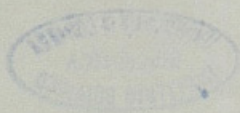


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REVISION OF THE *COMBRETACEAE*

by

A. W. EXELL and C. A. STACE

SINCE the publication of «The Genera of *Combretaceae*» by EXELL (1931), intensive work by STACE (1965 *a, b*) on epidermal structures in the family and the natural increase of knowledge during a period of 35 years have led to a few important changes in the classification. It now seems desirable to publish new keys to the subfamilies, tribes, subtribes and genera incorporating these changes. These new keys, if in some instances rather more complicated, are more precise and give, we hope, a more accurate picture of the relationships.

a) *The Family Combretaceae*

The family in its present circumscription is, we believe, an extremely natural one. The characteristic compartmented hairs are found in every genus (including *Strephonema*) and in the vast majority of species. We have no doubt that every genus here included in the family rightly belongs to it; nor do we suspect that any other genus known to us and at present placed in another family has any claim to be transferred to the *Combretaceae*. As has long been recognized, the family nearest to it is probably the *Myrtaceae* where, in fact, compartmented hairs are known to occur in a few genera (SOLEREDER, 1908).

A somewhat speculative account of ideas on lines of evolution in the family was given by EXELL (1962) in a paper entitled «Space Problems arising from the Conflict between two Evolutionary Tendencies in the *Combretaceae*». The



hypothesis elaborated was that several of the genera are based on characters which have arisen as solutions of problems resulting from evolutionary tendencies: (1) towards distribution by winged fruits; (2) towards massing of the flowers in more or less congested heads. The conjunction of these two tendencies seems to have resulted in certain problems concerning the spacing of the fruits in the infructescence.

A tendency towards elongation of the upper receptacle is well-marked in the *Combreteae* subtribe *Combretinae* (reaching a maximum in *Quisqualis indica*) and in the *Laguncularieae* but is absent in the *Combreteae* subtribe *Terminaliinae*. Any tendency towards increase in the number of stamens is extremely rare (*Combretum mellifluum* var. *hyperteleiandrum* Eichl. has 16 stamens) but a reduction to one whorl occurs in the *Combreteae* in subtribe *Combretinae* (*Meiostemon* and *Thiloa*), in subtribe *Terminaliinae* (*Terminaliopsis* and *Conocarpus*) and in the *Laguncularieae*. Nearly all the *Myrtaceae* have numerous stamens but as to whether the *Combretaceae* evolved from that condition by reduction or whether on the contrary the *Myrtaceae* show increase of stamens there is no evidence. The genus *Strephonema*, which by its only semi-inferior ovary has some claim to be an ancestral type in the *Combretaceae*, always has two whorls of stamens.

b) *Subfamilies, Tribes and Subtribes*

Strephonema differs fundamentally from all the other genera by its semi-inferior ovary, 2-armed hairs (in four of the five species), paracytic stomata and revolute domatia so that its recognition by ENGLER & DIELS (1899) as a separate subfamily, *Strephonematoideae*, as distinct from the *Combretoideae*, seems entirely justified. ENGLER and DIELS (loc. cit.) divided the *Combretoideae* into four tribes: *Combreteae*, *Terminalieae*, *Calycopterideae* and *Laguncularieae*. Of these the *Laguncularieae* are very distinct from the other three in possessing a pair of bracteoles adnate to the lower receptacle and in the lack of development of a pattern of the venous system on the upper epidermis. They are best recognized as

of equal status to all the rest of the subfamily *Combretoideae*. They constitute the tribe *Laguncularieae* while the other three tribes of ENGLER and DIELS are considered to form the single tribe *Combreteae*.

The three genera of *Laguncularieae* (*Laguncularia*, *Lumnitzera* and *Macropteranthes*), although obviously closely related to each other, are quite distinct on floral, fruit and epidermal characters.

The remaining genera of *Combretoideae* might easily be placed in three subtribes, each equivalent to the corresponding tribes of ENGLER and DIELS (loc. cit.), but the validity of one of these, *Calycopterideae*, is doubtful. In the *Combreteae* as here defined two major lines of development are recognizable, centred around *Combretum* and *Terminalia* respectively. The genera of the first group, in the main, have scales or stalked glands on the leaves (and often elsewhere), have a scarcely or non-lignified pericarp, have bisexual flowers, tend to have 4-5-winged or, less often, 4-5-ridged fruits, have no petiolar sessile glands, have opposite or pseudoverticillate leaves, have plicate cotyledons and have petals in most of the seven genera and in the great majority of the species. These are the *Combreteae* sensu Engler and Diels. Those of the second group, in the main, have no scales or stalked glands on the leaves (or elsewhere), tend to have a lignified pericarp, have andromonoecious flowers, tend to have flattened fruits, have alternate or spirally arranged leaves, have spirally convolute cotyledons and lack petals. These are basically the *Terminalieae* of ENGLER and DIELS. There are a few exceptions to almost all of these differences but petals are always absent and (as far as is known) the cotyledons are always spirally convolute in the *Terminalia*-group. A combination of characters will effect good separation of the two groups.

Calycopteris, the only genus of the tribe *Calycopterideae* Engl. & Diels, although separable from each of the above groups on a single well-defined character, does not form a group as distinct as either of them. Although it lacks petals and has spirally convolute cotyledons, both of which are *Terminalian* characters, it is clearly closer to the *Combretum*-

group as it has bisexual flowers, opposite leaves without petiolar glands and, most important, well-developed scales on the leaves. The distinctive character of *Calycopteris*, the accrescent petaloid calyx, is no more important than certain characters in such genera as *Buchenavia* and *Conocarpus* which might equally well be used to separate various tribes or subtribes.

Pteleopsis, included by ENGLER and DIELS in their *Combretaceae*, provides a problem, however, to which we have given long consideration. It appears to be exactly intermediate between the *Combretum*-group (subtribe *Combretinae* in our classification) and the *Terminalia*-group (*Terminaliinae*) and rather than attach it arbitrarily to either of these we have decided that it is best placed in a third subtribe, the *Pteleopsidinae*. It agrees with the *Combretinae* in having petals (absent without exception in the *Terminaliinae*) and opposite leaves: it agrees with the *Terminaliinae* in having spirally convolute cotyledons (recently kindly confirmed for us by T. MÜLLER who has germinated seedlings in Salisbury, Rhodesia), in the usually flattened fruits, in the andromonoecious flowers and, very important, in the complete lack of scales and stalked glands. Although the number of characters listed above seems to indicate a relationship rather nearer to the *Terminaliinae* than to the *Combretinae* great weight must obviously be given to the presence of petals (always absent in the *Terminaliinae*). It is easy to envisage a loss of petals occurring at some stage after the separation of the two main subtribes, as is presumably the case in *Thiloa*, *Calycopteris*, *Guiera*, *Combretum rupicola* and *C. apetalum*. But a *re-acquisition* of petals by *Pteleopsis* would seem far less probable. If that be excluded the only justification for placing it in the *Terminaliinae* would be to consider it a kind of prototype of that subtribe retaining the *Combretum*-like characters of petals and opposite leaves. In the absence of convincing evidence for this we eventually decided that its intermediate position is best indicated by giving it the status of a separate subtribe.

Thus three subtribes are recognized in the tribe *Combretaceae*: *Combretinae*, comprising the *Combretaceae* (excluding

Pteleopsis) and *Calycopterideae* of ENGLER and DIELS; *Pteleopsidinae*, with the single genus *Pteleopsis*; and *Terminaliinae* comprising the tribe *Terminalieae* of ENGLER and DIELS. They are considered to represent two main natural monophyletic evolutionary groups with a third intermediate group which may have evolved from either of them or may be equally ancient.

c) *Subtribe Combretinae*

This subtribe comprises the genera *Combretum* (with the great majority of species), *Quisqualis*, *Meiostemon*, *Thiloa*, *Calopyxis*, *Guiera* and *Calycopteris*.

Combretum itself has been divided into separate genera in various ways, the two most frequent segregates being *Cacoucia* and *Poivrea*. None of the characters used to delimit them is constant, however, and both names have been used for various quite different concepts. The distinctive characters of *Combretum* are the petalous bisexual flowers, the stamens in two whorls of 4-5 each (or rarely with one or two extra whorls in some specimens) and the presence of scales or stalked glands on the leaves (and elsewhere). Only two species, apart from occasional abnormal forms. Lacking petals, do not fit this diagnosis: *C. rupicola* (sect. *Terminaliopsis*, not to be confused with the genus of that name) with dioecious apetalous flowers (the male unknown) and scales on the leaves; and *C. apetalum* (sect. *Apetalae*) with bisexual flowers with ten stamens in two whorls but with no petals, and with scales and stalked glands on the leaves. *C. tetrandrum* and *C. humbertii*, each with only one whorl of four stamens, have been transferred to the new genus *Meiostemon*. The two aberrant species, *C. rupicola* and *C. apetalum* are in quite different categories. *C. rupicola* is obviously an isolated (it is confined to Fernando Noronha) evolution from sect. *Combretastrum* which has developed dioecism and lost its petals. Its place in the system is clearly next to that section. *C. apetalum* has no close relationship with any other species or section and will be considered later.

Apart from *C. apetalum*, the genus *Combretum* can be divided into two large groups: species with scales and those without scales but with stalked glands on the leaves and elsewhere. These two groups, based on the glandular trichomes, are easily distinguishable, at least microscopically, and are considered to represent two separate evolutionary lines which we recognize as subgenera: subgen. *Combretum*¹ (containing the type species of the genus, *C. fruticosum*) with scales; and subgen. *Cacoucia*¹ with stalked glands but no scales.

Up to the present *Cacoucia* (the earliest generic name available for scale-less species) has almost always been reserved (as a genus or section) for those species with elongated curved upper receptacles: we are thus considerably extending its circumscription. As far as we know the genus *Combretum* has never before been divided into subgenera but there have been several attempts to separate the pentamerous species (as genera or sections) from the tetramerous ones, the former usually under the name *Poivrea* [*Poivrea* Comm. ex Juss., Gen. Pl.: 320 (1789) in syn. (sphalm. *Pevraea*); ex Thou., Obs. Pl. Iles Austr. Afr.: 28 (1801) based on a Madagascar plant to which COMMERSON gave the manuscript name of *Poivrea*, later named *Combretum coccineum* (Sonnerat.) Lam.]. Thus EICHLER (1867) divided the genus *Combretum* (excluding *Cacoucia*) into three groups of which *Poivrea* contained the pentamerous species (comprising in Brazil only certain forms of one lepidote species, *C. hilarianum*, the scales being overlooked). CLARKE (1878) recognized four sections of *Combretum*, the name *Poivrea* being again used for the pentamerous species which, except for *C. apetalum*, were all non-lepidote. PERRIER DE LA BATHIE (1953) used *Poivrea* (as a genus) for only the Madagascan species of *Combretum*, but he was clearly in error as

¹ *Combretum* subgen. *Combretum* ramulis, foliis, floribus et fructibus lepidotis.

Combretum subgen. *Cacoucia* (Aubl.) Exell & Stace, subgen. et stat. nov. [*Cacoucia* Aubl., Pl. Guian. 1: 450, t. 179 (1775)] ramulis, foliis, floribus et fructibus elepidotis cum glandulis stipitatis.

the species of the island fall into two glandular sections and one lepidote section of ENGLER and DIELS.

As will be seen from the above, there is a loose correlation between pentamery and stalked glands on the one hand and between tetramery and scales on the other, but pentamery and tetramery show considerable inconstancy in *Combretum*, pentamerous and tetramerous species often being apparently closely related to each other, and both types of flower are at times found on the same individual. We are strongly of the opinion that the two main subgenera of *Combretum* should not be delimited on the pentamerous or tetramerous nature of the flowers but on the presence of either stalked glands or scales.

It remains to consider the second aberrant species mentioned above, *C. apetalum*, a very distinct species with no obvious close relations. Besides lacking petals it possesses both scales and stalked glands, a character otherwise very rare in *Combretum*. The scales are also unique in anatomy. As the loss of petals occurs elsewhere in *Combretum* (e. g. in *C. rupicola* and in abnormal forms and as the trichomes combine the characters of the subgenera *Combretum* and *Cacoucia* there seems little justification for separating it as a genus. We have decided to treat it as a subgenus, *Apetalanthum*¹.

Quisqualis was separated from *Combretum* by EXELL (1931) on the character of the adnation of the style to the upper receptacle. This led, however, to the transference of *Combretum hensii* to *Quisqualis* and this has since proved to be unsatisfactory as this species is certainly much better placed in *Combretum*. Moreover, L. LIBEN kindly sent us a specimen of *Ghesquière* 2706, which he has since described as *Combretum ghesquierei* (LIBEN, 1965), in which the style is very shortly adnate to the upper receptacle. This species has scales on the leaves (a character unknown in *Quisqualis*) and is undoubtedly a true *Combretum*. *Quisqualis* has there-

¹ *Combretum* subgen. *Apetalanthum* Exell & Stace, subgen. nov. Ramulis, foliis, floribus et fructibus lepidotis et cum glandulis stipitatis; petalis nullis. Type-species *Combretum apetalum* Wall. [Num. List no. 3990 (1828)].

fore had to be redefined and separated from *Combretum* by a combination of two characters: adnation of the style to the upper receptacle together with non-exsertion of the stamens (EXELL and STACE, 1964).

Quisqualis, with stalked glands but no scales, appears to be related to *Combretum* subgen. *Cacoucia*.

Meiostemon is a new genus which we are erecting for the two species *Combretum tetrandrum* and *C. humbertii*, each of which has only four stamens, petals, and very small flowers. *Meiostemon* differs from *Combretum* in having only one whorl of stamens, agreeing in this respect with *Thilsea* but differing from the latter in having petals. These relationships and differences are set out in the following table:

<i>Combretum</i> subgen. <i>Combretum</i>	<i>Combretum</i> subgen. <i>Cacoucia</i>	<i>Combretum</i> subgen. <i>Apetalanthum</i>
Petals present (absent in <i>C. rupicola</i> and abnormally in <i>C. molle</i> , etc.)	Petals present	Petals 0
2 whorls of stamens	2 whorls of stamens	2 whorls of stamens
Scales	Stalked glands	Scales and stalked glands

<i>Meiostemon</i>	<i>Thilsea</i>
Petals present	Petals 0
1 whorl of stamens	1 whorl of stamens
Scales	Scales

Meiostemon has an equal claim to generic status with several small genera in subtribe *Terminaliinae* and bears exactly the same relationship to *Combretum* as *Terminaliopsis* does to *Terminalia*. The two species *Combretum tetrandrum* and *C. humbertii*, unlike the aberrant *C. rupicola*, show no affinity with any known section of *Combretum*. The type of distribution (one species in Zambia and Rhodesia the other in Madagascar) is by no means unknown but indicates that the separation from *Combretum* is unlikely to be very recent.

The two species transferred to *Meiostemon* are *Combretum tetrandrum* Exell and *C. ? humbertii* Perrier. The first was

placed by EXELL in *Combretum* sect. *Haplostemon* Exell, a new section erected for it. This was logical at the time since he then considered *Terminaliopsis* to be a synonym of *Terminalia* and *C. tetrandrum* clearly required similar treatment under *Combretum*. The second was sent to EXELL by PERRIER DE LA BÂTHIE in 1953 as a possible new species of *Terminalia*. He was informed that it was a new species of *Combretum* (cf. sect. *Haplostemon* Exell) and published it with a query in that genus. It was the only species of *Combretum* (though with a query) which he admitted in Madagascar as he included all the other species of the genus in *Poivrea*. He made no mention of the important fact that the species has only four stamens. The fruit of *C. humbertii* is still unknown.

Guiera has distinctive scales and slender fruits topped by a persistent calyx.

The remaining three genera of the *Combretinae* (*Calopyxis*, *Calycopteris* and *Thiloa*) have no petals. They are all small except *Calopyxis* (22 spp., perhaps fewer) and the vast majority of species in the subtribe have petals. The loss of petals seems to have occurred quite independently in these genera and none of them shows any close relationship to the *Terminaliinae*.

Calycopteris has a persistent accrescent petaloid calyx: it has scales.

Calopyxis has stalked glands but no scales and a petaloid deciduous upper receptacle. Its relationship seems to be with *Combretum* subgen. *Cacoucia*.

Thiloa has a single whorl of four stamens (sometimes with a second whorl of four staminodes) and large scales (scales and stalked glands in one species). It apparently has no compartmented hairs on the vegetative parts but they occur on the disk and inside the upper receptacle.

d) Subtribe *Pteleopsidinae*

This contains the single genus *Pteleopsis*. The subtribe is intermediate between the *Combretinae* and *Terminaliinae* and its status and relationships have already been discussed above.

e) Subtribe Terminaliinae

The number of genera recognized within this group has varied with different opinions, but certain genera are well-defined. These are: *Buchenavia*, with anthers adnate to the filaments; *Bucida*, with small wingless fruits with a persistent calyx and upper receptacle; *Conocarpus*, with beakless flattened fruits tightly packed into a cone and stalked glands on the leaves (a unique character in the subtribe); *Anogeissus*, with beaked flattened fruits rather loosely packed into a cone; and *Finetia*, differing from the last in that the beak represents about half (rather than all) of the stalk-like portion of the upper receptacle. All the species not in the above five genera, as well as some which are, have been included at one time or another in the large genus *Terminalia*.

Ramatuella has been treated as distinct for well over a century, having woody actinomorphic 4-5-winged fruits clustered in more or less spherical heads. Such a combination is never found in *Terminalia* and it is feasible to retain *Ramatuella* as a distinct genus although its claim to be so appears to be rather smaller than that of any other genus here recognized. It is probable that we should have left the *Ramatuella* species in *Terminalia* if we had been examining the situation *de novo*; on the other hand we do not feel that there are strong enough reasons for altering the status quo, at least until *Terminalia* has been thoroughly studied.

Most other segregates from *Terminalia*, such as *Chuncoa* and *Pentaptera*, were founded on certain species without a full world-wide investigation of the genus and cannot be satisfactorily separated.

Terminaliopsis, however, based on *T. tetrandra*, differs in having one instead of two whorls of stamens (i. e. 4-5 instead of 8-10) and thus differs from *Terminalia* in exactly the same way that *Meiostemon* differs from *Combretum*. We consider that the character is of sufficient importance to maintain both these genera as distinct. Their claim to generic status seems to be at least as strong as that, say, of *Ramatuella* or even of *Buchenavia*, *Thiloa*, *Calopyxis* and *Quisqualis*. *Terminaliopsis* is endemic to Madagascar and consists

only of the species *T. tetrandra* as the other species which has been described in the genus, *T. seyrigii* Perrier, has in fact 8-10 stamens and is a normal *Terminalia*, as also noted by R. CAPURON on a ticket attached to the type-specimen in the Paris Herbarium.

f) *Systematic Summary and Keys*

In the two large genera *Combretum* and *Terminalia* we have not repeated the extensive generic synonymy given by EXELL (1931). Our summary stops short in this work at the generic level. We are still working at the very numerous sections of *Combretum* and hope that we may be able to give a systematic account of them at a later date.

