDES, op. cit.: 131, 143, 148).

[2] Variação da média do número de células do anel

| Valores | N.º de casos |
|---|---|
| 11 | 1 |
| 12 | 6 |
| 13 | 2 |
| 14 | 0 |
| 15 | 0 |
| 16 | 1 |

Confrontem-se estes valores com os referentes a *P. australe*, *P. vulgare* e *P. interjectum* (cf. R. FERNANDES, op. cit.: 118, 132, 149).

*P. azoricum* foi colhido desde 15 até 400 m. s. m., isto é, a altitudes pouco elevadas [1], mas, com excepção de um, os colectores não dão qualquer outra indicação sobre o habitat da planta. A época do aparecimento das folhas jovens parece ser o Verão. O começo da vegetação dá-se, portanto, mais cedo do que em *P. australe,* espécie na qual tem lugar em Outubro e Novembro, no continente português. Folhas adultas podem, por vezes, persistir sem murchar completamente durante o período estival.

Dos caracteres que permitem distinguir esta espécie, destaca-se, em primeiro lugar, a forma do limbo, o qual se apresenta em proporção bastante mais largo que em qualquer das suas afins, porquanto a largura, na maioria dos casos, iguala ou é pouco menor que o comprimento, havendo uma percentagem relativamente elevada de folhas mais largas do que compridas. Esta diferença é bem patente na fig. 1, em que se dá a correlação entre o comprimento do limbo e o índice foliar em *P. australe, P. azoricum* e *P. vulgare* [2]. Nela se vê que, para comprimentos de limbo iguais, *P. azoricum* apresenta, em regra, comparativamente às outras espécies, índices foliares mais baixos, sendo, portanto, a que possui folhas em proporção mais largas. A diferença relativamente a *P. vulgare* é tão acentuada que se não justifica de modo nenhum, em nosso entender, e considerando ainda outros caracteres, a inclusão da planta dos Açores em *P. vulgare,* como subespécie.

A forma dos segmentos mostra-se também muito característica: embora oblongos e obtusos, como sucede em *P. vulgare,* os segmentos são mais largos do que nesta espécie, visto poderem atingir 2 cm de largura, possuindo a margem crenada ou serrada, o que também se não verifica na última, e ou estão separados por sinus bastante estreitos

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[1] É possível que nos pontos mais altos das montanhas se encontre *P. vulgare,* espécie que, como se viu no trabalho anterior, em regiões de clima pouco frio habita, em regra, acima de 1000 m. s. m.

[2] *P. interjectum* não foi representado; os valores que lhe dizem respeito ficam compreendidos entre os de *P. australe* e os de *P. vulgare.*

ou contactam, sobrepondo-se mesmo em bastantes casos pelos bordos, em maior ou menor extensão.

O anel do esporângio pertence ao tipo «australe», sendo, pois, constituído por células largas, pouco abauladas, com as paredes espessadas de cor amarelo-dourada ou amarelo-clara, diferindo, no entanto, por começar mais perto do pedículo do que sucede em *P. australe*. Embora pelos caracteres das células do anel se aproxime desta espécie, afasta-se também dela pelo seu número mais elevado. Com efeito, não contámos nenhum anel com número de células inferior a 9, enquanto em *P. australe* encontrámos anéis com 4 e 5 células, sendo muito frequentes os de 7 e 9 e os mais frequentes os de 8 (cf. R. FERNANDES, op. cit.: 117-118). A média 12,5 é também mais elevada que a que obtivemos tanto em *P. australe* (8,9) como em *P. interjectum* (10,6), sendo pouco diferente da de *P. vulgare* (12,6). Todavia, o tipo do anel é completamente distinto do do último taxon.

No que se refere à presença de paráfises, não as conseguimos observar em espécimes que só possuiam folhas adultas. Todavia, nalguns com folhas jovens, notámos, na periferia dos soros em começo de desenvolvimento e por entre os esporângios exteriores, pequenas formações que se não distinguiam, nem quanto ao tamanho nem quanto à constituição, dos pêlos glandulares que se encontram disseminados na página inferior do limbo. Muito frágeis, devem destacar-se fàcilmente, pois não persistem nas folhas completamente desenvolvidas. A serem consideradas como paráfises, diferem das de *P. australe* pelas dimensões muito menores, maior delicadeza e maior caducidade. Para esclarecimento do problema da existência de paráfises nesta entidade, torna-se necessário, no entanto, estudar plantas vivas.

*P. azoricum* separa-se fàcilmente de *P. macaronesicum*, de que só vimos um exemplar (LISU, s. n., leg. *B. de Castelo de Paiva* [1]), pelas escamas do rizoma, as quais são

[1] Apesar do extremo do limbo foliar partido, o *If* deste exemplar é 1,8, superior ao máximo encontrado para *P. azoricum*; possui segmentos atenuados e muito agudos, com a maior largura (largura do segmento mais largo: 11 mm) na base, separados por sinus largos; a média do número de células do anel é 10; as esca-

QUADRO I

| Herbários | Local da colheita | Habitat | Altitude (m. s. m.) | Data da colheita | N.º de folhas | Estado dos soros | Caracteres dos segmentos | Dimensões de limbo | *If* | Compr. do pecíolo | *Ip* | Variação do n.º de cél. do anel e média | Determinação original |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1319 LISI | Ilha das Flores, Rocha dos Bordões | — | 250 | VIII 1963 | 1 f<br>1 j * | A | obl obt | 6,6 : 7<br>— | 0,9 | 2,5 | 2,6 | —<br>— | *Polypodium vulgare* var. *serratum* redet. *P. v.* ssp. *azoricum* |
| 19 LISI | Ilha das Flores, Santa Cruz | — | 150 | II 1963 | 2 f | B<br>D | obl obt<br>at obt | ? : 15<br>9,7 : 9,8 | —<br>1,0 | 11<br>9,5 | —<br>1,0 | 9(11)13<br>11,3<br>11 | *Polypodium vulgare* var. *serratum* redet. *P. v.* ssp. *azoricum* |
| 836 LISI | Ilha do Faial, Praia do Norte | — | 400 | I 1963 | 1 f | D | at ag | 16,5 : 15,5 | 1,1 | 9,3 | 1,8 | 11(12)14<br>12,1<br>12 | *Polypodium vulgare* var. *serratum* redet. *P. v.* ssp. *azoricum* |
| 99 LISI | Ilha do Faial, Horta | — | 120 | XI 1961 | 2 f | B | obl obt +<br>obl acut | ? : 11<br>? : 13 | ?<br>? | 13<br>14,5 | ?<br>? | —<br>— | *Polypodium vulgare* var. *serratum* redet. *P. v.* ssp. *azoricum* |
| 2086 LISI | Ilha do Faial, Horta | — | 15 | I 1968 | 15 f | C<br>D | obl obt<br>obl obt + ag | 6,2 : 7,2<br>17,6 : 15,4 | 0,9<br>1,1 | 3,2<br>10,4 | 1,9<br>1,7 | 11(12)16<br>12,7<br>13 | *Polypodium* . |
| 977 LISI | Ilha do Pico, Mistério de Santa Luzia | — | 120 | III 1963 | 1 f | D | obl obt | 21 : 14,7 | 1,4 | 21 | 1,0 | 10(11)17<br>12,2<br>12 | *Polypodium vulgare* var. *serratum* redet. *P. v.* ssp. *azoricum* |
| 43725 LISU | Ilha Graciosa, Caldeira | — | — | V 1937 | 2 f | D | obl obt | 5 : 6<br>6,6 : 7 | 0,8<br>0,9 | 3<br>3 | 1,7<br>0,9 | 10(12)14<br>11,7<br>12 | *Polypodium vulgare* |
| 601A COI | Ilha de S. Jorge | — | — | VII 1903 | 2 f | D | obl obt +<br>obl acut | 13,5 : 10<br>14,5 : 10,2 | 1,4<br>1,4 | 12<br>24 | 1,1<br>0,6 | 11(12)15<br>12,9<br>13 | *Polypodium vulgare* |
| 89 COI | Ilha Terceira, S. Mateus | Muros, sítios sombrios, mas secos | — | VIII 1966 | 3 f<br>7 j | A<br>D | obl obt | 13 : 11<br>13,5 : 12 | 1,2<br>1,1 | 6,5<br>5,5 | 2<br>2,5 | 12-22<br>15,6<br>16 | — |
| s. n. COI | Ilha de S. Miguel | — | — | — | 1 f | D | obl obt | 11,7 : 9 | 1,3 | 7,7 | 1,5 | 10(12)15<br>11,9<br>12 | *Polypodium vulgare* |
| 600 COI | Ilha de S. Miguel, Abelheira | — | — | III 1898 | 1 f | C | obl ag | 12: 11,6 | 1,0 | 10,2 | 1,2 | 8(11)14<br>11,5<br>12 | *Polypodium vulgare* |
| 2108 LISI | Ilha de Santa Maria, Vila do Porto | — | 400 | I 1968 | 7 f<br>2 st<br>1 j | A a<br>D | obl obt<br>obl obt + ag | 27,3 : 18<br>6 : 6 | 1,5<br>1 | —<br>2,3 | 2,6 | 11(12)17<br>12,3<br>12 | *Polypodium vulgare* ssp. *azoricum* |

* Por j designamos aqui as folhas jovens.

destituídas da larga faixa escura existente nas deste taxon, sendo também muito menos espessas; pela forma do limbo e dos segmentos; etc.

Há em LISE um espécime (folhas de herbário 8542 e 10135 p. p.), proveniente de um herbário anónimo e sem qualquer indicação, que consta de três folhas, as quais, pelos caracteres destas e dos soros, nos parece pertencer a *P. azoricum* (a folha maior deste exemplar mede 27 × 20,4 cm; *If* das três folhas: 1,2-1,3-1,4; média do número de células do anel: 14).

No herbário de WILLKOMM (COI) encontra-se o exemplar *Bourgeau* 1559, das Ilhas Canárias, que se aproxima muito de *P. azoricum* (escamas do rizoma idênticas às de *P. azoricum*; segmentos até 16 mm de largura; soros muito grandes, bastante afastados da margem; média do número das células do anel 10). Como a extremidade dos segmentos basilares está quebrada, não se pode calcular o *If*, o que não nos permite concluir pela existência dessa espécie nas Ilhas Canárias.

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mas do rizoma apresentam os caracteres que A. BOBROV indica para *P. macaronesicum* e que se notam muito bem na fig. 7 da Tab. II do trabalho desse autor. Neste espécime observámos paráfises longas e ramificadas, mas mais ténues que as de *P. australe*.

O espécime de LISU assemelha-se, quer pelo tamanho (24,5 × × 14 cm) e contorno do limbo, quer pela forma dos segmentos, ao espécime 2 do n.º 19657 do herbário de WILLDENOW, referido e figurado no nosso trabalho anterior (op. cit.: 138, Tab. V).

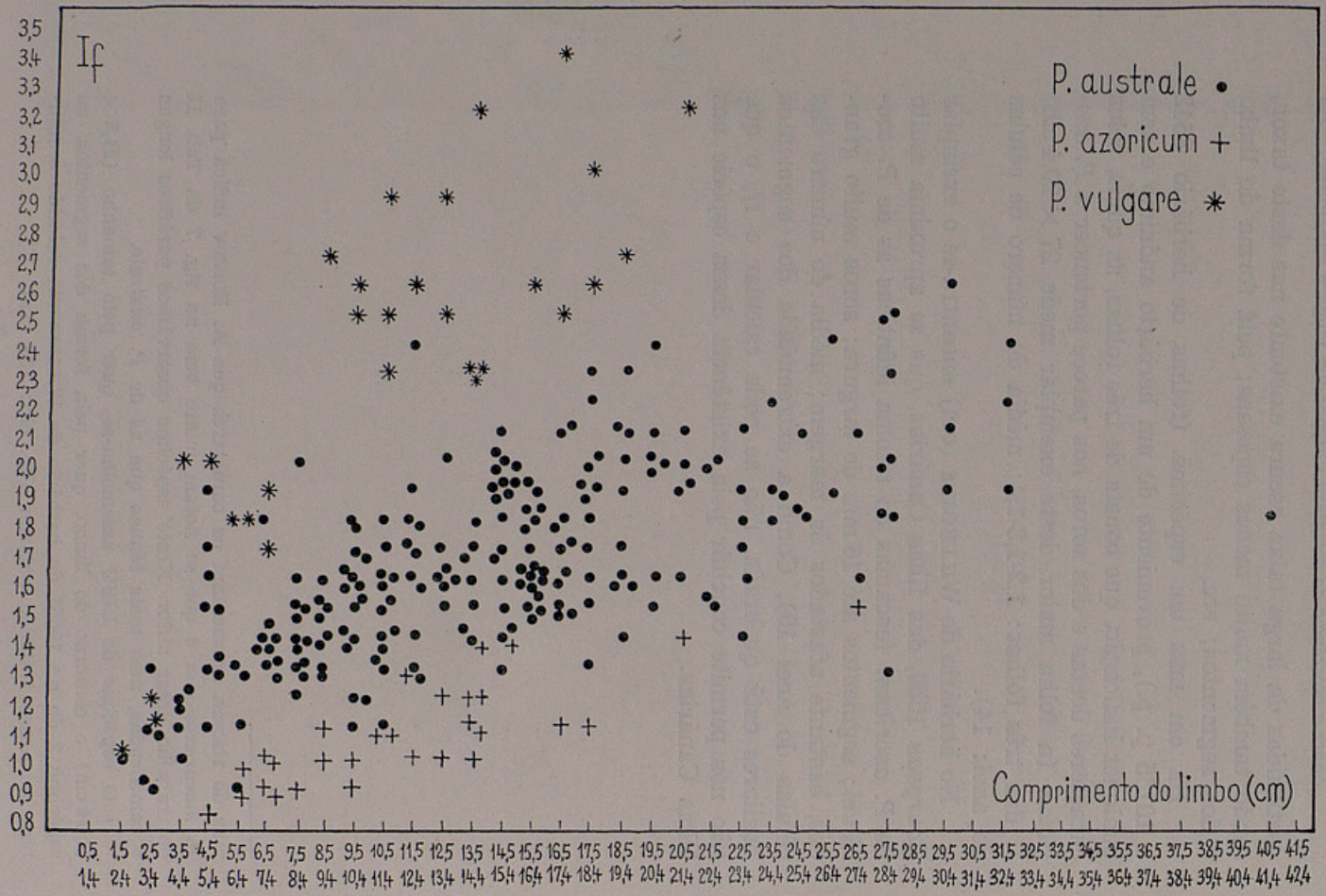
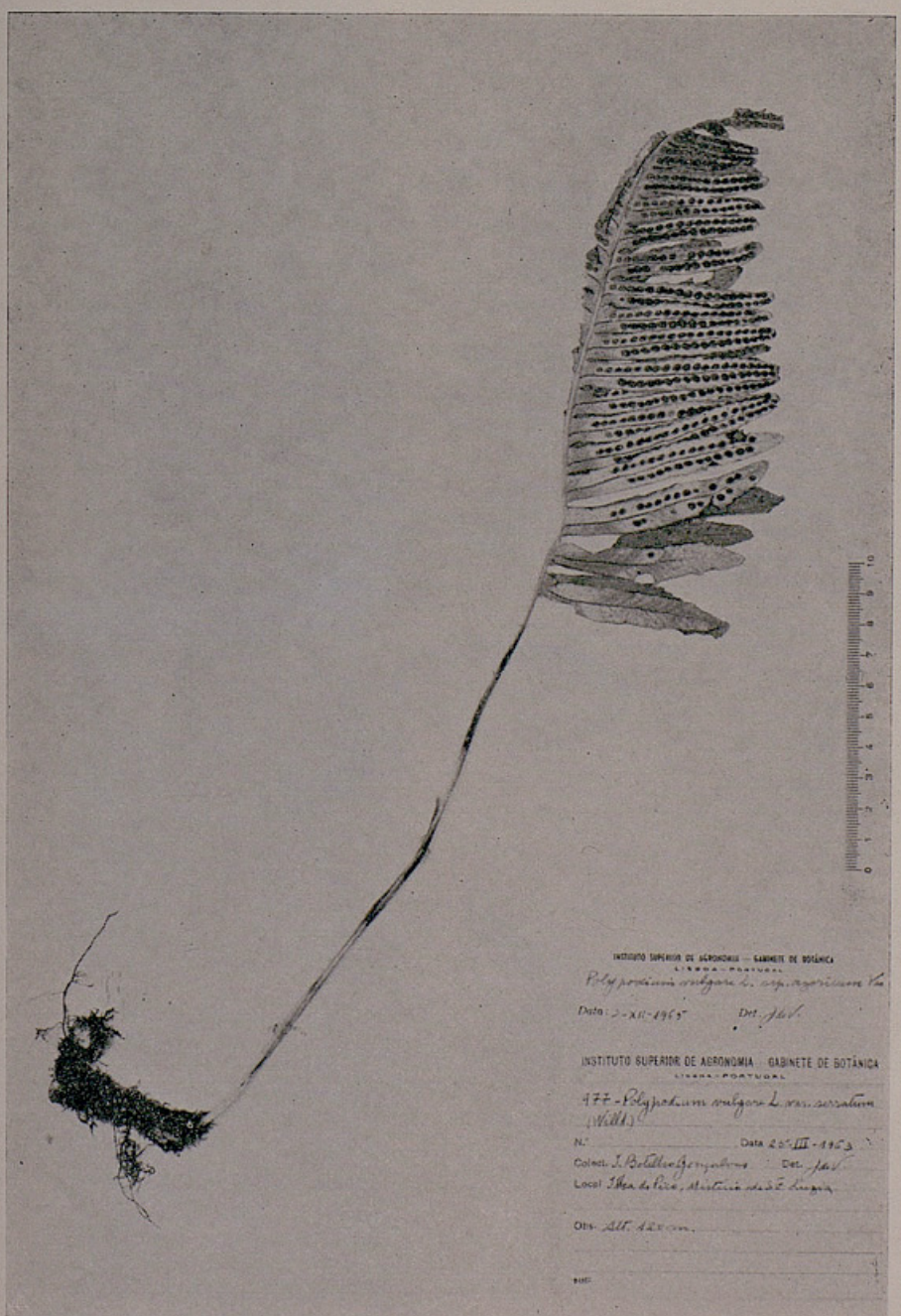
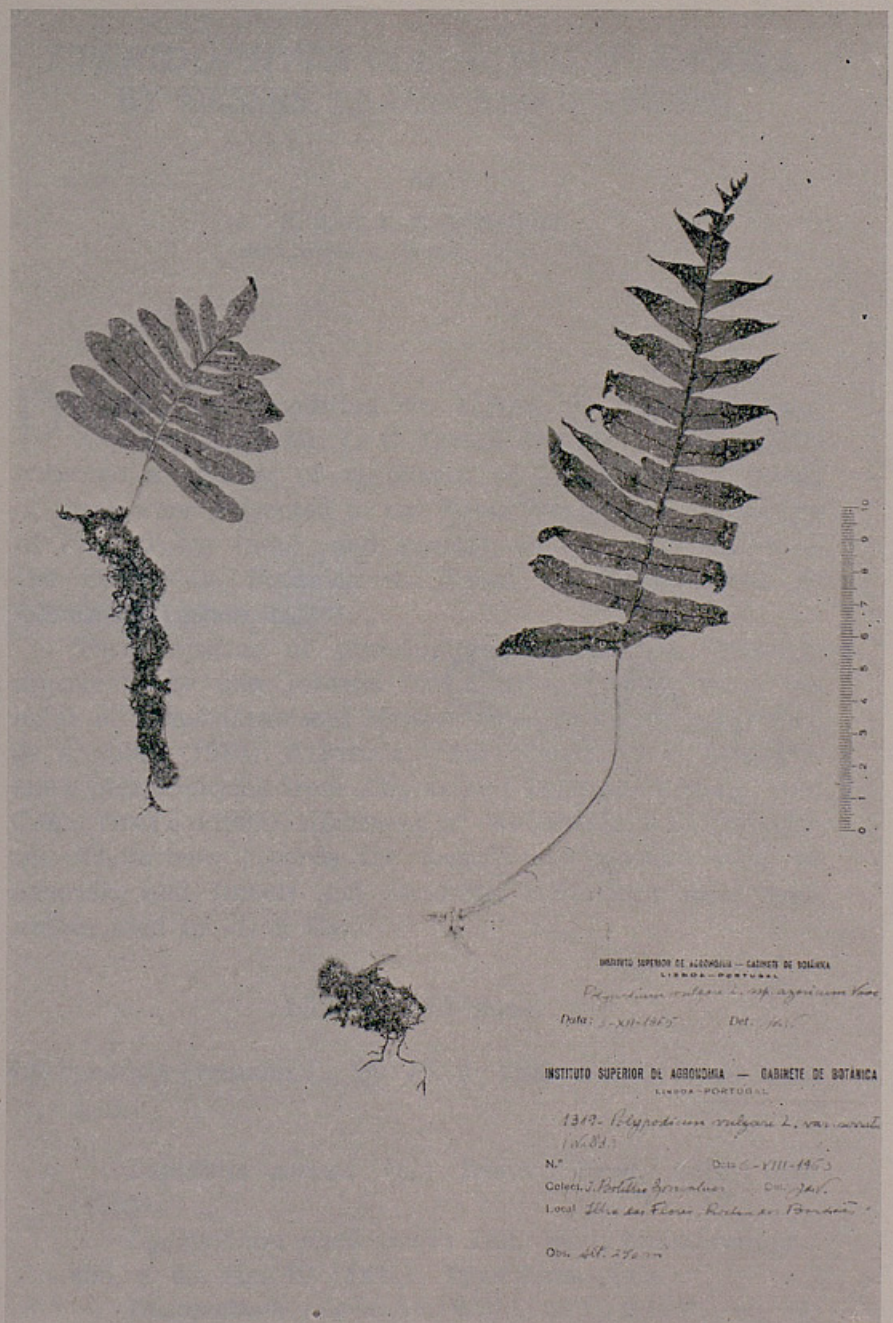



Fig. 1. — Relação entre o comprimento do limbo e o índice foliar em *P. australe*, *P. azoricum* e *P. vulgare*.




**Polypodium azoricum** (Vasc.) R. Fernandes
Espécime *Botelho Gonçalves* 977 (LISI).

**Polypodium azoricum** (Vasc.) R. Fernandes
Espécime *Ormonde* 89 (COI), constituído por uma folha adulta, outra (à direita) quase completamente desenvolvida e quatro muito jovens.




**Polypodium azoricum** (Vasc.) R. Fernandes
Espécime *Botelho Gonçalves* 1319 (LISI); à esquerda, uma folha adulta; à direita, uma jovem.

# *PTERIDOPHYTA* COLLECTED IN ANGOLA BY MESSRS. LEACH AND CANNELL

*by*

**E. A. C. L. E. SCHELPE**

Bolus Herbarium, University of Cape Town

DURING an expedition to Angola in September and October, 1967, Mr. L. C. LEACH and Mr. I. C. CANNELL collected a number of specimens of pteridophytes. A set of these were presented to the Bolus Herbarium, University of Cape Town (BOL), and another set has been given to the Centro de Botânica da Junta de Investigações do Ultramar, Lisbon (LISC).

Three species of pteridophytes from this collection appear to be new records for Angola, judging from the index of GOSSWEILER and MENDONÇA's «Carta fitogeográfica de Angola» (1939), ALSTON's (1934) treatment of GOSSWEILER's pteridophytes from Angola and Portuguese Congo and CARRUTHER's (1901) treatment of WELWITSCH's pteridophytes. These new records for Angola are marked with an asterisk, and LEACH and CANNELL collections have been abbreviated to «L & C».

## LYCOPODIACEAE

**Lycopodium cernuum** L., Sp. Pl. 2: 1103 (1753). Type from Asia.

*Lepidotis cernua* (L.) Beauv., Prod. Aeth.: 101 (1805).

*Lycopodium fruticescens* Dill., Hist. Musc. reimpr.: 456, t. 63, fig. 10 (1811). Type from Asia.

*Lycopodium marianum* Willd. in L. Sp. Pl., ed. iv, 5: 31 (1810). Type from Philippine Is.

*Lycopodium boryanum* A. Rich., Sert. Astrol.: 42 (1834). Type from Mascarene Is.

*Lycopodium heeschii* K. Muell. in Bot. Zeit. 19: 164 (1861). Type from Sierra Leone.

*Lycopodium hupeanum* K. Muell. in Bot. Zeit., 19: 165 (1861). Type from Borneo.

*Lycopodium secundum* K. Muell. in Bot. Zeit., 19: 164 (1861). Type from South Africa.

*Lycopodium sikkimense* K. Muell. in Bot. Zeit., 19: 164 (1861). Type from Sikkim Himalaya.

BIÉ: S. of Chimbango Hill, Chinguar, in wet dambo grassland with *Raphia* and relic swamp woodland, 13.viii. 1967, L & C 13878.

## SELAGINELLACEAE

**Selaginella dregei** (Presl) Hieron. in Hedwigia 39: 315 (1900).

*Lycopodium dregei* Presl, Bot. Bemerk.: 153 (1845) et in Abh. Böhm. Ges. Wiss., ser. 5: 583 (1845). Type from South Africa.

*Selaginella rupestris* Spreng. forma *dregei* (Presl) Milde, Fil. Europ. et Atlant.: 262 (1867).

*Selaginella rupestris* Spreng. var. *recurva* A. Br. ex Kuhn forma *dregei* (Presl) A. Br. ex Kuhn, Fil. Afr.: 214 (1868) ex err. «*dregeana*».

*Selaginella dregei* (Presl) Hieron. var. *bachmanniana* Hieron. in Hedwigia 39: 317 (1900). Type from South Africa.

*Selaginella dregei* (Presl) Hieron. var. *pretoriensis* Hieron. in Hedwigia 39: 317 (1900). Type from South Africa.

*Selaginella dregei* (Presl) Hieron. var. *rehmanniana* Hieron. in Hedwigia 39: 317 (1900). Type from South Africa.

*Selaginella dregei* (Presl) Hieron. var. *welwitschiana* Hieron. in Hedwigia 39: 318 (1900). Type from Angola, Pungo Andongo, *Welwitsch* 48, 39. (BM!).

CUANDO-CUBANGO: cliffs of Cuchi R. gorge, c. 5 mls. N. of Cuchi, on rock, 10.vii.1967, L & C 13852.

## SCHIZAEACEAE

**Anemia angolensis** Alston in Estud. Ens. Document. 12: 9, t. 2, fig. 3a (1954). Type from Angola, Huila, Morro de Monhino, *Welwitsch* 164 (BM!).

*Anemia schimperiana* Presl var. *angustiloba* Bonap., Not. Pterid. 1: 133 (1915). Type from Lake Tanganyika.

*Hemianemia schimperiana* (Presl) Prantl var. *angustiloba* (Bonap.) Reed in Bol. Soc. Bot., sér. 2, 21: 162 (1948).

*Anemia simii* Tard. var. *angustiloba* (Bonap.) Pic. Serm. in Webbia 9: 654 (1954).

CUANDO-CUBANGO: Cuchi R., c. 5 mils. N. of Cuchi, on rocky sides of gorge, 10.viii.1967, L & C 13853a.

## ADIANTACEAE

* **Adiantum schweinfurthii** Bak., Diagn. Fil. Nov. Socotr.: 1 (1882). Type from Socotra.

*Adiantum chevalieri* Christ in Bull. Soc. Bot. France 55, Mém. B: 105 (1908). Type from French Sudan.

HUAMBO: just E. of Lépi, on dry streambank on wooded hillside, 15.viii.1967, L & C 13892.

*A. schweinfurthii* has previously only been recorded from French Sudan, Guinée, Togo, Nigeria, Ubangi Shari, the Sudan and Socotora, and this record from near Lépi (12° 51′ S; 15° 20′ E) constitutes a considerable southward extension of its known distribution range.

**Adiantum capillus-veneris** L., Sp. Pl. 2: 1096 (1753). Lectotype from S. Europe.

*Adiantum coriandrifolium* Lam., Fl. Franç. 1: 29 (1778). nom. illegit.

*Adiantum capillus* Sw. in Schrad. Journ. 1800 (2): 83 (1801). Type from? Europe.

*Adiantum africanum* R. Br. in Tuckey, Narrat. Exped. Zaire, App. 5: 463 (1818). nom. nud.

*Adiantum marginatum* Schrad. in Gött. Gel. Anz. 1818: 918 (1818). Type from South Africa.

*Adiantum pseudocapillus* Fée, Mém. Fam. Foug. 5: 118 (1852): Mém. Fam. Foug. 7: 29, t. 1 (1857). Type from South Africa.

*Adiantum capillaceum* Dulac, Fl. Hautes-Pyrenées: 36 (1867). Type from S. Europe.

*Adiantum paradiseae* Bak. in Gard. Chron., ser. 3, 6: 558 (1889). Type from South Africa.

HUILA: escarpment above Bruco (W. of Tchivinguiro), on wet earthbank in heavy shade, 7.ix.1967, L & C 14005.

**Pteris vittata** L., Sp. Pl. 2: 1074 (1753). Type from China.

*Pycnodoria vittata* (L.) Small, Ferns S. States: 102, 48 (1938).

*Polypodium trapezoides* Burm., Fl. Ind.: t. 66, fig. 2 (1768). Type from Java.

*Pteris obliqua* Forsk., Fl. Aegypt.-Arab.: 185 (1775). Type from Yemen.

*Pteris lanceolata* Desf., Fl. Atlant. 2: 401 (1800). Type from Algeria.

*Pteris ensifolia* Poir., Encycl. Méth. Bot. 5: 711 (1804). Type from Spain.

*Pteris diversifolia* Sw., Syn. Fil.: 96, 288 (1806), nom. illegit. Type from Java.

*Pteris costata* Bory ex Willd. in L., Sp. Pl., ed. iv., 5: 367 (1810). Type, Mauritius, *Bory de St. Vincent* in Herb. Willd. No. 19970 (B!).

*Pteris inaequilateralis* Poir., Encycl. Méth. Bot. Suppl. 4: 601 (1816). Type from Réunion.

*Pteris aequalis* Presl, Reliq. Haenk.: 54 (1827). Type probably from Phillippine Is.

*Pteris alpinii* Desv. in Mém. Soc. Linn. Par. 6: 295 (1827). Type from the Orient.

*Pteris acuminatissima* Bl., Enum. Pl. Javae 2: 208 (1828). Type from Java.

*Pteris microdonta* Gaudich. in Freyc., Voy., Bot.: 387 (1829). Type from Timor.

*Pteris guichenotiana* Gaudich. in Freyc., Voy., Bot.: 387 (1829). Type from Timor.

*Pteris tenuifolia* Brack., U. S. Expl. Exped. 16: 112 (1854). Type from Tonga Is.

*Pteris vulcanica* Bertol., Misc. Bot. 18: (1858). Type from Italy.

HUILA: escarpment above Bruco (W. of Tchivinguiro), on streambank, 7.ix.1967, L & C 14014.

**Pteris cretica** L., Mantissa Pl.: 130 (1767). Type from? Italy.

*Pteris semiserrata* Forsk., Fl. Aegypt.-Arab.: 186 (1775). Type from Yemen.

*Pteris nervosa* Thunb., Fl. Jap.: 332 (1784). Type from Japan.

*Pteris serraria* Sw. in Schrad. Journ. 1800 (2): 65 (1801). Type from South Africa.

*Pteris pentaphylla* Willd. in L., Sp. Pl. ed. iv., 5: 362 (1810). Type from Réunion.

HUILA: escarpment above Bruco (W. of Tchivinguiro), on shady earthbank, 7.ix.1967, L & C 14014a.

**Doryopteris concolor** (Langsd. & Fisch) Kuhn. var. **kirkii** (Hook.) Fries, Wiss. Ergebn. Schwed. Rhod.-Kongo Exped. 1: 4 (1914).

*Cheilanthes kirkii* Hook., Sec. Cent. Ferns: t. 81 (1861). Type from Moçambique.

*Doryopteris kirkii* (Hook.) Alston in Bol. Soc. Brot., sér. 2, 30: 14 (1956).

HUILA: escarpment above Bruco (W. of Tchivinguiro), on earthbank, 7.ix.1967, L & C 14011.

**Cheilanthes welwitschii** Hook. ex Bak., Syn. Fil.: 142 (1867). Lectotype from Angola, Pungo Andongo, *Welwitsch* 148 (K!).

*Aleuritopteris welwitschii* (Hook. ex Bak.) Ching in Hong Kong Nat. 10: 202 (1941).

HUAMBO: just W. of Lépi, crevices on bald granite hills, 15.viii.1967, L & C 13885.

In some respects this collection is intermediate between typical *C. welwitschii* and *C. mossambicensis* Schelpe known from southern Tanganyika, northern Moçambique and Rhodesia. It exhibits the orange coloured farina of *C. mossambicensis* and the tufted narrowly oblong fronds of typical *C. welwitschii*. The pinnae are mostly 6-jugate, which is intermediate between the two species.

* **Cheilanthes multifida** (Sw.) Sw., Syn. Fil.: 129, 334 (1806).

*Adiantum multifidum* Sw. in Schrad. Journ. 1800 (2): 85 (1801). Type from South Africa.

*Adiantum globatum* Poir., Encycl. Méth. Bot., Suppl. 1: 144 (1810). Type from South Africa.

*Cheilanthes bolusii* Bak. in Hook., Ic. Pl.: t. 1636 (1886). Type from South Africa.

BIÉ: Chimbango Hill, Chinguar, in heavy shade under S facing rock, 13.viii.1967, L & C 13871.

HUAMBO: just W. of Lépi, on granite hills, 15.viii.1967, L & C 13886, 13887.

**Cheilanthes inaequalis** (Kunze) Mett. in Abhandl. Senckenb. Nat. Ges. 3: 68, t. 3, fig. 4 (1859); reimpr. in Mett., Farngatt., Cheil.: 24 t. 3, fig. 4 (1859).

*Notholaena inaequalis* Kunze, Farnkr. 1: 146, t. 64, fig. 1 (1844). Type from South Africa.

*Notholaena tricholepis* Bak. in Journ. of Bot. 21: 245 (1883). Type from Tanganyika.

BIÉ: Chimbango Hill, Chinguar, under S. facing rock, (juveniles) 13.viii.1967, L & C 13869; Chimbango Hill, among rocks in shallow soil, 13.viii.1967, L & C 13872.

CUANDO-CUBANGO: Cuchi R. gorge, c. 5 mls. N. of Cuchi, on cliffs, 10.viii.1967, L & C 13853.

HUAMBO: just W. of Lépi, on granite hills, 15.viii.1967, L & C 13888.

HUILA: Humpata, on rocky outcrop, 6.ix.1967, L & C 14004.

***Pellaea doniana** J. Sm. ex Hook., Sp. Fil. 2: 137, t. 125, fig. A (1858). Type from São Tomé.

*Pteris doniana* (J. Sm. ex Hook.) Kuhn, Fil. Afr.: 80 (1868).

*Pteridella doniana* (J. Sm. ex Hook.) Kuhn, v. Deck. Reisen, Bot., 3, 3: 13 (1879).

*Allosurus doniana* (J. Sm. ex Hook.) Kuntze, Rev. Gen. Pl. 2: 806 (1891).

HUAMBO: just E. of Lépi, on shady streambank on wooded hillside, 15.viii.1967, L & C 13894.

HUILA: escarpment above Bruco (W. of Tchivinguiro), on earthbank, 7.ix.1967, L & C 14013.

**Pellaea calomelanos** (Sw.) Link, Fil. Sp. Hort. Berol.: 51 (1841).

*Pteris calomelanos* Sw. in Schrad. Journ. Bot. 1800 (2): 70 (1801). Type from South Africa.

*Allosorus calomelanos* (Sw.) Presl, Tent. Pterid.: 153 (1836).

*Platyloma calomelanos* (Sw.) J. Sm. in Curtis Bot. Mag. 72. Comp.: 21 (1846).

*Notholaena calomelanos* (Sw.) Keys., Pol. Cyath. Herb. Bung.: 29 (1873).

HUILA: Humpata, on rocky outcrop, 6.ix.1967, L & C 14004: high rocks above Nheme R., c. 27 mls. S. E. of Sá da Bandeira, 8.ix.1967, L & C 14020.

* **Pellaea viridis** (Forsk.) Prantl var. **glauca** (Sim) Sim, Ferns S. Afr.: 209, t. 97-98 (1915).

*Pellaea hastata* var. *glauca* Sim, Kaffrarian Ferns: 30, t. 19 (1891). Type from South Africa.

HUILA: escarpment above Bruco (W. of Tchivinguiro), on earthbank, 7.ix.1967, L & C 14010a.

## POLYPODIACEAE

**Pyrrosia schimperiana** (Mett. ex Kuhn) Alston var. **mechowii** (Hieron.) Schelpe in Journ. S. Afr. Bot. 18: 129 (1952).

*Cyclophorus mechowii* Hieron. in Bot. Jahrb. 46: 395 (1911). Type from Cameroons.

*Pyrrosia mechowii* (Hieron.) Alston in Estud. Ens. Document. 12: 37 (1955).

CUANZA-SUL: Plantation c. 9 mls. W. of Gabela, on rocks, 23.viii.1967, L & C 13948.

**Microsorium punctatum** (L.) Copel. in Univ. Calif. Publ. Bot. 16: 111 (1929).

*Acrostichum punctatum* L., Sp. Pl., ed. ii, 2: 1524 (1763). Type probably from China.

*Polypodium punctatum* (L.) Sw. in Schrad. Journ., 1800 (2): 21 (1801) non Thunb. (1784).

*Pleopeltis punctata* (L.) Bedd., Ferns Brit. India: 22 (1876).

*Polypodium polycarpon* Cav. ex Sw. in Schrad. Journ. 1800 (2): 21 (1801). — Cav., Descr.: 246 (1802). Type from? Philippine Is.

*Niphobolus polycarpus* (Cav. ex Sw.) Spreng. in L., Syst. Veg., ed. xvi, 4: 45 (1827).

*Phymatodes polycarpa* (Cav. ex Sw.) Presl, Tent. Pterid.: 198, t. 8, fig. 19 (1836).

*Drynaria polycarpa* (Cav. ex Sw.) Brack., U. S. Expl. Exped. 16: 44 (1854).

*Pleopeltis polycarpa* (Cav. ex Sw.) Moore, Index: 78 (1857).

*Microsorium polycarpon* (Cav. ex Sw.) Tardieu in Humbert, Fl. Madag., Polypod. 2: 114 (1960).

*Polypodium irioides* Poir., Encycl. Méth. Bot. 5: 513 (1804). Type from Mauritius.

*Phymatodes irioides* (Poir.) Presl, Tent. Pterid.: 198 (1836).

*Drynaria irioides* (Poir.) J. Sm. in Journ. of Bot. 3: 398 (1841).

*Microsorium irioides* (Poir.) Fée, Mém. Fam. Foug. 5: 268 (1852).

*Pleopeltis irioides* (Poir.) Moore, Index: 78 (1857).

*Colysis irioides* (Poir.) J. Sm., Hist. Fil.: 101 (1875) err. «erioides».

*Polypodium lingulatum* Sw., Syn. Fil.: 30 (1806), nom. illegit.

*Polypodium crassinerve* Schumach. in Kongl. Dansk Vid. Selsk. Afh. 4: 227 (1829) non Blume (1828). Type from W. Africa.

*Microsorium irregulare* Link, Hort. Berol. 2: 110 (1833). Type cult. in Berlin, of unknown origin.

*Polypodium altum* Bojer, Hort. Maurit.: 417 (1837). Type from Mauritius.

*Polypodium sessile* Kaulf., nom. nud. in schedis.

*Phymatodes sessilis* Presl., Tent. Pterid.: 198 (1836) nom. nud.

*Microsorium sessile* Fée, Mém. Fam. Foug. 5: 268 (1852).

*Pleopeltis sessilis* Moore, Index: 78 (1857).

CUANZA-SUL: plantation c. 11 mls. W. of Gabela, epiphyte on oil palm, 23.viii.1967, L & C 13946.

## DAVALLIACEAE

**Arthropteris orientalis** (Gmel.) Posth. in Rec. Trav. Bot. Néerl. 21: 218 (1924).

*Polypodium orientale* Gmel. in L., Syst. Nat., ed xiii, 2: 1312 (1791). Type from Yemen.

*Dryopteris orientalis* (Gmel.) C. Chr., Ind. Fil.: 281 (1905).

*Polypodium pectinatum* Forsk., Fl. Aegypt.-Arab.: 185 (1775) non L. (1753). Type from Yemen.

*Aspidium albopunctatum* Bory ex Willd. in L., Sp. Pl., ed. iv, 5: 242 (1810). Type from Mauritius.

*Nephrodium albopunctatum* (Bory ex Willd.) Desv. in Mém. Soc. Linn. Par., 6: 255 (1827).

*Aspidium thonningii* Schumach, in Kongl. Dansk Vid. Seldk., Nat. & Math. Afh., 4: 229 (1829). Type from West Africa.

*Aspidium leucosticton* Kunze in Linnaea, 23: 227, 301 (1850). Type from Sierra Leone.

Bié: Chimbango Hill, Chinguar, among rocks, 13.viii. 1967, L & C 13873, 13874.

**Oleandra distenta** Kunze var. **welwitschii** (Bak. in Hook. & Bak.) Schelpe comb. nov.

*Oleandra articulata* var. *welwitschii* Bak. in Hook. & Bak., Syn. Fil.: 303 (1867) err. «welwitzchii» — basionym.

*Oleandra welwitschii* (Bak. in Hook. & Bak.) Pic. Serm. in Webbia 20: 764 (1965).

Bié: Chimbango Hill, Chinguar, in scanty humus in crack in vertical rock face and a N. facing ledge in full sun, 13.viii.1967, L & C 13876.

The small mat of rhizomes on this specimen mostly exhibits the squarrose scales regarded as characteristic for this taxon by Pichi Sermolli (1965). However, one rootless section of rhizome has clearly appressed scales, as is also the case with long pieces of sparsely rooted rhizome from the same locality. Consequently it seems from the material in hand that the squarrose disposition of rhizome scales is only developed on the branched parts of the rhizome and that this character is not of sufficient constancy to separate the Angolan plants as a distinct species.

## ASPLENIACEAE

**Asplenium aethiopicum** (Burm.) Becherer in Candollea 6: 22 (1935).

*Trichomanes aethiopicum* Burm., Fl. Cap. Prod., in Fl. Ind.: 28 (1768). Type from S. Africa.

*Asplenium adiantoides* Lam., Encycl. Méth. Bot., 2: (1786). Type from Cape Province.

*Asplenium furcatum* Thunb., Prod. Pl. Cap.: 172 (1800). Type from Cape Province.

*Tarachia furcata* (Thunb.) Presl, Epim. Bot.: 80 (1849).

*Asplenium falsum* Retz., Observ. Bot. 6: 38 (1791). Type from Cape Province.

*Asplenium gueinzianum* Mett. ex Kuhn, Fil. Afr.: 103 (1868). Type from Natal (abnormal frond).

HUILA: escarpment above Bruco (W. of Tchivinguiro), on earthbank, 7.ix.1967, L & C 14010.

ALSTON (1934) referred GOSSWEILER's Angolan specimens of this species to *A. filare* (Forsk.) Alston, based on *Acrostichum filare* Forsk., from the Yemen. The LEACH and CANNELL specimen at hand is not separable from the southern African representatives of this complex whereas the Yemen plants might be separable at the varietal or subspecific level.

## THELYPTERIDACEAE

**Thelypteris confluens** (Thunb.) Morton in Contrib. U. S. Nat. Herb. 38 (2): 71 (1967).

*Pteris confluens* Thunb., Prodr. Pl. Cap.: 171 (1800). Type from S. Africa.

*Aspidium thelypteris* (L.) Sw. var. *squamigerum* Schlechtend. Adumbr.: 23, t. 11 (1825). Type from S. Africa.

*Aspidium squamigerum* (Schlechtend.) Fée, Mém. Fam. Foug. 8: 104 (1857).

*Lastrea thelypteris* (L.) Bory var. *squamigerum* (Schlechtend.) Bedd., Handb. Ferns Brit. India, Suppl.: 54 (1892).

*Lastrea squamulosa* Presl, Tent. Pterid.: 76 (1836) nom. nud.

*Nephrodium squamulosum* Hook. f., Fl. N. Zeal. 2: 39 (1855).

*Thelypteris squamulosa* (Hook. f.) Ching in Bull. Fan. Mem. Inst. Biol. Bot. 6: 5, 329 (1936).

BIÉ: S. of Chimbanga Hill, Chinguar, in shade of relict swamp woodland, 13.viii.1967, L & C 13880.

**Thelypteris dentata** (Forsk.) E. St. John in Amer. Fern Journ. 26: 44 (1936).

*Polypodium dentatum* Forsk., Fl. Aegypt.-Arab.: 185 (1775). Type from Yemen.

*Dryopteris dentata* (Forsk.) C. Chr. in Vid. Selsk. Skr., Afd. 8, 6: 24 (1920).

*Cyclosorus dentatus* (Forsk.) Ching in Bull. Fan Mem. Inst. Biol. Bot. 8: 206 (1938).

*Aspidium natalense* Fée, Mém. Fam. Foug., 8: 102 (1857). Type from South Africa.

*Nephrodium hispidulum* A. Peter in Fedde, Rep. Sp. Nov., Beih., 40: 58, t. 4, figs. 1-2 (1929). Type from Rhodesia.

CUANZA-NORTE: near Quissiculo, c. 10 mls. W. of Salazar, on S. facing earthbank, 29.viii.1967, L & C 13968.

CUANZA-SUL: c. 6 mls. W. of Gungo, on earthbank in oil palm plantation, 21.viii.1967, L & C 13930.

HUAMBO: c. 1 ml. E. from Lépi, on dry earthbank above stream, L & C 13891.

HUILA: escarpment above Bruco (W. of Tchivinguiro), on stream side earthbank, 7.ix.1967, L & C 14012a.

* **Thelypteris chaseana** Schelpe in Journ. S. Afr. Bot. 31: 264, t. 1 fig. f (1965). Type from South West Africa.

HUILA: escarpment above Bruco (W. of Tchivinguiro), streamside earthbank, 7.ix.1967, L & C 14012.

## LOMARIOPSIDACEAE

**Elaphoglossum welwitschii** (Bak.) C. Chr., Ind. Fil.: 318 (1905).

*Acrostichum welwitschii* Bak., Syn. Fil.: 521 (1874). Type from Angola, *Welwitsch* 187 (K!).

HUAMBO: just E. of Lépi, on shady streambank on well wooded hillside, 15.viii.1967, L & C 13893.

## ASPIDIACEAE

**Dryopteris athamantica** (Kunze) O. Kuntze, Rev. Gen. Pl. 2: 812 (1891).

*Aspidium athamanticum* Kunze in Linnaea 18: 123 (1844). Type from S. Africa.

*Lastrea athamantica* (Kunze) Moore in Journ. of Bot. 5: 31 (853).

*Nephrodium athamanticum* (Kunze) Hook., Sp. Fil. 4: 125, t. 258 (1862).

*Lastrea plantii* Moore in Journ. of Bot. 5: 227 (1853). Type from S. Africa.

*Nephrodium eurylepium* A. Peter in Fedde Rep. Sp. Nov., Beih. 40: 57 (1929), Syntypes from E. Africa.

BIÉ: S. side of Chimbango Hill, Chinguar, among rocks, 13.viii.1967, L & C 13870.

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# NEW AND LITTLE KNOWN SPECIES FROM THE FLORA ZAMBESIACA AREA

## XXI

## NOTES ON THE GENERA *LONCHOCARPUS, PTEROCARPUS* AND *XERODERRIS*

*by*

**F. A. MENDONÇA & E. P. SOUSA**

**Dalbergia acutifoliolata** Mendonça & E. P. Sousa, sp. nov., affinitate dubia; probabiliter *D. fischeri* et *D. martini* affinis, pro indumento simile (legumen desideratum).

Frutex scandens. Ramuli foliaque juveniles tenuiter fulvo-pubescentes. Cortex ramorum vetustiorum pilis hispidis basi verrucosis cum tomento adpresso interspersis obtectus, demum glaber et lenticellis linearibus albidis instructus. Folia imparipinnata, 3-6 cm longa, stipulata, stipulis caducis; rhachis, petiolo incluso, 1.5-3 cm longa, minute puberula, cito glabra; foliola 2-juga, alterna, rare opposita, petiolulis 1-2.5 mm longis; lamina 1.5-5 cm longa, 0.5-1.5 cm lata, chartacea, lanceolata vel subelliptica, apicem versus acuta vel obtusa, supra glabra, intense viridis, subtus pallidiora, adpresse puberulo-glabrescens; costa supra leviter impressa, subtus prominens; nervi laterales obsoleti. Inflorescentiae axillares paniculam racemosam usque ad 2.5 cm longam formantes, minute fulvo-pubescentes, bracteis caducis et bracteolis circ. 1 mm longis, ad anthesin adsunt. Flores albidi, circ. 11 mm longi, pedicellis 1-2.5 mm longis. Calyx 4.5-5 mm longus, tenuiter fulvo-subsericeus, dentibus dorsalibus circ. 1 mm longis, acutis. Vexillum circ. 10 mm longum, obovatum, emarginatum, reflexum, ungue circ. 3 mm

longo; alae leviter incurvatae, obtusae, auriculatae, ungue 3 mm longo; carinae petala quam alae minores latioresque, dorsum arcuata, leviter connata, ad basin auriculato- acuta, ungue 3.5 mm longo. Stamina 10, diadelpha, utrinque 5 connata. Ovarium 2-ovulatum, glabrum, stipite circ. 2.5 mm longo; stylus 2 mm longus. Legumen ignotum.

Icon. nostr.: Tab. I.

**Zambia.** Northern Distr. Kawambwa «in mushitu Kolwe stream», fl. 15.viii.1962, *R. M. Lawton* 963 (FHO, holotypus; K).

**Lonchocarpus eriocalyx** Harms subsp. **wankieënsis**

The history of the specimen *Levy* 67, from Rhodesia, dates from 1933. This fragmentary specimen consists of disarticulated leaves, a panicle in flower, a solitary juvenile pod and ripe pods of the preceding season. Registered in the *Herbarium Transvaal Museum* (now PRE) under n.° 23129, it was sent to Kew for identification. From there they sent the information: *Lonchocarpus* sp., «not represented at Kew, ... 3.5.1935». Three years later the same specimen was sent to HARMS (Berlin-Dahlem) who provided some clarification. In a letter dated 3rd. of March, 1936 (attached to the specimen) that author gave his opinion on LEVY's plant, saying in resume: *Lonchocarpus* very near to *L. eriocalyx* Harms, but the latter seems to have larger flowers and an inflorescence with a cottony indumentum denser than that of *Levy* 67, so that the Rhodesian plant perhaps represents a new species. And, for further comparison, HARMS added to LEVY's plant some flowers (2) from his own species, which are to be found in the capsule containing the pods of *Levy* 67 (at PRE). These flowers and a pencil sketch (at K) are, apparently, all that now exists of the type of HARMS's species. Thanks to the kind foresight of HARMS, we can compare the flowers of the type of *L. eriocalyx* with those of LEVY's plant, and with those of conspecific material of recent collections in the Zambezi Valley and, in this way, support HARM's suggestion that it might be a new taxon, in our opinion at the subs-

pecific level. Moreover, the comparison of Rhodesian material with a good number of specimens from the area of *L. eriocalyx* shows appreciable qualitative differences (apparently related to the geographical disjunction and evidently distinct ecological factors) summarized in the following table:

| Subsp. *eriocalyx* | Subsp. *wankieënsis* |
|---|---|
| Leaflets obovate; lateral nerves and reticulation prominent on the lower surface. | Leaflets ovate or elliptic; lateral nerves prominulous and reticulation evanescent on the lower surface. |
| Panicle with cottony indumentum. | Panicle with ± tenuous tomentellous indumentum. |
| Calyx-tube equalling or greater than the teeth. | Calyx-tube shorter than the teeth. |
| Pod tomentellous, glabrescent when mature. | Pod velutinous when mature. |

The small number of specimens representing the proposed subspecies are confined, as we show later, to the Zambezi Valley, a known subcentre of endemism.

**Lonchocarpus eriocalyx** Harms subsp. **wankieënsis** Mendonça & E. P. Sousa, subsp. nov., a subsp. eriocalyci accedit, sed flores minores; calycis dentibus quam tubus majoribus; foliolis reti-venularum plus minusve evanescentibus differt.