COMBRETACEAE

Combretaceae R. Br., Prodr. 1: 351 (1810). — DC., Mém. Fam. Combrét.: 1-42, Pl. I-V (1828) pro parte excl. gen. *Agathisanthes* Bl. et *Ceratostachys* Bl. — G. Don, Gen. Syst. 2: 655 (1832). — Hook. f. in Benth. & Hook., Gen. Pl. 1, 2: 683 (1865) pro parte excl. gen. *Illigera* Bl., *Gyrocarpus* Jacq. et *Sparattanthelium* Mart. — Eichl. in Mart., Fl. Bras. 14, 2: 78 (1876). — Brandis in Engl. & Prantl, Nat. Pflanzenfam. 3, 7: 106 (1893). — Engl. & Diels, Mon. Afr. Pflanz.-Fam. u. Gatt. 3, 1: 2 (1899). — Exell in Journ. of Bot. 69: 113 (1931).

20 genera throughout the tropics and subtropics.

Type genus: *Combretum* Loebl.

Key to the Subfamilies

- Ovary semi-inferior; cotyledons hemispherical, massive;
2-armed hairs present in 4 species but absent in 1; stomata paracytic 1. *Strephonematoideae*
Ovary quite inferior; cotyledons convolute or variously plicate; 2-armed hairs always absent; stomata cyclocytic or anomocytic 2. *Combretoideae*

1. *Strephonematoideae* Engl. & Diels

Strephonematoideae Engl. & Diels, Mon. Afr. Pflanz.-Fam. u. Gatt. 3, 1: 2 (1899).

1 genus: *Strephonema* Hook. f.

1. **Strephonema** Hook. f. in Benth. & Hook., Gen. Pl. 1, 3: 782 (1867). Lectotype species [Exell in Journ. of Bot. 69: 116 (1931)]: *S. mannii* Hook. f.

7 spp. described in Western tropical Africa from Sierra Leone to the Congo.

2. **Combretoideae**

19 genera.

Key to the Tribes

Lower receptacle without adnate bracteoles 1. *Combreteae*
 Lower receptacle with 2 adnate bracteoles 2. *Laguncularieae*

1. **Combreteae**

16 genera.

Key to the Subtribes

Flowers all usually bisexual (dioecious in *Combretum rupicola*); petals usually present (absent in *Thiloa*, *Calycoperis*, *Calopyxis* and a very few species of *Combretum*, but then scales and/or stalked glands present on the leaves); fruits never in tight cones, usually terete or 4-5-winged or -ridged, with scarcely or non-lignified pericarp; leaves usually opposite or verticillate, and without petiolar glands, with scales or stalked glands (rarely both) 1. *Combretinae*

Flowers andromonoecious; petals absent (except in *Pteleopsidinae* which have no scales or stalked glands); fruits sometimes in tight cones, terete or flattened, often 2-5-winged or -ridged, with pericarp often lignified; leaves usually spiral or alternate (opposite in *Pteleopsidinae*), often with petiolar glands, without scales or stalked glands (except in *Conocarpus* which has fruits in tight cones):

- Petals present; leaves $\pm$ opposite . . . 2. *Pteleopsidinae*
 Petals absent; leaves usually spiral or alternate (rarely
 subopposite) . . . 3. *Terminaliinae*

1. Combretinae

7 genera.

Key to the Genera

Upper receptacle not persistent in fruit; leaves with or
 without scales:

Petals present (absent in a very few species of *Combretum*
 but then stamens 8-10 or flowers dioecious and leaves
 with scales):

Stamens 8-10(16) (unknown in *Combretum rupicola*
 which has dioecious flowers):

Style not adnate to the tube of the upper receptacle
 or only extremely shortly so; stamens usually
 exserted (if not exserted then upper receptacle
 patelliform to campanulate); leaves with scales or
 stalked glands (rarely both) . . . 2. *Combretum*

Style adnate to the tube of the upper receptacle for
 about $\frac{1}{2}$ the length of the latter; stamens not
 exserted; leaves with stalked glands; upper recep-
 tacle infundibuliform, elongate-infundibuliform or
 bucciniform . . . 3. *Quisqualis*

Stamens 4; flowers bisexual . . . 5. *Meiostemon*

Petals absent:

Stamens 4; upper receptacle not petaloid; leaves with
 conspicuous scales . . . 6. *Thilsea*

Stamens 8-10; upper receptacle petaloid; leaves with
 stalked glands but no scales . . . 4. *Calopyxis*

Upper receptacle persistent in fruit; leaves with scales:

Petals present; calyx-lobes not accrescent in fruit . . .

. . . 7. *Guiera*

Petals absent; calyx-lobes accrescent, conspicuous . . .

. . . 8. *Calycopteris*

2. **Combretum** Loebl., *Iter Hispan. App.*: 308 (1758) *nom. conserv.* [see Exell in *Journ. of Bot.* 69: 116 (1931) for full synonymy].

Type species: *C. fruticosum* (Loebl.) Stuntz.

Throughout the tropics (except in Australia) and extending to the subtropics in Asia, Africa and S. America.

Number of species still very uncertain: there will probably be between 150 and 200 when all are fully investigated.

3. **Quisqualis** L., *Sp. Pl. ed. 2, 1*: 556 (1762). — Exell in *Journ. of Bot.* 69: 117 (1931) excl. *Q. hensii*. — Exell & Stace in *Bol. Soc. Brot. Sér. 2, 38*: 139 (1964).

Udani Adans., *Fam. Pl. 2*: (22) (1763), *nom. illegit.*

Kleinia Crantz, *Inst.*: 448 (1766) non Jacq. (1763).

Sphalanthus Jack in *Mal. Misc. 2, 7*: 55 (1822).

Campylogyne Welw. ex Hemsl. in Hook., *Ic. Pl.*: t. 2550 (1897).

Type species: *Q. indica* L.

About 16 species in tropical Asia and tropical and sub-tropical Africa.

4. **Calopyxis** Tul. in *Ann. Sci. Nat., Sér. 4, 6*: 86 (1856).

Lectotype species [Exell in *Journ. of Bot.* 69: 125 (1931)]: *C. sphaeroides* Tul.

22 spp. have been described, all endemic in Madagascar, but it is likely that the number will be reduced on investigation. PERRIER DE LA BÂTHIE (154) recognized 18.

5. **Meiostemon** Exell & Stace, gen. nov.¹. **TAB. I.**

Combretum sect. *Haplostemon* Exell in *Journ. of Bot.* 77: 173 (1939).

Type species: *M. tetrandrus* (Exell) Exell & Stace.

2 species: one in Zambia and Rhodesia, the other in Madagascar.

¹ *Meiostemon* Exell & Stace, gen. nov. Ab *Combreto* differt staminibus 4, uniseriatis.

Key to the Species

Petals elliptic, c. 1×0.7 mm; leaf-lamina conspicuously lepidote beneath, otherwise glabrous except for pubescence on the midrib above and domatia in the axils of the principal nerves beneath; inflorescences up to 9 cm long; bracts rather persistent, equalling the lower receptacle 1. *tetrandrus*

Petals narrowly elliptic, minute, c. 0.5×0.2 mm; leaf-lamina inconspicuously lepidote, pubescent above, rather densely pubescent to pilose beneath; inflorescences up to 3 cm long; bracts absent or caducous 2. *humbertii*

1. **Meiostemon tetrandrus** (Exell) Exell & Stace, comb. nov.

Type: W. Allen 3 (BM, holotype; FHO).

Combretum tetrandrum Exell in Journ. of Bot. 77: 172 (1939).

Type as above.

Zambia and Rhodesia.

2. **Meiostemon humbertii** (Perrier) Exell & Stace, comb. nov.

Type: Humbert 12554 (P, holotype).

Combretum? humbertii Perrier in Ann. Mus. Col. Marseille, Sér. 7, 1: 37 (1953).

Type as above.

Madagascar.

6. **Thiloa** Eichl. in Flora, 49: 149 (1866).

Lectotype species [Exell in Journ. of Bot. 69: 125 (1931)]: *T. glaucocarpa* (Mart.) Eichl.

3 spp. in Brazil, Venezuela, Paraguay, Bolivia and Colombia.

7. **Guiera** Juss., Gen. Pl.: 320 (1789).

Type species: *Guiera senegalensis* Lam.

1 sp. in savanna regions of northern tropical Africa.

8. **Calycopteris** Lam., Ill. Gen.: t. 357 (1791-96); Tabl. Encycl. 2: 485 (1819).

Getonia Roxb., Pl. Corom. 1: 61, t. 87 (1798). — Exell in Journ. of Bot. 69: 127 (1931).

Type species: *C. floribunda* (Roxb.) Lam.

1 sp. in India, Assam, Burma, Indo-China and the Malay Peninsula.

For a discussion of the question of priority between *Calycopteris* and *Getonia* see EXELL [in Fl. Males., Ser. 1, 4: 584 (1954)].

2. **Pteleopsidinae** Exell & Stace, subtrib. nov.¹

1 genus: *Pteleopsis* Engl.

9. *Pteleopsis* Engl. [in Abh. Preuss. Akad. Wiss. 1893-95: 25 (1894) *nom. nud.*] Pflanzenw. Ost-Afr. C: 293 (1895).

Type species: *P. variifolia* Engl.

Probably about 10 spp., all in tropical Africa.

3. **Terminaliinae** Exell & Stace, subtrib. nov.²

«*Terminaliées*» DC., Mém. Fam. Combrét.: 4 (1828) pro parte.

Terminalieae G. Don, Gen. Syst. 2: 656 (1832) pro parte. Eichl. in Mart., Fl. Bras. 14, 2: 81 (1867). — Engl. & Diels, Mon. Afr. Pflanz.-Fam. u. Gatt. 3: 2 (1899).

Type genus: *Terminalia* L.

8 genera.

¹ Subfam. *Combretoidae* trib. *Combreteae* subtrib. **Pteleopsidinae** Exell & Stace, subtrib. nov. *Flores* andromonoecii. *Petala* 5. *Fructus* 2-5-alatus. *Cotyledones* convolutae. *Folia* ± opposita, petiolis eglandulosis. *Lepides* et *glandulae stipitatae* nullae. Genus unicum: *Pteleopsis* Engl.

² Subfam. *Combretoidae* trib. *Combreteae* subtrib. **Terminaliinae** Exell & Stace, subtrib. nov. *Flores* andromonoecii. *Petala* nulla. *Fructus* complanatus vel teres nonnunquam 2-5-alatus vel -angulatus, pericarpio plerumque lignoso. *Cotyledones* convolutae. *Folia* plerumque spiraliter ordinata vel alterna, petiolis nonnunquam glanduliferis. *Lepides* et *glandulae stipitatae* (salvo in *Conocarpum*) nullae. Genus typicum: *Terminalia* L.

Key to the Genera

Fruits not aggregated into tight cones:

 Anthers versatile:

 Stamens 8-10:

 Upper receptacle deciduous:

 Fruits flattened or terete or 2-5-winged or -ridged,
 if winged then usually not actinomorphic, or if
 both winged and actinomorphic then without
 strongly lignified pericarp (except Sect. *Pent-*
 taptera), not crowded into $\pm$ spherical heads at
 maturity 10. *Terminalia*

 Fruits 4-5-winged, actinomorphic, with strongly
 lignified pericarp, crowded into $\pm$ spherical
 heads at maturity 11. *Ramatuella*

 Upper receptacle persistent until maturity of fruits

 13. *Bucida*

 Stamens 4(5) 12. *Terminaliopsis*

 Anthers adnate to the filaments 14. *Buchenavia*

Fruits aggregated into tight cones:

 Fruit beaked; leaves without stalked glands:

 Beak of fruit consisting of the whole of the stalk-like
 portion of the upper receptacle; fruit 2-winged . .
 15. *Anogeissus*

 Beak of fruit consisting of about half of the stalk-like
 portion of the upper receptacle; fruit c. 4-10-ridged
 16. *Finetia*

 Fruit not beaked; leaves with stalked glands
 17. *Conocarpus*

10. *Terminalia* L., Syst. Nat. ed. 12, 2: 674 (err. 638)
(1767); Mant. Pl.: 21 (1767) *nom. conserv.*

 Type species: *T. catappa* L.

 Number of spp. will probably prove to be between 100
 and 150, throughout the tropics (including Australia and
 Polynesia).

 For full synonymy see EXELL [in Journ. of Bot. 69: 125
(1931) excl. *Terminaliopsis* Danguy].

11. *Ramatuella* Kunth, Nov. Gen. & Sp. Pl. 7: 253
(1825) («*Ramatuela*»). — Maguire in Mem. N. Y. Bot. Gard.

8: 130 (1953).—Exell & Stace in Bull. Brit. Mus. (Nat. Hist.) Bot. 3, 1: 38 (1963).

Type species: *R. argentea* Kunth.

6 spp. in Venezuela, Colombia and Brazil.

For a discussion of the spelling of the generic name and a revision of the species see EXELL and STACE (loc. cit.).

12. **Terminaliopsis** Danguy in Bull. Mus. Hist. Nat. Par. 29: 108 (1923).

Type species: *T. tetrandra* Danguy.

1 sp. from Madagascar.

T. seyrigii Perrier [in Ann. Mus. Col. Marseille, Sér. 7. 1: 21 (1953)] was described in this genus but is a species of *Terminalia*. The type of *Terminaliopsis seyrigii* (Seyrig 323) was cited by PERRIER DE LA BÂTHIE under *Terminalia monoceros* Perrier [in Fl. Madag., Combrét.: 52 (1954)] and was figured (as *Terminaliopsis*) with 8 stamens.

13. **Bucida** L., Syst. Nat. ed. 10, 2: 1025 (1759) *nom. conserv.*

Buceras P. Browne, Hist. Jam.: t. 23 (1756).

Type species: *B. buceras* L.

9 spp. have been described, all from tropical and subtropical America, but several of these are probably not distinct.

14. **Buchenavia** Eichl. in Flora, 49: 164 (1866) — Exell & Stace in Bull. Brit. Mus. (Nat. Hist.) Bot. 3, 1: 4 (1963).

Lectotype species [Exell in Journ. of Bot. 69: 126 (1931)]: *B. capitata* (Vahl) Eichl.

22 spp. in the West Indies, Panama, tropical South America and southern Brazil.

Since the revision by EXELL and STACE (loc. cit.) a study of further material kindly sent from Brazil shows that *B. discolor* Diels is a synonym of *B. ochroprumna* Eichl. and that *B. huberi* Ducke is a synonym of *B. grandis* Ducke.

15. **Anogeissus** [Wall., Numer. List: no. 4014 (1832) *nom. nud.*] Guill. & Perr. in Guill., Perr. & Rich., Fl. Senegamb. Tent. 1: 280, t. 65 (1833).

Andersonia Roxb. ex DC., Mém. Fam. Combrét.: 8 et 25 (1828) *nom. nud.* non R. Br.

Andersonia Buch.-Ham. ex Wall., Numer. List: sub no. 4014 (1832) *nom. nud.* non R. Br.

Type species: *A. acuminata* (Roxb. ex DC.) Wall.

14 spp. have been described in tropical Asia and tropical Africa.

16. *Finetia* Gagnep. in Notul. Syst. 3: 278 (1916).

Type species: *F. rivularis* Gagnep.

1 sp. in Indo-China.

17. *Conocarpus* L., Sp. Pl. 1: 176 (1753); Gen. Pl. ed. 5: 81 (1754).

Rudbeckia Houst. ex L., Gen. Pl. ed. 5: 81 (1754) in syn. non L.

Rudbeckia Adans., Fam. 2: 80 et 599 (1763) non L.

Type species: *C. erectus* L.

2 spp.: 1 widely distributed in tropical and subtropical America and Western tropical Africa; 1 in Somalia and Arabia.

2. **Laguncularieae** Engl. & Diels

Laguncularieae Engl. & Diels, Mon. Afr. Pflanz.-Fam. u. Gatt.: 3, 1: 2 (1899).

Key to the Genera

Bracteoles not accrescent; stomata cyclocytic; leaves with abundant water-storage tissue; plants exclusively maritime:

Leaves opposite; deeply sunken glands present on leaves

. 18. *Laguncularia*

Leaves alternate; glands absent from leaves

. 19. *Lumnitzera*

Bracteoles accrescent to form 2 wings to the fruit; stomata simply anomocytic; leaves without obvious water-storage tissue; plants not maritime . . . 20. *Macropteranthes*

18. *Laguncularia* Gaertn. f., Fruct. 3: 209, t. 217 (1807).

Sphenocarpus Rich., Démonstr. Bot.: 92 (1808) *nom. nud.*

1 or 2 spp. in littoral regions of tropical and subtropical America and Western tropical Africa.

Horau Adans. is excluded from the synonymy as it is now known to be *Avicennia* L.

19. *Lumnitzera* Willd. in Ges. Naturf. Fr. Berl. Neue Schr. 4: 186 (1803).

For synonymy see EXELL [in Journ. of Bot. 69: 128 (1931)].

Type species: *L. racemosa* Willd.

2 spp.: 1 in Eastern tropical Africa, Madagascar, tropical Asia, Northern Australia and Polynesia; 1 in tropical Asia, Northern Australia and Polynesia.

20. *Macropteranthes* (F. Muell.) F. Muell. in Fragm. Phytogr. Austral. 3: 91 (1862).

Lumnitzera sect. *Macropteranthes* F. Muell., op. cit. 2: 149 (1861).

Type species: *M. montana* (F. Muell.) F. Muell. EXELL [in Journ. of Bot. 69: 128 (1931)] chose *M. leichhardtii* as the lectotype as «this was the first species to which MUELLER gave the name *Macropteranthes*». *M. montana*, however, was in fact the first species to which this name was applied [F. Muell. op. cit. 2: 149 (1861) under *Lumnitzera* sect. *Macropteranthes* which MUELLER elevated to generic rank the subsequent year].

4 spp. in north and north-east Australia.

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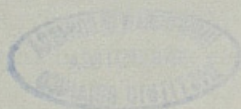
STACE, C. A.