Arbor parva 4-8 m alta. Ramuli foliaque fulvo-puberuli. Folia 8-20 cm longa; stipulae 2-5 mm longae, persistentes; petiolus 2-5 cm longus; rhachis 4-10 cm longa, puberula; foliola 4-6-juga opposita, interdum alterna, stipellis 1-2 mm longis et petiolulis circ. 2 mm longis; lamina (1.5)2-7 cm longa, (1.5)1.8-3.5 cm lata, chartaceae, ovata vel elliptica vel oblongo-elliptica, interdum emarginata, supra glabra, subtus adpresso-puberula, demum glabra, nervis retis et venulis subtus prominulis sed plus minusve evanescentibus. Flores caeruleo-purpurascentes, circ. 9 mm longi; calycis dentes quam tubo majores, dorsalibus brevissime lobulatis, ventralibus 2-3.5 mm longis, acutis; vexillum circulare, circ.

9 mm in diam., basin calloso-bigibbosum, auriculis brevibus inflexis et ungue circ. 2 mm longo; alae ovatae, auriculis acutis, ungue 2 mm longo; carinae petala dorsum breviter connata, subacuta. Staminum vagina circ. 7 mm longa. Ovarium 3-4-ovulatum, breviter stipitatum, dense pilosum, stylo glabro. Legumen 1-2-spermum, coriaceum, subsessile, apice rotundatum, basi obtusum, stramineum, sericeum. Semen 14 × 9 × 5 mm, testa brunnea.

**Zambia.** 15 ft. tree of open mopane woodland, leaves pinnate, pub. on nerves below, pod brown, pub., fr. 22.v. 1961, *Fanshawe* 6600 (K). **Rhodesia.** Urungwe south of Naodsa R. on a rocky hillside in mopane country, small tree ± 12 ft., bark dark grey, flowers pale blue, scentless, Chigowa name MUTUNDURU, fl. 26.i.1956, *R. J. Phelps* 113 (K; LISC; SRGH); Urungwe, small deciduous tree, flaky bark, fr. 23.viii.1956, *F. B. Armitage* 225/56 (SRGH); Urungwe, Kariba, Nyanyanya, tree 30 ft., bole 9 ins., bark light grey with flakes of old bark adhering, wood brittle, leaves light green, soft, clustered at the ends of branches and arrested branchlets, found on Mopani-Jesse fringe, st. 29.xi. 1956, *J. Allen* 15 (K; SRGH); Urungwe, Sanyati, tree on open stony slope, bark light grey and flaky, leaves arising in cluster from side shoots, flowers lilac-coloured, fl. 6.i.1958, *R. Goodier* 526 (K; LISC; SRGH); Wankie, fl. bluish, xi.1932(?), *Levy* 67 (PRE, holotype; SRGH). Wankie, fr. immat. iii.1932, *Kelly Edwards* (SRGH); Wankie, on hillside with mopane, *Guibourtia conjugata* and *Combretum*, 12 ft. tree, flowers purple, fl. xii.1952, *L. M. Hodgson* 1/52 (K; LISC; SRGH).

**Lonchocarpus nelsii** (Schinz) Schinz ex Heering & Grimm.

Subsp. **katangensis** (De Wild.) Mendonça & E. P. Sousa, comb. et stat. nov.

*Lonchocarpus katangensis* De Wild. in Ann. Mus. Congo Belg., Bot. Sér. IV, 1: 195 (1903). — Bak. f., Legum. Trop. Afr. 2: 549 (1929). — Hauman in Fl. Congo Belg. 6: 10 (1954). — White, For. Fl. N. Rhod.: 159 (1962).

*Lonchocarpus hockii* De Wild. in Fed. Rep. **11**: 539 (1913). — Bak. f., tom. cit.: 550. — Hauman, loc. cit. in syn.

Inflorescence reddish-tomentose; young branchlets and leaf-rhachis corsely or densely pilose, with generally similarly coloured hairs; leaves all 3-5-foliolate.

**Zambia.** N: Abercorn, tree with spreading crown, to 30 ft. or more, flowers purple, secundary *Brachystegia* woodland, fairly frequent, fl. 30.vii.1951, *Bullock* 4000 (K; SRGH); Abercorn, rd. to Kalumbo Falls, tree 15 ft., fl. 22.vii.1960, *Mrs. Richards* 12899 (K; SRGH). W: Ndola, small branchy shrub, fl. 24.ix.1951, *W. D. Holmes* 134 (FHO; SRGH).

Subsp. **katangensis** differs from typical subspecies in having inflorescence, young branchlets and leaf-rhachis with reddish-brown tomentose indumentum (cinereous in subsp. *nelsii*), and leaflets always 1-2-jugate; this corroborated by geographical disjunction. It forms a more or less homogeneous population south of Lake Tanganyika, spreading westwards to Haut-Katanga (Congo Republic), and eastwards to western Province of Tanzania, not far from that Lake. Subsp. *nelsii* has a much more large range in drier areas from southern Zambia, north and west of Rhodesia to SW. Africa and south-west of Angola. It generally has 1-foliolate leaves, but it is not infrequent the tendency, even in the more arid places, to 3-foliolate or 1-3-5-foliolate on same plant.

We acknowledge Mr. R. M. POLHILL asking our attention for some specimens from south and east of Lake Tanganyka, and mapping their distribution.

**Pterocarpus rotundifolius** (Sond.) Druce and **P. polyanthus** Harms

WHITE (in For. Fl. N. Rhod.: 162, 1962) united *Pterocarpus polyanthus* Harms with *P. rotundifolius* (Sond.) Druce, thus delimiting the latter species in a broad sense. Nevertheless, these two taxa are separable by qualitative

characters correlated with a considerable geographical disjunction. It is true that the number of leaflets does not always have diagnostic value, but such value can certainly be attributed to the texture and the character of the indumentum, especially when connected with appreciable differences of form and dimensions of other organs. The voluminous material which we have studied is easily separable into two distinct populations: one to the south of the Zambezi with a branch up the Shire Valley as far as Blantyre; the other to the north of the Zambezi, with a prolongation to the south along the hills overhanging the Urema depression as far as Mt. Chiluvo (latitude of Beira). In this small zone of interpenetration the difference of habitat of the two populations appears to be constant. In our opinion the differences between the two taxa attain the subspecies level. We thus have:

| Subsp. *rotundifolius* | Subsp. *polyanthus* |
|---|---|
| Leaflets 1-3-jugate, pale-green; indumentum cinereous. | Leaflets (3)4-8(9)-jugate, dark-green; indumentum fulvous. |
| Lamina coriaceous, circular to elliptic, rounded or retuse at the apex; lateral nerves conspicuous on the upper surface. | Lamina chartaceous, ovate to elliptic, obtuse or acuminate at the apex; lateral nerves obsolete on the upper surface. |
| Ovary glabrous. | Ovary glabrous or pubescent. |

*Pterocarpus rotundifolius,* whose area stretches from the Transvaal and Swaziland to the Zambezi Valley, turning towards the west, and which appears to accompany the *Colophospermum mopane* formation as far as the south-east of Angola, ascending by the escarpment of the plateau to Cuanza Norte (locality of the type of *P. mellifer*), does not show appreciable variation. Subsp. *polyanthus,* whose area is situated at generally more elevated altitudes, from Mozambique, Tanzania and south-east Kenya, Zambia and Katanga (Congo), does show variability in the hot and dry *talweg* of the Zambezi, an isolated homogeneous population differentiated by the persistent presence of a more or less dense and soft fulvous indumentum (*P. martinii* Dunkley). It seems advisable to maintain this form at varietal level.

For brevity and concision, in the present note we mention only the literature concerning the basonyms, reserving the subsidiary literature for *Flora Zambesiaca*. For the same motive we are citing only sufficient specimens to cover our area, not all those we possess, for these are numerous.

**Pterocarpus rotundifolius** (Sond.) Druce in Rep. Bot. Club Brit. Is. **4**: 642 (1917).

*Dalbergia rotundifolia* Sond. in Linnaea, **23**: 35 (1850).

*Pterocarpus sericeus* Benth. in Journ. Linn. Soc., Bot. **4**, Suppl.: 75 (1860).

*Pterocarpus mellifer* Welw. ex Bak. in Oliv., Fl. Trop. Afr. **2**: 239 (1871) «melliferus».

*Pterocarpus buchananii* Schinz in Bull. Soc. Bot. Genève **6**: 66 (1899).

Subsp. **rotundifolius**

Branches, leaves and inflorescences cinereo-sericeous, glabrescent; leaflets 1-3-jugate; petiolules 6-20 mm. long; lamina circular to elliptic, rounded or retuse at the apex, coriaceous, pale-green; lateral nerves and reticulation conspicuous on the lower surface. Ovary glabrous.

**Botswana.** Gold-fields, fl. 1870, *Baines* s. n. (K). **Rhodesia.** W: Matobo, fl. xii.1953, *Miller* 2047 (K; SRGH). C: Salisbury, fl. i.1949, *Davies* 350 (K; SRGH). E: Chirinda, fl. i.1906, *Swynnerton* 28 (BM; K; SRGH). S: Fort Victoria, fl. 1905, *Monro* 750 (BM; SRGH). **Malawi.** S: Blantyre, fl. & fr. *Buchanan* 38 (BM), 38 bis (K; P). **Moçambique.** Tete, Macanga, entre Furancungo e Angónia, árvore de 10 m, fr. 15.vii.1949, *Andrada* 1769 (COI; LISC; PRE); Manica e Sofala, Manica, montes de Macequece, fl. 5.xi.1943, *Torre* 6203 (BM; K; LISC; LM); Manica, entre Mavita e Dombe, árvore de 10-12 m, fl. 21.i.1948, *Barbosa* 853 (LISC); Báruè, Vila Gouveia, estrada da serra de Choa, *Torre & Correia* 15412

(COI; LISC); Lourenço Marques, Sábiè, Moamba, árvore de 5-6 m, fl. 2.vii.1940, *Torre* 2189 (COI; LISC); Maputo, Goba, árvore de 10 m, fl. 22.xi.1944, *Mendonça* 3042 (BM; COI; K; LISC; LM).

**Distr. Geogr.:** Transvaal and Transkei, Swaziland, S. W. Africa and Angola. Tree 5-12 m. high of open deciduous woodland.

Subsp. **polyanthus** (Harms) Mendonça & E. P. Sousa, comb. et stat. nov.

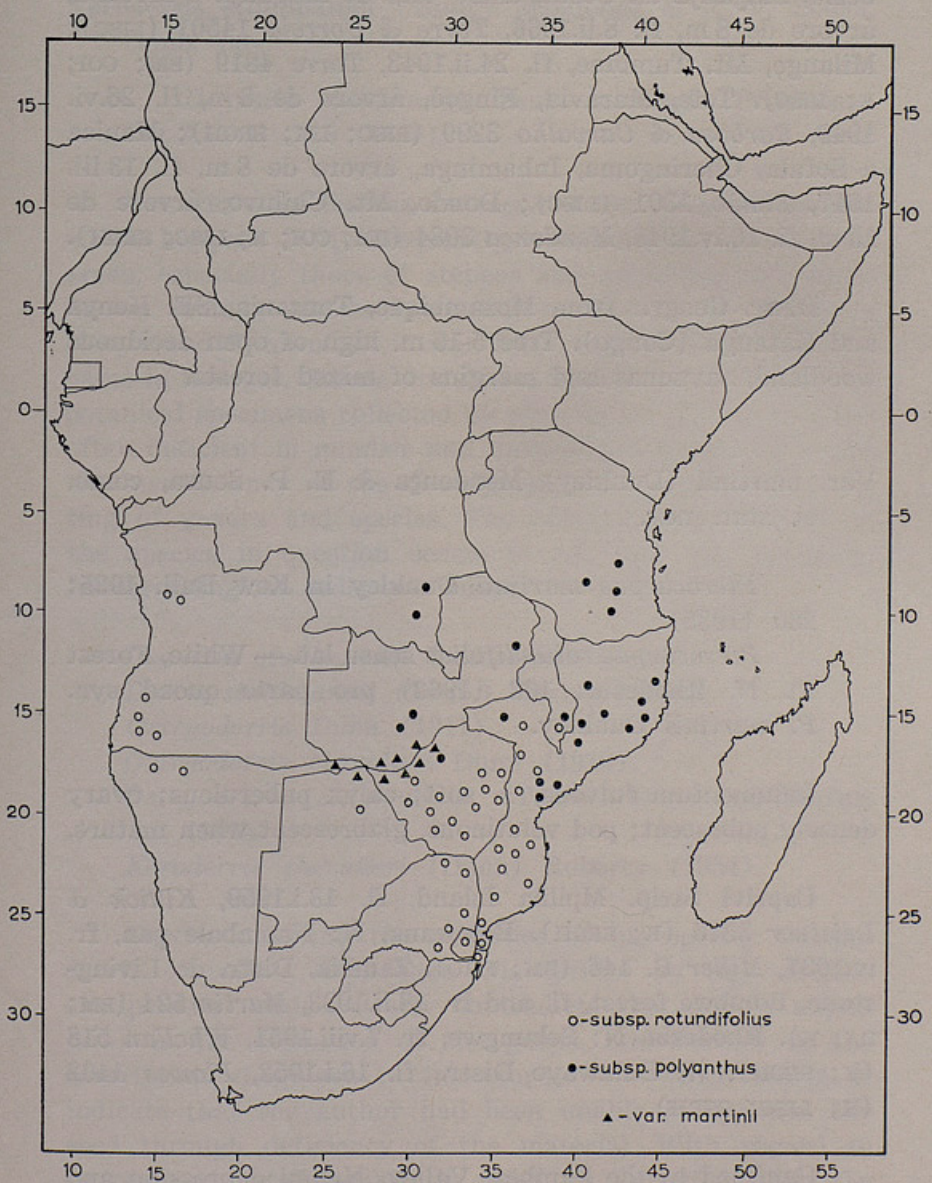
*Pterocarpus polyanthus* Harms in Engl., Bot. Jahrb. **53**: 473 (1915). — Torre & Barbosa in Garcia de Orta **5**, 1: 125 (1957).

*Pterocarpus rotundifolius* sensu lat.— White, Forest Fl. N. Rhodesia: 162 (1962) pro parte quoad syn. *P. polyanthus* Harms.

Var. **polyanthus**

Branches, leaves and inflorescences fulvous-puberulous, glabrescent. Leaflets (3)4-8(9)-jugate, with petiolules 2-8 mm. long; lamina ovate or ovate-oblong, rounded or obtuse or acuminate-acute at the apex, chartaceous, dark-green, shiny on the upper surface, more pallid, puberulous and glabrescent on the lower surface, with lateral nerves obsolete and finely reticulate. Ovary glabrous.

**Zambia.** C: Lusaka, fl. 25.v.1934, *Miller* 37 (FHO). S: Mazabuka, fl. 1.1930, *Browne* 50 (FHO). E: Luangwa Valley, Isoka Distr., alab. 16.i.1938, *Trapnell* 1817 (K). **Rhodesia.** N: Urungwe, fl. 31.i.1958, *Drummond* 5397 (K; SRGH). **Malawi.** S: Mlange, Likabula, fl. 19.i.1958, *Chapman* 516 (BM; EA; FHO). **Moçambique.** Niassa, Amaramba, entre Cuamba e Mecanhelas, árvore de 8 m, fl. 17.ii.1964, *Torre & Paiva* 10629 (LISC); Moçambique, Malema, Mutuáli, fl. 14.ii.1958, *Gomes e Sousa* 4190 (COI; EA; LISC; LM; SRGH); Moma, Chaláua, fr. 6.viii.1948, *Barbosa* 1766 (LISC); Zam-




Area of *Pterocarpus rotundifolius*.

bézia, Maganja da Costa, entre Vila de Maganja e Mocuba, árvore de 8 m, fl. 8.ii.1966, *Torre & Correia* 14501 (LISC); Milange, Mt. Tumbine, fl. 24.ii.1943, *Torre* 4819 (BM; COI; K; LISC). Tete, Marávia, Fíngoè, árvore de 8 m, fl. 26.vi. 1949, *Barbosa & Carvalho* 3299 (LISC; LM; SRGH); Manica e Sofala, Cheringoma, Inhaminga, árvore de 8 m, fl. 13.iii. 1947, *Simão* 1301 (LISC); Dondo, Mt. Chiluvo, árvore de 15 m, fl. 16.iv.1948, *Mendonça* 3984 (BM; COI; K; LISC; SRGH).

**Distr. Geogr.:** from Mozambique, Tanzania, SE. Kenya and Katanga (Congo). Tree 5-15 m. high of open deciduous woodland, savannas and margins of mixed forests.

Var. **martinii** (Dunkley) Mendonça & E. P. Sousa, comb. et stat. nov.

*Pterocarpus martinii* Dunkley in Kew Bull. **1935**: 260 (1935).

*Pterocarpus rotundifolius* sensu lat. — White, Forest Fl. N. Rhodesia: 162 (1962) pro parte quoad syn. *P. martinii* Dunkley.

Indumentum fulvous, ± soft; calyx puberulous; ovary densely pubescent; pod velutinous, glabrescent when mature.

**Caprivi Strip.** Mpilila Island, fl. 13.i.1959, *Killick & Leistner* 3376 (K; SRGH). **Botswana.** N: Namabale pan, fr. iv.1937, *Miller* B. 146 (BM; FHO). **Zambia.** Distr. de Livingstone, Bombwe forest, fl. and fr. 18.ii.1933, *Martin* 524 (BM; EA; K). **Rhodesia.** N: Sebungwe, fr. 7.viii.1951, *Whellan* 518 (K; SRGH). W. Bulawayo Distr., fl. 16.i.1952, *Plowes* 1402 (K; LISC; SGRH).

Confined to the Zambezi Valley, Ngami depression and Caprivi Strip, in hot dry places, associated with *Colophospermum mopane,* on Kalahari Sand.

**Xeroderris stuhlmannii** (Taub.) Mendonça & E. P. Sousa, comb. nov.

*Deguelia stuhlmannii* Taub. in Engl., Pflanzenw. Ost-Afr. C: 218 (1895).

TAUBERT's species has a somewhat controversial history, which happens fairly frequently with taxa occupying vast areas, especially those of steppes and savannas. Originally known from countries bordering on the Indian Ocean — Kenya and Tanzania — it was later baptized with another name in Senegal, Guinea and Sierra Leone. As is customary, botanical specimens collected by pioneers in the interior are often deficient in number and quality and from this arises the insufficiency of the descriptions concerned or the uniting of genera and species. The nomenclatural history of the species in question seems to fall into this category. In chronological order we have:

*Deguelia stuhlmannii* Taub. (1895).
*Derris stuhlmannii* (Taub.) Harms (1900).
*Ostryoderris Dunn* (1911).
*Ostryoderris chevalieri* Dunn (1914).
*Ostryoderris stuhlmannii* (Taub.) Dunn ex Harms (1915).
*Xeroderris chevalieri* (Dunn) Roberty (1954).

DUNN, in giving the affinities of his species *Ostryoderris chevalieri,* says that this differs by the «foliolis exstipellatis» which clearly contradicts the «foliola stipellata» in the definition of the genus, and further in the description «Legumen ... immaturum ...» which seems to indicate that the author had been unable to examine the seed through deficiency of the material. With regard to *Ostryoderris stuhlmannii,* it must be admitted that the specimen or specimens (destroyed?) seen by the author of the new combination had no ripe pods or that he did not examine the seed, since, otherwise, he would have recognized the fundamental difference between TAUBERT's plant and

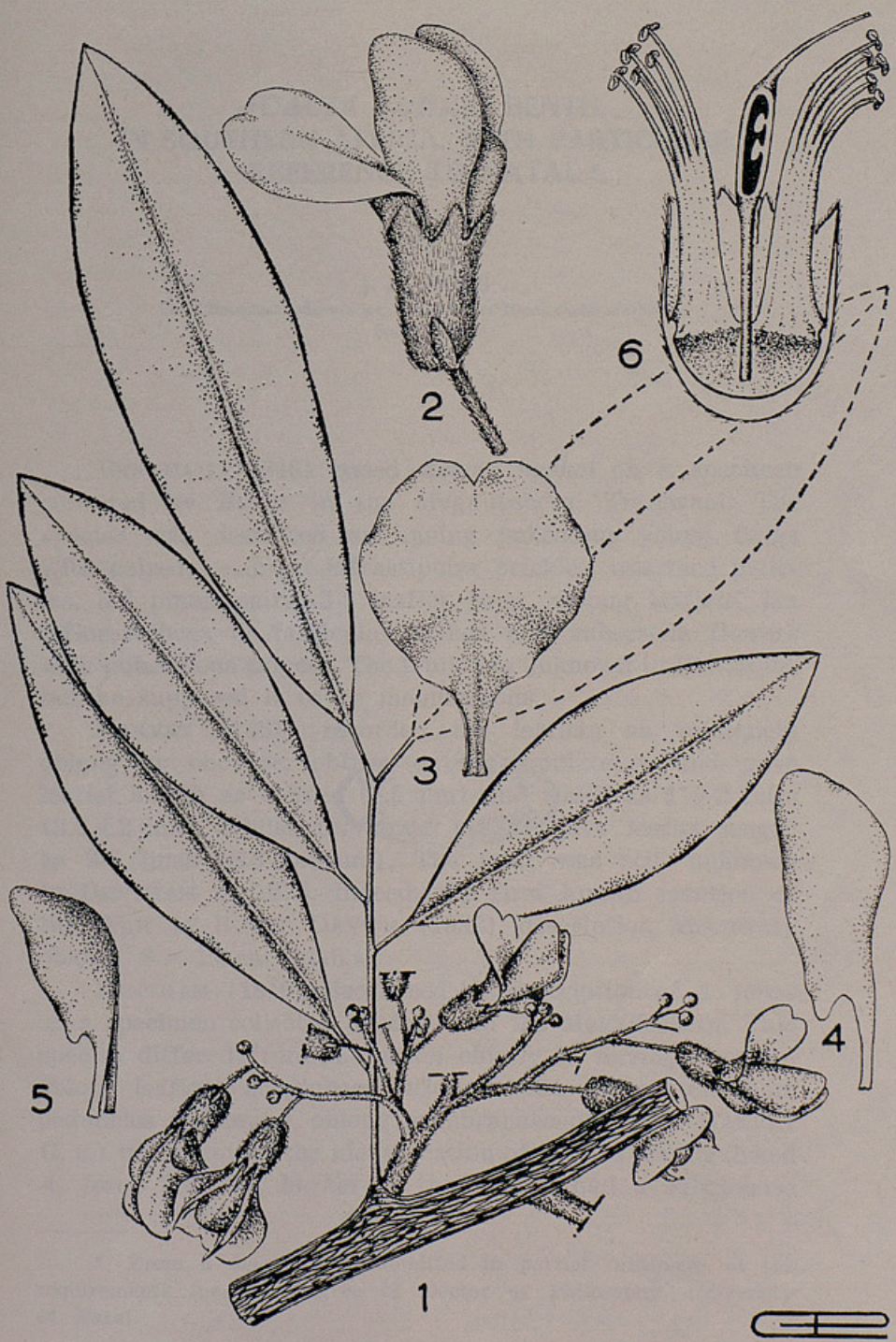
his genus *Ostryoderris*. Nevertheless, both species have flourished for half a century under the aegis of the prestige of the author.

In 1954, however, ROBERTY recognized that *Ostryoderris chevalieri* Dunn does not belong to *Ostryoderris* but represents a new genus which he called *Xeroderris*, the species becoming *Xeroderris chevalieri* (Dunn) Roberty. This species is confined to Senegal and neighbouring countries. Four years later HEPPER (in Fl. W. Trop. Afr. ed. 2, 1, 2: 522, 1958) reduced *Ostryoderris chevalieri* to a synonym of *O. stuhlmannii* (Taub.) Dunn ex Harms and, in consequence, *Xeroderris* Roberty was reduced to synonymy, already registered by HUTCHINSON (Gen. Pl. 1: 381, 1964).

A prolonged study of the voluminous herbarium material from eastern, central and western Africa and comparison with typical specimens of the genus *Ostryoderris* has led us to the conclusion that it would be difficult to agree to the maintenance of TAUBERT's plant in DUNN's genus.

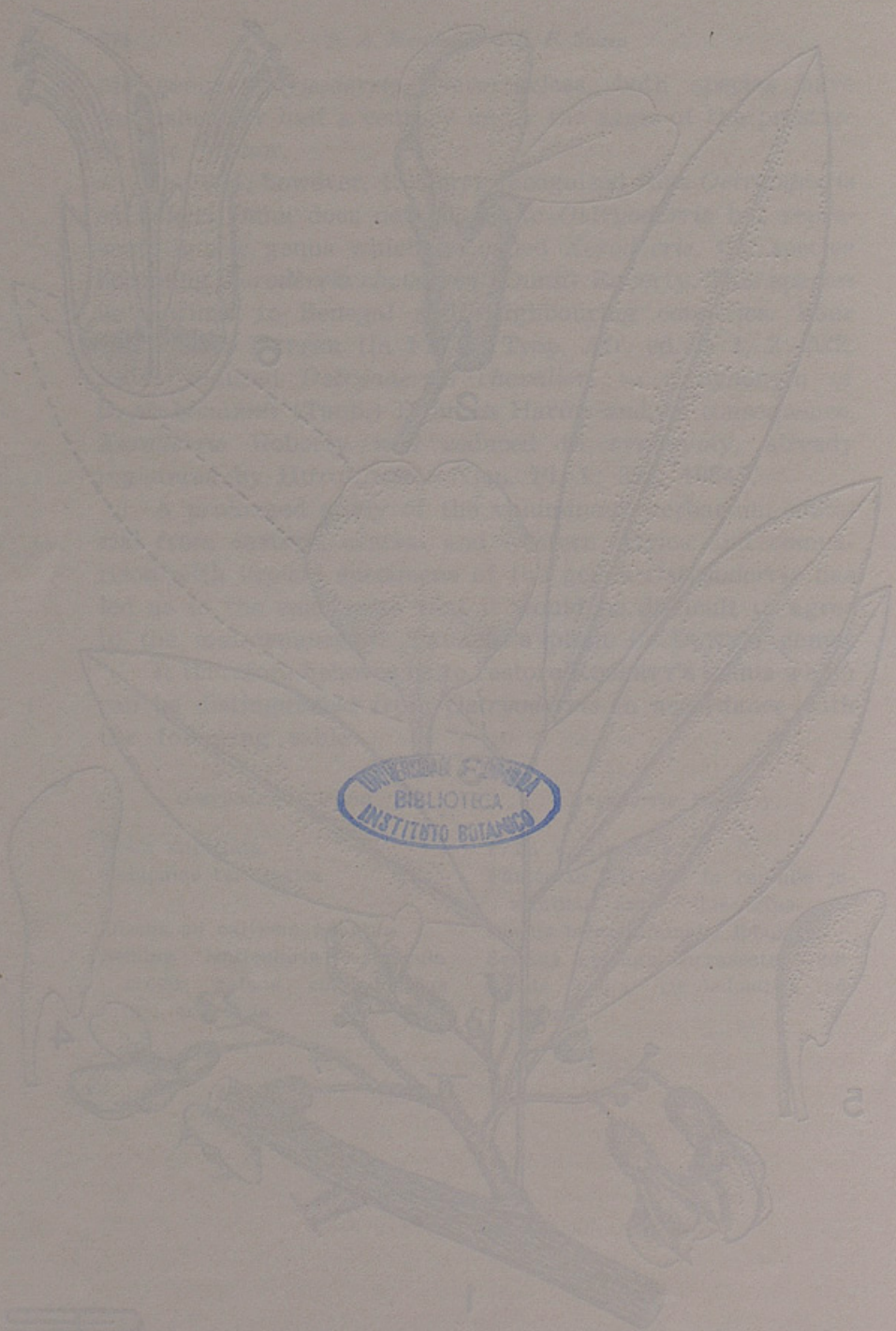
It therefore behoves us to restore ROBERTY'S genus which can be distinguished from *Ostryoderris* in accordance with the following table:

| *Ostryoderris* Dunn | *Xeroderris* Roberty |
|---|---|
| Folia stipellata. | Folia exstipellata. |
| Paniculae terminales. | Paniculae laterales in ramulis juvenilibus ante foliae ortae. |
| Discus ad calycem adnatus. | Discus intrastaminalis lobulatus. |
| Semina lenticularia; radicula brevis, patens, cotyledonibus non adpressis. | Semina oblonga incrassata; radicula longa, cotyledonibus adpressis. |




**Dalbergia acutifoliolata** Mendonça & E. P. Sousa

1, flowering branch (× 2); 2, flower (× 4); 3, vexillum (× 4); 4, wing (× 4); 5, carina (× 4); 6, stamens and ovary (× 6).