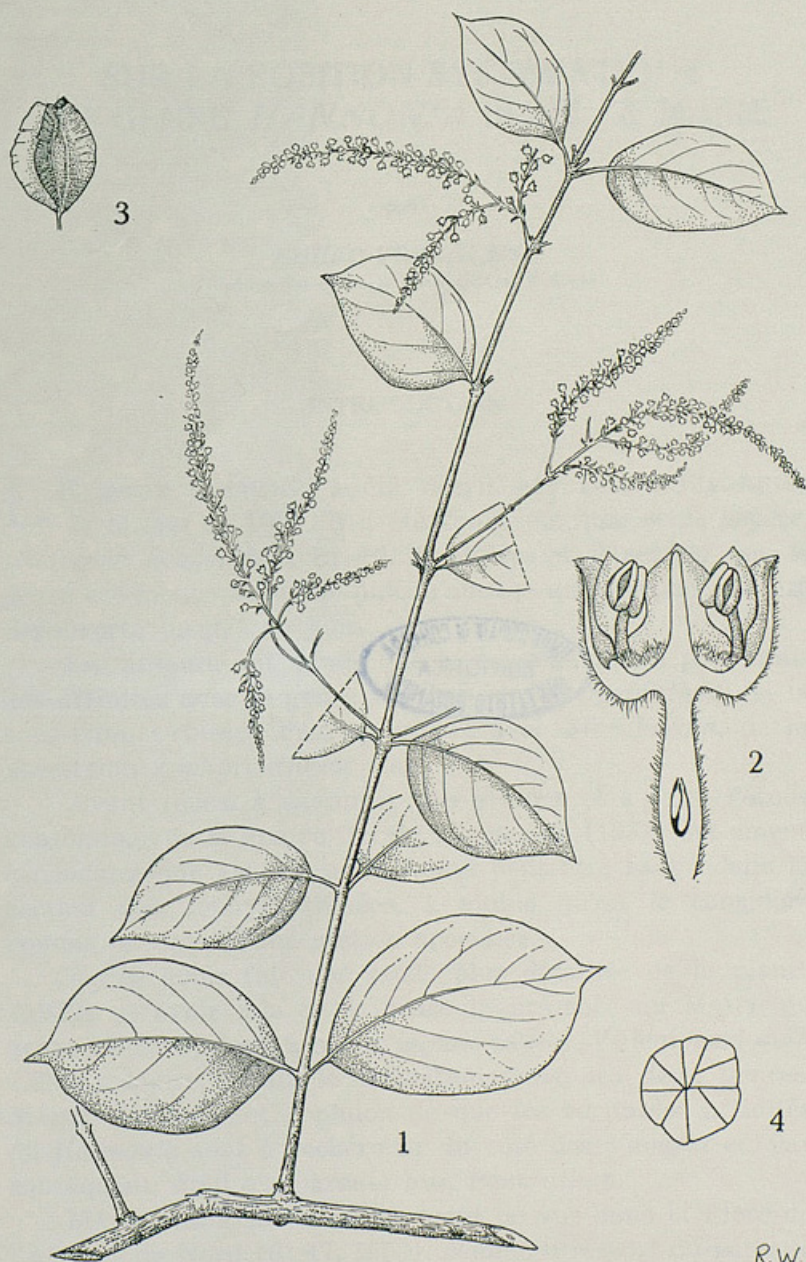
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1968. *At the Way to the Future*. By J. H. ...
 1969. *The ...* ...
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 1971. *The ...* ...
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 2000. *The ...* ...





Meiostemon tetrandrus (Exell) Exell & Stace

1. Flowering branchlet ($\times \frac{2}{3}$) *Fanshawe* 4896; 2. Vertical section of flower ($\times 10$) *Fanshawe* 4896; Fruit ($\times 1$) *Bainbridge* 502; Scale ($\times 270$) from a drawing by C. A. STACE.



SUR LA POSITION SYSTÉMATIQUE DU GENRE *HANNONIA* BR.-BL. & MAIRE

par

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INTRODUCTION

LE genre *Hannonia* a été décrit par BRAUN-BLANQUET & MAIRE en 1931. Il a été fondé sur une seule espèce, *Hannonia hesperidum* Br.-Bl. & Maire, et il semble que le genre est monospécifique, puisqu'aucune autre espèce n'a été découverte jusqu'à ce jour.

Les auteurs ont admis que le nouveau taxon présentait des affinités avec le genre austro-africain *Cyrtanthus*, de la sous-tribu *Crininae* Pax, et encore avec *Sternbergia*, de la sous-tribu *Zephyranthinae* Pax.

Ayant réussi à examiner des graines et à faire l'étude anatomique de la hampe florale, EMBERGER (1932) est amené à conclure que «le genre *Hannonia* peut être rangé dans la section des Zéphyranthinées, à moins qu'on le considère comme le type d'une section spéciale».

Après avoir fait une étude plus détaillée de la plante (1933) et avoir mis en évidence la présence au Maroc du genre *Vagaria*, dont, à son avis, une espèce, *V. legionariorum* (Emb.) Maire, ferait la transition entre les deux genres, MAIRE (1936) émet l'opinion de que les véritables affinités du *Hannonia* sont à rechercher du côté des *Vagaria* et, par conséquent, qu'il s'apparente aux *Pancratium*.

MAIRE maintient le même point de vue dans la Flore de l'Afrique du Nord (6: 47, 1959), comme il ressort du passage suivant: «Cette plante (*Hannonia hesperidum*) est très voisine du *Vagaria Ollivieri* Maire, dont elle est difficile à distinguer à l'état végétatif, mais elle est plus grêle, à fleurs

toujours géminées, et elle fleurit plus tôt. En raison de ses affinités avec le *V. Ollivieri* nous l'avons rangée dans les *Dentiferae*, malgré l'absence totale de paracorolle».

D'après HUTCHINSON (1959), *Hannonia* ne peut pas se distinguer de *Vagaría* et, par ce fait, il considère le premier genre comme synonyme du deuxième.

L'opinion de MAIRE n'est pas partagée par TRAUB (1963), auteur qui, bien que provisoirement, car il attendait du matériel vivant pour faire des études plus achevées, range *Hannonia* dans la tribu *Galantheae* Salisb., entre les genres *Lapiedra* Lag. et *Leucojum* L., et classe *Vagaría* Herb. dans la tribu *Pancratieae* auprès de *Pancratium* L.

Ayant pu nous procurer quelques bulbes et des graines du *Hannonia hesperidum* et du *Vagaría Ollivieri*, nous avons eu l'opportunité d'examiner les chromosomes somatiques de ces taxa et d'étudier les respectifs caryotypes. Ces données caryologiques sont employés ici dans le but d'essayer à résoudre le problème controversé de la position systématique du genre *Hannonia*.

MATÉRIEL ET TECHNIQUE

Grâce à l'obligeance de M. l'Ing. J. GATEFOSSÉ, à qui nous exprimons notre profonde gratitude pour l'aide qu'il a toujours bien voulu nous accorder en nous envoyant généreusement des bulbes d'Amaryllidacées du Maroc, nous avons réussi à obtenir quelques bulbes du *Hannonia hesperidum* récoltés sur les «berges de l'oued Sous au l'oued Zeïma (entre Agadir et Taroudante)».

D'autre part, Monsieur L. S. HANNIBAL, dont l'enthousiasme pour la culture des Amaryllidacées est bien connu, nous a envoyé des graines de ce taxon. Nous lui présentons nos plus vifs remerciements, non seulement pour l'offre des graines, mais aussi pour l'intérêt qu'il a toujours témoigné à l'égard de notre travail.

Monsieur J. GATEFOSSÉ nous a procuré aussi des bulbes du *Vagaría Ollivieri*, ramassés à l'«embouchure de l'oued Drâa (Sudouest du Maroc)».

Les bulbes et les graines de ces plantes nous ont fourni des méristèmes radiculaires qui ont été fixés au liquide de Navachine (modification de Bruun). Les coupes transversales, d'une épaisseur de 18 μ , ont été colorées au violet de gentiane.

Malheureusement, la culture de ces plantes s'est révélée très difficile sous le climat de Coimbra. Les bulbes étaient morts l'année suivante après son arrivée et nous n'avons réussi à obtenir aucune plante à partir des graines qui ont germé. Par cette raison, nous n'avons pas pu examiner les caractères de la morphologie externe de ces taxa.

OBSERVATIONS

Hannonia hesperidum Br.-Bl. & Maire

Les plaques métaphasiques des cellules des méristèmes radiculaires de la plupart des plantes nous ont montré 14 chromosomes, correspondant à 7 paires dont la morphologie est la suivante (fig. 1, a-c):

- A — Paire isobrachiale ou presque, à bras très longs.
- B — Paire semblable au précédente.
- C — Paire hétérobrachiale du type Ll.
- D — Paire semblable au type précédent, mais à bras court légèrement moins long.
- E — Paire semblable au type précédent, mais à bras un peu plus courts.
- F — Paire céphalobrachiale longue, à constriction acinétique au tiers proximal. Un satellite à l'extrémité proximale d'un des éléments de la paire a été observé sur quelques figures.
- G — Paire céphalobrachiale plus courte que la précédente, à satellite à l'extrémité proximale et à constriction acinétique au tiers proximal. Quelques images de ce chromosome ont suggéré que cette constriction aurait de l'activité centromérique.

L'idiogramme peut donc être représenté par la formule suivante:

$$2n = 14 = 4 \text{ LL (Ll)} + 4 \text{ Ll} + 2 \text{ lm} + 2 \text{ L.} + 2 \text{ l.}'$$

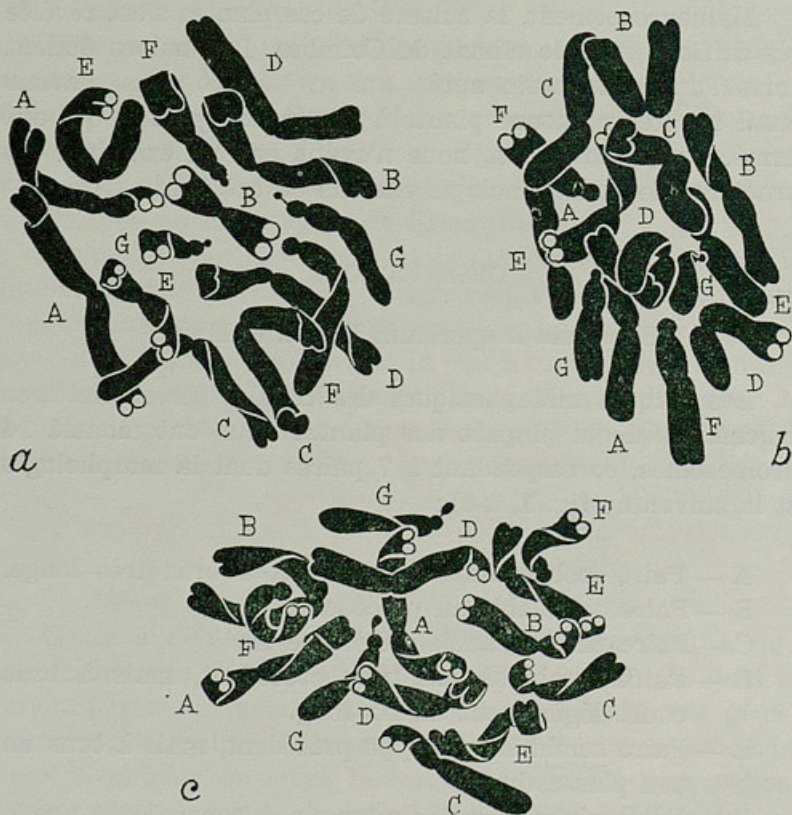


Fig. 1. — *Hannonia hesperidum* Br.-Bl. & Maire. a, Plaque équatoriale dans une cellule de la région médiane du périlème de la racine, montrant des chromosomes allongés. Remarquer la présence d'un satellite à l'extrémité proximale d'un des chromosomes de la paire F. b, Idem dans une région plus profonde, montrant des chromosomes plus raccourcis. c, Idem dans la racine d'une plantule obtenue par germination d'une graine. Les paires chromosomiques sont indiquées par les lettres A-G. $\times$ ca. 3000.

Dans les méristèmes radiculaires fournis par un des bulbes, nous avons dénombré 21 chromosomes. Il s'agissait donc d'une plante triploïde. La garniture observée correspondait à la triplication de celle de l'état haploïde (fig. 2).

Vagaria Ollivieri Maire

Dans les vues polaires des métaphases des cellules des méristèmes radiculaires, nous avons dénombré 22 chromosomes, aux caractères morphologiques suivants (fig. 3) :

- A — Paire isobrachiale ou presque, à bras très longs.
- B — Paire hétérobrachiale du type Lp.
- C — Paire semblable au type précédent.
- D — Paire semblable au type précédent, mais à bras long un peu plus court.
- E — Paire semblable au type antérieur.
- F — Paire céphalobrachiale satellitifère.
- G — Paire semblable au type antérieur, mais à satellites hétéromorphes (un assez gros et un autre très petit). Il est probable que des plantes à satellites égaux existent aussi.
- H — Paire céphalobrachiale du type 1.
- I — Paire semblable au type antérieur, mais un peu plus courte.
- J — Idem.
- K — Paire courte presque isobrachiale.

De cette façon, la garniture diploïde peut être représentée par la formule suivante :

$$2n = 22 = 2 LL + 8 Lp + 2 L.' + 2 L.' + 6 l. + 2 PP$$

DISCUSSION

Comme nous l'avons remarqué, la description originale du *Hannonia hesperidum* par BRAUN-BLANQUET & MAIRE (loc. cit.) a été accompagnée de la suggestion de l'affinité de ce taxon avec le genre *Cyrtanthus*. Les études sur la caryologie de ce dernier genre sont particulièrement dûes à WILSENACH (1963) qui a établi l'idiogramme de 19 espèces.

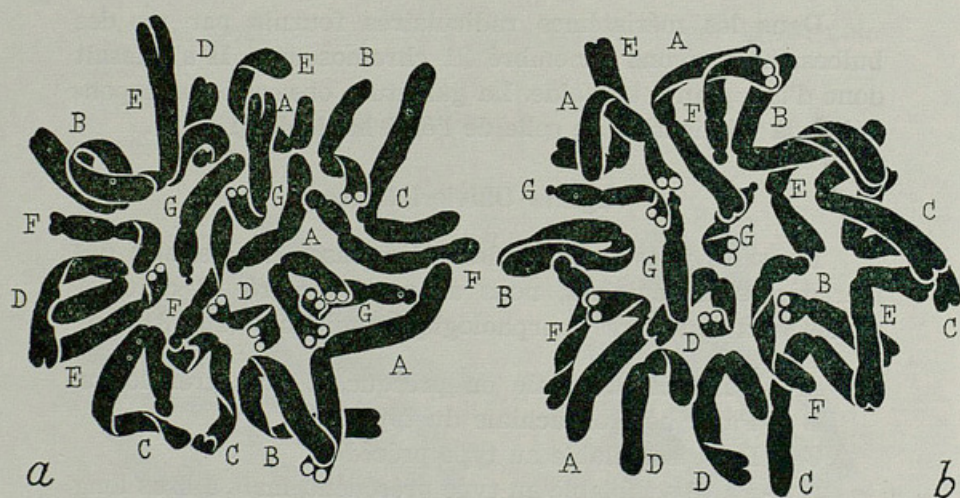


Fig. 2. — *Hannonia hesperidum* Br.-Bl. & Maire. *a* et *b*, Plaques équatoriales dans des cellules du méristème racinaire d'une plante triploïde. Les chromosomes sont indiqués par les lettres A-G.

× ca. 3000.

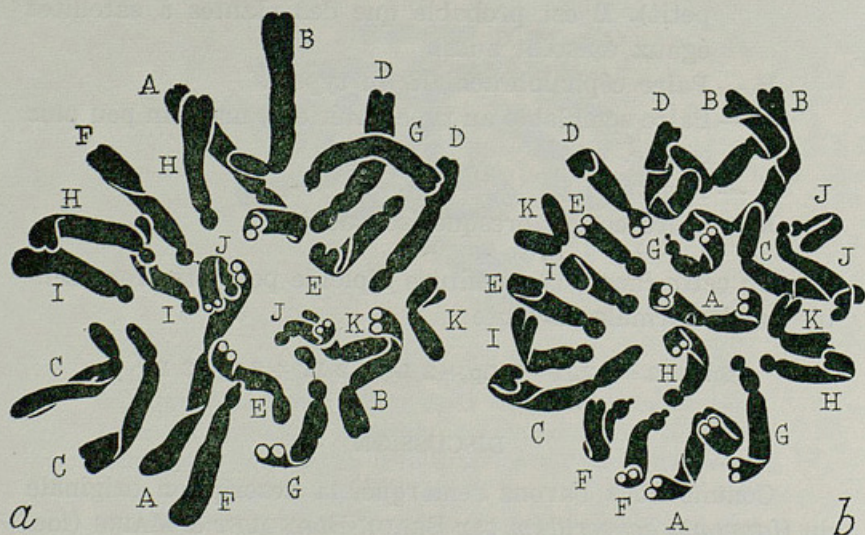


Fig. 3. — *Vagaria Ollivieri* Maire. *a* et *b*, Plaques équatoriales dans des cellules du méristème racinaire montrant 22 chromosomes.

Les paires sont indiquées par les lettres A-K.

× ca. 3000.

La comparaison des chromosomes du *Hannonia* avec ceux des espèces de *Cyrtanthus* montre le suivant:

- a) Le nombre de base est 7 chez *Hannonia* et 8 chez *Cyrtanthus* et les genres voisins (*Anoanthus* et *Vallota*);
- b) L'ensemble des chromosomes céphalobrachiaux et hétérobrachiaux à bras court moins long que la moitié du bras long est plus élevé chez les espèces de *Cyrtanthus* que chez *Hannonia*, dont l'idio-gramme ne possède que deux paires céphalobrachiales.

Il semble donc que les caractères caryologiques ne s'accordent pas très bien avec l'idée de considérer le genre *Hannonia* comme voisin de *Cyrtanthus*.

Bien que nous n'ayons examiné aucun spécimen du *Hannonia*, il nous semble, d'après les descriptions, que les caractères de la morphologie externe de cette plante ne s'accordent pas aussi avec le même point de vue. En effet, chez *Cyrtanthus*, le tube du péricône est assez long et considérablement élargi supérieurement, tandis que chez *Hannonia* il est cylindrique et ne dépasse pas 5 mm. D'autre part, les graines des *Cyrtanthus* sont aplaties, tandis que celles du *Hannonia* sont ovées-subfusiformes. D'autres différences moins importantes concernant le nombre des fleurs par inflorescence, longueur des filets, forme du stigmate, etc. existent aussi.

La caryologie du *Sternbergia lutea* Ker.-Gawl. a été étudiée par plusieurs auteurs (vid. MOOKERJEA, 1954; DARLINGTON & WYLIE, 1955; SHARMA, 1955), mais ce sont les recherches de BATTAGLIA (1949) qui nous semblent les plus exactes. D'après cet auteur, le nombre de base du genre est 11 et l'idio-gramme de l'espèce étudiée est constitué par une paire de chromosomes isobrachiaux, deux paires hétérobrachiaux et 8 paires céphalobrachiaux. De cette façon, on constate que, au point de vue caryologique, *Hannonia* est très différent de *Sternbergia* pour que les deux genres puissent être rapprochés.

En ce qui concerne les caractères de la morphologie externe, les différences les plus importantes sont celles mentionnées dans le Tableau I.

TABLEAU I

<i>Hannonia</i>	<i>Sternbergia</i>
Hampe florale $\pm$ fistuleuse, à faisceaux libéro-ligneux disposés en un seul cercle.	Hampe florale pleine, à faisceaux libéro-ligneux disposés en plusieurs cercles.
Fleurs géminées dans un involucre à deux spathes.	Fleur généralement solitaire dans une spathe tubuleuse à la base.
Fleurs pédonculées.	Fleur sessile.
Tube du périgone cylindrique, jusqu'à 0,5 cm long.	Tube du périgone cylindrique, 0,6-2,5 cm long.
Style filiforme à stigmate entier et non renflé.	Style filiforme à stigmate $\pm$ renflé ou brièvement 3-lobé.
Fruit sec.	Fruit un peu charnu.
Graines ovées-fusiformes ou subglobuleuses, ca. $2,5 \times 2$ mm.	Graines subglobuleuses, $3-4 \times 2,5$ mm.

Quant aux genres *Gethyllis* et *Apodolirium* aussi suggérés par EMBERGER (loc. cit.) comme ayant des affinités avec *Hannonia*, les différences morphologiques sont encore plus nettes.