# *ACACIA BURKEI* BENTH. IN SOUTHERN AFRICA, WITH PARTICULAR REFERENCE TO NATAL *

*by*

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BENTHAM (1846) based *Acacia burkei* on a specimen collected by *Burke* in the Magaliesberg, Transvaal. The species was described as having pubescent young twigs with paired, recurved infrastipular prickles, unarmed petioles, 3-6 pinna pairs, 5-8 leaflet pairs, oblong leaflets, lax inflorescences in fascicular spikes and subsessile flowers with puberulous calyces. The fruit was unknown to BENTHAM, but he supposed it to be membranous.

HARVEY (1861) recorded the leaflets as «obliquely oblong or obovate, obtuse or mucronulate...» and gave leaflet length as 4 lines (8.5 mm) and width as 1½-2 lines (3.2-4.2 mm), whilst BENTHAM (1875) gave leaflet length as 3-5 lines (6.3-10.6 mm). The fruit was still unknown to BENTHAM in 1875. Indeed, the first known mention of the fruit is BURTT DAVY's (1932) description «narrowly oblong, 8 × 1.5 cm, glab.».

BENTHAM (1846) also based his description of *A. ferox* on a specimen collected by *Burke* in the Magaliesberg. This species differed from *A. burkei* chiefly in having obovate-oblong leaflets, subglobose inflorescences, flowers on short peduncles and broad, oblong membranaceous fruits. HARVEY (l. c.) in his key to the identification of species distinguished *A. ferox* from *A. burkei* as the former had a subglobose

* From a dissertation submitted in partial fulfilment of the requirements for the Degree of Doctor of Philosophy, University of Natal.

inflorescence and the latter a spicate one. BENTHAM (1875) maintained the two as distinct species, but it is now evident that the type specimen of *A. ferox* is a mixed gathering comprising a shoot of *A. burkei* and a shoot of *A. mellifera* (Vahl.) Benth. subsp. *detinens* (Burch.) Brenan. Consequently *A. ferox* cannot be upheld as a valid species.

It was mentioned (ROSS, 1968) that *A. burkei* forms one of a complex of very closely related species, and that within this complex the degree of pubescence of the calyx is the character of prime importance in distinguishing two main groups. *A. burkei* and *A. rovumae* Oliv., which alone have pubescent calyces, constitute the smaller group. *A. nigrescens* Oliv., *A. welwitschii* Oliv. and *A. goetzei* Harms, which have glabrous calyces, constitute the larger group.

*A. rovumae* differs from *A. burkei* in having paired prickles that are typically straightish or only slightly curved and pointing upwards a little, shorter and sparser pubescence on the calyces, and fruits that are apparently indehiscent. In addition, *A. rovumae,* which usually occurs on, or near, the coast, where it frequently grows near saline water, is geographically distinct from *A. burkei. A. rovumae* is unknown south of the Zambesi River being recorded from northern Mozambique, Tanzania, Kenya and Madagascar, whereas *A. burkei* is endemic south of the Zambesi.

Since *A. rovumae* is tropical, it has been customary to refer all plants with pubescent calyces within this complex in southern Africa to *A. burkei.* However, some of the Natal plants have in the past (HENKEL, 1934; 1937) been incorrectly referred to *A. mossambicensis* Bolle. HENKEL (1934) regarded *A. burkei as* a synonym of *A. mossambicensis,* whilst MILLER (1952) reversed this synonymy. However, *A. mossambicensis* is a synonym of *A. albida* Del. The position was further complicated by BAKER (1930) who confused *A. mossambicensis* with *A. goetzei.* BURTT DAVY (1908) cited in his notes on *A. burkei* a specimen, *Meller 9,* from Manganja Hills on the Zambesi but examination of this specimen revealed it to be *A. goetzei.*

*A. burkei* is a more variable entity than was initially imagined. In recent years it has been customary in Natal

to distinguish loosely between «small leaflet» *A. burkei* and «big leaflet» *A. burkei,* the former typically having leaflets less than 3 mm wide and the latter leaflets more than 3 mm wide. The choice of 3 mm as a means of differentiation was probably influenced by BRENAN's (1956, 1959) treatment of the closely related *A. goetzei* where two subspecies were recognised primarily on the basis of leaflet width: leaflet width in subsp. *microphylla* being less than 3 mm and in subsp. *goetzei* more than 3 mm. BENTHAM's type specimen of *A. burkei* is referable to «big leaflet» *A. burkei.*

The opinion has been expressed, although not in print, that either «small leaflet» *A. burkei* or, «big leaflet» *A. burkei* is a species distinct from *A. burkei.* That confusion is widespread is evidenced by the examination of numerous unnamed or tentatively named specimens, and specimens hesitantly referred to *A. burkei,* to *A. delagoënsis* Harms or to *A. goetzei.* Consequently populations in Natal were sampled in an attempt to establish the range of morphological variation within, and among, the populations, and to establish whether the «small leaflet» and «big leaflet» populations are distinct from one another, or from *A. burkei.*

## DISTRIBUTION, HABIT AND HABITAT

a) *In Natal*

The known distribution of «big leaflet» and «small leaflet» populations of *A. burkei* in Natal is shown in Fig. 1.

Populations extend from near the border of Mozambique in the north to little further south than the Tugela river mouth, and inland to a little west of Nongoma. Four populations occur south of the Tugela river, three within the Lower Tugela district and one in the Mapumulo district. The distribution of *A. burkei* in Natal is very similar to that of *A. senegal* (L.) Willd. var. *rostrata* Brenan.

Populations of «small leaflet» *A. burkei* occur typically on sandy soil or, less frequently, on coarse sandy, boulder strewn areas, whilst «big leaflet» *A. burkei* typically favours hard loam where it frequently grows in association with *A. nigrescens.* However, «small leaflet» and «big leaflet»

plants sometimes occur in the same population, for example, at Essiena.

Growth form is invariably a tree, although small stunted shrubs, heavily browsed by goats, were observed on the summit of the Lebombo mountains. Plants are often

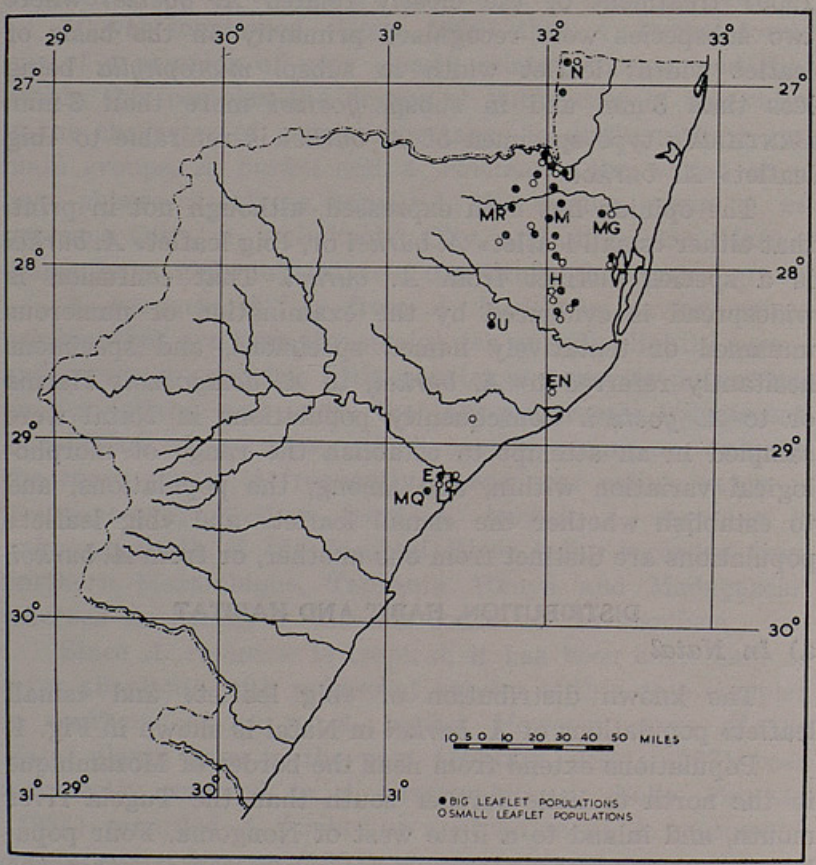


Fig. 1. — The known distribution of *Acacia burkei* in Natal.

dominant over fairly extensive areas where they may form an open or a closed woodland. The crown in «small leaflet» plants is often very dense and varies from rounded to slightly flattened and spreading (Fig. 2), whereas in «big leaflet» plants it may be less dense and irregularly rounded, open and lax (Fig. 3).

Fig. 2. — «Small leaflet» tree of *A. burkei* 14 m high with slightly rounded and spreading crown, growing on deep sandy soil. Natal, Hlabisa Distr., Mfekeya Halt, 15 miles N. of Matubatuba. Apr., 1966.

Fig. 3. — «Big leaflet» tree of *A. burkei* 12 m high with irregular, somewhat rounded crown, growing on hard red loam with *A. nilotica* (L.) Willd. ex Del. subsp. *kraussiana* (Benth.) Brenan, *A. tortilis* (Forsk.) Hayne subsp. *heteracantha* (Burch.) Brenan, *A. nigrescens* Oliv. and *Dichrostachys cinerea* (L.) Wight & Arn. Natal, Ubombo Distr., Mkuze Station. Apr., 1966.

The bark, which varies in colour from pale to dark yellowish- or grey-brown to black, is rough and irregularly fissured and flaking (Fig. 4), whilst on the young branchlets it is yellowish-brown to grey or purplish and sometimes flaking minutely. The young branchlets have numerous, minute, somewhat transversely elongated lenticels that may be white and conspicuous or, reddish-brown and relatively inconspicuous. The slash varies from pale salmon to deep pink. Plants are armed with strongly recurved prickles that occur in pairs below the nodes. The bark is frequently covered with numerous persistent prickles that may have slightly swollen bases, but these are not as large as the knob-like swellings in *A. nigrescens*.

Flowering starts in early to mid-spring depending upon prevailing local climatic conditions, and is usually over by mid-summer. «Big leaflet» and «small leaflet» plants normally flower together and at the same time as *A. nigrescens*. Plants tend to flower before the leaves are produced, or whilst the latter are still young, so that the flowers are conspicuous. All plants within a population do not always flower together so that occasionally a few out of season flowers may be found in mid to late summer.

b) *Remainder of Africa*

The known distribution of *A. burkei* in southern Africa is shown in Fig. 5.

The species is endemic to Africa south of the Zambesi river. Populations extend from Botswana in the west, through the Transvaal to Mozambique in the east and southward through Swaziland to Natal. There is a doubtful record from the south eastern area of Rhodesia.

## DIAGNOSTIC CRITERIA AND SAMPLING TECHNIQUE

The characters selected for measurement or qualitative estimation were those adopted in a similar study of *A. nigrescens* Oliv. (Ross, 1968). Thus, all characters previously regarded of taxonomic value in the delimitation of *A. burkei* from closely related species were considered.

Fig. 4. — Close up of the rough, irregularly flaking, pale to dark yellowish- or grey-brown to black bark of *A. burkei*. Natal, Ubombo Distr., Mkuze Station. Apr., 1966.

Individual plants were sampled uniformly according to the method of GORDON-GRAY (1965). A brief description of the habitats occupied by the Natal populations together with the number of plants sampled and approximate climatic data pertaining in each is given in Table I. Where «big leaflet»

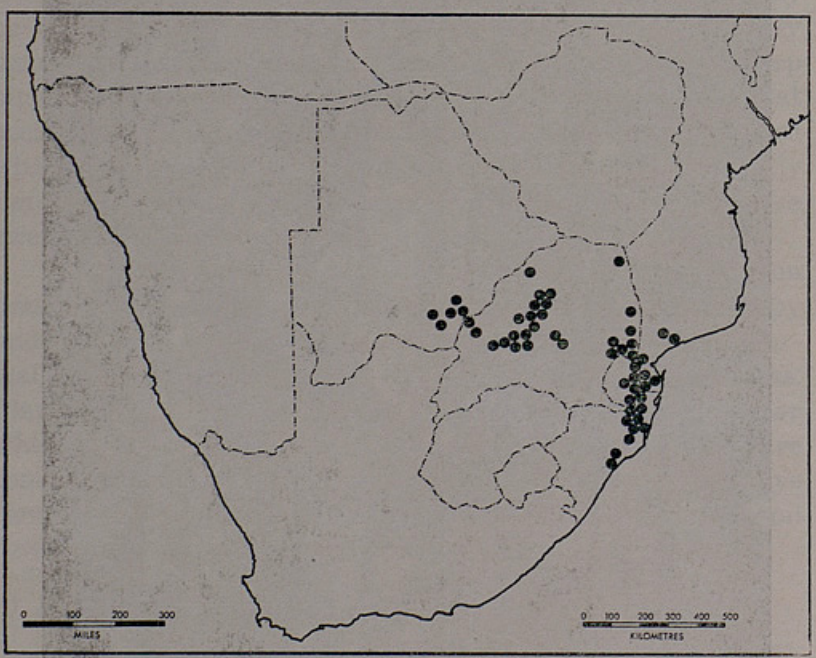


Fig. 5. — The known distribution of *A. burkei* in southern Africa.

and «small leaflet» populations were sampled from the same locality it was necessary to differenciate between them. This was achieved by use of the suffix 'B' for «big leaflet» and 'S' for «small leaflet» populations in Tables I-III and Figs. 6-10.

One Transvaal and one Swaziland population were sampled but for most localities outside Natal, herbarium specimens were relied upon almost exclusively.

TABLE I

Habitats of populations of *Acacia burkei* sampled in Natal and approximate climatic data pertaining in these habitats

| Populations and symbols | Number of plants sampled | HABITAT | Approximate Climatic Data | | | |
|---|---|---|---|---|---|---|
| | | | Nearest weather station | Altitude in m | Mean Rainfall in mm | Annual Temp. in 0° C |
| Enseleni EN | 5 | marginal to small patch of coast forest; sandy soil | Empangeni | 135 | 1085.1 | 21.1 |
| Essiena E | 5 | locally dominant on sandy soil in dry valley scrub near Tugela River | Stanger | 46 | 800-1000 | 21.4 |
| Hluhluwe H | 10 | locally dominant on white sandy soil near the Hluhluwe River | Hlabisa | 512 | 1126.2 | 19.9 |
| Jozinidam J'S' | 10 | locally common on boulder strewn slope on summit of Lebombo Mts., open treeveld | Jozinidam | 600 | 600-700 | 22.7 |
| Jozinidam J'B' | 5 | tree savanna on very rocky N. facing slope | Jozinidam | 600 | 600-700 | 22.7 |
| Mandini LT | 5 | locally common on stony, yellowish ground in dry river valley scrub | Stanger | 46 | 800-1000 | 21.4 |
| Maqumbi MQ | 3 | locally common on sandy soil in dry valley scrub | Mapumulo | 549 | 800-1000 | 21.4 |
| Mkuzana River MR | 5 | boulder strewn slope adjacent to Mkuzana River; *A. nigrescens* woodland | Magudu | 329 | 650 | 20.7 |
| Mkuze M | 10 | locally dominant on hard red loam; in proximity to *A. nigrescens* | Mkuze | 122 | 500-600 | 21.6 |
| Mkuze Game Reserve MG'S' | 10 | common on sandy soil in *Terminalia sericea* woodland | Mkuze | 122 | 500-600 | 21.6 |
| Mkuze Game Reserve MG'B' | 10 | common on light reddish-brown sandy soil; *Acacia* woodland | Mkuze | 122 | 500-600 | 21.6 |
| Ndumu Game Reserve N'S' | 10 | common on red sand in *Terminalia sericea* woodland | Ndumu | 75 | 638.6 | 22.7 |
| Ndumu Game Reserve N'B' | 10 | common on red sand overlying discontinuous cemented sandstone horizon | Ndumu | 75 | 638.6 | 22.7 |
| Umfolosi Game Reserve U'S' | 10 | sandy soil in dry *Acacia* woodland | Hlabisa | 512 | 1126.2 | 19.9 |
| Umfolosi Game Reserve U'B' | 10 | locally common on rocky hillside slope; *A. nigrescens* woodland | Hlabisa | 512 | 1126.2 | 19.9 |

## RESULTS AND DISCUSSION

### a) *Measurable Characters*

Parameters obtained for all measurable morphological characters indicate that the Natal populations exhibit continuous variation. Population means given in Table II are arranged according to decreasing petiole length.

Population extremes and modes are given in Table III.

The correlations revealed in Table II are not as evident as in other species considered (Ross, 1966; Ross & Gordon-Gray, 1966a, 1966b). However, several overall tendencies, which are not readily apparent from Table II, since so much information is lost in the calculation of population means, are more obvious from Figs. 6, 7, 8, 9 and 10 where mean parameters for individual plants for all Natal populations were used. The variation within, and among, populations is clearly evident from Figs. 6-10. In these figures «big leaflet» populations were purposely represented by «dark» symbols and «small leaflet» populations by «open» symbols in order to accentuate any differences between the two that might be present.

There is an overall tendency for rachis length, and to a far lesser degree rachilla length, to be positively correlated with petiole length, whilst number of pinna pairs tends to be negatively correlated with rachis length. Number of leaflet pairs shows no obvious correlation with rachilla length. The two rachillae of each pinna pair often do not leave the rachis at opposite points, and are frequently of unequal length so that the leaves may develop asymmetrically. Leaflet length and leaflet width are positively correlated with one another, and with petiole length.

Pod size, although fairly uniform on a single plant, varies considerably from plant to plant within a population and from one population to another. Pod width does not appear to be correlated with pod length as both the narrowest and the broadest pods within a population frequently have the same length. As in all other species examined, pod length shows no apparent correlation with any other character.

TABLE II

Mean morphological parameters for populations of *Acacia burkei* sampled in Natal

| Populations sampled | Petiole length in mm | Rachis length in mm | Leaf length in mm | Rachilla length in mm | Number of pinna pairs | Number of leaflet pairs | Leaflet length in mm | Leaflet width in mm | Pod length in mm | Pod width in mm |
|---|---|---|---|---|---|---|---|---|---|---|
| Maqumbi . . . . . | 24.0 | 42.7 | 66.7 | 22.7 | 3.0 | 4.0 | 11.4 | 5.2 | 95.2 | 14.7 |
| Jozinidam 'B' . . . . . | 20.8 | 38.6 | 59.4 | 20.6 | 2.0 | 2.0 | 11.1 | 6.5 | 101.1 | 19.1 |
| Ndumu Game Reserve 'B' | 18.5 | 53.6 | 72.1 | 28.6 | 4.4 | 4.9 | 13.1 | 6.2 | 108.2 | 18.0 |
| Umfolosi Game Reserve 'S' | 17.8 | 46.8 | 64.6 | 23.4 | 6.4 | 9.7 | 7.6 | 2.7 | 87.9 | 15.7 |
| Hluhluwe Game Reserve . | 17.1 | 46.1 | 63.2 | 26.1 | 6.3 | 9.4 | 7.9 | 3.1 | 131.8 | 17.2 |
| Mkuze . . . . . | 16.0 | 47.0 | 63.0 | 24.1 | 5.6 | 6.2 | 8.3 | 3.8 | 117.3 | 21.2 |
| Mkuze Game Reserve 'B' | 15.8 | 38.0 | 53.8 | 19.4 | 4.5 | 4.0 | 8.4 | 4.4 | 81.4 | 20.2 |
| Mandini . . . . . | 15.6 | 45.0 | 60.6 | 25.8 | 7.8 | 11.2 | 5.2 | 2.1 | 73.1 | 16.5 |
| Umfolosi Game Reserve 'B' | 15.3 | 36.0 | 51.0 | 20.8 | 4.3 | 4.1 | 10.3 | 5.9 | 72.0 | 18.6 |
| Ndumu Game Reserve 'S' | 14.6 | 47.7 | 62.3 | 25.3 | 7.6 | 10.9 | 6.6 | 2.6 | 101.2 | 16.2 |
| Enseleni . . . . . | 13.2 | 34.6 | 47.8 | 18.0 | 8.0 | 12.2 | 4.6 | 1.7 | 75.4 | 18.1 |
| Essiena . . . . . | 12.8 | 28.4 | 41.2 | 19.2 | 5.6 | 8.8 | 5.5 | 2.3 | 78.3 | 17.9 |
| Mkuzana River . . . . | 12.8 | 31.8 | 44.6 | 20.4 | 4.0 | 3.0 | 9.5 | 5.1 | 84.3 | 18.7 |
| Jozinidam 'S' . . . . . | 11.0 | 34.3 | 45.3 | 19.5 | 7.1 | 10.7 | 5.1 | 1.7 | 71.5 | 16.9 |
| Mkuze Game Reserve 'S' | 10.2 | 31.4 | 41.6 | 20.0 | 8.6 | 11.1 | 4.1 | 1.4 | 104.1 | 18.3 |

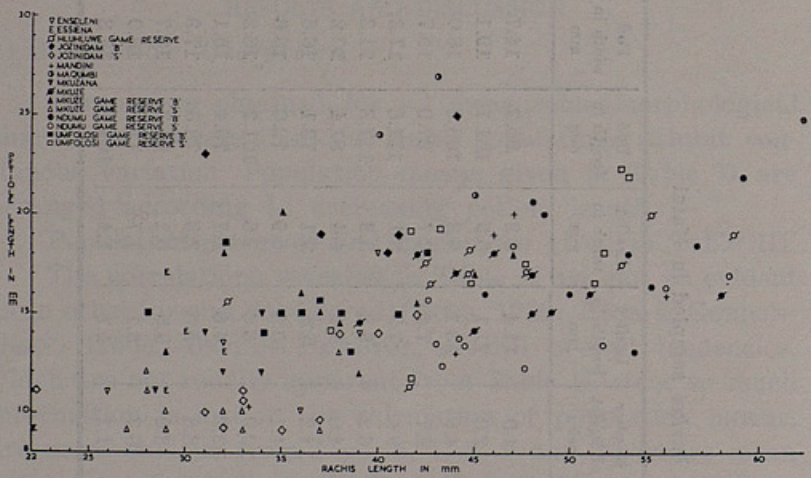


Fig. 6. — Scatter diagram showing the variation in petiole length and in rachis length within, and among, the Natal populations of *A. burkei*.

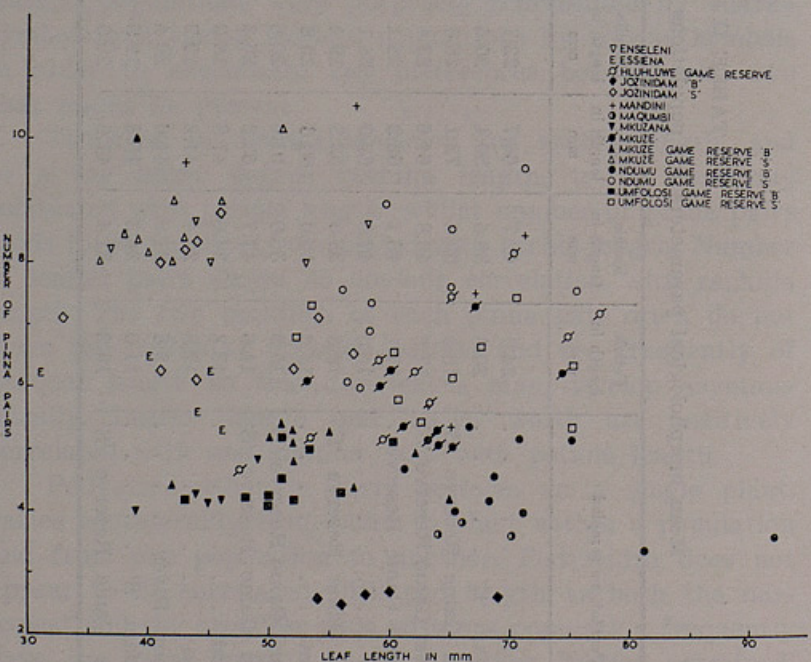


Fig. 7. — Scatter diagram showing the variation in leaf length and in number of pinna pairs within, and among, the Natal populations of *A. burkei*.