À notre connaissance, la caryologie du genre *Vagaria* était inconnue. Les observations rapportées ici montrent que le nombre de base est 11 et que, par son caryotype, le genre se rattache à la tribu des *Pancratieae* où il est rangé par TRAUB (loc. cit.). Ce fait est mis en évidence, d'une façon assez nette, par la comparaison des plaques métaphasiques de notre fig. 3 avec les figures présentées par FERNANDES (1933) pour *Pancratium maritimum* L., SATÔ (1938) et BRUMFIELD (1941) pour *P. illyricum* L., SHARMA & BAL (1956) pour *P. zeylanicum* L., REESE (1957) pour *P. saharæ* Coss. et MORTON (1965) pour *P. hirtum* A. Chev.

Étant donné que *Vagaria* appartient à la tribu *Pancratieae*, les ailes des filets qu'on trouve chez les espèces de ce genre doivent être considérées comme correspondant à l'ébauche de la couronne staminale qu'on rencontre très bien déve-

loppée chez *Pancratium*, *Chapmanolirion* et *Klingia* (vid. TRAUB, loc. cit.).

La comparaison de l'idiogramme du *Hannonia* avec celui du *Vagaria* montre tout d'abord qu'il s'agit de deux genres distincts et, par conséquent, que HUTCHINSON (loc. cit.) a tort quand il considère *Hannonia* comme synonyme de *Vagaria*. D'autre part, les différences entre les idiogrammes montrent que les deux genres ne peuvent pas se ranger dans le même groupe. Le manque de couronne staminale chez *Hannonia* est d'accord avec ce point de vue. Tous ces faits mettent donc en évidence que l'affinité suggérée par MAIRE ne peut pas se maintenir.

Il ne nous reste qu'examiner la suggestion de TRAUB (loc. cit.), c'est à dire que le genre *Hannonia* doit être rangé dans la tribu *Galantheae* Salisb.

Dans cette tribu, on trouve les nombres de base 5, 7, 8, 9 et 11 et des idiogrammes constitués par des chromosomes appartenant aux types qu'on rencontre chez *Hannonia*. Particulièrement remarquables sous ce point de vue sont *Leucojum autumnale* (vid. NEVES, 1939), qui possède le même nombre de base et des chromosomes des mêmes types, et *Lapiedra Martinezii* (vid. FERNANDES, 1950), qui, bien que possédant un autre nombre de base (11), présente aussi des chromosomes du même type. Les données fournies par le caryotype du *Hannonia* ne s'opposent donc à l'idée de considérer ce genre comme appartenant à la tribu *Galantheae* Salisb.

En outre les caractères de la morphologie externe mentionnés par TRAUB (loc. cit.), nous pouvons ajouter un caractère anatomique rapporté par EMBERGER (loc. cit.) concernant la disposition en un cercle des faisceaux libéro-ligneux de la hampe florale du *Hannonia*. Ce caractère est aussi mentionné par PAX & HOFFMANN (1930) dans la diagnose de la sous-tribu *Galanthinæ* Pax.

Étant donné que chez *Galanthus* et *Leucojum* les anthères sont basifixes et poricides, il semble que *Hannonia* a plus d'affinités avec *Lapiedra*, puisque chez ces deux derniers genres les anthères sont dorsifixes et s'ouvrent par des fentes longitudinales. Comme nous l'avons remarqué, les types chro-

mosomiques existant chez *Hannonia* et *Lapiedra* sont les mêmes. Le fait que chez le premier genre le nombre de base est 7, tandis que chez le deuxième est 11, peut n'avoir pas de signification, puisque chez *Leucojum* nous trouvons des espèces à 7 et d'autres à 11 chromosomes.

Cependant, on constate que chez *Leucojum* les anthères ne sont vraiment poricides, car il y a, comme MAIRE (pag. 12, 1959) le signale, des «fentes de déhiscence se formant seulement dans leur moitié supérieure». Ce caractère et le fait que chez le sous-genre *Acis* de *Leucojum* les divisions du périanthe sont quelquefois brièvement soudées à la base révèlent aussi des affinités entre *Hannonia* et ce sous-genre de *Leucojum*. Il est à remarquer que quelques espèces du sous-genre *Acis* (*L. autumnale* et *L. trichophyllum*) possèdent une garniture à $n = 7$, constituée par des chromosomes de types semblables à ceux qu'on trouve chez *Hannonia*.

Nous pourrions donc conclure que, d'après les caractères caryologiques et de ceux de la morphologie externe, le genre *Hannonia* doit être rangé entre *Lapiedra* et *Leucojum*.

En discutant les nombres chromosomiques de la famille des *Amaryllidaceae*, comprise dans l'acception de comporter des plantes à inflorescence en ombelle soit avec l'ovaire supère ou infère, TRAUB (loc. cit.) est amené à la conclusion qu'il est probable que le nombre de base de la famille soit 6. En partant de cette supposition, qui nous semble bien vraisemblable, le genre *Galanthus* aurait été engendré par polyploïdie, puisque nous y trouvons des espèces à $2n = 24, 36$ et 48 . Il pourra arriver même que des formes à $2n = 12$ existent encore à présent.

Le genre *Hannonia* pourrait avoir pris naissance à partir de la forme ancestrale à $n = 6$, dont l'idiogramme serait constitué seulement par des chromosomes longs isobrachiaux et hétérobrachiaux, au moyen de la division transversale du centromère d'un chromosome hétérobrachial du type Ll. Cette clivage du centromère aurait été suivie de translocations qui ont rendu le centromère sous-terminal. Au moyen de ce processus, les chromosomes L. et l. auraient été engendrés.

Il semble que le même mécanisme a agit dans l'évolution du genre *Leucojum*, puisqu'on constate d'une façon générale

que le nombre des chromosomes céphalobrachiaux monte et celui des isobrachiaux et hétérobrachiaux baisse au fur et à mesure que le nombre chromosomique devient plus élevé (vid. NEVES, loc. cit.: 568).

Cependant, une autre origine pourra être envisagée en ce qui concerne les espèces à $n = 11$: formation de tétraploïdes à partir de la forme ancestrale, clivage du centromère de certains chromosomes et élimination de chromosomes télacentriques correspondant à des bras. Nous considérons probable que *Lapiedra Martinezii* ait été engendré au moyen de ce processus.

RÉSUMÉ ET CONCLUSIONS

1. *Hannonia hesperidum* Br.-Bl. & Maire est une Amaryllidacée dont la position systématique a été l'objet de controverses. Ainsi, d'après BRAUN-BLANQUET & MAIRE, les affinités du genre seraient avec *Cyrtanthus*; d'après EMBERGER avec *Sternbergia* ou avec d'autres genres apparentés (*Gethyllis* et *Apodolirion*); d'après MAIRE et HUTCHINSON avec *Vagaria*; et d'après TRAUB avec *Lapiedra* et *Leucojum*.

2. Dans le but de contribuer à éclaircir ce problème, nous avons étudié la caryologie du *Hannonia hesperidum* et du *Vagaria Ollivieri* dont nous avons établi les respectives formules chromosomiques.

3. Les caractères caryologiques et ceux de la morphologie externe ne s'accordent ni avec l'idée de considérer *Hannonia* comme ayant des affinités avec *Cyrtanthus*, ni avec *Sternbergia*, ni avec *Vagaria*. Les ressemblances avec ce dernier genre sont superficielles, puisque *Hannonia* est dépourvu de la couronne staminale caractéristique des *Pancratieae* qui se trouve en ébauche sous la forme des ailes des filets chez *Vagaria*.

4. Les données caryologiques (nombre et forme des chromosomes) indiquent des affinités avec les *Galantheae*, particulièrement avec *Lapiedra* et *Leucojum*, ce qui est en accord avec les points de vue de TRAUB. Les caractères de la morphologie externe et les anatomiques parlent aussi en faveur de cette opinion.

5. Il est probable que *Hannonia hesperidum* ait été engendré à partir d'une forme ancestrale à $n = 6$, au moyen de la division transversale du centromère d'un chromosome du type Ll, suivie de translocations qui ont rendu les centromères sous-terminaux.

6. Les formes à $n = 11$, qui sont fréquentes chez les Amaryllidacées, pourraient avoir été engendrées à partir de formes tétraploïdes à nombre de base 6, au moyen de la division transversale des centromères de quelques chromosomes, suivie de l'élimination de quelques bras correspondant à des chromosomes télocentriques.

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UM NOVO FUNGO ISOLADO DO RIZOMA DE *HEDYCHUM* *GARDNERIANUM* ROSCOE

«CONTEIRA» *

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O *Hedychium Gardnerianum* Roscoe, popularmente denominado «Roca de Vénus» (MENEZES, 1926), foi introduzido no Arquipélago dos Açores como planta ornamental onde lhe é dado o nome de «Conteira». Porém, devido às condições ecológicas destas ilhas, atingiu tal desenvolvimento e dispersão que constitui actualmente uma verdadeira praga.

As plantas de «Conteira» utilizadas neste trabalho foram colhidas pelo Eng. Silvicultor D. NATALINA FERREIRA DOS SANTOS DE AZEVEDO, em Junho de 1960, na Mata da Granja, próximo de Ponta Delgada, na Ilha de S. Miguel.

Os rizomas, a parte da planta em que apareciam sinais de podridão, apresentavam, além do micélio característico de *Armillaria mellea* (Vahl. ex Fr.) Kummer, um outro micélio branco, nalguns pontos levemente acastanhado, do qual fizemos isolamentos em meios culturais, tendo obtido os melhores resultados em aveia e malte a pH 4.5.

O desenvolvimento deste fungo é bastante demorado. Nos primeiros dias o inóculo começa por apresentar um micélio aéreo branco e abundante, que se estende ao longo da cultura e após quinze a vinte dias inicia-se a formação de manchas castanhas escuras junto à superfície do substracto. Só muito mais tarde começam a aparecer as pri-

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meiras formações negras onde são originados os conceptáculos. Estes, muito ricos em esporos — «cirros de esporos» — têm superficialmente o aspecto de uma massa de cor branco-sujo, passando algumas vezes a amarelo-salmão.

A fim de completar as observações fizemos culturas em troncos de pinheiros esterilizados e obtivemos colónias com aspecto macroscópico e microscópico idêntico ao das culturas feitas em gelose.

O fungo apresentava nas culturas em meio gelosado e em troncos de pinheiros as características seguintes:

Observações microscópicas

Formações estromáticas esparsas $750-900 \times 525-825 \mu$, cónico-obtusas, de vértice bastante proeminente, negras, contendo vários lóculos; lóculos de forma irregular e variada, 225μ diam., de excípulo negro mais ou menos carbonáceo, revestido internamente por inúmeros esporóforos fasciculados, cilíndricos, na maioria simples, raramente bifurcados, hialinos, $12.6-16.2 \times 1.6 \mu$; esporos biformes: A — numerosos, oblongo-ovóides, elipsóides com duas gotas, contínuos, hialinos, $5.4-9 \times 1.8-2.7 \mu$; B — raríssimos, filiformes, curvos numa das extremidades, hialinos, $16.2-23.4 \times 1.4-1.6 \mu$.

No rizoma de *Hedygium Gardnerianum* Roscoe, Ilha de S. Miguel, pr. Ponta Delgada, Mata da Granja, *Natalina de Azevedo*, Junho 1960, s. n.: F. 241.

Fizemos várias tentativas para obter a forma perfeita deste fungo, mas ainda não conseguimos.

Portanto:

SPHAEROPSIDALES (LÉV.) SACC.

SPHAERIOIDACEAE SACC.

Hyalosporae SACC.

Phomopsioides P. COSTA & CAM.

Phomopsioides Natalinae n. sp. (Fig. 1).

Stromatibus, in culturis, sparsis, 750-900 $\times$ 525-825 μ , obtuse conoides, profunde immersis, vertice tantum prominulis, atris intus plurilocularibus; loculis irregularibus 225 μ .

diam.; excipulo atro fere carbonaceo; sporophoris numerosis, fasciculatis, cylindraceis, simplicibus vel 2-furcatis, hyalinis, $12.6-16.2 \times 1.6 \mu$; sporulis, biformibus: A — oblongo-ovoides, ellipsoideis, biguttulatis, hyalinis, $5.4-9 \times 1.8-2.7 \mu$; B — paucis, hamatis, hyalinis, $16.2-23.4 \times 1.4-1.6 \mu$.

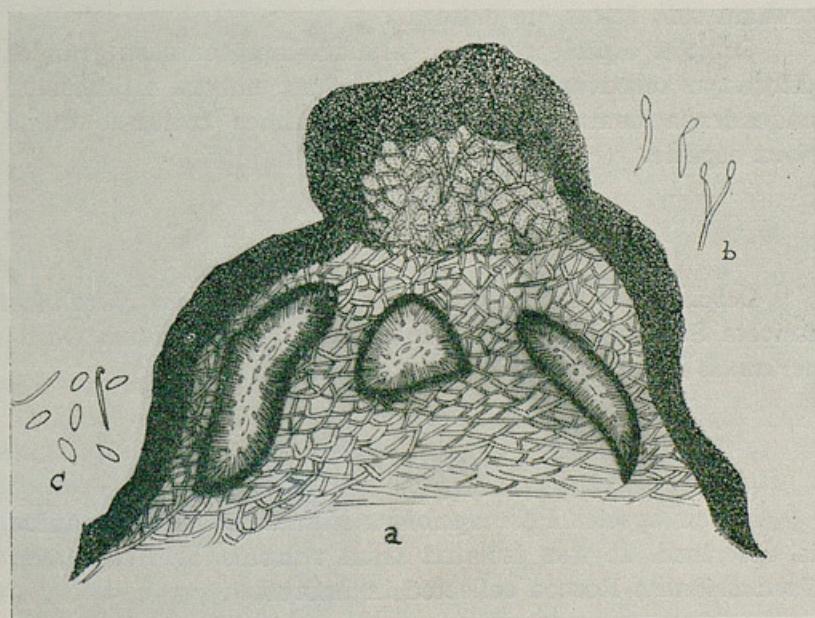


Fig. 1. — *Phomopsioides Natalinae*: a — estroma; b — esporóforos com esporos; c — esporos.

In rhizomate *Hedychii Gardneriani* Roscoe, Ilha de S. Miguel, Mata da Granja (*Natalina de Azevedo*, Junio 1960, s. n.: F. 241).

A claríssima Eng. Silv. D. NATALINA DOS SANTOS DE AZEVEDO dicata species.

MARIA E. A. PEREIRA COSTA & E. SOUSA DA CÂMARA (1954) criaram o género *Phomopsioides*, com o qual o fungo por nós agora estudado apresenta grandes afinidades. Os mesmos autores, em 1955 (MARIA R. SOUSA DIAS & E. SOUSA DA CÂMARA), e ainda ANICETA C. DOS SANTOS & E. SOUSA DA CÂMARA, no mesmo ano, citam nos seus trabalhos fungos do mesmo género.

Em 1958, ANICETA C. DOS SANTOS determinou um outro *Phomopsioides* em *Poinsettia (Euphorbia) pulcherrima* (Willd.) R. Grah.

Pelas características atrás citadas, fomos levados a incluir o fungo encontrado no *Hedychium Gardnerianum* Roscoe no mesmo género, embora as nossas observações tenham sido feitas em cultura.

Como a espécie por nós estudada apresentasse grandes diferenças relativamente às já descritas, embora nitidamente enquadrada dentro do género, concluímos tratar-se duma nova espécie.

SUMÁRIO

Descreve-se uma nova espécie, *Phomopsioides Natalinae* Aniceta Santos. Foi isolada do rizoma de *Hedychium Gardnerianum* Roscoe, colhido nos Açores.

SUMMARY

A new species *Phomopsioides Natalinae* Aniceta Santos is described. It was isolated from rhizome of *Hedychium Gardnerianum* Roscoe collected in Azores.

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PHOMOPSIS CASUARINAE (F. TASSI) DIEDICKE *

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INTRODUÇÃO

N O Horto do Laboratório de Patologia Florestal, na Quinta do Marquês, em Oeiras, vimos notando há tempo o aparecimento de tumores nos troncos e ramos das Casuarinas, especialmente na *Casuarina humilis* Otto & Dietr.¹

Este aspecto começou a tornar-se mais evidente em Agosto de 1961, verificando-se que as árvores, embora com aspecto saudável e verde, apareciam com pequenas formações que a pouco e pouco se avolumavam, atingindo o diâmetro aproximado de 4 × 5 cm. Estes tumores, inicialmente de cor amarelada, tornam-se acastanhados e finalmente negros.

A observação macroscópica levou-nos inicialmente a atribuir estas galhas a bactérias do tipo «crown-gall». Porém, por observação microscópica, verificámos a formação de picnídios, na Primavera e Verão, sobre a superfície das mesmas, os quais se apresentam com aspecto de pequenas pontuações negras. Internamente os tecidos apresentavam-se invadidos por hifas.

Segundo alguns autores, estas formações podem ser devidas a diversos agentes, entre eles, insectos, bactérias, fungos (BAXTER, 1952) e até por possíveis associações dos mesmos (CARTER, 1962).

* Comunicação apresentada à 14.ª Secção do XXVII Congresso Luso-Espanhol para o Progresso das Ciências — Bilbao, 20-24 de Julho de 1964.

¹ As espécies *C. Cunninghamiana* Miq., *C. glauca* Sieb. e *C. stricta* Ait., em cultura do mesmo local, não mostram sinais de infecção.

O agente responsável por estas formações parece ser o *Phomopsis casuarinae* (F. Tassi) Diedicke, aliás já citado por CÂMARA (1929), em *Casuarina stricta* Dryand, como *Phoma casuarinae* F. Tassi, considerado como parasita fraco e que penetra nos ramos e troncos através de feridas (BAXTER, 1952; BOYCE, 1961; e CARTER, 1961).

Duma maneira geral, os fungos do género *Phomopsis* são considerados como parasitas fracos; porém BIRCH (1935) considera principalmente o *P. strobil* fortemente parasita, produzindo cancro no tronco de *Pinus radiata* D. Don. Segundo BOYCE (1961), certos *Phomopsis*, como *P. (Phacidio-pycnis) pseudotsugae* (Wilson) Hahn. e *P. lokoyae* Hahn., causam cancos em *Pseudotsuga taxifolia* (Lam.) Br. = *P. menziesii* (Mirb.) Franco e *Abies*, e o *P. boycei* Hahn, em *Abies concolor* Lind. & Gord.

A espécie detectada por NATALINA DE AZEVEDO (1961), embora pouco frequente e não causando grandes estragos, pode, no entanto, por vezes, deformar muito os exemplares atacados, dando-lhes aspecto muito desagradável.

IDENTIFICAÇÃO

Nos cortes examinados notavam-se bastantes hifas negras que atravessavam as células em diversas direcções e, na periferia, picnídios gregários (2 a 3), raramente solitários, elipsóides, papilados, escuros, $262.3-375 \times 165-225 \mu$; esporóforos fasciculados, filiformes, $12.6-16.2 \times 1.5-1.8 \mu$; esporos oblongos, elípticos, com 2 gotas, hialinos, $5.4-9 \times 1.9-2.2 \mu$.

Nos tumores de *Casuarina humilis* Otto & Dietr., colec-tor NATALINA DE AZEVEDO, Agosto 1961 s. n.: F. 286, e ANI-CETA SANTOS, Maio 1963.