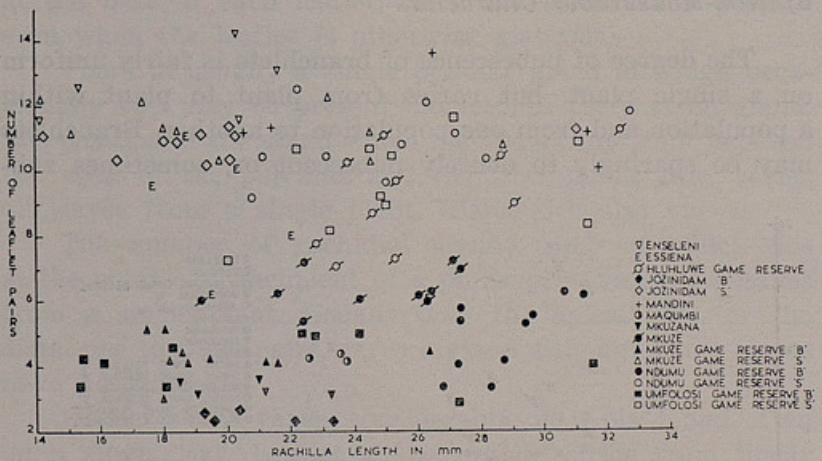


Fig. 8. — Scatter diagram showing the variation in rachilla length and number of leaflet pairs within, and among, the Natal populations of *A. burkei*.

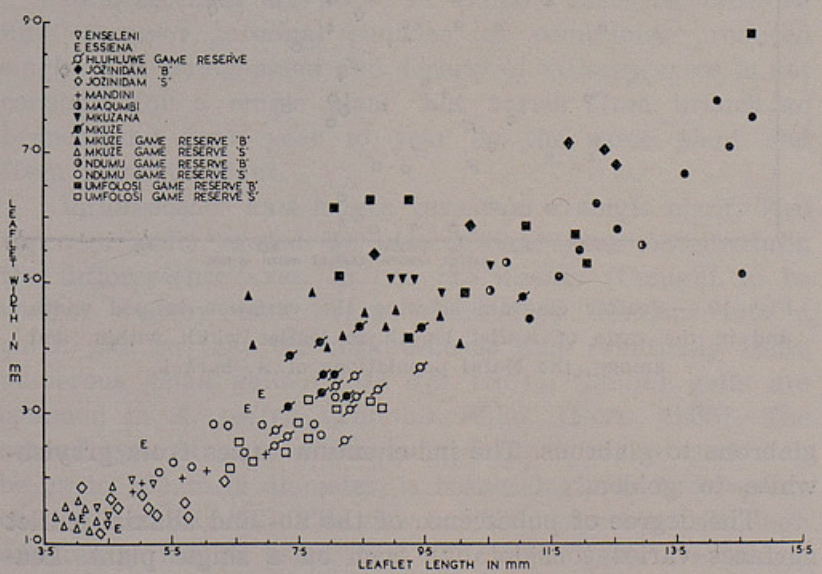


Fig. 9. — Scatter diagram showing the variation in leaflet length and in leaflet width within, and among, the Natal populations of *A. burkei*.

b) *Non-Measurable Characters*

The degree of pubescence of branchlets is fairly uniform on a single plant, but varies from plant to plant within a population and from one population to another. Branchlets may be sparingly to densely pubescent or, sometimes sub-

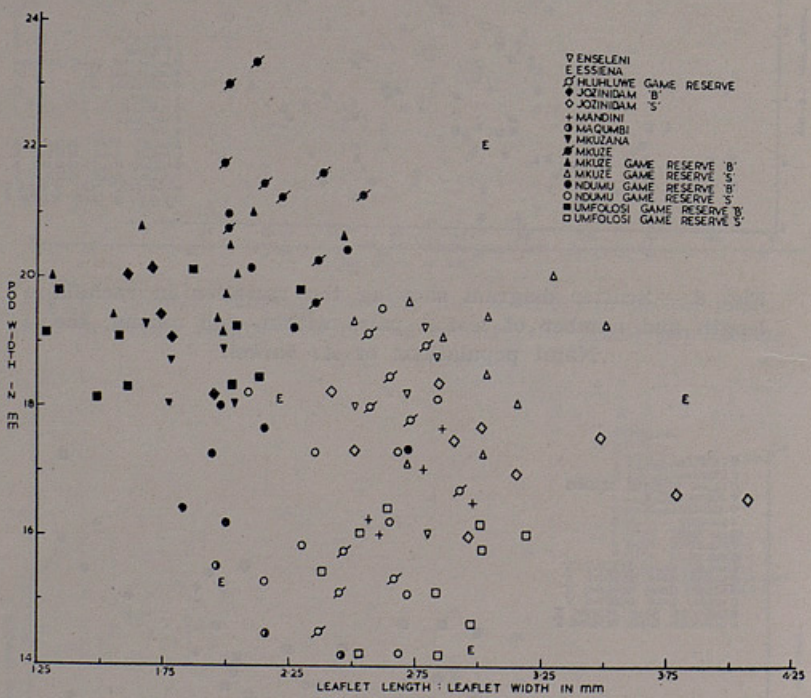


Fig. 10. — Scatter diagram showing the variation in pod width and in the ratio of leaflet length to leaflet width within, and among, the Natal populations of *A. burkei*.

glabrous to glabrous. The indumentum varies from greyish-white to golden.

The degree of pubescence of the ab- and adaxial leaflet surfaces varies considerably, even on a single plant. Leaflets may be completely glabrous ab- and adaxially or, glabrous except for marginal cilia or, sparingly to densely appressed pubescent ab- and/or adaxially. There is typically a small abaxial tuft of hairs to one side of the midrib

at the base of each leaflet. This tuft is normally present even when the leaflet is otherwise glabrous.

There is usually a single petiolar gland although occasionally two may be present. Sometimes there is no gland. The position of the gland which may be at any point between the apex of the pulvinus and the first pinna pair, varies on leaves from a single plant. Gland size also varies.

The number of rachidial glands, each of which lies at the point of attachment of a pinna pair, varies on leaves from a single plant. Usually only the apical pair, or the distal one to three pairs, carry a gland although some leaves have no glands.

Leaflet shape varies considerably on a plant and often on a single leaf. Leaflet shape, which varies from linear to linear-oblong to obovate, obovate-oblong, oblanceolate-oblong to orbicular, is undoubtedly the most variable character displayed by the species. Part of the range of variation in leaflet size and shape is shown in Fig. 11.

Inflorescences are borne in axillary fascicles, crowded into irregular terminal panicles, or sometimes produced singly. The arrangement and density of inflorescences is not constant for a single plant, but varies from branch to branch and from year to year on the same plant and from plant to plant.

Inflorescence axis length varies on a single plant. Two types of galls caused by insects have been observed on the inflorescence axes. In one the insects (thought to be wasps) destroy each ovary which then develops into a small gall so that the inflorescence axis eventually bears numerous small galls [*Ross 679* (NU)]. Similar galls are common in *A. caffra* (Thunb.) Willd. (Ross, 1965). The second type of gall, which is typically spherical and may be up to 26 mm in diameter, is borne singly or in irregular clusters (see Fig. 12). The view has been expressed, although apparently not in print, that the latter galls are caused by a butterfly. Whilst this may well be correct observations on this and on other *Acacia* species indicate that a wasp is more likely to be responsible.

«Big leaflet» plants typically produce fewer pods than «small leaflet» plants, but despite this the former often produce relatively more mature seeds.

The seeds lie transversely in the pods. Weevils, of the family Bruchidae, destroy vast quantities of seed.

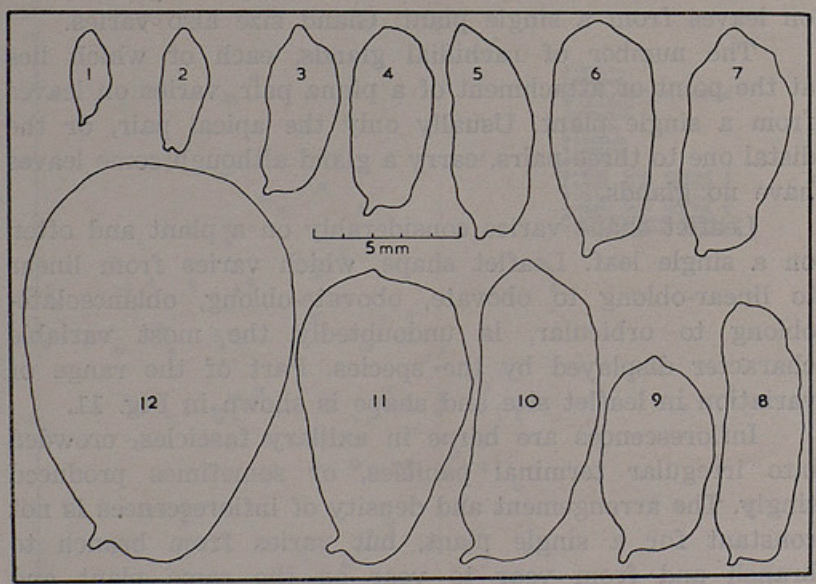


Fig. 11. — Diagrammatic representation of part of the range of variation in leaflet size and shape within the Natal populations of *A. burkei*. 1 from *Ross 1169*; 2 from *Ross 649*; 3, 6 and 11 from *Ross 709*; 4 from *Ross 1377*; 5 from *Ross 647*; 7 from *Ross 1375*; 8 from *Ross 522*; 9 from *Ross 1108*; 10 from *Ross 1111* and 12 from *Ross 648*.

Germination tests show that seeds from both «big leaflet» and «small leaflet» plants are viable.

Leaflet colour, although fairly uniform on a single plant, sometimes varies from plant to plant. This is especially apparent from herbarium specimens. Leaflets may be uniformly green or in some instances the adaxial surfaces are olive-brown and the abaxial green, whilst in others the adaxial surface is glaucous and the abaxial olive-brown. Consequently some specimens «look» different. On some

specimens the leaflets bear numerous yellowish discoid concretions whilst on others abaxial, rust coloured, discoid «hair like» processes have been noted.

Fig. 12. — Close up of the typically spherical, irregularly clustered galls that occur frequently on the inflorescence axes of *A. burkei*. Natal, Hlabisa Distr., Mfekeya Halt, 15 miles N. of Matubatuba. Apr., 1966.

## GENERAL DISCUSSION

a) *Natal Populations*

It has been customary in Natal to distinguish between «big leaflet» plants that grow typically on hard loam together with, or in proximity to, *A. nigrescens,* and between «small leaflet» plants that grow typically on sandy soil. Figures 6-10 reveal the presence of continuous morphological variation within, and among, all populations. It is now proposed to re-examine these figures to establish whether it is possible to differentiate the «big leaflet» from the «small leaflet» plants.

Figure 6 reveals that there is no discontinuity between the «big leaflet» and the «small leaflet» populations on the basis of petiole length or rachis length. Admittedly shortest petioles occur in «small leaflet» and longest petioles in «big leaflet» populations but this is of little significance.

Leaf length (Fig. 7) likewise provides no means of distinguishing between «big leaflet» and «small leaflet» populations. However, although there is no clear discontinuity, there is an overall tendency for leaves of «small leaflet» plants to have more pinna pairs than «big leaflets» plants. It might be suggested that leaves with fewer than six pinna pairs typify «big leaflet» plants since only 10 out of 65 (15.39 %) «small leaflet» plants have leaves with less than six pinna pairs. Similarly, leaves with more than six pinna pairs might be held to typify «small leaflet» plants since only 4 out of 53 (7.55 %) «big leaflet» plants have leaves with more than six pinna pairs. However, when the extremes for number of pinna pairs in Table III are examined it is evident that in seven of the eight «small leaflet» populations the lower extreme is below six. Of the «big leaflet» populations only Mkuze has more than six pinna pairs. 53.85 % of all «small leaflet» plants sampled had some leaves with fewer than six pinna pairs, whilst 14.0 % of the «big leaflet» plants had some leaves with more than six pinna pairs. Thus it is apparent that although «big leaflet» plants tend to have fewer than six pinna pairs, and «small leaflet» plants more than six, number of pinna pairs provides no clear discontinuity.

Rachilla length (Fig. 8) does not provide a means of differentiating between «big leaflet» and «small leaflet» plants. However, as in the case of number of pinna pairs, it is evident that «big leaflet» plants tend to produce fewer leaflets than «small leaflet» plants. In this instance it might be suggested that leaves with fewer than seven leaflet pairs typify «big leaflet» plants and leaves with more than seven, «small leaflet» plants. However, when the extremes for number of leaflet pairs in Table III are examined it is again evident that in seven of the eight «small leaflet» populations the lower extreme is less than seven. 26.15 % of all «small

TABLE III

Extreme and modal morphological parameters for populations of *Acacia burkei* sampled in Natal

| Populations sampled | Petiole length in mm | | Rachis length in mm | | Leaf length in mm | | Rachilla length in mm | | Number of pinna pairs | | Number of leaflet pairs | | Leaflet length in mm | | Leaflet width in mm | | Pod length in mm | | Pod width im mm | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Extremes | Mode | Extremes | Mode | Extremes | Mode | Extremes | Mode | Extremes | Mode | Extremes | Mode | Extremes | Mode | Extremes | Mode | Extremes | Mode | Extremes | Mode |
| Maqumbi . . . . . | 13-33 | 26.6 | 0-63 | 46.6 | 14-94 | 75.1 | 11-34 | 26.0 | 1-4 | 4.0 | 4-5 | 4.0 | 4.3-15.1 | 12.2 | 2.2-8.1 | 5.2 | 71-116 | 103.1 | 13-16 | 14.4 |
| Jozinidam 'B' . . . . . | 10-34 | 25.0 | 11-54 | 37.8 | 21-84 | 60.8 | 6-33 | 21.0 | 2-3 | 3.0 | 1-3 | 3.0 | 4.6-18.9 | 10.3 | 2.6-13.1 | 5.8 | 71-126 | 95.6 | 17-20 | 19.1 |
| Ndumu Game Reserve 'B' | 10-35 | 19.1 | 31-80 | 56.2 | 44-112 | 77.2 | 16-46 | 27.1 | 3-6 | 4.3 | 3-8 | 4.6 | 7.1-20.2 | 12.7 | 3.2-11.9 | 6.0 | 66-131 | 92.2 | 15-22 | 17.6 |
| Umfolosi Game Reserve 'S' | 8-31 | 18.4 | 28-74 | 47.5 | 37-105 | 69.6 | 16-45 | 25.0 | 4-8 | 6.4 | 6-14 | 9.5 | 5.0-11.1 | 7.4 | 1.0-4.8 | 2.8 | 63-111 | 82.3 | 13-17 | 16.2 |
| Hluhluwe Game Reserve . | 7-29 | 16.9 | 24-84 | 46 9 | 33-109 | 63.8 | 17-42 | 26.2 | 4-10 | 6.3 | 6-14 | 9.5 | 5.1-11.9 | 8.1 | 1.8-5.1 | 3.0 | 82-162 | 123.1 | 13-19 | 18.0 |
| Mkuze . . . . . | 8-27 | 16.7 | 11-78 | 47.2 | 20-101 | 67.9 | 9-39 | 25.5 | 3-7 | 5.6 | 3-9 | 6.6 | 3.2-13.6 | 8.7 | 1.8-7.8 | 3.9 | 78-136 | 113.7 | 18-23 | 21.1 |
| Mkuze Game Reserve 'B' | 6-26 | 16.5 | 17-63 | 41.4 | 23-85 | 59.6 | 9-35 | 21.8 | 3-6 | 4.5 | 2-6 | 4.2 | 2.9-13.9 | 8.9 | 1.8-8.2 | 4.5 | 61-108 | 78.4 | 16-22 | 19.8 |
| Mandini . . . . . | 5-34 | 17.0 | 10-78 | 49.4 | 16-102 | 64.2 | 9-46 | 27.2 | 3-12 | 8.4 | 5-16 | 11.6 | 2.9-10.3 | 6.2 | 0.9-5.1 | 2.3 | 57-91 | 78.1 | 15-19 | 16.0 |
| Umfolosi Game Reserve 'B' | 6-26 | 16.6 | 12-58 | 37.2 | 18-81 | 53.8 | 6-44 | 22.4 | 3-6 | 4.3 | 2-6 | 4.2 | 4.4-18.9 | 10.6 | 1.8-12.7 | 6.0 | 51-98 | 63.9 | 17-21 | 19.1 |
| Nduma Game Reserve 'S' | 8-28 | 14.9 | 31-86 | 48.4 | 41-113 | 62.1 | 16-40 | 24.7 | 4-13 | 7.6 | 6-16 | 11.2 | 4.1-11.2 | 6.6 | 1.5-4.1 | 2.5 | 58-134 | 88.9 | 14-19 | 16.5 |
| Enseleni . . . . . | 5-31 | 14.6 | 18-59 | 35.0 | 24-69 | 49.6 | 8-34 | 19.0 | 5-12 | 8.2 | 6-19 | 12.2 | 1.4-6.2 | 4.8 | 0.8-2.4 | 1.6 | 62-91 | 71.0 | 15-20 | 17.4 |
| Essiena . . . . . | 6-23 | 14.2 | 8-43 | 31.4 | 15-63 | 47.3 | 10-29 | 20.8 | 2-7 | 5.8 | 4-13 | 8.8 | 2.9-8.8 | 5.8 | 0.8-4.8 | 2.2 | 58-99 | 75.2 | 14-22 | 18.1 |
| Mkuzana River . . . . | 6-24 | 13.4 | 19-52 | 34.0 | 26-73 | 47.1 | 7-30 | 19.4 | 3-6 | 4.2 | 2-4 | 4.0 | 3.9-14.9 | 8.9 | 3.2-8.7 | 5.0 | 62-108 | 73.7 | 17-21 | 18.2 |
| Jozinidam 'S' . . . . . | 4-21 | 10.8 | 19-57 | 34.3 | 23-75 | 44.7 | 6-47 | 20.6 | 4-11 | 7.0 | 6-14 | 11.1 | 1.9-8.1 | 5.1 | 0.8-3.0 | 1.6 | 59-97 | 72.2 | 15-19 | 16.8 |
| Mkuze Game Reserve 'S' | 5-17 | 10.8 | 9-48 | 33.1 | 14-64 | 42.3 | 7-36 | 20.7 | 6-11 | 8.0 | 7-14 | 10.9 | 1.2-5.8 | 4.3 | 0.8-2.2 | 1.4 | 51-125 | 101.0 | 16-21 | 19.0 |

leaflet» plants sampled had some leaves with fewer than seven leaflet pairs, whilst 14.0 % of all «big leaflet» plants had some leaves with more than seven leaflet pairs. Thus although «big leaflet» plants display a strong tendency to produce fewer leaflet pairs than «small leaflet» plants there is no clear discontinuity.

It is evident (Fig. 9) that there is continuous morphological variation in leaflet length and in leaflet width within, and among, all populations. It has been customary to regard «small leaflet» plants as having leaflets less than 3 mm wide, and «big leaflet» plants as having leaflets more than 3 mm wide. In Fig. 9 no «big leaflet» plants have leaflets less than 3 mm wide, but 18.46 % of «small leaflet» plants have some leaflets more than 3 mm wide. However, when the individual measurements, and not merely the means for each plant within a population are examined, it is apparent that of all plants sampled 29.66 % had no leaflets more than 3 mm wide, 14.41 % had no leaflets less than 3 mm wide, whilst 55.93 % had some leaflets more than, and some less than, 3 mm wide. Thus the value of leaflet width as a means of distinguishing between «small leaflet» and «big leaflet» plants seems questionable.

Plants are frequently encountered on which both «big» and «small» leaflets occur, for example *Ward 4618* (NH). Nearly all plants on which «big» and «small» leaflets have been found together have been typical «small leaflet» plants. In only one instance were «small» leaflets found on a predominantly «big» leaflet plant, and then the «small» leaflets were few and apparently the result of some malformation. Sometimes it is the leaves on coppice shoots of a «small leaflet» plant that are large, whilst in other instances the «big» leaflets are irregularly scattered amongst the «small» leaflets. Frequently the leaf, in whose axil a young branchlet develops, has «big» leaflets. Field notes on the specimen *Ward 4578* (PRE) read «leaflets on some lower young twigs considerably larger than those on older and/or more exposed parts». Others report the leaflets at the crown of the tree being larger than those lower down.

«Big» leaflets are often less pubescent than «small» leaflets.

Pod length provides no distinction between «big leaflet» and «small leaflet» populations. There is a tendency (Fig. 10) for pod width to be greater in «big leaflet» than in «small leaflet» plants. Similarly, seeds in «big leaflet» plants are frequently larger (7.5-10.5 mm wide) than in «small leaflet» plants (6.5-8.5 mm wide), but once again there is no discontinuity. Areole shape in both is similar although the larger seeds have larger areoles. Seeds are usually reddish-brown but in some «big leaflet» plants the seeds are olive-brown.

Although inflorescence axis length varies on a single plant there is a tendency for axes to be longer on «big leaflet» than on «small leaflet» plants.

b) *Relationship of Natal plants to those in remainder of southern Africa*

«Big leaflet» and «small leaflet» populations occur throughout the species range of distribution. From the little information available plants in these remaining areas appear relatively more uniform than the Natal plants, but this may be the result of inadequate knowledge.

In the Transvaal calyces are often distinctly pinkish-red and only sparingly pubescent, whereas in Natal they usually show only a feint pinkish tinge and are densely pubescent. However, apart from these differences the comments on the Natal plants are generally applicable to those in the remaining areas of distribution.

## TAXONOMIC CONCLUSIONS

Neither the «big leaflet» nor the «small leaflet» populations in Natal differ significantly from those in the remaining areas of distribution. Furthermore, field observations in the type locality of *A. burkei* plus examination of the type specimen indicate that neither the «big leaflet», nor the «small leaflet» plants, can be differentiated from

typical *A. burkei* at specific level. Thus it remains to establish whether it is possible to distinguish between «big leaflet» and «small leaflet» plants at infraspecific level within *A. burkei.*

The characters typifying «big leaflet» and «small leaflet» plants are summarised in Table IV.

TABLE IV

Synopsis of characters typifying «big leaflet» *A. burkei* and «small leaflet» *A. burkei*

| «Big leaflet» *A. burkei* | «Small leaflet» *A. burkei* |
|---|---|
| Less than 6 pinna pairs | More than 6 pinna pairs |
| Less than 7 leaflet pairs | More than 7 leaflet pairs |
| Leaflets more than 3 mm wide | Leaflets less than 3 mm wide |
| Leaflets usually broader towards the apex and thus obovate, obovate-oblong or oblanceolate-oblong to orbicular | Leaflets usually linear or linear-oblong |
| Pods broader than in «small leaflet» | Pods narrower than in «big leaflet» |
| Seeds larger than in «small leaflet» (7.5-10.5 mm wide) | Seeds smaller than in «big leaflet» (6.5-8.5 mm wide) |
| Inflorescence axes longer than in «small leaflet» | Inflorescence axes shorter than in «big leaflet» |
| Grows typically on hard loam, often with, or in close proximity to *A. nigrescens* | Grows typically on sandy soil |

These characters typifying each entity are not necessarily correlated but vary independently. Certain combinations of characters are commoner than others, but each combination is frequently modified by the substitution of individual characters which show correlation, to varying degrees of imperfection, with other characters. Thus, athough specimens at either extreme of the range of morphological variation may be readily sorted into two groups there remain numerous specimens that cannot be referred to either group

with certainty. The latter are so common that it is doubtful whether it is desirable to recognise infraspecific taxa.

Although «big leaflet» and «small leaflet» plants each exhibit certain tendencies, there is no absolute distinction between them. For example, typical «big leaflet» plants are characterised in having leaflets more than 3 mm wide and «small leaflet» plants leaflets less than 3 mm wide, but 55.93 % of all plants sampled had some leaflets more than, and some less than, 3 mm wide. Similarly, although leaves of «small leaflet» plants typically have more than six pinna pairs, 53.85 % of all «small leaflet» plants sampled has some leaves with less than six pinna pairs.

The range of morphological variation within, and among, the plants is often not readily apparent to a casual collector, or even from an examination of material in many herbaria, so that to put the extremes, which look so very different, into the same species seems ridiculous. However, when the entire range of variation is inspected it is difficult to divide it satisfactorily. Many specimens cannot be referred to either «big leaflet» or to «small leaflet» with certainty, whilst some specimens exhibit «big» and «small» leaflets.

The are undoubtedly differences between typical «big leaflet» and typical «small leaflet» plants but these differences do not manifest themselves morphologically in a manner that provides a satisfactory means of differentiating one from the other. Consequently, it has been decided not to recognise infraspecific taxa within *A. burkei* at present, but rather to regard it as an inherently variable species. Although not according the «big leaflet» and «small leaflet» plants formal taxonomic recognition, the occurrence of certain tendencies in each must not be disregarded.

Although quite distinct from *A. nigrescens* in having hairy calyces and very conspicuous hairy bracts subtending the flowers, certain *A. burkei* specimens with exceptionally large leaflets superficially bear a strong resemblance to *A. nigrescens*. This resemblance is strengthened since these plants often grow with, or in close proximity to, *A. nigrescens*. Indeed, the view has been expressed, although not in print, that these «big leaflet» *A. burkei* plants might

be the outcome of hybridisation between «small leaflet» *A. burkei,* which may once have been a distinct species, and *A. nigrescens.* Observations in the Ndumu Game Reserve support this suggestion. In the rest camp «small leaflet» plants grow on sandy soil whilst on the boulder bed outcrops near Nyamiti Pan, not very far distant, *A. nigrescens* is found. In the intervening area where the boulder beds are overlain by sand «big leaflet» plants occur in large numbers. Thus, in a relatively short distance typical «small leaflet» *A. burkei,* typical «big leaflet» *A. burkei,* and *A. nigrescens* may be found. Hybridisation between *A. nigrescens* and «small leaflet» *A. burkei* is presumably possible since both flower together. The situation in the Ndumu Game Reserve suggests an ecological differentiation between «big leaflet» and «small leaflet» *A. burkei* but this difference in habitat preference breaks down in other areas. For example, at Essiena «big leaflet» plants occur together with «small leaflet» plants. However, if «big leaflet» *A. burkei* is the outcome of hybridisation between *A. nigrescens* and «small leaflet» *A. burkei* it is difficult to account for the presence of «big leaflet» plants at Essiena and Maqumbi which are both a great distance from the nearest *A. nigrescens* population. As far as is known *A. nigrescens* did not occur within a hundred miles of these populations even in earlier times.