Atendendo à bibliografia consultada, dentro deste âmbito, as nossas observações harmonizam-se com as descritas por DIEDICKE (1911), pelo que concluímos que o fungo encontrado por nós é o *Phomopsis casuarinae* (F. Tassi) Diedicke.

Esta espécie foi identificada pela primeira vez, em 1896, por TASSI como *Phoma casuarinae*. Este taxonomista apresentou para o fungo a seguinte descrição:

«Peritheciis sparsis vel sub-seriatibus, paucis, globulosis, epidermide velatis, 200-250 μ diam., late pertusis, contextu luteo-fuligineo; sporulis oblongo-ellipticis, utrinque attenuatis, 2 vel 4 obsolete guttulatis, hyalinis, 6-8 $\times$ 2-3 μ , basidiis filiformibus triplo longioribus suffultis.

Hab. in ramulis emortuis *Casuarinae equisetifoliae*, in Horto Botanico Senensi».

Em 1911, DIEDICKE, integra-o nos *Phomopsis* como *Phomopsis casuarinae* (F. Tassi). Tab. I, fig. 6. «Diaporthe —; auf *Casuarina* Allescher VII p. 792). A länglich-elliptisch, beidendig verschmälert, mit zwei bis vier Öltropfen, 6-8 $\times$ 2-3 μ . Sporenträger fadenförmig, dreimal länger als die sporen.

Berst gerade, nadelförmig 13-16 $\times$ 1-1.5 μ , späters förmig oder hakig gebogen, 20 $\times$ 1-1.5 μ . Gehäuse sehr gross (fast 1 mm). Dick warzenförmig, oben unregelmässig abgestutzt, sehr verdickt, unten vielfach kammerig».

Em Portugal, CÂMARA (1929) determinou o *Phoma casuarinae* F. Tassi: «In ramulis emortuis *Casuarinae strictae* Dryand, horto Coloniale Ajudense, Ulissippone, leg. *Branquinho de Oliveira*, Junio, 1927».

ISOLAMENTOS E CULTURAS

Procedemos aos isolamentos a partir de esporos retirados dos picnídios e de tecido obtido por corte à mão do material atacado. Utilizámos, como meio de cultura, gelose de Dox.

Das culturas obtidas seleccionámos uma que, pelo seu aspecto, se assemelhava a outras do género *Phomopsis* existentes na Micoteca deste Laboratório.

Fizemos então a sementeira do micélio em gelose de Dox, cenoura, aveia, milho, e incubámos em estufa à temperatura de 25° C. Obtivemos melhor desenvolvimento micelial em gelose de malte.

Para o estudo das suas características culturais, utilizámos o mesmo meio de cultura, verificando que inicialmente se desenvolveu um micélio branco, algodinoso, com predominância de hifas aéreas. Depois de cerca de 20 dias de incubação aparecem corpos escuros muito abundantes donde se liber-

tam cirros de esporos, idênticos aos que observámos nas Casuarinas doentes.

ESTUDO HISTOLÓGICO

Para melhor exame das formações tumorais, fixámos estas com Fixador I, incluimo-las em parafina e cortámos as peças no micrótomo a 14 μ .

Depois dos cortes montados e devidamente preparados, usámos corantes específicos para bactérias (Orange G) e fungos (Azul de algodão e Safranina).

Após cuidadosa observação ao microscópio, notámos que, na periferia, se encontravam conceptáculos do fungo determinado e que as hifas invadiam os tecidos tumorais, atravessando as paredes celulares.

SUMÁRIO

No Horto do Laboratório de Patologia Florestal, na Quinta do Marquês, em Oeiras, vimos notando há tempo o aparecimento de tumores nos troncos e ramos de *Casuarina* spp., especialmente na *Casuarina humilis* Otto & Dietr.

As espécies *C. cunninghamiana* Miq., *C. glauca* Sieb. e *C. stricta* Ait., em cultura no mesmo local, não mostram sinais de infecção.

Pelo aspecto apresentado por estas formações, fomos levados de início a considerá-los como tumores do tipo «crown gall». Porém, o estudo histológico, com colorações especiais para determinação de bactérias nos tecidos vegetais, levou-nos a pôr de lado esta hipótese.

No entanto, a observação microscópica de cortes imediatos permitiu-nos localizar picnídios em grande número na superfície dessas formações que, pelo aspecto macroscópico, pela sua constituição histológica e pelo agente que lhe dá origem devem ser considerados galhas.

Assim, determinámos um fungo, o *Phomopsis casuarinae* (F. Tassi) Diedicke, de que fazemos a descrição.

Procedemos aos isolamentos a partir de esporos retirados dos picnídios e obtivemos culturas com aspecto semelhante

a outras do género *Phomopsis* existentes na Micoteca do Laboratório. Após algum tempo de desenvolvimento foi possível, por observação de picnídios formados, confirmar que o fungo em cultura correspondia à espécie por nós detectada.

SUMMARY

In experimental plots the rearing-place of the Forestry Pathology Laboratory, at Quinta do Marquês, in Oeiras, we are detecting some tumours on the stems and branches of the *Casuarina* spp., especially the *Casuarina humilis* Otto & Dietr.

The exemplars of the species *C. Cunninghamiana* Miq., *C. glauca* Sieb. and *C. stricta* Ait., don't show any symptom of disease, although its culture at the same place.

The aspect of those formations seem very similar to the tumours of the type «crown gall». However doing its histopathological study by special colorations for determining bacterias in the vegetable tissue, we decided to change our first hypothesis.

So, by microscopic observation of some immediate tangencial sections we could find a great number of pycnidia on the surface of those formations which by its macroscopic aspect, its histologic constitution and the agent that gives its origin must be considered galls.

We determine that way a fungus the *Phomopsis casuarinae* (F. Tassi) Diedicke, which description we do.

We made the isolations from the spores removed from the pycnidia and we obtained some cultures of a similar aspect with others of the class *Phomopsis* that can be seen in the «myco cabinet» of the Laboratory. Some time after by observing the pycnidia we confirmed that the fungus in culture answered to the species we detected.

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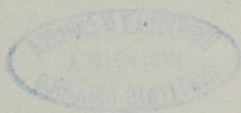
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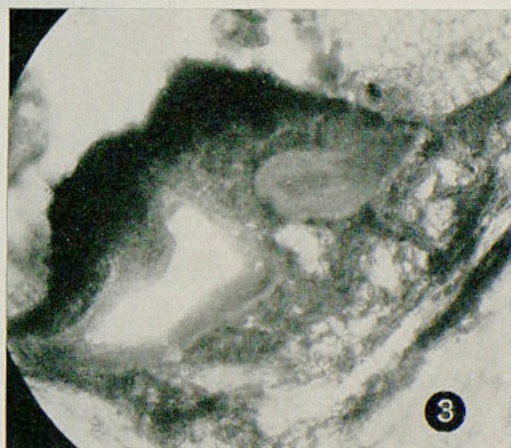
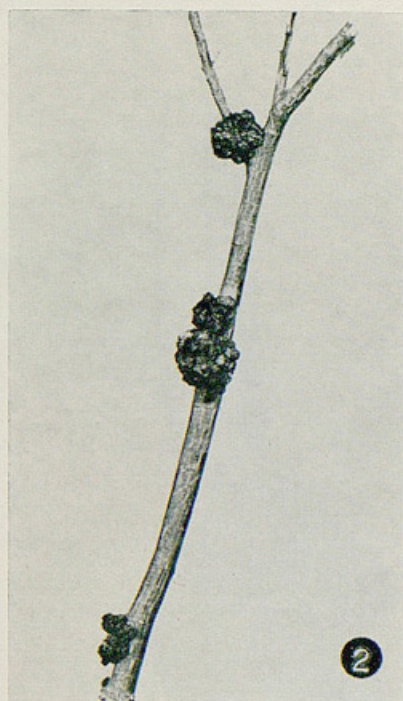
ESTAMPAS

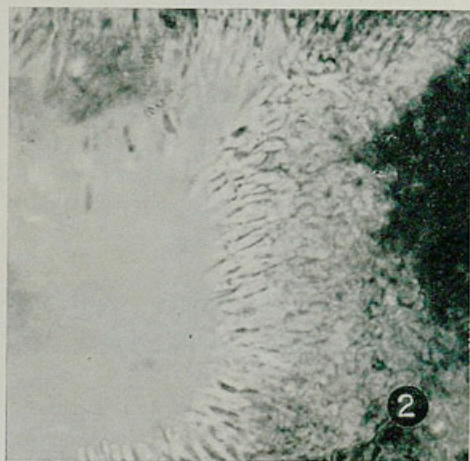
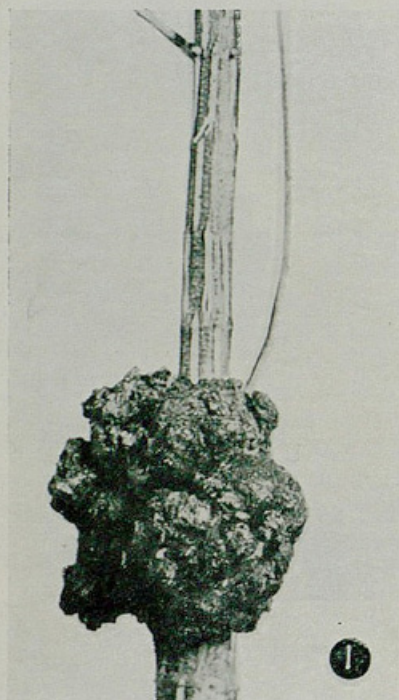


ESTAMPA I

- Fig. 1. — Aspecto dum ramo muito novo de *Casuarina humilis* Otto & Dietr. com galhas.
A young branch of *Casuarina humilis* Otto & Dietr. with some galls.
- Fig. 2. — Ramo mais lenhificado com galhas bem desenvolvidas.
A woody branch with well developed galls.
- Fig. 3. — Picnídios gregários de *Phomopsis casuarinae* (F. Tassi) Diedicke.
Two gregarious pycnidia of *Phomopsis casuarinae* (F. Tassi) Diedicke.







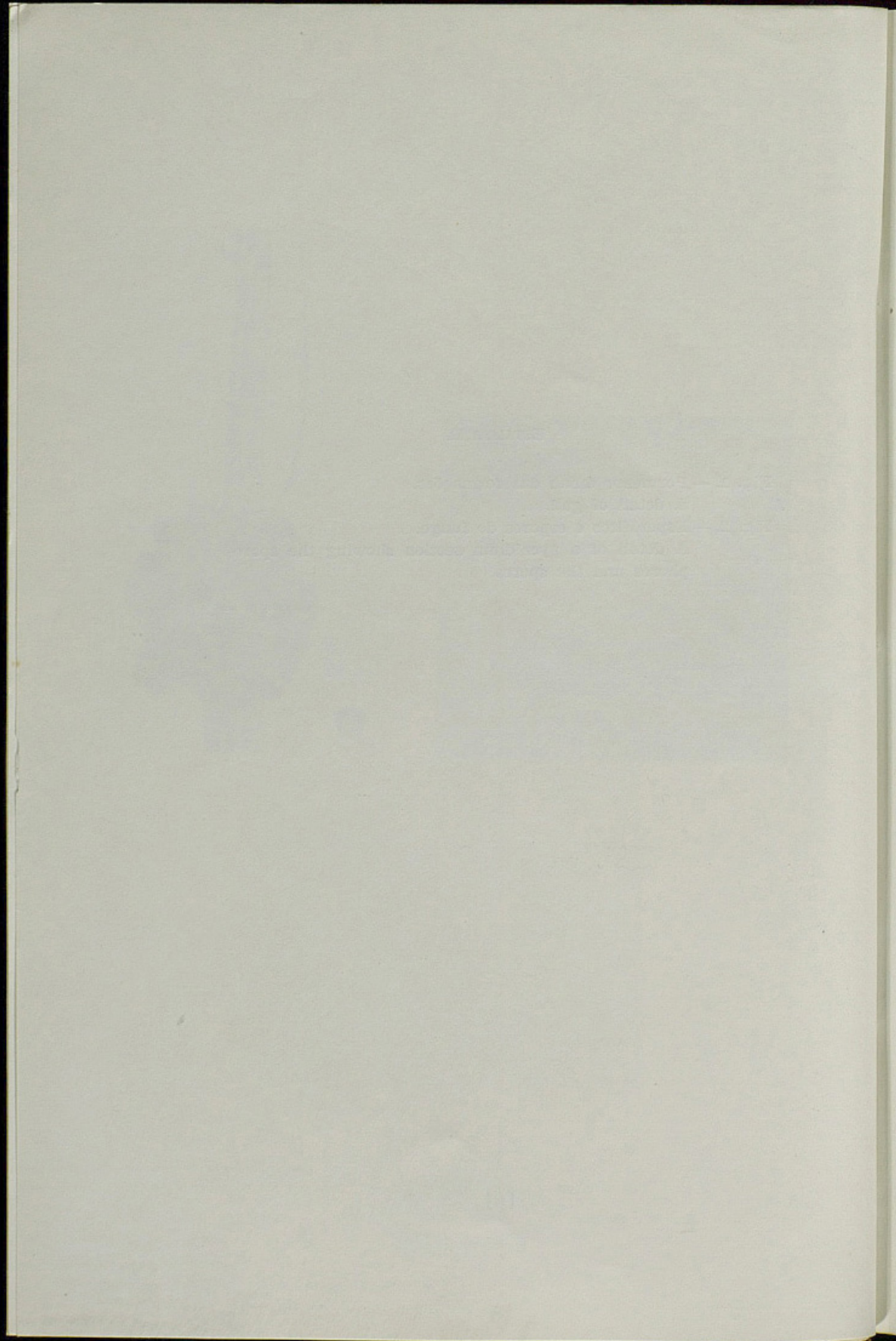
ESTAMPA II

Fig. 1. — Pormenor duma das formações.

A detail of gall.

Fig. 2. — Esporófitos e esporos do fungo.

A detail of a pycnidium section showing the sporophores and the spores.



THE FAMILY *CISTACEAE* IN TROPICAL AFRICA

by

B. VERDCOURT

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UNTIL quite recently the family *Cistaceae* was not known from continental tropical Africa. In 1954, GILLET described a species from the Somali Republic (N. Region) based on three gatherings, two of which had been communicated to Kew by the East African Herbarium, Nairobi. Other species have been collected and it is the object of this short paper to deal with these as far as is possible at present. The occurrence of the family in the north-eastern part of tropical Africa is perhaps not surprising since two species have been known from southern Arabia for many years and another was described from the Cape Verde Islands well over 100 years ago.

KEY TO THE SPECIES OF *HELIANTHEMUM* KNOWN FROM TROPICAL AFRICA AND SOUTHERN ARABIA

Leaves narrowly linear-cylindrical, 1.2-3.7 cm. long, 0.8-1.5 mm. wide *H. cylindrifolium* sp. nov.
(Somali Republic)

Leaves not cylindrical, mostly elliptic and much broader:

Flowers sessile or almost so; style rather mushroom-shaped; stamens 6-40:

Sepals accrescent in fruit, about 5 mm. wide; stems often decumbent, not very pale nor whitish; stigma and style about 2 mm. long; indumentum of inflorescence rhachis fine and silky . . . *H. stipulatum* (Forsk.)

C. Christensen
(French Somaliland)

Sepals not so accrescent in fruit, scarcely attaining 3 mm. in width; stems mostly erect, pale; stigma and style about 1 mm. long:

Indumentum of inflorescence rhachis coarsely granularly stellate *H. ellipticum* (Desf.) Pers.
(Central Sahara)

Indumentum of inflorescence rhachis finer and silkier; stamens often as few as 6, rarely up to 25
. *H. lippii* (L.) Dum. Cours.
(S. Arabia and Tibesti)

Flowers pedicellate:

Inflorescence well exceeding the leaves or, if almost as long, then plant a dwarf woody herb about 5 cm. tall; stamens about 30-50¹:

Leaves very small, inrolled, about 6 × 2 mm.; pedicels 3 mm. long; inflorescence much exceeding the leaves; ovary densely silvery pubescent; erect shrublet 20 cm. tall with slender branches
. *H. argyraeum* Bak.
(S. Arabia)

Leaves larger, up to 14 × 8 mm.:

Leaves with very fine stellate tomentum; inflorescence well exceeding the leaves; pedicels about 4 mm. long; ovary densely hairy
. *H. gorgoneum* Webb
(Cape Verde Is.)

Leaves with fine pubescence and numerous longer apparently simple hairs about 1 mm. long (actually joined at the base); inflorescence 1-2-flowered, just exceeding the leaves; pedicels 4.5-12 mm. long; ovary pubescent at apex and along the sutures *H. humile* sp. nov.
(Somali Republic)

¹ In both *argyraeum* and *gorgoneum* the number is many more than that claimed by GROSSER (Pflanzenreich: *Cistaceae*) but in neither case have flowers been boiled up since the material is sparse; the numbers indicated can be seen in the dry state and are doubtless an underestimate.

Inflorescence scarcely, if at all exceeding the leaves;
 woody shrub 50-70 cm. tall; leaves 1.1-2.3 cm. long,
 6-10 mm. wide; stamens about 100
 *H. somalense* Gillett
 (Somali Republic)

DESCRIPTION OF NEW SPECIES AND NOTES
 ON SOME OTHERS

Helianthemum cylindrifolium Verdcourt sp. nov.

A congeneribus foliis lineari-cylindricis floribus axillari-
 bus valde differt.

Suffrutex 0.5 m. altus, ramis basi lignosis circa 5 mm. diametro, cortice saturate griseo-brunneo desquamante obtectis. *Ramuli* juveniles 1.5 mm. diametro, velutine appresse griseo-tomentosi, inter stipulas linea elevata transverse notati. *Internodia* 0.3-3 cm. longa. *Folia* opposita; lamina lineari-subcylindrica, 1.2-3.7 cm. longa, 0.8-1.5 mm. lata, apice acuta, basi angustata, dense incano-tomentosa, supra linea impressa longitudinaliter excavata; petiolus 0.5-1.5 mm. longus; stipulae lineari-lanceolatae, 1.5 mm. longae, incanae. *Flores* axillares, solitarii vel gemini, pedicellis 0.7-1.2 cm. longis incanis. *Sepala* 2 exteriora lineari-oblonga, 2.5 mm. longa; 3 interiora majora, oblongo-elliptica, 7-8.5 mm. longa, 5 mm. lata, apice acuta, 5-nervata, intus glabra, extra tomentosa. *Petala* 5, flava, obovata, 5-6(-7.5) mm. longa, 2.8-3(-5) mm. lata, venosa, margine subintegra. *Stamina* circa 90, filamentis 3-4 mm. longis apice leviter incrassatis, antheris 0.5 mm. longis. *Ovarium* pseudo-3-loculare, placentis valde intrusis, 1.5 mm. longum, dense pilosum, ovulis in toto 15-21. *Stylus* 5.3 mm. longus, flexuosus, apice incrassatus, glaber, stigmate parvo. *Capsula* immatura 5 mm. longa.

Icon. nostr.: tab. I et II.

SOMALI REPUBLIC (N. REGION). North of Erigavo, slope of isolated gypseous hillock, 1980 m., 27 Sept. 1960, *Hemming* 1943 (EA, holotype; K, isotypes): soft white-leaved bush with yellow flowers, up to 45 cm. high, vernacular name (Somali)

«sera adeis». 24 km. west of Erigavo, Dyaha, shallow soil on limestone/gypsum hills, 1500 m., 1 June 1958, *Boaler* B 98 (K): low shrub to 30 cm.

The general appearance of the foliage is almost that of a *Suaeda*; usually there are condensed leafy shoots about 2 cm. long in the axils giving a pseudoverticillate effect. In the larger sepals there are three nerves to the right of the costa and one to the left. The indumentum is not strictly stellate on the stems and foliage but the hairs are fasciculate lacking a common stalk; on the sepals there is a mixture of simple and fasciculate hairs. Some specimens of *H. lavandulifolium* Mill. show a very slight resemblance in foliage but the leaves are not genuinely terete in that species and the multi-flowered inflorescence is totally different.

Helianthemum stipulatum (Forsk.) C. Christensen in Dansk. Bot. Arkiv 4(3): 20 (1922) — Tab. III.

FRENCH SOMALILAND. Dai Slopes, stony ground, 1050 m., 2 Feb. 1954, *Popov* 1334 (EA; K): small woody herb to 10 cm. tall.

The plant cited is undoubtedly very close to *H. stipulatum* and closely resembles material from Cyprus and other parts of the eastern Mediterranean. The sepals certainly look as if they are accrescent but further material is required to prove this. The texture of the indumentum is exactly right and I feel that the plant is at least no more than varietally distinct. Mr. MEIKLE, who has seen the species in the field in Cyprus, agrees with this determination which marks an interesting extension of range. A brief description of the specimen is given below.

Small herb 5-10 cm. tall with a woody but possibly annual rootstock. Leaves 1-1.5 cm. long, 5-6 mm. wide, rather coarsely stellately pubescent; costa impressed above, prominent below together with the lateral nerves. Inflorescences exceeding the leaves, several-flowered. Flowers sessile; sepals 5 mm. long, with long white hairs as well as a fine stellate pubescence. Stamens 16-21. Ovary pilose with 30-34 ovules. Stigma mushroom-shaped.

Helianthemum ellipticum (Desf.) Pers., Syn. 2: 78 (1806).

CENTRAL SAHARA. 25.6 km. south of Tamenrasset, foothills of the Hoggar Mts., in rocky valley with *Aerva javanica* and *Cymbopogon schoenanthus*, 1200 m., 15 Nov. 1952, *Money-Kyrle* Sah. 45 (K). Saharanet, dry ground, 1770 m., 10 March 1931, *Meinertzhagen* 130 (K). Oued Tit, rocky slopes, 1320 m., 12 March 1931, *Meinertzhagen* 150, 151 (K).

This is a well-characterised species with narrow, scarcely accrescent sepals and discrete, rather granular, stellate indumentum on the stems, inflorescence rachises and sepals; there are also longer, apparently simple hairs on the sepals.

Helianthemum lippii (L.) Dum. Cours., Le Botaniste Cultivateur 3: 130 (1802); Pers., Syn. 2: 78 (1806); Grosser in Pflanzenreich, *Cistaceae*: 98 (1903); Burt and Lewis in Kew Bull. 4: 305 (1949).

Some additional specimens are cited here.

ARABIA. Oman: Jebel Fayah, in sandy soil, Feb. 1952, *Lee Oldfield* 54 (BM; EA): an erect woody herb, leaves elliptic, veined, fleshy (*sic*), alternate; flowers tiny, yellow; very common; vernacular name (Arabic) «charee» and Sharjah, Dec. 1950, *Lee Oldfield* 12 (BM; EA) and on coast between Sharjah and Ghezira, sandy areas, 19 Feb. 1950, *Guichard* KG 89/OMAN (BM; EA).

CHAD. Tibesti, Tarso Toussidé, on plateau, rhyolites, 1500-1800 m., 25 Aug. 1957, *Grove* 45 (K): vernacular name «korkubu».

Helianthemum humile Verdcourt sp. nov.

A congeneribus habitu humili, pedicellis 4.5-12 mm. longis, ovario pauci-ovulato, capsula subglabra differt.

Herba parva, usque 5 cm. alta, basi lignosa; caulis 5 mm. diametro cortice rugoso obtectus. *Ramuli* breves, dense albido-pilosi. *Internodia* circa 6 mm. longa. *Folia* opposita; lamina elliptica, 8.3-10.5 mm. longa, 2.5-3.5 (-4.5) mm. lata, supra velu-

tine pubescens, subtus dense pubescens et ubique pilis circa 1 mm. longis obiecta, margine revoluta, nervo mediano et nervis lateralibus utrinque 3-4 supra impressis subtus prominentibus; petiolus 1 mm. longus; stipulae lanceolatae, circa 2 mm. longae, pilosae. *Pedunculi* 4-6 mm. longi, 1(-2)-flori, pedicellis 4.5-12 mm. longis, bracteis 2 lanceolatis. *Sepala* 2 exteriora linearia, 3.5 mm. longa, 0.8 mm. lata, pilosa et pubescentia, subacuta vel obtusa, mucronulata; 3 interiora oblique oblonga, 7 mm. longa, 3.8 mm. lata, intus glabra, extra pilosa et pubescentia, 5-7-rubro-venosa. *Petala* 5, flava, obovata, 7 mm. longa, 5 mm. lata. *Stamina* circa 50, filamentis 3.5-4.5 mm. longis, antheris 0.5 mm. longis. *Ovarium* ovoideum, 0.8 mm. longum, apice et ad suturas pilosum, placentis 3 ovulis in toto 8-9. *Stylus* 4-6.2 mm. longus, stigmatibus parvis. *Capsula* ovoidea, leviter 3-angulata, 5 mm. longa, 3.5 mm. lata, glabra vel apice pilis paucis ornata.

Icon. nostr.: tab. IV.

SOMALI REPUBLIC (S. REGION). Mt. Surud, eastern slope, on limestone slopes, 2310 m., 30 Oct. 1956, *Bally* 11283 (EA, holotype; K, isotype): dwarf woody plant with bright yellow flowers.

Helianthemum somalense Gillett in Kew Bull. 9: 493 (1954).

SOMALI REPUBLIC (N. REGION). Near Erigavo, limestone hill slopes, 15 Dec. 1953, *Popov* 1147 (K, holotype; EA, isotype): erect woody herb, height 60 cm.; flowers yellow; vernacular name (Somali) «wan'ad». Moledere, 10° 9' N., 47° 15' E., circa 1500 m., 24 Jan. 1945, *Glover and Gilliland* 649 (EA; K): golden-flowered shrublet of 50-70 cm.; vernacular name (Somali) «wanad». Buran (Sorl), 10° 13' N., 48° 47' E., 900 m., on rocky ground, 6 Oct. 1929, *Collett* 120 (K): plant of 20 cm., flowers green; stamens yellow; vernacular name (Somali-Warsangeleh) «gedad» (a variant with about 50 stamens and alternate leaves).

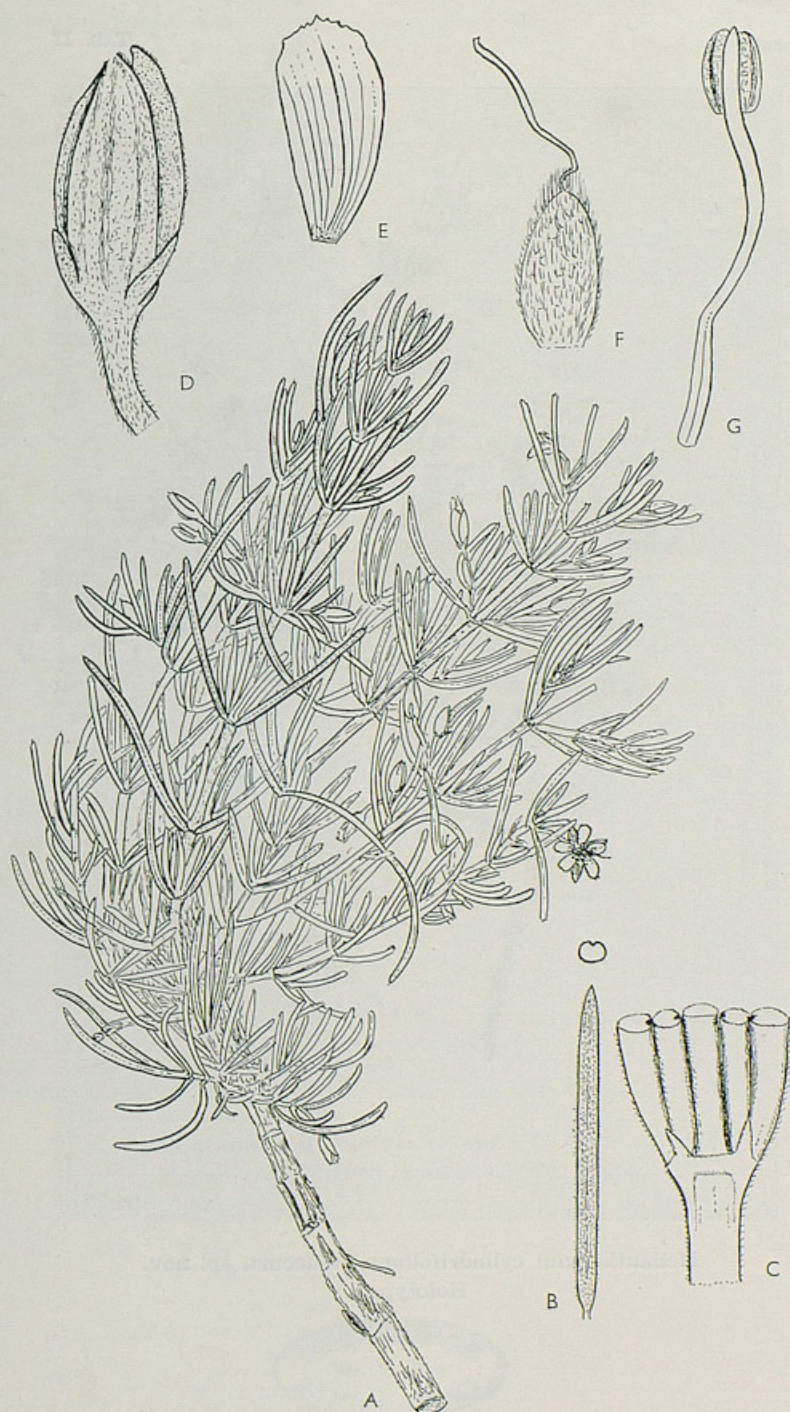
GILLETT stated that his new species seemed to occupy an isolated position in the genus and I have been equally in

difficulty in placing my two new species. Using GROSSER's key they appear to come near to section *Pseudomacularia* Grosser. Until ripe seeds are available the possibility of new sections being required is left in abeyance. *H. stipulatum*, *H. ellipticum*, *H. lippii* and *H. gorgoneum* belong to the section *Eriocarpum* Dunal. *H. argyraeum*, treated by GROSSER as a synonym of *H. ellipticum*, is a distinct species placed by SCHWARTZ [Mitt. Inst. allgem. Bot. Hamburg 10: 169 (1939)] in the section *Helianthemum* itself.

The distribution of the various species is shown in tab. V. The curious nature of the new species described above seems to support GILLET's contention that the genus was formerly more widely distributed in Africa but some of the other species may be due to more recent immigrations.

My thanks are due to the Director, Royal Botanic Gardens, Kew, for permission to use the Kew herbarium and library and to him and also to Mr. ZABEAU for photographing two of the sheets concerned and enlarging a further photograph of my own.

TAB. I



Helianthemum cylindrifolium Verdcourt, sp. nov.

- A, flowering shoot, $\times \frac{2}{3}$. B, single leaf and cross-section, $\times 1\frac{1}{3}$.
 C, node showing stipules, $\times 4$. D, bud, $\times 4$. E, petal, $\times 4$.
 F, ovary and style, $\times 4$. G, stamen, $\times 18$
 (all from isotype).

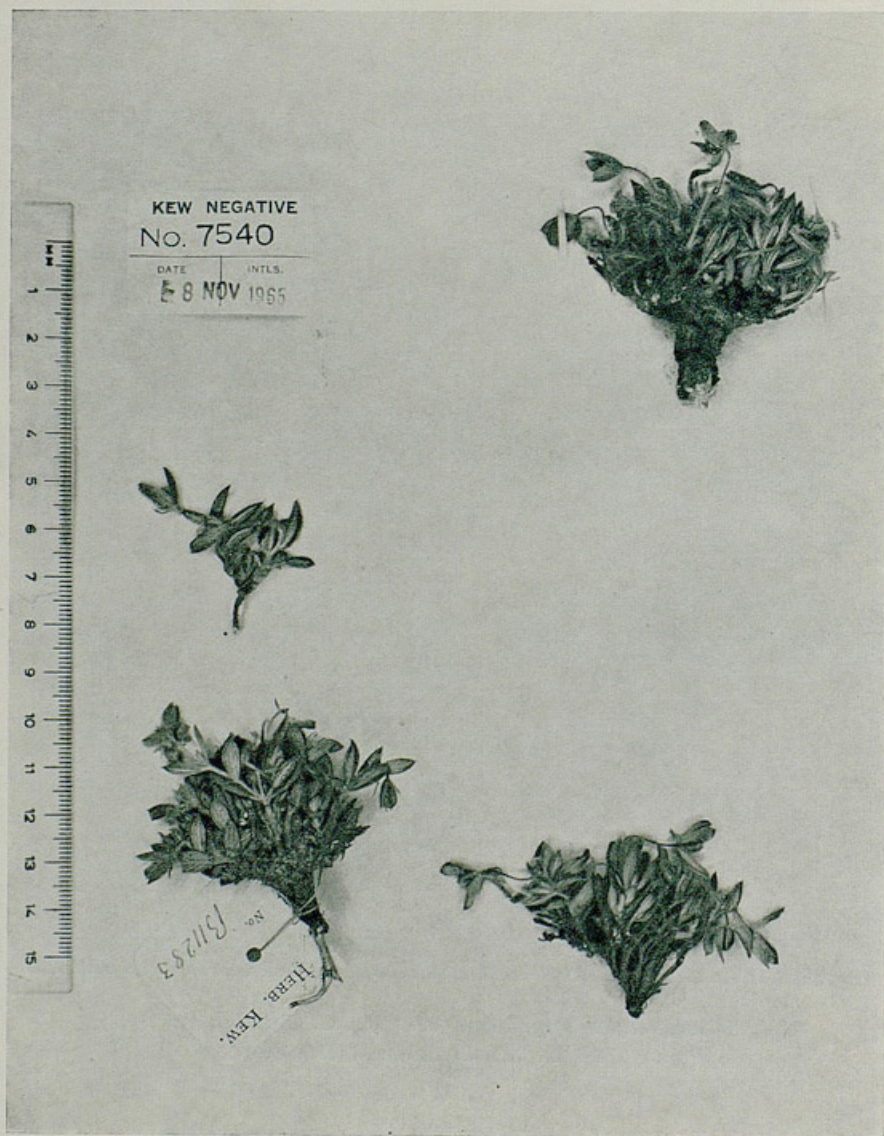


Helianthemum cylindrifolium Verdcourt, sp. nov.
Holotype.



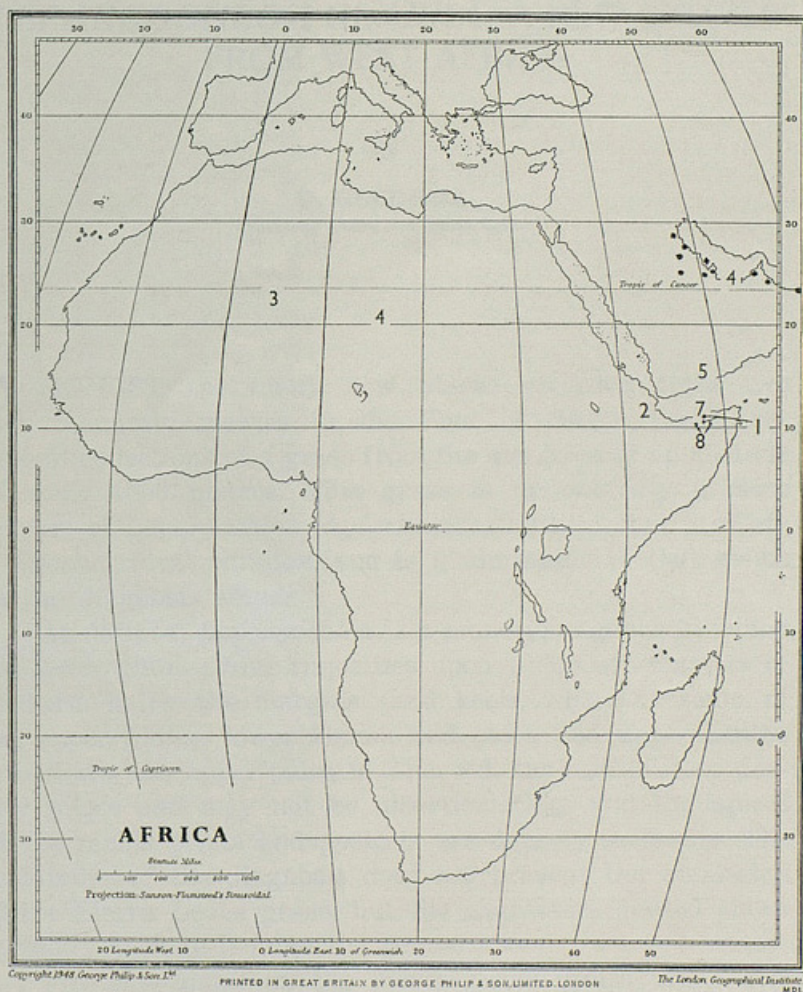
Helianthemum stipulatum (Forsk.) C. Christensen
 Popov 1334, French Somaliland, Dai Slopes.





Helianthemum humile Verdcourt
 Composite photograph made up of holotype and isotype.

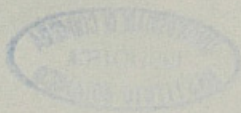
TAB. V



Distribution of *Helianthemum* species in tropical Africa,
 1) *cylandrifolium*, 2) *stipulatum*, 3) *ellipticum*, 4) *lippii*,
 5) *argyraeum*, 6) *gorgoneum*, 7) *humile*,
 8) *somalense*.



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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LEPARGOCHLOA GLABRA; A NEW SPECIES FROM WEST AFRICA

by

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AMONGST the many new plants recorded from two mountain masses in the East of Sierra Leone are several collections of a grass from the meadows at an altitude of some 1300 metres. This grass is undoubtedly a close relative of *Lepargochloa rhytachnoides* Launert, but presents a nomenclatural paradox, and is inadmissible to that genus as the diagnosis stands.

As defined, *Lepargochloa* is a monotypic genus in which the lower glumes bear rugosities upon which are clusters of setiform hairs, the margins (and keels, where present) of the upper glume, lower lemma and palea and upper lemma are ciliate, the upper palea is 2-nerved, the racemes are densely pilose and may not be disarticulating, and the apices of the rachis joints and pedicels are densely sericeous. The remainder of the diagnosis does not prevent the admission of the Sierra Leone grass, but the characters quoted above certainly exclude it from the genus.