The range of morphological variation within *A. burkei* parallels closely that prevailing in *A. goetzei.* The status of the two subspecies recognised within *A. goetzei* by Brenan (1956) is uncertain since numerous specimens cannot be referred to either with any degree of certainty. That the concept of hybridisation in *Acacia* is not new is evidenced by White's (1962) statement that «it is possible that subsp. *microphylla* (corresponding to «small leaflet» *A. burkei*) is a distinct species, in which case its correct name would be *A. ulugurensis* Taub., and that the plants placed in subsp. *goetzei* (corresponding to «big leaflet» *A. burkei*) have been produced by hybridisation between *A. nigrescens* and *A. ulugurensis*».

Alternatively, «small leaflet» *A. burkei* might perhaps be the outcome of hybridisation between *A. nigrescens* and

«big leaflet» *A. burkei.* In support it must be mentioned that leaflets on a «big leaflet» plant are often relatively more uniform than those on «small leaflet» plants. «Small» leaflets are infrequently found on a predominantly «big» leaflet plant whereas «big» leaflets are often found on «small leaflet» plants.

The manner in which individual genotypes respond to micro-environmental changes is unknown but is quite possible that a character selected in one plant may not be selected in a neighbouring plant. Perhaps the occurrence of big and small leaflets on a single twig can be accounted for by non-disjunction, or some other process, resulting in an uneven distribution of genetic material at cell division so that some cells become larger than others. However, too little is known at present to more than speculate. Preliminary investigations indicate that the cells in «big» leaflets are often larger, but not necessarily more numerous, than in «small» leaflets.

DE WINTER *et al.* (1966) drew comparisons between *A. nigrescens, A. burkei* and *A. galpinii* Burtt Davy and noted that *A. burkei* «could be a hybrid» between *A. nigrescens* and *A. galpinii,* but «its relatively wide distribution and the large number of trees found, makes this seem unlikely». Whilst *A. burkei* may be a hybrid between *A. nigrescens* and *A. galpinii* observations suggest crosses between *A. nigrescens* and *A. welwitschii* subsp. *delagoënsis* or, between *A. nigrescens* and *A. goetzei,* as more likely.

The origin of *A. burkei* is not clear. Most popular is the belief that it is of hybrid origin, for in this way an attempt is made to account for the wide range of morphological variation exhibited. In all attempts to trace the origin of *A. burkei, A. nigrescens* is regarded as a putative parent. The possibility exists that *A. burkei* is the outcome of hybridisation between *A. nigrescens* and another species which has subsequently lost its identity. There is, however, little doubt that *A. burkei* forms part of a complex of closely related species that is taxonomically one of the most perplexing within the African Acacias.

*A. burkei* Benth. in Hook., Lond. J. Bot. 5: 98 (1846); Benth. in Trans. Linn. Soc. XXX: 518 (1875), pro parte excl. *Meller 9* (K) from Manganja Hills and *Kirk*; Harv. in F. C. 2: 282 (1894); Burtt Davy in Kew Bull. Misc. Inform.: 156 (1908), p. p. excl. *Meller 9* (K); Glover in Ann. Bol. Herb. 1: 146 (1915); Burtt Davy in Kew Bull. Misc. Inform.: 325 (1922); Burtt Davy in Man. Fl. Pl. Tvl.: 337-9, Fig. 56 (1932); Codd in Trees and Shrubs Kruger N. Park: 40 (1951); Miller in J. S. Afr. Bot. XVIII: 19 (1952); Young in Candollea 15: 115-7 (1955); Palmer & Pitman in Trees S. Afr.: 150 (1961); de Winter et al. in Sixty-six Tvl. Trees: 42-3 (1966). Type: Transvaal, Magaliesberg, *Burke 126* (K, holo., BM, PRE, iso.).

Syn.: *A. ferox* Benth. in Hook., Lond. J. Bot. 5: 97 (1846), pro parte; Benth. in Trans. Linn. Soc. XXX: 517 (1875), p. p.; Harv. in F. C. 2: 282 (1894), p. p.; non Mart. & Gal. in Bull. Acad. Brux. X: 11 (1843). Type: Transvaal, Magaliesberg, *Burke* (K).

*A. mossambicensis* sensu Henkel in Woody Pl. Natal and Zululand: 233 (1934); sensu Henkel in Ecol. Hluhluwe Game Res.: 17, Pl. VI (1937); non Bolle in Peters Reise Mossamb. Bot. 1: 5 (1861).

Tree to 27 m high with rounded, flattened and somewhat spreading or irregularly open crown. Bark pale or dark yellowish-, grey or reddish-brown, sometimes almost black, rough, irregularly fissured, flaking, often with persistent paired prickles; slash pale salmon to deep red. Young branchlets pale or dark yellowish-, grey or reddish-brown to black, flaking, often minutely, with numerous somewhat transversely elongated reddish- to grey-brown, or whitish lenticels, subglabrous to densely pubescent. Prickles in pairs below nodes, strongly recurved, often with slightly swollen bases, grey- or reddish-brown to black, yellowish when young, up to 1.0 (0.5 ± 0.2) cm long. Leaf: petiole 0.4-3.5 (1.8 ± 0.5) cm long, subglabrous to densely pubescent, ada-

xial gland often absent, variable in position when present, usually slightly raised, rounded to oval, reddish-brown to black, 0.3-0.7 mm long, 0.1-0.4 mm wide; rachis 0-9.1 (4.8 ± 1.4) cm long, subglabrous to densely pubescent, abaxial surface usually without recurved prickles, gland usually present between distal or 1-3 distal pinna pairs only; pinnae 1-13 pairs; rachillae 0.6-5.7 (2.2 ± 0.6) cm long, subglabrous to densely pubescent; leaflets 1-19 pairs, 1.2-20.2 mm long, 0.8-13.1 mm wide, variable in shape, linear to linear-oblong or obovate, obovate-oblong, oblanceolate-oblong to orbicular, apex acute to rounded, veins often prominent abaxially, glabrous ab- and/or adaxially or sparingly to densely pubescent ab- and/or adaxially, typically with small basal tuft abaxially. Stipules in pairs above nodes, ± linear, 1.0-3.5 mm long, 0.2-0.6 mm wide, densely pubescent, caducous. Inflorescence spicate, fascicled or crowded into an irregular terminal panicle, occasionally solitary; flowers sessile or shortly pedicellate, yellowish-white to pale cream; spikes 1.4-14.6 (6.5 ± 2.0) cm long; peduncle 0.4-2.0 (1.3 ± 0.5) cm long, terete, olive-green to reddish-brown, sparingly to densely pubescent, occasionally subglabrous; calyx yellowish-white and tinged with pink or distinctly pinkish-red, campanulate, sparingly to densely pubescent, tube 0.7-1.6 (1.0 ± 0.2) mm long, lobes 0.4-1.1 (0.6 ± 0.2) mm long; corolla yellowish-white and tinged with pink or distinctly pinkish-red, campanulate, glabrous or apices or lobes sparingly pubescent, tube 1.5-2.1 (1.8 ± 0.2) mm long, lobes up to 1.2 (0.8 ± 0.2) mm long, alternating with calyx lobes; stamen filaments free, up to 6.0 mm long, yellowish-white. Ovary glabrous, shortly stipitate, to 1.6 mm long; style glabrous to 4.5 mm long. Legume olive- or dark reddish-brown to black, oblong, usually linear, 4.1-16.9 (9.2 ± 2.2) cm long, 0.9-2.4 (1.8 ± 0.2) cm wide, acuminate at both ends, or apex rounded and slightly beaked, dehiscing longitudinally, venose, coriaceous, often slightly umbonate over the seeds, glabrous, margin ridged. Seeds olive to olive- or reddish-brown, subcircular-lenticular, compressed, 6.0-13.0 mm × 6.0-11.0 mm; central areole distinct 4.0-8.0 × 3.0-8.0 mm, horse-shoe shaped.

## SPECIMENS EXAMINED

Herbarium specimens from the entire distributional range of *A. burkei* in southern Africa were examined but in view of the number involved only one specimen from each magisterial district has been cited.

**Botswana.** SOUTH EASTERN PROV. GABERONES DISTR.: near Gaberones Township, 11 Dec. 1961, *Yalala 150* (PRE, SRGH). KANYE DISTR.: Pharing, Oct. 1946, *Miller B/492* (PRE). KGATLA DISTR.: Mochudi, 15 Oct. 1955, *Reyneke 423* (BM, K, PRE).

**Transvaal.** BARBERTON DISTR.: 3 miles S. E. of Kobinja, top of Lebombo Range, 21 Apr. 1953, *Codd 7809* (PRE). BRITS DISTR.: 26 miles from Pretoria on Rustenburg rd., Magaliesberg, farm Sandfontein, 22 Oct. 1964, *Ross 1512* (NU). GROBLERSDAL/MIDDELBURG DISTR.: slopes of hills in vicinity of Loskop Dam, 30 Apr. 1944, *Mogg 17307* (K, PRE). MARICO DISTR.: 60 miles N. of Zeerust, 6 Oct. 1946, *Louw 1503* (PRE). NELSPRUIT DISTR.: Kruger National Park, Pretoriuskop, 4 Oct. 1954, *v. d. Schyff 3894* (K, PRE). PIET RETIEF DISTR.: Pongola settlement, 5 Mar. 1962, *Codd 10153* (PRE). POTGIETERSRUST DISTR.: on flats at Pruizen, 15 Apr. 1906, *Burtt-Davy* 5239 (BOL, PRE). PRETORIA DISTR.: Pienaarsrivier, Jan, 1931, *Bremekamp H29161* (PRE). RUSTENBURG DISTR.: 27½ miles S. E. of Derdepoort, 9 Feb. 1957, *Acocks 19182* (BM, K, PRE). WATERBERG DISTR.: 1 mile S. of Nylstroom, 27 Sept. 1945, *Codd 4421* (PRE, SRGH). ZOUTPANSBERG DISTR.: Kruger National Park, 5 miles N. E. of Punda Maria, 31 Oct. 1948, *Codd & Dyer 4572* (K, PRE).

**Mozambique.** LOURENÇO MARQUES PROV.: region of Maputo, S. of Lourenço Marques, 21 Aug. 1948, *Gomes e Sousa 3801* (LISC, PRE, SRGH). SUL DO SAVE PROV.: Macia, S. of Martinho, 16 Jul. 1947, *Pedro & Pedrógão 1463* (PRE, SRGH).

**Swaziland.** LUBOMBO DISTR.: Blue Jay Ranch, 27 Sept. 1960, *Compton 30157* (PRE). MANZINI DISTR.: Tulwane, 3 Mar. 1960, *Compton 29876* (K, PRE). SHISELWENI DISTR.: 15 miles from Gollel on Hluti rd., 25 Oct. 1964, *Ross 1526* (NU).

**Natal.** ESHOWE DISTR.: Umhlatuzi valley, 8 miles from Eshowe on Empangeni rd., 22 Jan. 1963, *Edwards 2872* (NU, PRE). HLABISA DISTR.: Hluhluwe Game Reserve, near Hluhluwe R., 29 Oct. 1953, *Ward 1653* (NH, NU, PRE). INGWAVUMA DISTR. Ndumu Game Reserve, lower margins of Ndumu Hill, 29 Jan. 1964, *Tinley 898* (NU). LOWER TUGELA DISTR.: 3 miles S. of Mandini on old main rd., 12 Oct. 1964, *Ross 1359* (NU). LOWER UMFOLOSI DISTR.: 1 mile S. of Enseleni R., 7 miles N. of Empangeni, 12 Oct. 1964, *Ross 1364* (NU). MAPUMULO DISTR.: Otimati valley, Oqaqeni, 28 Mar. 1957, *Edwards 1797* (NU, PRE). NGOTSHE DISTR.: between Candover and Magudu, 31 Jan. 1963, *Strey 4789* (NH, PRE). NONGOMA DISTR.: 11 miles from Nongoma on Magudu rd., 26 Apr. 1964, *Ross 1076* (NU). UBOMBO DISTR.: Mkuze station, 12 Oct. 1964, *Ross 1378* (NU).

## SUMMARY

Population sampling of *Acacia burkei* Benth. was carried out in Natal. Parameters for all measurable morphological characters revealed the presence of continuous variation within, and among, these populations. Herbarium specimens from the species range were examined and the nature of the morphological variation presented. An attempt was made to account for the range of variation exhibited by *A. burkei*. No infraspecific categories were recognised within *A. burkei*.

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# THE *GEISSASPIS, BRYASPIS, HUMULARIA* COMPEX

*by*

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DUVIGNEAUD (1954) revised the taxonomy of the genus *Geissaspis* (Wight and Arnold, 1834) sensu Baker (1908), and erected the new genera *Bryaspis* and *Humularia* to accommodate those taxa occurring in Africa which differ from the Asiatic taxa in having, amongst other characters, stipules which are not attached at a point on their surface but which are basifixed.

The Flora of West Tropical Africa (1958) contains a note under *Bryaspis lupulina* (Planch. ex Benth.) Duvign. on a specimen from Genne Loffa, Kolahun district, Liberia (*Baldwin* 10097), with filiform bracteoles at the base of the calyx. The presence of bracteoles excludes this material from the genus *Bryaspis (stipulis basi non productis, bracteis obliquiter evolutis, bracteolis nullis, vexillo suborbiculare, carenae petalis non coaliescentibus sed fimbriis jurictis).*

A gathering from the Gbenge Hills, Bumban, Sierra Leone (SL 2886) likewise possesses bracteoles and, sharing many morphological features with the Liberian material, suggests that a reappraisal of the *Geissaspis, Bryaspis, Humularia* complex of genera is necessary.

**Geissaspis** Wight and Arnold, Prod. 1834.

Based upon *G. cristata* Wight and Arn. this genus was attributed to the tribe Hedysareae as having the following generic features: Flowers in terminal racemes, with large, persistent, membranous, prominently veined bracts; calyx deeply bilabiate, upper lip entire, lower lip obscurely toothed;

corolla 2-3 times as long as the calyx; standard suborbicular with a short claw; keel obtuse; stamens monadelphous, anthers uniform; ovary sub-stipitate, biovulate; style incurved; stigma minute, capitate; fruit 1-2 segmented with 1 seed in each segment, indehiscent; segments turgid centrally and with distinct flat margin, reticulately veined.

HOOKER's account of the genus (Fl. Ind. 2; 141. 1879) notes that its members are annuals, with two pairs of leaflets and that the bracts, which are ciliate, are half as long again as the flowers.

BAKER, 1908, proposed the subdivision of the much-broadened genus into two sections. Thus the Asiatic species, *G. cristata* Wight and Arn. and *G. tenella* Benth., were allied with *G. lupulina* Planch. ex Benth. from West Tropical Africa, in the section *Eugeissaspis,* the members of which lak bracteoles below the calyx, and other species, mainly from the eastern and central regions of equatorial Africa, were allied in the section *Bracteolaria,* whose members have bracteoles. This, together with reappraisal of other genera, such as *Damapana, Smithia, Kotschya* and *Aeschynomene,* by BAKER, DE WILDEMAN (1914), DEWIT and DUVIGNEAUD (1954), DUVIGNEAUD (1954) (A and B) and others subscribed to the recognition and enlargement of the genus *Humularia.* The former complex of some 45 species of *Geissaspis* is now represented by 55 taxa of *Humularia,* 18 being infraspecific (mainly in Central Africa and extending to Angola and Cameroun and Zambia and Sudan), one species, *Bryaspis lupulina,* in West Africa, and 15 species remaining in *Geissaspis,* extending in Africa from Angola, Congo and Central Africa through East Tropical Africa to Rhodesia and also from India to China. The distributions of the three genera are illustrated in the map (Tab. 1).

**Bryaspis** Duvigneaud. Bull. Soc. Roy. Bot. Belgique 86; 151. 1954.

Represented by the single species *Bryaspis lupulina* (Planch.) Duvign. (*Geissaspis lupulina* Planch. ex Benth., *G. heudelotiana* Baill. ex Tisserant, *G. psittacorhynca* Taub.

of F. W. T. A. ed. 1, 1: 416), which extends throughout much of the Sudan zone of West Tropical Africa and is a characteristic component of the vegetation supported by the thin peaty soils over surface lateritic hardpans, even in the wetter forest areas on the coast in Sierra Leone. The diagnosis of this genus has been given in full above. DUVIGNEAUD gave the diagnosis as a footnote to his key to the genera, being primarily concerned with the taxonomy of the genus *Humularia*. The morphology and distribution of *Bryaspis* confirm that it is correctly established as a distinct genus derived from a *Humularia*-like ancestor. This will be considered later.

**Humularia** Duvigneaud. *loc. cit.*

This genus coincides closely with BAKER's section *Bracteolaria* of *Geissaspis*. Its members are more or less woody, often with bulbous based hairs on stems, leaves, stipules, bracts and bracteoles. The presence of well-developed bracteoles at the base of the calyx is characteristic of the genus and DUVIGNEAUD also attaches significance to the ± foliaceous, auricled or cordate, strongly digitately-nerved stipules, the large, persistent, strongly imbricated and digitately-nerved, bilobed bracts which partially or completeley conceal the flowers and fruits, the panduriform standard with thickened auricles above the claw, the union of the wings by auricular appendages, the union of the keel petals by tangentially elongated cells near their apices, the diadelphous arrangement of the stamens, and the hard, non-reticulated walls of the fruit segments.

Unlike *Geissaspis* and *Bryaspis* species, the members of *Humularia* are very variable and suggest a close affinity with certain *Aeschynomene* species. This is particularly true of the section *Rubrofarinaceae,* with zigzag inflorescences and flowers exposed beyond the bracts, and such species as *Ae. lateritia* Harms. (*Bakerophyton lateritium* Hutch.), but less so in the sections *Lupulariae,* with bracteate, scorpioid inflorescences, and *Bidentatae,* which occurs in the Sudan zone of Central Africa. This suggests that

*Humularia* has recently undergone a phase of evolutionary diversification.

*The Liberian and Sierra Leone materials*

BALDWI'S specimen (*Baldwin* 10097.K) is described as being up to 5 feet tall. This compares with many *Humularia* species, which attain heights up to 2.5 metres, and contrasts with *Bryaspis*, seldom over 2 feet tall, and *Geissaspis*. The taxonomically important features, however, are those of the leaves and stipules, and of the inflorescence (see Tab. 2). The stems, leaves and inflorescence bracts are hispid to setose pilose with hairs arising from swollen bases. The stamens, alae, vexillum and fruit are the only structures which lack at least marginal and/or superficial hairs or cilia.

The leaflets are obliquely obelliptic to oblong, abruptly obtuse at the apex, asymmetrically rounded at the base with the lower margin auricled, 1.4 cm. long and 0.7 cm. wide. The principal vein is prominent below, more or less oblique and excurrent into the minute terminal mucro and its long, multicellular bristle. The lateral venation is obscure and laxly reticulate. The upper epidermis is densely and minutely punctate.

The stipules are simple, ovate, without basal extensions or auricles, somewhat asymmetrically obtuse at the base, acute at the apex, 1 cm. long and 0.5 cm. wide, setose pilose on the margin, with long hairs and short hairs, and with scattered long hairs on the outer surface, and with five prominent veins ascending from the base and looped within the margin.

The inflorescences are pedunculate, humuliform racemes in which the flowers are only partially concealed by the imbricated, orbicular-reniform bracts. Bracts with closely setose pilose margins and numerous setose hairs scattered on the outer surface, up to 1 cm. long and 1.4 cm. wide: the primary venation consisting of conspicuous radiating veins, prominently looped within the margin; secondary veins less prominent and forming a network of long cells near the base and ± isodiametric cells towards the periphery.

The flowers are pedicelled; the pedicels being 0.5 cm. long, shortly hispidulous on the abaxial face, and bearing a fimbriated linear bracteole at each side below the calyx. The receptacle is shortly and shallowly concave and the persistent, bilabiate calyx arises from its rim. The lower calyx lip is 4.5 mm. long, tripartite, the lateral lobes smaller than the central lobe but each acute and ciliate on the margins, and with almost parallel venation. The upper lip is strongly keeled, emarginate at the apex, 6 mm. long; the keel and free margin are setose pilose in the upper two-thirds and hairs also occur on the outer surfaces; the venation is prominent, with a loose reticulum of long cells at the base and ± isodiametric cells at the apex.

The vexillum is ± orbicular, widely and shallowly emarginate and with a small mucro at apex, rounded at the base into a very short claw, 5.5-8.0 mm. long, orange coloured and glabrous, its venation being obscure and consisting of elongate cells towards the base and shorter cells towards the periphery. The alae are obovate elliptic, obtuse, auricled on the upper margin above the short claw, slightly undulate denticulate on the lower margin towards the apex, 5 mm. long and 3 mm. wide, with obscure ascending veins forming elongate cells below and smaller cells towards the apex. The carina is oblong in profile, 6-8 mm. long, its lobes being auricled at the base on the upper margin above the short claws, with a few setose hairs at the apex and ciliate to minutely undulate denticulate on the upper margin, united along the lower margin by minute papilla-like cellular outgrowths, with an obscure, ascending, little-branched venation, reticulate only towards the apex.

The stamens are diadelphous, in two bundles of five; the filaments are alternately long and short (3 long and 2 short in one bundle, 3 short and 2 long in the other).

The ovary is shortly stipitate, 3-ovuled, with a simple upcurved style and simple, terminal stigma. The mature fruit has not been seen but young stages suggest that it is usually 2-segmented with non-reticulated walls.

This specimen resembles *Humularia* in having hairs with enlarged bases, bracteoles, strongly-nerved and ± coria-

ceous leaves and, probably, smooth-walled fruit segments. It resembles *Bryaspis* in having simple stipules, an emarginate upper calyx lip, reniform bracts, an emarginate vexillum, and carina segments joined by intermingled cellular fringes. Its poorest alliance, despite its similar facies, is with *Geissaspis;* with which it shares the characters of marginal setae and very short vexillary claw. More significant from the point of view of circumscription, however, are the character differences which exclude this specimen from the three existing genera. The shapes and structures of the bracts, petals, and stipules exclude it from *Humularia.* The stipules, bracteoles and arrangement of the carina exclude it from *Geissaspis* (sensu Duvigneaud). The bracteoles and hairiness exclude it from *Bryaspis.*

The Sierra Leone specimen (*Morton,* SL. 2886) is a slightly woody herb, up to 1½ feet, growing on peaty soil over rock. Like the Liberian specimen it has long (up to 3 mm.) setose pilose, pale yellowish hairs on stems, stipules, leaves, bracts and calyx.

The leaves are imparipinnate with 3 pairs of opposite leaflets; the leaflets (see Tab. 3) are narrowly and obliquely obovate, obtuse at the apex and asymmetrically rounded at the base, within the lower margin sub-auriculate, up to 1.5 cm. long and 6 mm. wide, margins setulose pilose and hairs also present (sometimes sparsely) on the lower surface, mid vein prominent below, lateral veins obscure and simply looped within the margin, texture coriaceous, upper and lower epidermis densely and minutely punctate.

The stipules are linear lanceolate, slightly acicular, acute, without basal appendages or auricles, prominently ascending nerved, 7 mm. long and 1 mm. wide, setose pilose on the margins and outer surface. The inflorescences are terminal and lateral towards the stem apices, shortly pedunculate humuliform racemes in which the flowers are exposed up to 5 mm. beyond the bracts. Bracts orbicular reniform, up to 1 cm. long and 1.5 cm. wide, closely setose pilose on the margin and with scattered setose hairs on the outer surface; venation consisting of 10-12 prominent veins, looped

within the margin, and a less prominent reticulum of subsidiary veins between, the cells of the reticulum only slightly elongate towards the base of the bract.

Pedicels 4-5 mm. long, sparsely ciliate on the abaxial surface and bearing a setose-fimbriate bracteole at each side below the calyx. Receptacle shortly concave with the persistent bilabiate calyx on its rim. Lower lip of calyx 3 mm. long, ± tripartite at the apex, acute, setose on the margins and with 7 ascending, little-branched nerves. Upper lip of calyx strongly keeled, emarginate at the apex, 6 mm. long, setose pilose on the margins and keel in the upper third, strongly veined with ascending veins looped within the margin and a few cells towards the apex.

The vexillum is obcordate, deeply emarginate at the apex, narrowed into a claw at the base, 5 mm. long and 3.0-3.5 mm. wide, orange, and completely glabrous. Its venation is obscure and consists of elongate cells and smaller cells near the margins. The alae are obliquely obovate, obtuse, auricled on the upper margin above the claw, minutely undulate denticulate towards the apex, 4.5-5.0 mm. long, obscurely veined. The carina is narrowly obovate in profile, its lobes being auricled on the upper margin above the claw; margins with setose hairs and minutely undulate denticulate at the rounded apices, united below by papilla-like fringes; venation obscure.

The stamens are diadelphous, with the vexillary stamen connate with one group and more or less adnate to the other, but the two groups quite free on the lower margin and equitant to the upper suture of the ovary; free part of filaments alternately long and short.

The ovary is shortly stipitate, 3-ovuled, with a simple upcurved style and simple, terminal stigma. The mature fruit is exposed beyond the bracts of the inflorescence, two-segmented (through abortion of the basal ovule), 5-6 mm. long and 2 mm. wide, with a flattened upper suture and a narrow but distinct lower suture deeply indented between the segments; walls of segments convex, membranaceous, lightly veined; style persistent, straight or sharply reflexed.

Seed obliquely reniform ellipsoid, 2 mm. long and 1½ mm. wide, brown, glabrous; funicle subterminal.

This specimen is clearly congeneric with the Liberian specimen; the principal morphological differences being plant size and stipule shape. They occupy similar habitats and, with our present incomplete knowledge of the West African flora, represent two isolated populations within the general area occupied by *Bryaspis lupulina* and remote from their allies in *Humularia* and *Geissaspis* [1]. The relationship between the two specimens is very close, whereas their relationship to other members of the three existing genera is less evident. There are indeed some structural features which suggest an affinity with *Smithia*; a genus which has been much reduced by several authors (DE WIT and DUVIGN., 1954, HEPPER, 1956, WHITE, 1962, WILD, 1964) having transferred species to the genera *Kotschya, Aeschynomene* and *Humularia.* It is evident that the taxonomy of all these genera is very largely influenced by the fact that many of their taxa have been described from limited material from isolated localities; the exceptions to this being the more common and widespread species which, except in *Humularia,* exhibit little variation throughout their range. Few species of *Geissaspis, Bryaspis, Humularia, Smithia, Kotschya* and *Aeschynomene* can be regarded as weeds. Most are components of rather specialised ecological communities, which suggests that their present representatives are probably the results of fragmentation, following centrifugal evolution and dictated by the major fluctuations in the African climatic zones which have occurred in the recent geological past.