The only hairs on the Sierra Leone grass are a few minute cilia towards the apex of the lower glume and below the aristulate apex of the upper glume, at the junction of the leaves with their sheaths, and within the base of the involute leaves. The racemes are usually deeply anthocyanosed, disarticulating at maturity; the base of the disarticulating spikelets and rachis joints bearing a protruding knob of tissue and the apex of the joint having a corresponding depression. The spikelets gape at anthesis, due to the impression of a narrow cartilaginous band at the base of the lower

glume. The caryopsis, unknown for LAUNERT's type species, is ovate-lanceolate, 4.5 mm long, has an embryo which occupies half the length of the grain and a large, sub-circular, sub-basal, dark brown hilum.

I do not consider that the excluding characters warrant the erection of a second monotypic genus, even though the two populations are as widely separated as Angola and Sierra Leone and the generic name '*Atrorubrochloa*' would be more appropriate for the Sierra Leone grass. I propose, therefore, to amend the diagnosis of *Lepargochloa* Launert (in Bol. Soc. Brot. sér. 2, 37: 82-4, 88-9. 1963) in order to accommodate the Sierra Leone grass in it. This necessarily perpetuates another botanical paradox; the Sierra Leone grass becoming the 'glabrous, silver-feathery shoot'.

The characters which are important in defining the genus are those which distinguish it from *Loxodera* Launert, *Lasiurus* Boiss., *Elionurus* Humb. & Bonpl., *Rhytachne* Desv. and *Rottboellia* Linn.

Lepargochloa Launert, emend. D. Gledhill

Gramen cum racemis solitariis spiciformis ad apices culmorum. Culmi sine ramis, paucinodi, flexuosi. Spiculae binae ad nodos rhacheos, altera sessilis in excavationibus rhacheos inserta, altera pedicellata, similes, biflorae; flosculo inferiore ♂, superiore hemaphrodito vel raro ♀ in spicula pedicellata. Gluma inferior coriacea iugata; iugis rugosis, raro erugosis; 7-nervis. Gluma superior plusminusve membranacea, cymbaeformis, carinata, acuta vel aristulata, 5-nervis. Lemma inferior membranaceum, 2-3 nervis. Palea inferior tenuiter membranacea, 2-nervis. Lemma superior tenuiter membranaceum 2-3 nervis. Palea superior tenuiter membranacea, 0-2 nervis. Lodiculae 2, cuneatae, oblique truncatae, laciniatae. Stamina tria in flosculo utroque. Ovarium cum stylis 2, utrisque instructis stigmati plumoso emergente e latere spiculae anthesi hiantis. Rhacheos articuli transverse, ad nodos disarticulantes, intus planiusculi, extus paullo convexi, apice incrassati sed haud appendiculati. Pedicelli haud articulis fusi, similes articulis sed breviores. Callus angustus paullo depressus.

Species duae, Africae tropicae occidentalis inhabitentes.
Typus generis *Lepargochloa rhytachnoides* Launert.

Lepargochloa glabra D. Gledhill, spec. nov.

Gramen perenniale dense caespitosum ad 90 cm altum crescens, e rhizomati brevi et erecto. Culmi solitarii, sine ramis, erecti, tenues, nodiferi 2-3, nodis glabris angustis et fuscis. Internodi tenues, striati longiores vaginis, pedunculo supremo apicem versus incrassato longe exserto, concavo siccato. Folia basi linearia flexuosa, fuso-involuta raro explanata, ad 60 cm longa et 2 mm diametro secta, levia ciliata solum in margine auricularum membranacearum cum vagina conjuncto, breviter et dense pilosa basi medi-nervi super ligulam. Folia culmi longitudine supra decrescentia, supremo lanceolato, longo ad 3 cm et lato ad 4 mm. Ligula obtuse truncata, membranacea, 1 mm longa. Vaginae leves striatae, epilosae, basi persistentes et saepissime ambustae. Racemi solitarii apice culmorum, erecti, glabri, ad 6 cm longi et 5 mm lati. Articuli late lineares, 7 mm longi, intus plani, extus paullo incrassati, striati, glabri. Callus angustus transversus. Spiculae sessiles ovato-lanceolatae, glabrae vel minute ciliatae in marginibus apicem versus, 6-7 mm longae. Gluma inferior aequalis spiculae, acuta vel minute bifida apice, dorso convexa, marginibus inflexis, 7-nervis, eminente jugata super nervos, jugis levibus vel plerumque manifeste rugosis ad basin, marginibus membranaceis. Gluma superior cymbaeformis, acute carinata, 5-nervis, membranacea, apice acutissima et arista 1 mm longa. Flosculus inferior ♂; lemma ovatum, obtusum vel emarginatum, membranaceum, obscure 4-nervis, 5 mm longum; palea plusminusve linearis, alte bifida, membranacea, obscure 2-nervis, 5 mm longa. Flosculus superior hermaphroditus; lemma anguste ellipticum, acutum, membranaceum, obscure 3-nervis, 4 mm longum; palea anguste elliptica, trifida vel laciniata, membranacea, enervis, 2.5-3 mm longa. Lodiculi bini, cuneati, laciniati. Antherae lineares, croceae, laterale exsertae spiculo; eae flosculi inferioris 3 mm longae, eae flosculi superioris 2 mm longae. Stigmata 2, plumosa, rubicunda, antheris laterale exsertis spicula anthesi. Spiculae

pedicellatae similes sessilibus, aut flosculos superiore ♀ et gluma inferiore minus rugosa.

Icon. nostr.: fig. 1 et tab. I.

Typus *Morton et Gledhill* SL1885 (SL) Tingi Mts, Sierra Leone.

Isotypi in K, WAG, Gh, IFAN et BM.

Huc pertinet etiam; *Gledhill* s. n., 1960, Tingi Mts. (SL). *Morton et Gledhill* SL1094 (SL; K; WAG; BM), SL1876 (SL; K), SL1060 (SL; Gh; FHI) and SL1096 (SL; K; WAG; BM).

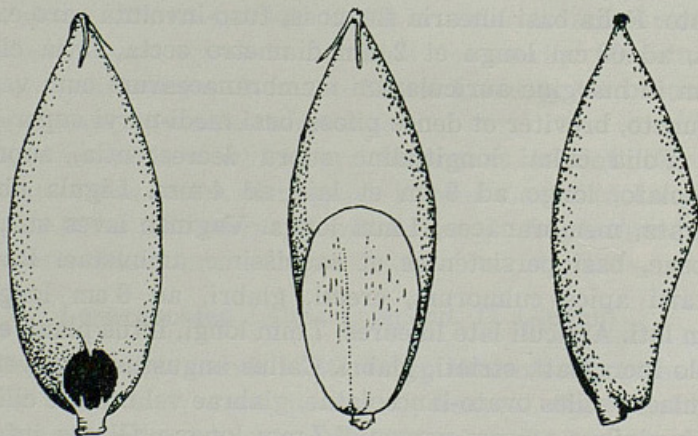


Fig. 1. — *Lepargochloa glabra*. Ventral (left) dorsal and lateral views of mature caryopsis.

The meadows in which this grass grows are subject to burning, being ignited either by native hunters or by ground strikes of lightning. The frequency of burning is a matter of chance, but at its worst it is an annual event. The flowering cycle of this and other grasses (such as *Elionurus argenteus* Nees, *Panicum ecklonii* Nees, *Sporobolus montanus* Engl. and *S. centrifugus* Nees) occurs during the early stage of regrowth. The new shoots arise from swollen, adpressed-hairy, tuberos outgrowths from the previous year's rhizome. This growth pattern produces tussocks, of the entangled roots and rhizomes, up to 20 cm high, on which the charred basal leaf-sheaths persist for some time. When regrowth of the meadows has continued for a whole year or more, the species

so far mentioned become less conspicuous and broader leaved grasses (*Monocymbium* spp., *Loudetia* spp., *Hyparrhenia* spp. and *Andropogon* spp.) become dominant locally.

The somatic chromosome number of *Lepargochloa glabra* is 20.

I am indebted to Mr. R. J. COLLETT B. A. who kindly translated the diagnosis.

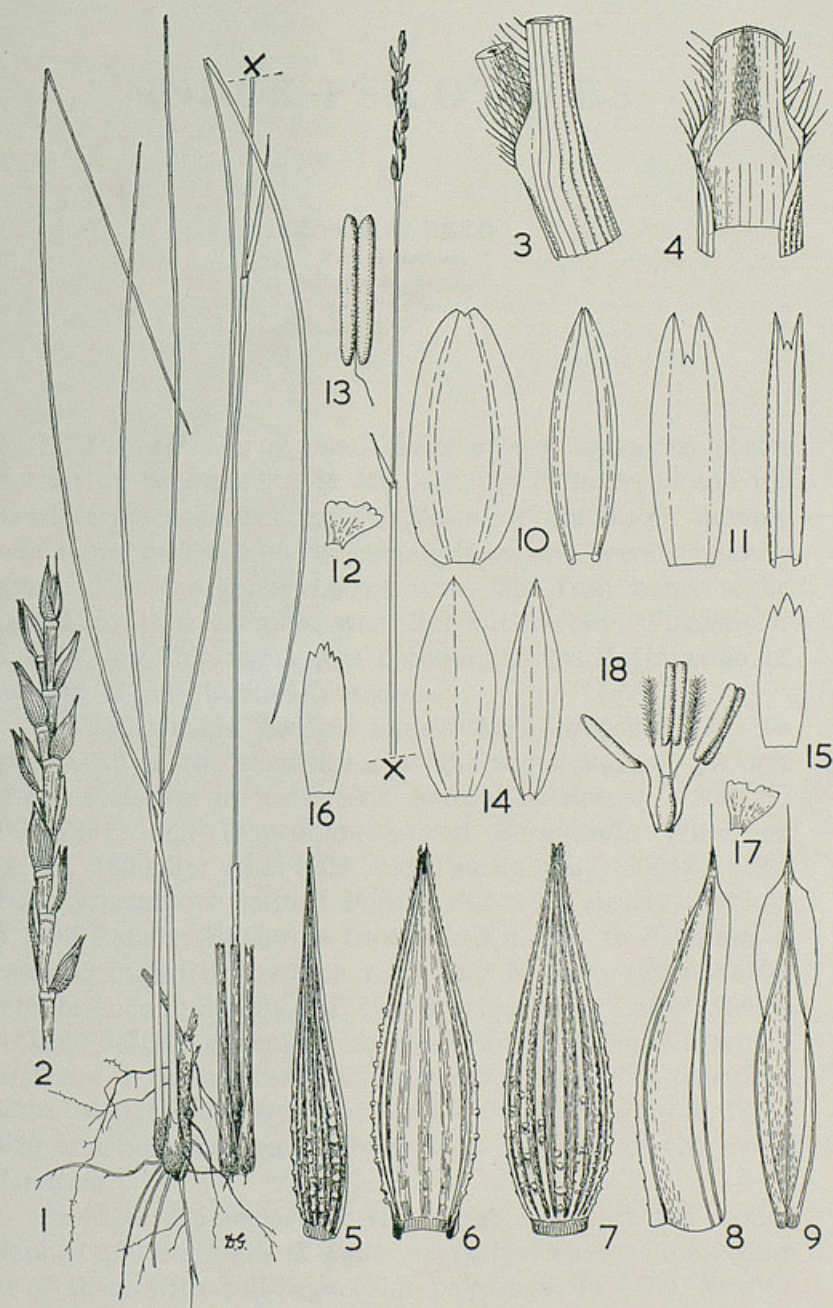
TABULA

TABULA I

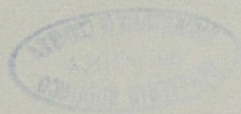
Lepargochloa glabra D. Gledhill

1. Habit.
2. Raceme.
3. Lateral view of junction of leaf-sheath and lamina.
4. Leaf sheath junction with lamina opened to display ligule.
5. Lower glume in profile.
6. Lower glume external view.
7. Lower view internal view.
8. Upper glume in profile.
9. Upper glume internal view.
10. Lemma of inferior floret flattened and internal view.
11. Palea of inferior floret flattened and internal view.
12. Lodicule of inferior floret.
13. Anther of inferior floret.
14. Lemma of superior floret flattened.
15. Paleas of superior florets showing variation in apex.
16. Palea of superior floret with laciniate apex.
17. Lodicule of superior floret.
18. Essential organs of superior floret.

TAB. I



I. 100



INDEX PSILOTALES

by

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THE *Psilotales* is a small order of cryptogamous plants having two monotypic families, the *Psilotaceae* and the *Tmesipteridaceae*. The type species of *Psilotum*, namely *nudum*, and of *Tmesipteris*, namely *tannensis*, were originally described in the genus *Lycopodium*. The first name to be applied to this complex was *Hoffmannia* by WILLDENOW in 1789, but this name was preoccupied by *Hoffmannia* of SWARTZ (1788) in the *Rubiaceae*.

In 1801 three generic names were proposed for the species, all in the same issue of the same journal. SWARTZ named *Psilotum* in Schrader's Journal of Botany, 1800(2): 109. 1801; and BERNHARDI named *Bernhardia* Willd. ex Bernh., 1800(2): 132. 1801 and *Tmesipteris*, 1800(2): 131. 1801. WILLDENOW defined *Bernhardia* more clearly in 1802. In 1805 PALISOT-BEAUVOIS transferred *nudum* to *Psilotum*, a combination which has been overlooked by many taxonomists, in preference to SWARTZ's *Psilotum triquetrum*. Later (1806), SWARTZ described another species, *Ps. complanatum*, which WILLDENOW transferred to *Bernhardia* (1810). *Psilotum flaccidum* Wall. became confused with *Ps. complanatum* in 1828-1829 and has been variously treated in relation with *complanatum*.

In 1836, a Japanese horticulturist described and monographed 120 cultivars of *Psilotum (triquetrum)*, illustrating 60 of them with full-page color paintings. In 1850, SPRING (Lyc. Monogr. II: 265-272) reviewed the species of *Psilotum* and *Tmesipteris* known at that time. In 1856, KARL MÜLLER

(«Monographische Kritik der Lycopodiaceen-gattung *Psilotum* Sw.») accepted *Bernhardia* in a very broad sense, establishing three sections: I. *Tmesipteris* (Bernh.) K. Müll., II. *Eubernhardia* K. Müll. and III. *Psilotum* (Sw.) K. Müll. For the last two sections he established the same three subsections in each: 1. *Flaccidae* K. Müll., 2. *Strictae* K. Müll. and 3. *Fastigiatae* K. Müll. He included or described 18 species in *Bernhardia*.

In 1850 PAYER made *Psilotum* the type of this family *Psilotées* (= *Psilotaceae*) and included in it *Psilotum*, *Tmesipteris* and *Isoëtes*. Of course, *Isoëtes* must be excluded, but at that time it was being tossed about different groups and this was a convenient repository for a while. MÜLLER probably felt PAYER's grouping of *Psilotum* and *Tmesipteris* was strong enough to include both in his treatment of *Bernhardia*, discussed above. On the other hand, in 1881 BERTRAND felt that *Tmesipteris* was sufficiently different to set up the family *Tmesipteridées* (= *Tmesipteridaceae*).

In 1889 BENNETT and MURRAY raised the whole group to an order, *Psiloteae* (*Psilotales*), a grouping followed by SCOTT and WETTSTEIN and others since 1900. ENGLER (1898) raised the group to Unterreihe (*Psilotineae*); ZIMMERMANN (1926) raised it to Class (*Psilophyta*); DARRAH (1939) raised it to Division (*Psilopsida*); and more recently KOIDZUMI (1939) and NEMEJC (1963) have established even more super groups, mainly to cope with the fossil counterparts and correlative groups.

The internal anatomy of various species of *Psilotum* and *Tmesipteris* has been studied extensively (see papers listed in the bibliography). The consensus of opinion is that these genera represent reduced and specialized life forms rather than primitive forms. Earlier, these genera had been thought of as being closely related to the *Rhynia-Horneophyton* complex of Devonian land plants. Gradually the fossils have been grouped in the *Psilopsida* and more recently in the *Psilophytopsida*. PICHI-SERMOLLI (1959) reviewed the status of these groups and concluded that our present-day plants belong in the *Psilopsida* and the fossils in the *Psilophytopsida*, which remains a rather heterogeneous complex of fossil

types. NEMEJC (1963) completely separates the fossils from the *Psilotales*, and then places the *Psilotales* closer to the *Lycopodiales*.

INDEX PSILOTALES

- Bernhardia* Willd. ex Bernh. in Schrad. Jour. Bot. 1800(2): 132. 1801; Willd., Act. Acad. Erford., pp. 11-12. 1802; Spec. Pl. 5: 56. 1810; Pursh, Fl. Amer. Septentrion. 2: 655. 1814; Kaulf., Enum. Fil., 21. 1924; Bischoff, Die Rhizokarpen und Lycopodeen, p. 124. 1828; K. Müller, Bot. Zeit. 14: 217-227, 233-243, 11 figs. 1856. = *Psilotum*.
- Bernhardia* sect. I. *Tmesipteris* (Bernh.) K. Müller, Bot. Zeit. 14: 220, 240. 1856. (Based on *Tmesipteris* Bernh., 1801). = *Tmesipteris* Bernh.
- Bernhardia* sect. II. *Eubernhardia* K. Müller, Bot. Zeit. 14: 220, 241. 1856. = *Psilotum*.
- Bernhardia* sect. II. *Eubernhardia* subsect. 1. *Flaccidae* K. Müller, Bot. Zeit. 14: 240-241. 1856. = *Psilotum*.
- Bernhardia* sect. II. *Eubernhardia* subsect. 2. *Strictae* K. Müller, Bot. Zeit. 14: 240-241. 1856. = *Psilotum*.
- Bernhardia* sect. II. *Eubernhardia* subsect. 3. *Fastigiatae* K. Müller, Bot. Zeit. 14: 240-241. 1856. = *Psilotum*.
- Bernhardia* sect. III. *Psilotum* (Sw.) K. Müller, Bot. Zeit. 14: 220, 241. 1856. (Based on *Psilotum* Sw., 1801). = *Psilotum* Sw.
- Bernhardia* sect. III. *Psilotum* subsect. 1. *Flaccidae* K. Müller, Bot. Zeit. 14: 240-241. 1856. = *Psilotum*.
- Bernhardia* sect. III. *Psilotum* subsect. *Strictae* K. Müller, Bot. Zeit. 14: 240-241. 1856. = *Psilotum*.
- Bernhardia* sect. III. *Psilotum* subsect. *Fastigiatae* K. Müller, Bot. Zeit. 14: 240-241. 1856. = *Psilotum*.
- B. antillarum* K. Müller, Bot. Zeit. 14: 234. 1856. (Jamaica, Martinique, Trinidad, Brazil). = *Psilotum nudum*.
- B. californica* K. Müller, Bot. Zeit. 14: 222, f. 3-5. 1856. (California). = *Psilotum complanatum*.
- B. capensis* K. Müller, Bot. Zeit. 14: 238-239. 1856. (Natal). = *Psilotum nudum*.