On this basis, it is proposed to regard the Liberian and Sierra Leone specimens as conspecific and to compare their

[1] For the purpose of this account, the doubtful record for *Geissaspis psittachorhyncha* is omitted from consideration, although the presence of this species in Cape Verde would have considerable importance in respect of the phyllogeny of members of this complex in West Africa.

affinities with the genera *Geissaspis, Bryaspis* and *Humularia* (see Table).

1) The stipule character distinguishing *Geissaspis* is very marked. The peltate attachement and basal prolongation are strikingly similar to those found in *Smithia elliotii* Bak. f., and identical with those of many *Aeschynomene* species. The stipules of *Bryaspis* are distinguished from those of *Humularia* by DUVIGNEAUD as being narrowed to the base and loosely reticulately veined. This distinction is not reliable since rounded to slightly auriculate bases are common in *Bryaspis* and the principal venation consists of 8-9 prominent veins, radiating from the insertion; the reticulation being very inconspicuous in more coriaceous specimens.

2) The presence of bracteoles must be regarded as more important, taxonomically, than variation in stipule characters. Again, the bracteoles of some *Humularia* species are not distinguishable from those of *Smithia elliotii* and some *Aeschynomene* species. Other *Humularia* species (e. g. *H. elizabethvilleana* De Wild.) have marginal hairs with enlarged bases on the bracteoles and these resemble the fimbriate structure of the Liberian and Sierra Leone specimens.

3) The fusion of the keel petals is regarded by DUVIGNEAUD as important in distinguishing *Bryaspis* which, he states, has intermingled fringes on the margin, as compared with a fused condition in *Humularia* (the suture being composed of tangentially elongated cells). In *H. elizabethvilleana,* however, the suture between the keel petals is composed of a loose tissue of cells not distinguishable from the papillose arrangement in *Bryaspis,* and the margins above and below the fused portion are papillose to ciliate. This is also the condition in *Smithia elliotii.*

4) The stamens are inserted in two bundles of five, on the receptacle, but this diadelphous arrangement is obscured by various degrees of adnation on the adaxial side of the bundles. The vexillary stamen is connate, with four others, to form one of the bundles but is often strongly adnate with the other group, in *Humularia* and the Sierra

Table of affinities between Liberian and Sierra Leone specimens, *Geissaspis*, *Bryaspis* and *Humularia*

| | *Geissaspis* | *Bryaspis* | *Humularia* | Liberian and Sierra Leone specimens |
|---|---|---|---|---|
| Stipules | peltate, appendaged (1) | sub-auriculate | simple to cordate | simple |
| Bracts | obliquely ovate to reniform | ± obliquely reniform | ± flabellate, emarginate | ± obliquely reniform |
| Bracteoles | none | none | simple, lanceolate (2) | simple, linear |
| Calyx | lips simple, rounded on back, lower longer | upper lip emarginate, keeled, longer than 3-fid lower | upper lip emarginate, rounded, lower lip 3-fid | upper lip emarginate, keeled, longer than 3-fid lower |
| Vexillum | orbicular, entire | orbicular, emarginate | pandurate | orbicular emarginate |
| Alae | auricled, free | auricled, free | auricles united | auricled, free |
| Carina | fused | united by papillose margin | fused or united by papillose margin (3) | united by papillose margin |
| Stamens | monodelphous but inserted as two bundles of 5 | diadelphous to adnate above. Filaments of 2 lengths (4) | diadelphous. Filaments of 2 lengths | diadelphous. Filaments of 2 lengths |
| Ovary | 2(-3)-ovuled | 2(-3)-ovuled | 2-ovuled | (2-)3-ovuled |
| Fruit | 2-1-segmented | 2-1-segmented | 2-segmented | 2-segmented |

Leone specimen. In *Geissaspis* fusion of the adaxial margins of the bundles is complete, except at the base where they are inserted as two bundles of five.

Other characters regarded as taxonomically important in this group include the branching of the inflorescence, the contraction of the inflorescence, the concealment of the flowers and fruits, the shape of the receptacle, the texture of the walls of the fruit and the morphology of the pollen grains.

The writer regards the mode of branching of the inflorescence to be of minor importance as a generic character in this group. *Geissaspis, Bryaspis* and *Humularia* are racemose and the humuliform nature of some taxa is due to the foreshortening of the raceme internodes and the great size of the bracts. Concealment of the flowers and fruits is due to the lateral deflection of the pedicel and erect posture of the flower in *Bryaspis* and the Sierra Leone and Liberian specimens. In many *Humularia* species the shorter pedicels are the factor which determines concealment.

The shape of the receptacle has not been found to provide a reliable generic character. In general, it is a shallow concave structure with the stipe of the ovary inserted centrally, within, and the staminal bundles flanking the base of the stipe. The calyx and corolla are borne upon the rim of the concave receptacle. Differences between species, in *Humularia* in particular, are as great as the differences between the three genera, and appear to be correlated with flower size.

The fruit characters of *Geissaspsis* include the reticulately-veined segment walls with a distinct, wing-like margin. This condition is also seen in young fruits of *Humularia* (e. g. *H. purpureo-caerulea* Duvign.), but mature fruits in this genus have more or less muricate, sclerified segment walls and a thickened suture all round the margin and across the constriction between the segments (as in *Kotschya* spp.). An opposite trend is seen in *Bryaspis,* in that its fruits have fully turgid segments with chartaceous walls, loosely but prominently veined and with sutures scarcely thicker than the veins. The fruits of the Sierra

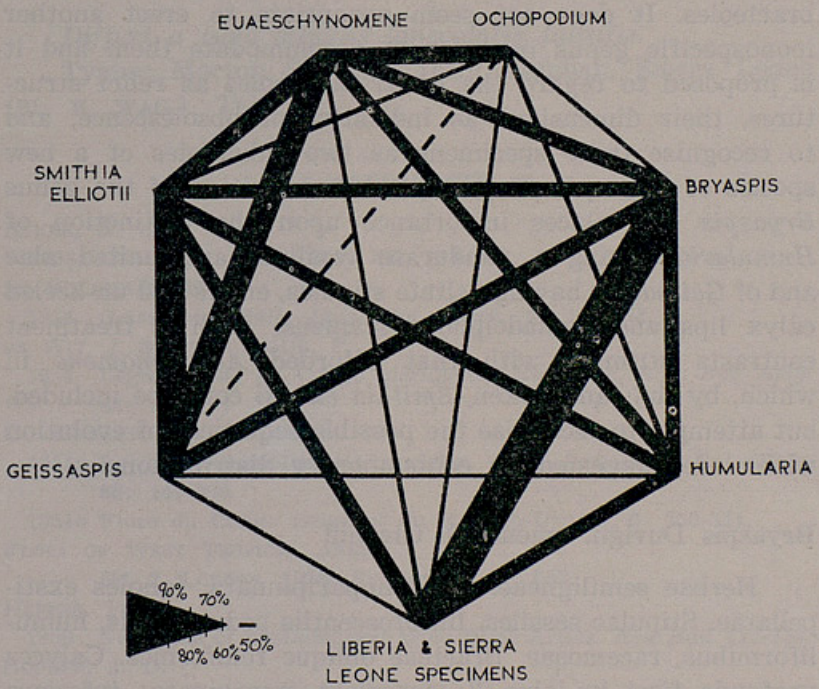
Leone, and probably also of the Liberian, specimen are like those of *Bryaspis* in these characters.

The seed of all the *Geissaspis, Bryaspis* and *Humularia* material examined is remarkably uniform, and differs only in size and testa colour. Seeds of *Smithia* and *Kotschya* are of the same form, and of *Aeschynomene* of similar form.

Pollen morphology may provide additional data of use in the taxonomy of this complex but the writer has only examined pollen of *Humularia purpureo-caerulea, Bryaspis lupulina* and the Liberian specimen. *Humularia purpureo-caerulea* and the Liberian specimen have circular to rounded-triangular triporate grains, about 24$\mu$ diameter, with smooth exine differing only in that the bacules of the Liberian specimen are smaller and therefore produce the effect of a finer reticulum. The grains of *Bryaspis* are circular, triporate, 19$\mu$ in diameter and the smooth exine is very minutely reticulate. From these very limited data, it is suggested that pollen morphology may only prove to be taxonomically useful if samples show that variations within species are small and that variation between genera are clear-cut.

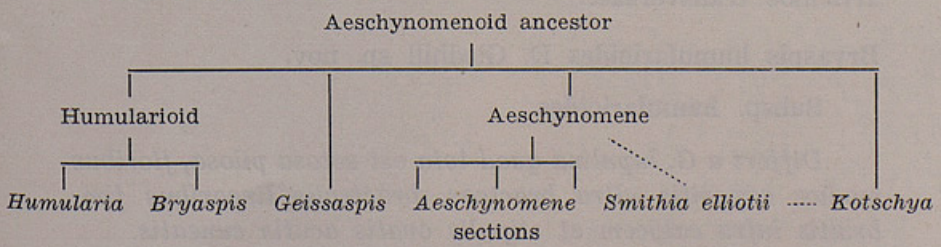
In considering the character combinations which distinguish *Geissaspis, Bryaspis* and *Humularia,* it is significant to note that the same features are also employed as diagnostic of the sections and species of *Aeschynome.* Thus, peltate stipules produced below the point of insertion and a 2-lipped calyx *(Euaeschynomene)* are contrasted with sessile stipules and a 5-partite calyx *(Ochopodium),* 1-2-segmented fruits are contrasted with many-segmented fruits, presence of bracteoles is contrasted with their absence and coiling of the fruits (c. f. *Humularia*) is contrasted with straight fruits. Variation in hairiness, patterns of venation of leaves, stipules, bracts, floral parts and walls of the fruit segments in *Aeschynomene* parallels that between the three genera under consideration here. DUVIGNEAUD postulates the evolution of *Humularia* from *Aeschynomene* and of *Bryaspis* and *Geissaspis* from an earlier ancestor. On the basis of generic size and its pantropic distribution *Aeschynomene* might be regarded as an ancient genus, but

correlation of stipule, bracteole, inflorescence, calyx, corolla and fruit characters (a total of 14 characters, each scored at three levels of similarity) shows the relationship between *Bryaspis,* the Liberian and Sierra Leone specimens and




Correlation polygon to show similarities in respect of 14 characters. Each character was scored at three levels (alike — 3, intermediate — 2, distinctly contrasted — 1). The summed results between taxa are expressed as percentages (maximum correlation score = 42) at five levels.

Sierra Leone specimens and *Humularia* to be greater than DUVIGNEAUD's postulate suggests. A more probable phylogeny might be suggested as:



The Liberian and Sierra Leone specimens can either be regarded as a *Humularia* specis with the unfused wing petals and orbicular vexillum as in *Bryaspis* or as a *Bryaspis* species which has retained an ancestral character of having bracteoles. It does not seem apropriate to erect another monospecific genus in order to accommodate them and it is proposed to regard the linear bracteoles as relict structures, their dimensions as indicative of obsolescence, and to recognise these specimens as two subspecies of a new species of *Bryaspis*. This requires redefinition of the genus *Bryaspis* and places importance upon the distinction of *Humularia* having a pandurate vexillum and united alae and of *Geissaspis* having peltate stipules, entire and un-keeled calyx lips and monadelphous stamens. Such a treatment contrasts strongly with that afforded *Aeschynomene* in which, by the same token, *Smithia elliotii* could be included, but attempts to recognise the possible sequences of evolution which are suggested by contemporary distributions.

**Bryaspis** Duvign. emend D. Gledhill

Herbae semiligneae. Folia imparipinnata, folioles exstipellatae. Stipulae sessiles. Inflorescentiis pedunculatis, humuliformibus, racemosae. Bracteae oblique reniformes. Calyces profunde fissi in labia 2; superiore emarginato; inferiore ad apicem 3-dentato. Vexillum orbiculatum, emarginatum, unguiculatum. Alae auriculis non jugatae. Carina marginibus fimbriatis conjugata. Stamina diadelphidia, antherae uniformes, filamenta alia longa alia deinceps brevia. Legumen breviter stipitatum, articulis 2, sutura inferiore inter articulos indentata; articulis biconvexis, chartaceis, paucis et prominentibus nervis; suturae marginales angustae et inter articulos transversae.

**Bryaspis humularioides** D. Gledhill sp. nov.

Subsp. **humularioides**

*Differt a G. lupulina quod tota est setosa pilosa, floribus modice expositis ultra bracteas, bracteolis linearibus fimbriatis infra calycem et stipulis ovatis acutis cuneatis.*

Typus: *Baldwin,* 10097 from Genne Loffa, Liberia (K). Tab. 2.

Subsp. **falcistipulata** D. Gledhill subsp. nov.

*Differt a typo stipulis lanceolatis falcatis.*

Typus: Morton SL 2886 from Bumban, Sierra Leone (SL. K. WAG.). Tab. 3.

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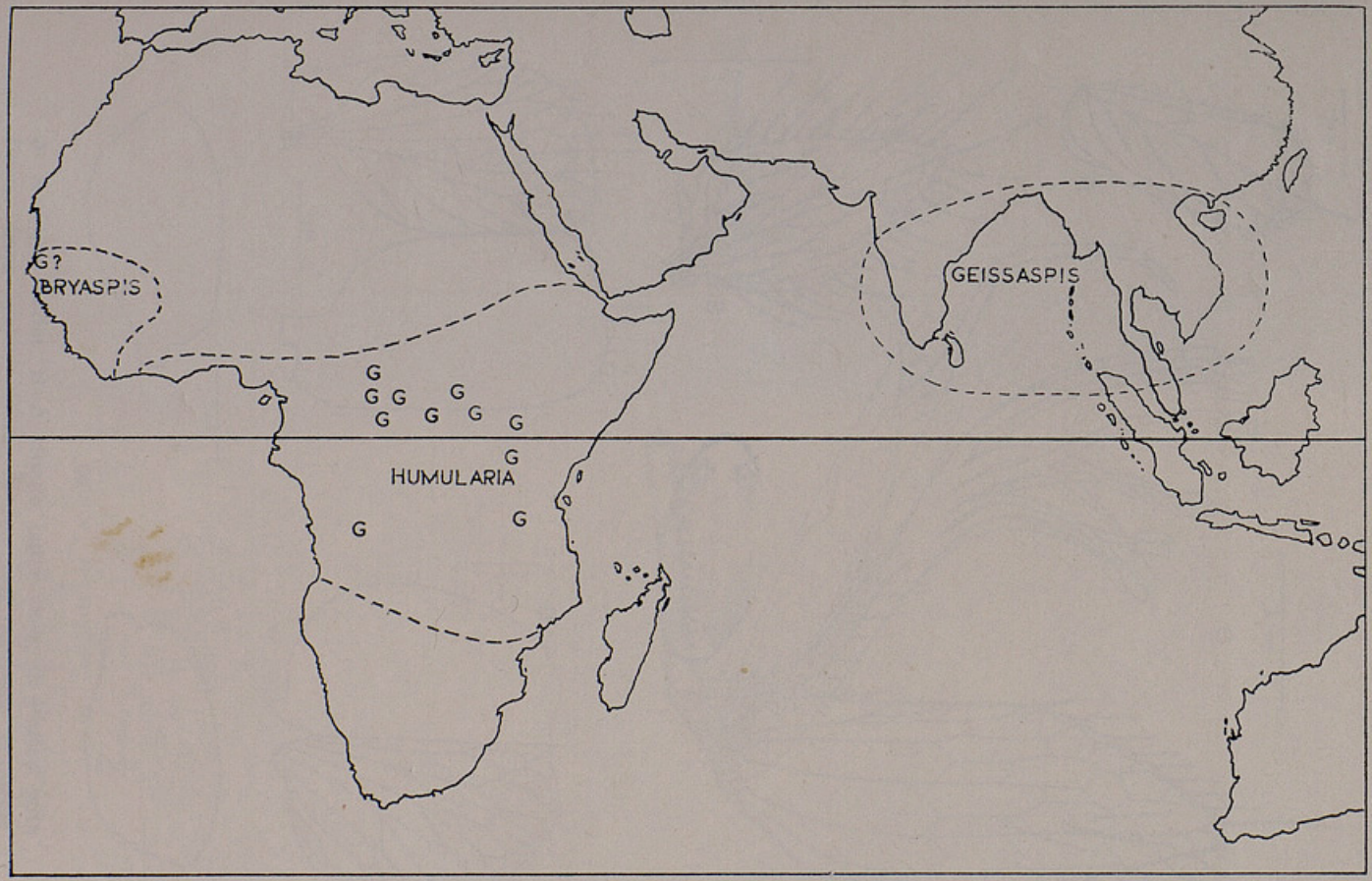
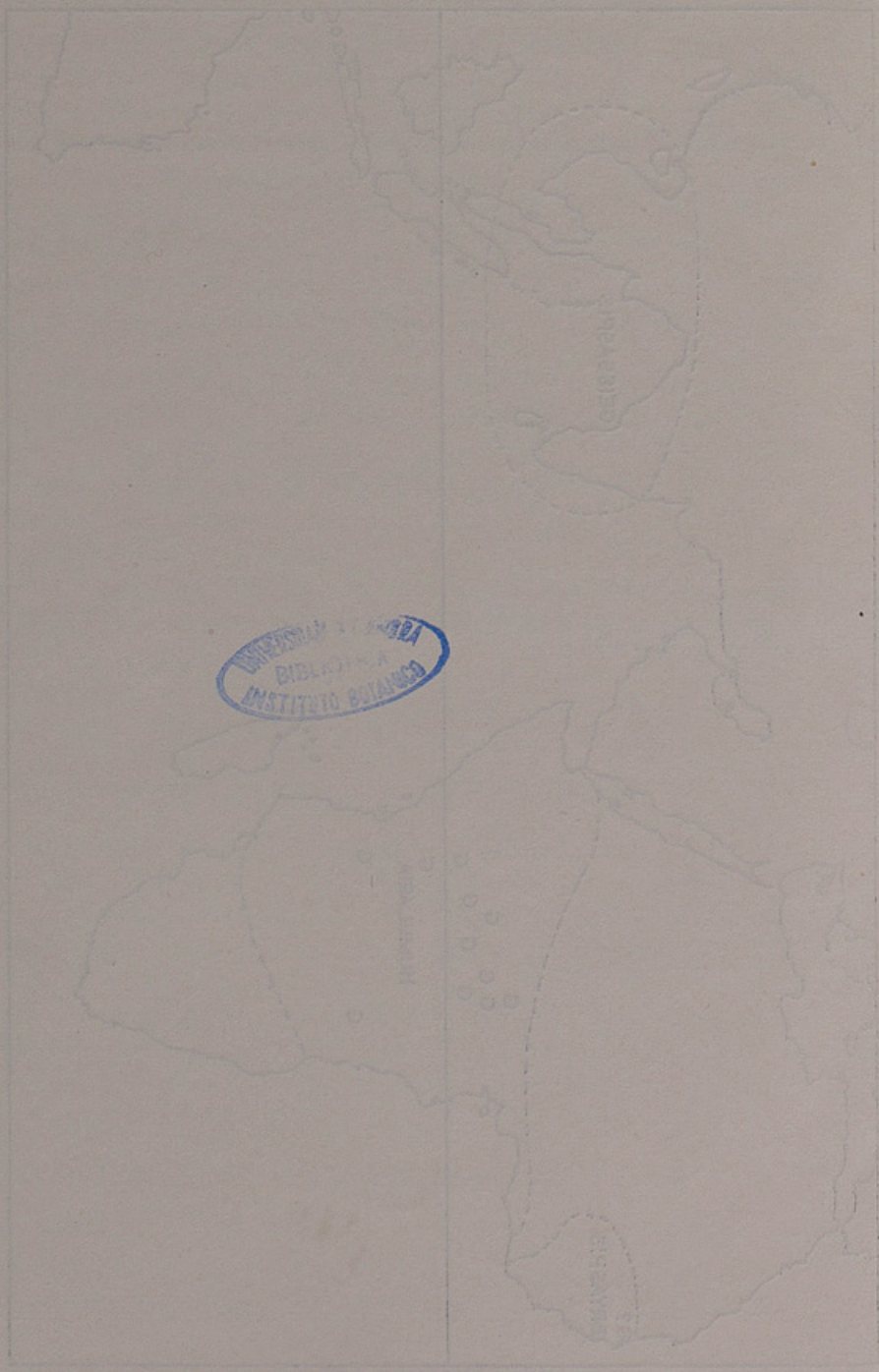
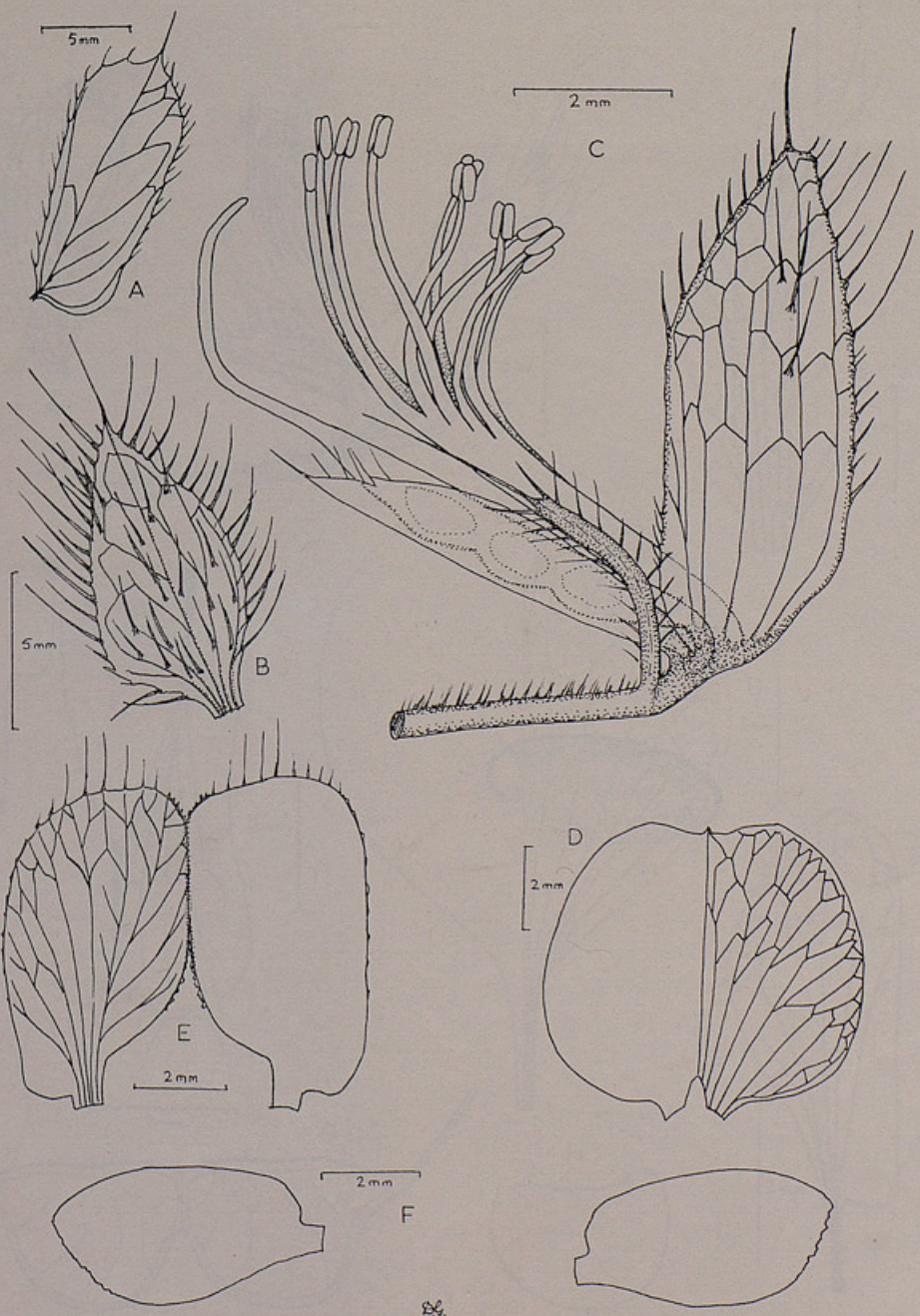


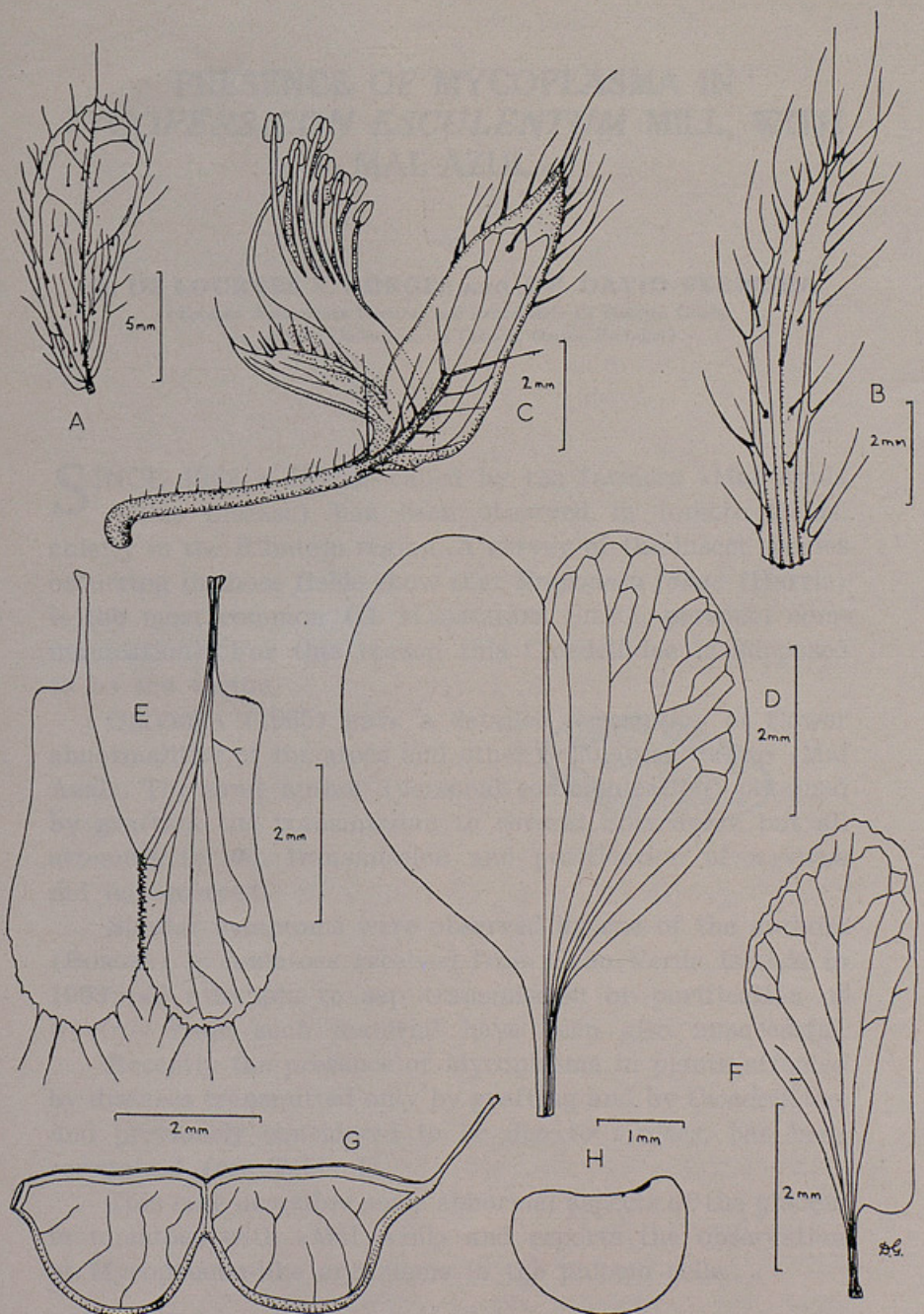

The principal areas of the *Geissaspis*, *Bryaspis* and *Humularia*. The symbol G in the *Humularia* area indicates the approximate areas from which *Geissaspis* species have been described which have not been transferred to *Humularia*.

TAB. I

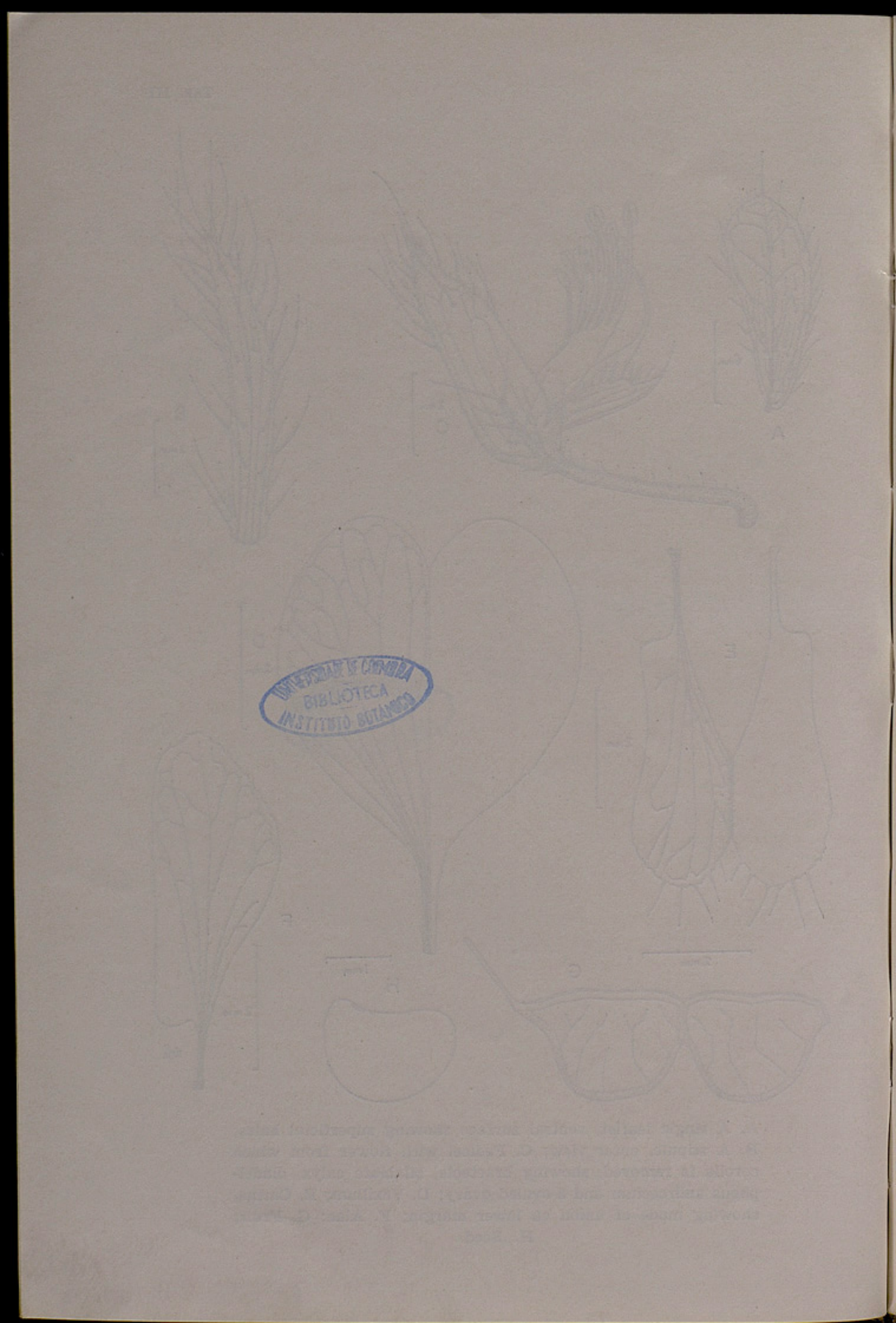





A. A single leaflet; B. A stipule, outer view; C. Pedicel with flower from which corolla is removed, showing bractecle, bilabiate calyx, diadelphous androecium and 3-ovuled ovary; D. Vexillum; E. Carina, showing mode of union along lower margin; F. Alae.




A. A single leaflet, ventral surface showing superficial hairs; B. A stipule, outer view; C. Pedicel with flower from which corolla is removed, showing bracteole, bilabiate calyx, diadelphous androecium and 3-ovuled ovary; D. Vexillum; E. Carina, showing mode of union on lower margin; F. Alae; G. Fruit; H. Seed.



# PRESENCE OF MYCOPLASMA IN *LYCOPERSICON ESCULENTUM* MILL. WITH « MAL AZUL » *

*by*

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SINCE 1962 a disease called by the farmers «Mal Azul» (Blue disease) has been observed in tomato fields, chiefly in the Ribatejo region. A survey of the insect species occurring in those fields show that *Empoasca fabae* (Harris) is the most common (G. MAGALHÃES SILVA, personal communication). For this reason this Cicadellidae is supposed to be the vector.

OLIVEIRA (1965) gave a detailed description of flower abnormalities of tomatoes and other Solanaceae due to «Mal Azul». The same author (personal communication) obtained by grafting the transmission to several Solanaceae but all attempts to sap transmission and purification of a virus did not succeed.

Similar symptoms were observed by one of the authors (BORGES) in tomatoes received from Cabo Verde Islands in 1963; all attempts to sap transmission or purification of a virus from such material have been also unsucessful.

Recently the presence of Mycoplasma in plants affected by diseases transmitted only by grafting and by *Cicadellidae*, and previously considered to be due to viruses, has been recognised (see Table I).

This note describes some abnormal aspects of the phloem in tomatoes with «Mal Azul» and reports the observation of Mycoplasma-like organisms in the phloem cells.

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## MATERIAL AND METHODS

From tomatoes (*Lycopersicon esculentum* Mill.) with typical and severe symptoms of «Mal Azul», graft transmissions have been made to tomato and tobacco plants under insect proof glasshouse. In all these plants no viruses have been detected by sap inoculation in the conventional differential hosts.

Longitudinal sections of adventitious roots, petiols and sepals, including conducting tissues, were fixed in 3 % glutaraldehyde followed by 2 % osmium tetroxide (phosphate buffered). The tissues were embedded in Epon and the thin sections, cut in an LKB Ultrotome, were collected on carbon coated grids. After double staining with uranyl acetate and lead citrate they were examined in a Siemens Elmiskop 1A at 80 Kv. Longitudinal and transversal sections of adventitious roots and stems obtained in a freezing microtome were observed in the light microscope after staining with HEITZ'aceto-carmine.

Naturally and experimentally infected tomatoes as well as healthy ones have been studied.

## RESULTS AND DISCUSSION

Symptoms of «Mal Azul» have been observed in tomato plants a month after grafting. The symptoms begin by a yellowing and rolling of the leaf margins, followed by epinasty, which gives the gotic aspect, typic of Stolbur disease in tomato. The plant becomes thick and by development of lateral conical shoots, the stem looks successively bifurcated. Later on the leaves, due to changes in anthocyanins, become blue-purplish thus giving the name to the disease. The sepals frequently coalesce, the calices usually enlarge and the whole flower structure is disturbed.

In naturally infected plants the fruits are in limited number and usually show woodiness. The seeds are few and sterile. The presence of a great amount of adventitious roots is also a common symptom (fig. 2)

Severity of symptoms is rather dependent on environmental conditions of light and temperature. The symptoms

shown in fig. 1 are developed under low light intensity in a glasshouse.

By the symptoms in tomato and way of transmission «Mal Azul» resembles attenuated aspects of Big Bud disease (SAMUEL *et al.*, 1933), Stolbur disease (KLINKOWSKI, 1958; COUSIN *et al.*, 1966) and Potato Witches' Broom (WRIGHT, 1958).

Under the light microscope an accumulation of chromophilous substances is observed in the phloem cells of roots and stems (fig. 3-7).

An intense hyperplasia of the internal and external phloem is specially obvious in transversal sections of stems (fig. 4). In longitudinal sections, the chomophilous substances are seen in long chains of phloem cells. Under immersion (1250 ×) small granules were observed which may correspond to mycoplasma cells (fig. 7). In sections from healthy plants no similar aspects have been observed.

The alterations we described have been signaled by others in similar diseases. SAMUEL *et al.* (1933) and CICCARONE (1951) refer to the thickness of internal phloem in sections of petiols of tomatoes with Big Bud.

ESAU (1961) studying the anatomic effects of Curly Top and Aster Yellows in order to seek means of distinguishing between the two diseases in the tomato plant found in plants with Aster Yellows, the development of adventitious roots, hyperplasia of internal and external phloem of stems and chromophily of the phloem cells. The corresponding symptoms in tomato plants with «Mal Azul» are more accentuated (fig. 3-7).

COUSIN *et al.* (1966) found abnormal fluorescence in the phloem of plants with Stolbur. Using several staining techniques they observed chromophily in the phloem cells of *Solanum melongena, Datura stramonium* and *Vinca rosea* but not in *Lycopersicon esculentum* and *Solanum nigrum.*

Under the electron microscope mycoplasma-like organisms have been observed (fig. 8 and 9) in the phloem cells of adventitious roots, petiols and sepals from naturally and experimentally infected tomatoes.

The Mycoplasma were observed in the central vacuoles of the phloem cells. Usually the cells were so numerous that they filled completely those vacuoles. Due to the absence of a cell wall, the mycoplasma cells are pleomorphic and in the sections show circular or irregular elongated forms. The circular ones are about 300 to 600 mμ in diameter. Their limiting membrane, 90 mμ thick, has two electron dense layers separated by a less dense one. In some zones the outer layer seems thicker.

Inside the cells an electron dense substance is irregularly distributed close to the membrane. Ribosome-like granules could be recognised. In areas of low electron opacity a net of filaments, usually diverging from a dense bar, have been observed and interpreted as the fine threads of DNA described in Mycoplasma (DIENES *et al.*, 1967, DOMERMUTH *et al.*, 1964).

Besides the elements we just described, smaller cells, the so-called elementary bodies, have also been recognised. They have a limiting membrane and are completely filled with a granular dense material. No threads are visible in those elements.

Fig. 9 shows near a sieve plate mycoplasma cells with round or elongated protrusions. Some of the cells have been blocked by callose on the way to the next phloem cell through the pores of the sieve plate.

We have not yet succeeded in cultivating outside the host the Mycoplasma observed in the infected plants in order to fulfill Koch's postulates. However, the absence of Mycoplasma cells in healthy plants and their presence in organs of plants of different species with similar diseases in different countries (Table I), could be considered as good evidence to accept them as the causative agent.

The effects of antibiotics of tetracycline group in suppressing or, at least, retarding symptoms development of mulberry dwarf disease (ISHIIE *et al.*, 1967), also support this oppinion.

The great number of Mycoplasma cells present in the phloem is sufficient to explain some of the alterations, characteristic of «Mal Azul». The development of lateral

TABLE I

Diseases related with the presence of Mycoplasma-like organisms

| Country of origin | Disease | Plant host | Author |
|---|---|---|---|
| Czechoslovakia | Parastolbur | — | MARAMOROSCH *et al.*, 1968 |
| France | Clover Phyllodie | *Trifolium repens* L. [2] | GIANNOTTI *et al.*, 1968*a* |
| » | Aster Yellow | *Vinca rosea* L. | MAILLET *et al.*, 1968 |
| » | Clover Phyllodie | » » » | » » » |
| » | Stolbur | » » » | » » » |
| » | » | *Nicotiana Tabacum* L. | » » » |
| » | Apple Proliferation | *Malus sylvestris* L. | GIANNOTTI *et al.*, 1968*b* |
| » | Stolbur | *Solanum lycopersicum* L. | » » 1968*c* |
| Japan | Aster Yellows | *Petunia* sp. | DOI *et al.*, 1967 |
| » | Mulberry Dwarf | *Morus* sp. | » » » |
| » | Potato Witches'Broom | *Solanum tuberosum* L. | » » » |
| » | Paulownia Witches'Broom | *Paulownia* sp. | » » » |
| Philippines | Rice Yellow Dwarf | *Oriza sativa* L. | SHIKATA *et al.*, 1968 |
| Portugal | «Mal Azul» | *Lycopersicon esculentum* Mill. | in the present paper |
| Rumania | Stolbur | — | MARAMOROSCH *et al.*, 1968 |
| Taiwan | Sugar Cane White Leaf | *Saccharum* sp. | SHIKATA *et al.*, 1968 |
| U. S. A. | Aster Yellows | *Calistephus chinensis* Nees | MARAMOROSCH *et al.*, 1968 |
| » | » » | *Nicotiana rustica* L. | » » » |
| » | Maize Stunt | *Zea mays* L. [3] | » » » |
| » | » » | » » » [3] | GRANADOS *et al.*, 1968 |
| U. S. S. R. | Crimean Yellows | — | MARAMOROSCH *et al.*, 1968 |

[1] Names according to MARTYN (1968), except «Mal Azul»

[2] Mycoplasma has been also found in the insect vector *Euscelis plebejus* Fall

[3] Idem in *Dalbulus elimatus* (Ball)

shoots, great number of adventitous roots, rolling and thickness of the leaves and lower resistance to humidity changes are typical symptoms of a disease of the conducting tissues.

## CONCLUSIONS

Mycoplasma-like organisms have been consistently observed in the phloem of adventitious roots, petiols and sepals of tomatoes naturally and experimentally infected with «Mal Azul». No similar microorganisms have been found in healthy plants. Mycoplasma are tentatively accepted as the causative agent of the disease.

The demonstration of Mycoplasma in plants affected with Stolbur, Parastolbur, Aster Yellows, Clover Phyllodie, Potato Witches'Broom and «Mal Azul» supports the previous suggestion of a relationship amongst those diseases. The differences observed in the severity of simptoms and host range implies the possibility that different strains or species of Mycoplasma are involved.

## SUMÁRIO

O «Mal Azul», enfermidade do tomateiro, frequente em Portugal, é transmissível por enxertia e supõe-se ter como vectores naturais *Cicadellidae*. A sua etiologia tem sido até agora atribuída a vírus.

A observação ao microscópio electrónico de cortes de raízes adventícias, pecíolos e sépalas de tomateiros com infecções naturais e experimentais revelou, nas células do floema, a presença de microorganismos morfològicamente idênticos a Mycoplasmas. Observações semelhantes foram feitas no Japão, França e Estados Unidos da América em enfermidades idênticas em diversos hospedeiros provenientes de vários locais e também até agora atribuídas a vírus.

Estas observações, assim como o facto de ter sido conseguida no Japão a eliminação de doenças deste grupo após tratamento com antibióticos do grupo das tetraciclinas, levam a considerar os Mycoplasmas como agentes patogénicos para as plantas. Tendo em conta estes dados é necessária

e urgente a revisão da etiologia das enfermidades até agora atribuídas a vírus e apenas transmissíveis por enxertia ou por enxertia e vectores do tipo dos *Cicadellidae*.

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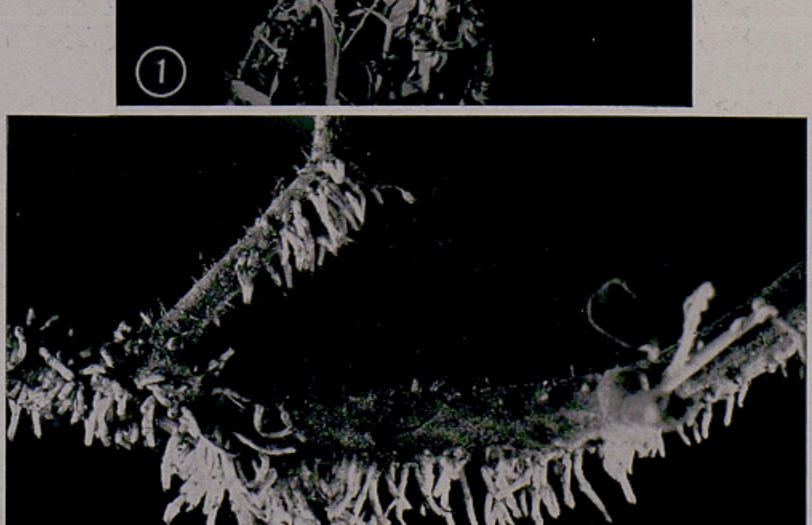
# PLATES

PLATE I

**Lycopersicon esculentum** L. with «Mal Azul»
Symptoms in plants experimentally infected by grafting (fig. 1).
Prostrated stem of naturally infected plant showing a great number of adventitious roots (fig. 2).

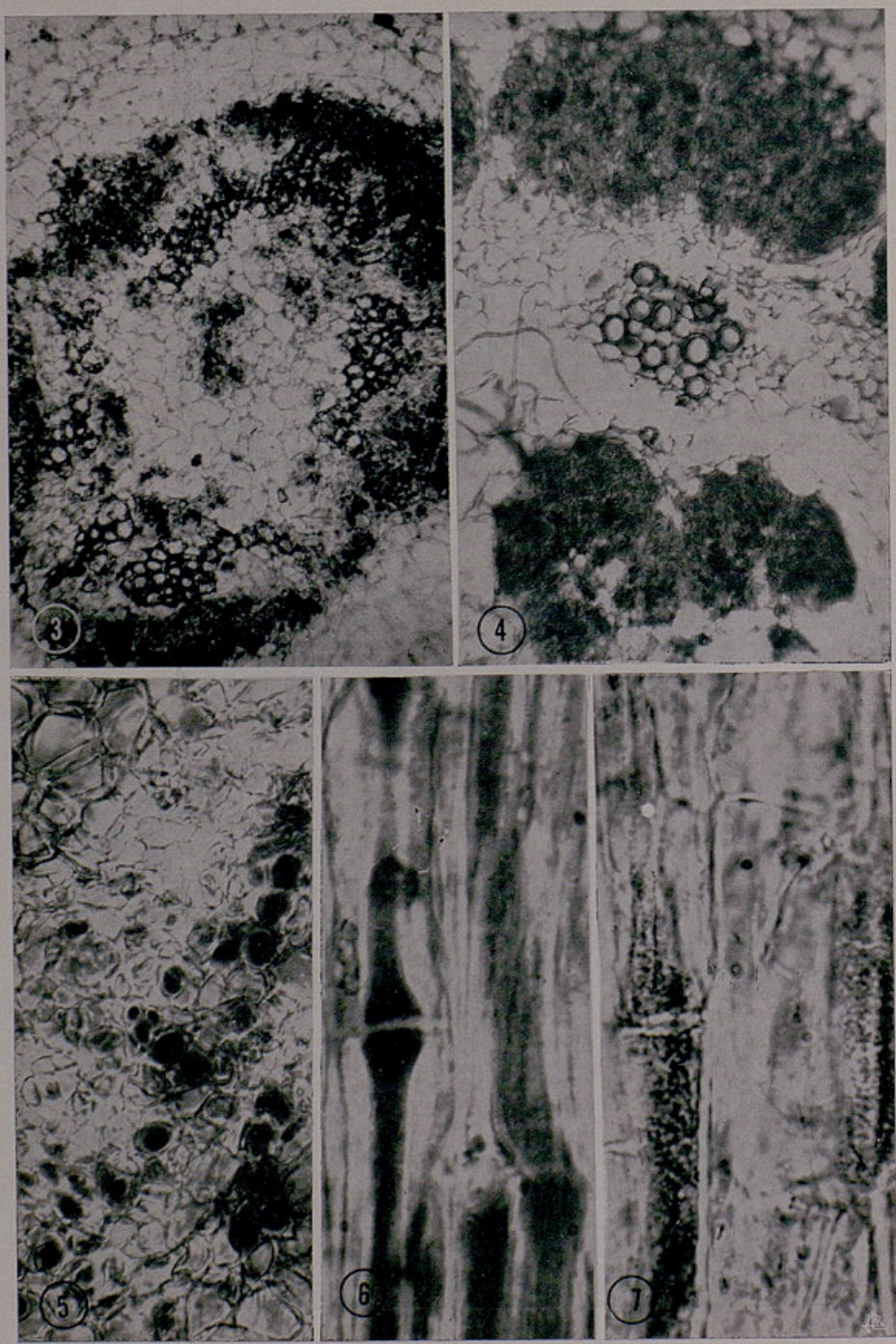

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PLATE II

**Lycopersicon esculentum** with «Mal Azul»
Abnormal development of phloem and presence of chromophilous substances inside phloem cells.
Transversal section of adventitious root (fig. 3). Detail (fig. 5). Transversal (fig. 4) and longitudinal (fig. 6 and 7) sections of stems.

PLATE III

**Lycopersicon esculentum** with «Mal Azul»

Transversal section of a phloem cell, showing the cell wall (w), marginal cytoplasm (c) and mycoplasma cells.

It is possible to recognise in the larger mycoplasma-cells the unit membrane, ribosomes and DNA threads (fig. 8).


W
C
8

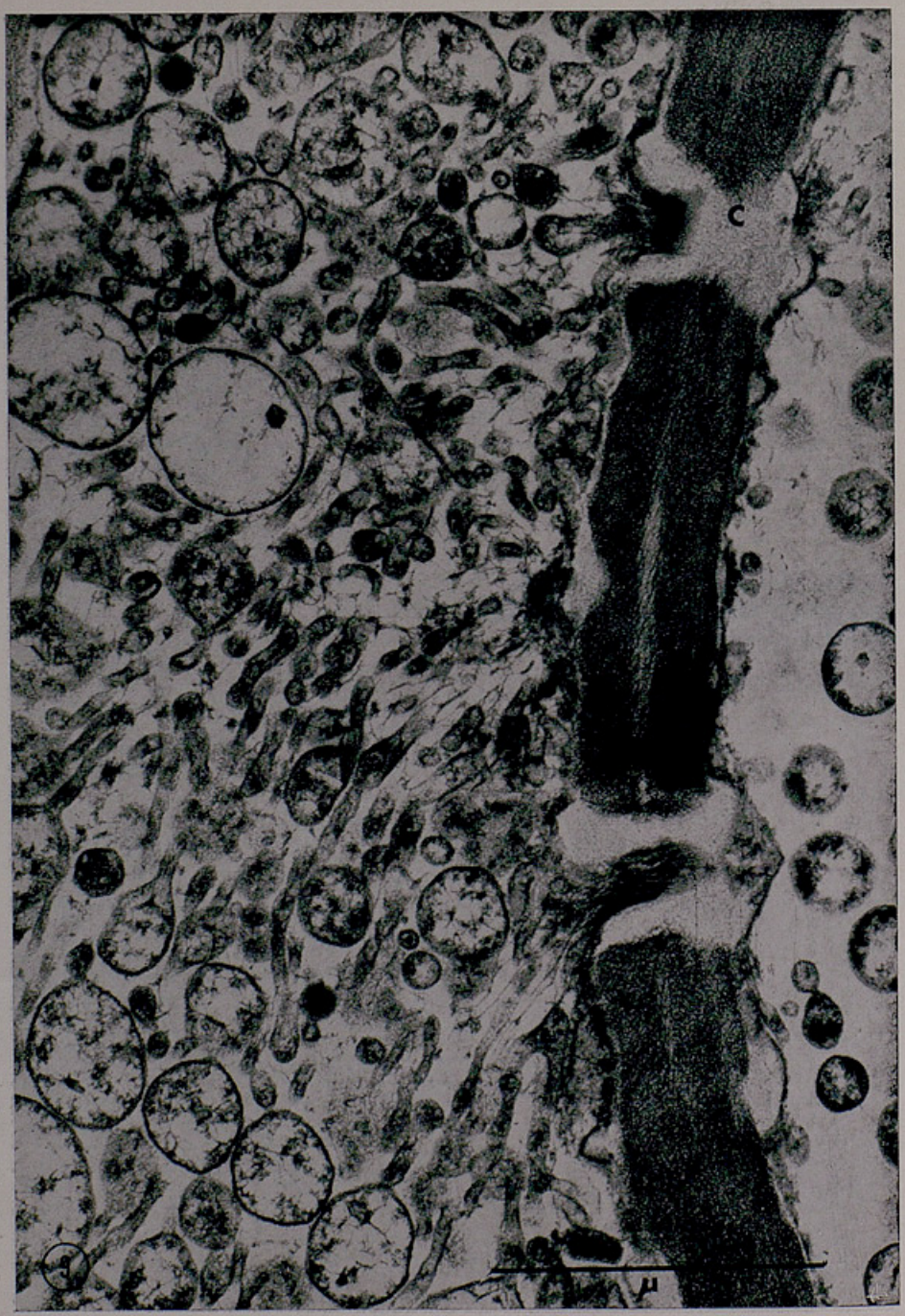
C
μ

PLATE IV

**Lycopersicon esculentum** with «Mal Azul»
Longitudinal section of a sieve element. The sieve pores of the plate are filled with callose (c).
Elongated forms of Mycoplasma have been blocked on their way through the pores (fig. 9).

# ÍNDICE