- B. complanata* Willd., Spec. Pl. 5: 57. 1810; K. Müller, Bot. Zeit. 14: 220-221, f. 6. 1856. (Jamaica, 'parasitic on trees'). = *Psilotum*.
- B. complanata* Pöpp., Coll. Pl. Cub.; pro syn. in K. Müller, Bot. Zeit. 14: 234. 1856. = *Psilotum nudum*.
- B. deppeana* K. Müller, Bot. Zeit. 14: 235. 1856. (California). = *Psilotum nudum*.
- B. dichotoma* Willd. ex Bernh., in Schrad. Jour. Bot. 1800(2): 132. 1801; Willd., Act. Acad. Erford., pp. 11-12. 1802; Spec. Pl. 5: 56. 1810; Pursh, Fl. Amer. Septentrion. 2: 655. 1814; Kaulf., Enum. Fil., p. 21. 1824. = *Psilotum nudum*.
- B. dichotoma* sensu Kaulf., Enum. Fil. Chamiss., p. 21. 1824. (= *B. oahuensis*). = *Psilotum nudum*.
- B. floridana* (Michx.) K. Müller, Bot. Zeit. 14: 233. 1856. (Florida, Bahamas, Cuba). = *Psilotum nudum*.
- B. indica* K. Müller, Bot. Zeit. 14: 236. 1856. (Java, Ceylon). = *Psilotum nudum*.
- B. mariana* K. Müller, Bot. Zeit. 14: 238-239. 1856. (Ins. Marianae, Rawack). = *Psilotum complanatum*.
- B. mascarenica* K. Müller, Bot. Zeit. 14: 239. 1856. (Ins. Mascarenes, Mauritius, Bourbon). = *Psilotum nudum*.
- B. novae-hollandiae* K. Müller, Bot. Zeit. 14: 237. 1856. (Nova Hollandia; Sidney, Australia; Kermadec Ins.). = *Psilotum nudum*.
- B. oahuensis* K. Müller, Bot. Zeit. 14: 238. 1856. (Ins. Sandwicensis, Ins. Oahu, Ins. Radak). = *Psilotum nudum*.
- B. pedunculata* Desv. in Herb. Juss.; Spring, Monogr. Lyc. II: 269 (pro syn.). 1850. = *Psilotum nudum*.
- B. ramulosa* K. Müller, Bot. Zeit. 14: 222-223, f. 7-8. 1856. (Ins. Sandwicensis, Woahoo). = *Psilotum complanatum*.
- B. schiedeana* K. Müller, Bot. Zeit. 14: 222, f. 9-11. 1856. (Mexico, Jalapa). = *Psilotum complanatum*.
- B. tannensis* (Spreng.) K. Müller, Bot. Zeit. 14: 221. 1856. = *Tmesipteris*.
- B. truncata* (R. Br.) K. Müller, Bot. Zeit. 14: 221. 1856.
- B. zollingeri* K. Müller, Bot. Zeit. 14: 223, f. 1-2. 1856. (Java, 'parasitic on trees'). = *Psilotum complanatum*.
- Bernhardiae* Reichb., Handbuch, p. 163. 1837 (Sub Fam.

- Lycopodiaceae); Pfeiffer, Nomenclator Botanicus, I, 1: 396. 1873.
- Buchosia* Commerson, in Herb. Mus. Paris; Spring, Monogr. Lyc. II: 269 (pro syn.). 1850. = *Psilotum*.
- B. furtiflora* Commerson, in Herb. Mus. Paris; Spring, Monogr. Lyc. II: 269 (pro syn.). 1850. = *Psilotum nudum*.
- Garsaultia* Commerson, in Herb. Pal.-Beauv. (H. Deless.); Spring, Monogr. Lyc. II: 268-269 (pro syn.). 1850. = *Psilotum*.
- G. minutiflora* Commerson, in Herb. Pal.-Beauv. (H. Deless.); Spring, Monogr. Lyc. II: 269 (pro syn.). 1850. = *Psilotum nudum*.
- Hoffmannia* Willd., in Roem. et Usteri, Mag. Bot. 6: 17. 1789; Leman, Dict. 21: 271. 1821. = *Psilotum*.
- H. aphylla* Willd., in Roem. et Usteri, Mag. Bot. 6: 17. 1789. (Based on *Lycopodium nudum* L.); Spring, Monogr. Lyc. II: 269 (pro syn.) 1850. = *Psilotum nudum*.
- Ipphia* Noronha, in Aub. du Petit-Thouars, Melanges Bot. et Voy., 1811; Desv., Prodr. Fam. Foug., p. 192. 1827 (pro syn.). = *Psilotum*.
- I. polyquestra* Noronha, in Aub. du Petit-Thouars, Melanges Bot. et Voy., 1811. = *Psilotum nudum*.
- Lycopodioides frutescens* Dill., Hist. Musc., t. 65, f. 4. 1741; Pal.-Beauv., Prodr. Aethéog., p. 109 (pro syn.). 1805. = *Psilotum nudum*.
- Lycopodium nudum* L., Sp. Pl. ed. 1, 2: 1100. 1753; ed. 2, 2: 1564. 1763. = *Psilotum*. (Genotype of *Psilotum* Swartz).
- L. tannense* Sprengel, in Schrad. Jour. Bot. 2: 267. 1799; Sprengel, Linné Syst. Veg. 4(1): 11. 1827. = *Tmesipteris*. (Genotype of *Tmesipteris* Bernh.).
- Osmundioides* Forster, in Herb.; Spreng., Schrad. Jour. Bot. 2: 267 (*Osmundoides*). 1799; Sprengel, Linne Syst. Veg., 4(1): 11 (*Osmundoides* Forst., pro syn.). 1827; Spreng. ex Endlich., Prodr. Flor. Norfolk, p. 6. 1833; Spring, Enum. Lyc., in Acad. Roy. Brux. 10(3): 234. 1843; Monogr. Lyc. II: 266 (pro syn.). 1850. = *Tmesipteris tannensis*.
- Psilophyta Zimmerman, Zeitsch. f. Bot. 19: 126-170. 1926; Campbell, Evolution of Land Plants, p. 209 (Class). 1940; Bold, Morphology of Plants, p. 320 (Division). 1957;

- Tagawa, Coloured Illustrations of the Japanese Pteridophyta, p. 6. 1959; Nemejc, Paleobotanika, 2: 97-130. 1963.
- Psilopsida Darrah, Textbook of Paleobotany, Chap. 5: 55-80. 1939; Principles of Paleobotany, Chap. 5 and 6: 35-38. 1939; Arnold, Introd. to Paleobotany, pp. 11-12 (Division). 1947; Bold, Morphology of Plants, p. 320 (Class). 1957; Foster & Gliford, Comp. Morph. Vasc. Pl., pp. 101-129. 1959; Darrah, Principles of Paleobotany, 2nd. ed., Chap. 5: 41-56. 1960.
- Psilotaceae [Payer, Botanique Cryptogamique, p. 212 (*Psilotées*, as fam. 59^a)¹. 1850. (*Psilotum*, *Tmesipteris*; excl. *Isoëtes*)]; Prantl, Lehrbuch Botanik, p. 190. 1886; Solms-Laubach, Fossil Botany, ed. 1, p. 190. 1886-1887; rev. ed., p. 189. 1891; Campbell, Structure and Development of Mosses and Ferns, 1st ed., p. 463 (Ordo), 480-485. 1895; 2nd. ed., p. 485 (Fam.), 504-510. 1905; Luerssen, in Rabenhorst's Kryptogamen Flora, 3: 4, 781. 1889; Pritzel, in Engl. u. Prantl, Nat. Pfl.-fam. 1(4): 606-619. 1901 (1902); Fossil Psilotaceae by H. Potonie, pp. 620-621. 1901 (1902); Small, Flora Southeastern United States, 1st. ed., p. 23. 1903; 2nd. ed., p. 29. 1913; Wettstein, Handbuch der Syst. Bot., 1st ed., 2: 91. 1903; ed. 3: 342-345. 1924; ed. 4: 386-388. 1933; Seward, Fossil Plants, 2: 12-16. 1910; Warming-Möbius, Syst. Bot., 4 Aufl., p. 188. 1929; Krishtofovich, Textbook of Paleobotany, pp. 186-187. 1934; Koidzumi, Acta Phytotax. et Geobot. 8: 186. 1939; Eames, Morphology of Vascular Plants, Lower Groups, 1st. ed., Chap. IV: 71-87. 1936; Lawrence, Tax. Vasc. Pl., p. 339. 1951; Riemers in Engler's Syllabus der Pflanzenfamilien, 1: 281. 1954; Pichi-Sermolli, Vistas in Botany, Pteridophyta, p. 461. 1959; Sporne, The Morphology of Pteridophytes, p. 38. 1962; Nemejc, Paleobotanika, 2: 250. 1963.
- Psilotales Bennett & Murray, Handbook of Cryptogamic Botany, pp. 61-64, f. 40-41 (*Psiloteae*, as Ordo 2)¹. 1889;

¹ Art. 18, International Code of Botanical Nomenclature, states that «when a name of a family has been published with an improper

- Scott, Studies in Fossil Botany, ed., 1, p. 116, 499 (*Psiloteae*). 1900; ed. 2, 1: 126 (*Psiloteae*). 1908; ed. 2, 2: 626-632 (Class). 1909; Wettstein, Handbuch der Syst. Bot., 1st. ed., 2: 91 (Ordo). 1903; Seward, Fossil Plants, 2: 17-29. 1910; Scott, Studies in Fossil Botany, 3rd. ed., 1: 412-416. 1920; Arber, Devonian Floras, pp. 86-88. 1921; Compton, Jour. Linn. Soc. Bot. 45: 461. 1922; Zimmerman, Zeitsch. Bot. 19: 131, 160. 1926; Hirmer, Handbuch der Paläobotanik, p. 343. 1927; Warming-Möbius, Syst. Bot., 4 Aufl., p. 188. 1929; Bower, Primitive Land Plants, pp. 123-147 (Class). 1935; Eames, Morph. Vasc. Pl., Lower Groups, p. 87. 1936; emend. Koidzumi, Acta Phytotax. et Geobot. 8: 186. 1939; Wettstein, Tratado de Botanica Sistemática, p. 335. 1944; Manton, Problems Cytol. and Evol. in Pteridophyta, pp. 233-243. 1950; Lawrence, Tax. Vasc. Pl., p. 339. 1951; Wardlaw, Phylogeny and Morphogenesis, pp. 66-69. 1952; Reimers, in Engler's Syllabus der Pflanzenfamilien, 1: 280. 1954; Wardlaw, Embryogenesis in Plants, pp. 85-92. 1955; Harris, Manual of Spores New Zealand Pteridophytes, p. 46. 1955; Sporne, The Morphology of Pteridophytes, p. 38. 1962; Nemejc, Paleobotanika, 2: 250. 1963.
- Psilotariae* Koidzumi, Acta Phytotax. et Geobot. 8: 186 (pro syn.). 1939. = *Tmesipteridiae* Koidz., 1939.
- Psilotidae* Nemejc, Paleobotanika, 2: 250. 1963 (Podtrida sub Trida *Psygmoptylopsida* Nemejc).
- Psilotinae* Wettst., Handbuch der Syst. Bot., 3rd. ed., p. 325 (Klasse). 1924; 4th. ed., 1: 386 (Klasse). 1933; Tratado de Bot. Sist., p. 336 (Klasse), 362-364. 1944; Strasburger's Textbook of Botany, 6th. English ed., 515 (Class). 1930; Engler & Diels, Syllabus der Pflanzenfamilien, pp. 106-107. 1936; Hirmer in Verdoorn, Manual Pteridology, pp. 507-510. 1938; Lawrence, Tax. Vasc. Pl., p. 339 (Class). 1951. = *Psilotopsida* Rothm.

Latin termination, the ending must be changed to accord with the rule, without change of the author's name». Although *Psilotées* and *Tmesipteridées* were in the French forms, the concept of family was definite in each.

- Psilotineae* Engler, Syllabus der Pflanzenfam., 2nd. ed., p. 64 (Unterreihe). 1898; 3rd. ed., 68 (Unterreihe). 1903; Campbell, Evolution of the Land Plants (Embryophyta), pp. 193, 209 (Class). 1940.
- Psilotites* Fr. Braun, Verz. Kreis-Nat. Samml. Bayreuth. Petr., p. 98 (nom. nud.). 1840.
- Ps. robustus* Fr. Braun, Verz. Kreis-Nat. Samml. Bayreuth. Petr., p. 98 (nom. nud.). 1840. Trias (Kemper): Bavaria, Eckersdorf.
- Psilotites* Münster, Beitr. Petr.-Kunde, V: 188, t. 13, f. 11, t. 15, f. 20. 1842; Unger, Gen. et Sp. Pl. Foss., p. 279. 1850.
- Ps. filiformis* Münster, Beitr. Petr.-Kunde, V: 188, t. 13, f. 11, t. 15, f. 20. 1842; Unger, Gen. et Sp. Pl. Foss., p. 279. 1850; Zigno, Fl. Foss. Form. Oolith, 1(5): 214. 1867. Jurassic: Germany. (Permain: Rheinische Prussia).
- Ps. furcatus* (Lindley & Hutton) Brongn., Dict. Univ. Hist. Nat. 13 (Tableau): 90 (41). 1849. (= *Solenites*?).
- Ps. inermis* (Newberry) Schimper, Pal. Veg., 3: 547. 1874; Knowlton, U. S. Geol. Surv. Bull. 152: 186. 1898. = *Cabomba inermis*.
- Ps. lithanthracis* Goldenberg, Fl. Saraepontana. Foss., Pt. 1: 13, t. 2, f. 7. 1855. Upper Carboniferous: Rheinisch Prussia.
- Ps. unilateralis* Kidston, Ann. Mag. Nat. Hist., London, V, 17: 594, ff. a-d. 1886. Upper Carboniferous: Scotland, Baillieston Pits, Lancashire.
- Psilotopsida* Rothm., Fedde Repert. 54(2-3): 261 (Class). 1951 (Oct.); Reimers, in Engler's Syllabus der Pflanzenfam., 1: 271, 280. 1954; Pichi-Sermolli, in Pteridophyta, in Vistas in Botany, p. 451, 460 (Class). 1959; Ching, Flora Reipublicae Sinicae, 2 (Pteridophyta): 3. 1959; Tagawa, Coloured Illustrations of the Japanese Pteridophyta, pp. 2, 4, 6. 1959; Sporne, The Morphology of Pteridophytes, pp. 38-49. 1962. Syn.: *Psilotinae* Wettst., 1924.
- Psilotum* Swartz, in Schrad. Jour. Bot. 1800(2): 109. 1801; Swartz, Syn. Fil., 187. 1806; R. Br., Prodr., p. 164. 1810; Nuttall, North Amer. Pl., 2: 248. 1818; Desv., Prodr., p. 192. 1827; Spring, Monogr. Lyc. II: 268-272. 1850;

- K. Müller, Bot. Zeit. 14: 217-227, 233-243, 11 figs. 1856; Domin, Bibliotheca Bot. 20: 234. 1915; Pritzel, in Engl. u. Prantl, Nat. Pfl.-fam. 1(4): 606-619. 1901 (1902). Syn.: *Bernhardia* Willd. ex Bernharti, 1801; Willd., 1802; *Hoffmannia* Willd., 1789; *Ipphia* Noronha, 1811; *Tristeca* Pal.-Beauv. ex Desv., 1827; *Garsaultia* Commerson, ex Spring, 1850; *Buchosia* Commerson, ex Spring, 1850.
- Ps. bernhardi* Hort.; Beekman, Rec. Trav. Bot. Néerl. 21: 1-61, illus. 1924; Schoute, in Manual of Pteridology, p. 67. 1938. = *Ps. nudum*.
- Ps. capillare* Blume, Enum. Pl. Javae, 2: 272. 1830; Spring, Monogr. Lyc. II: 272. 1850. (Java, Ins. Philipp.). (*Viscum capillare* Bl., 1825-26) = *Ps. nudum*.
- Ps. complanatum* Sw., Syn. Fil., 188 and 414, t. 4, f. 5. 1806; Sprengel, Linne Syst. Veg. 4(1): 11. 1827; Spring, Monogr. Lyc. II: 271. 1850; F. v. Muell., Fragm. 4: 166. 1864; l. c. 5: 112. 1866; Sec. Cens., 228. 1889; Lueres., Jour. Mus. Godeffr. 3: 102. 1875; Griseb., Fl. Brit. West Indian Isls., 648. 1864; Benth., Fl. Austr. 7: 682. 1878; Bailey, Fern World Austr., 79. 1881; Syn. Queensl. Fl., 675. 1883; Catal. Pl. Queensl., 58. 1890; Queensl. Fl. 6: 1928. 1902; Baker, Handb. Fern Allies, 30. 1887; Domin, Bibliotheca Bot. 20: 234. 1915. Pantropical: Australia (Queensland); Borneo; Sumatra; New Guinea; Philippine Islands; Solomon Isl.; Samoa; Fiji; Sandwich Isl.; Admiralty Isl. Jamaica; Cuba; Mexico. Syn.: *Bernhardia complanata* Willd., 1810; *B. schiedeana* K. Müll., 1856; *B. californica* K. Müll., 1856; *B. ramulosa* K. Müll., 1856; *B. zollingeri* K. Müll., 1856; *Ps. flaccidum* auct. p. p. (Pritzel, Nat. Pfl.-fam. 1(4): 619. 1902).
- Ps. complanatum* var. *flaccidum* (Wall.) Domin, Bibliotheca Bot. 20: 234. 1915. = *Ps. flaccidum*.
- Ps. complanatum* var. *latissimum* Spring, Monogr. Lyc. II: 271. 1850. (Mexico).
- Ps. complanatum* var. *mexicanum* Domin, Bibliotheca Bot. 20: 234. 1915. (Mexico).
- Ps. complanatum* Blume, Enum. Pl. Javae, 2: 272. 1830; non Swartz, 1806. = *Ps. flaccidum*.

- Ps. dichotomum* Link, Fil. Hort. Berol., 160. 1833. = *Ps. nudum*.
- Ps. domingense* Gdgr., Bull. Soc. Bot. Fr. 66: 306. 1919. [Antilles, S. Domingo (*Bory*)]. = *Ps. nudum*.
- Ps. flabellatum* Gdgr., Bull. Soc. Bot. Fr. 66: 306. 1919. [Australia, N. S. Wales, Berowra (*Boorman*)]. = *Ps. nudum*.
- Ps. flaccidum* Wall., Cat. No. 45. 1828; Hook. & Grev., Enum. Fil., pl. 4. 1829; Spring, Monogr. Lyc. II: 271. 1850; Pritzel in Engl. u. Prantl, Nat. Pfl.-fam. 1(4): 619, f. 383. 1901 (1902); Stiles, Ann. Bot. 24: 373-387. 1910; Manton, Probl. Cytol. & Evol. Pteridophyta, p. 235, f. 230 (Pendulous plant, diploid, $n = 52-54$). 1950. Ins. Singapore; Java; Australia (Queensland); Tahiti; Madagascar. Syn.: *Ps. complanatum* Blume, 1830, non Sw.; *Ps. pervillei* Decaisne in Herb. Mus. Paris.
- Ps. floridanum* Michx., Fl. Bor. Amer. 2: 281. 1803; Desv., Prodr. Fam. Foug., 192. 1827. = *Ps. nudum*.
- Ps. forsteri* Endlicher, Iconogr., t. 85. 1838; acc. Wakefield, Vict. Nat. 60: 143. 1944. (New Zealand; Norfolk Isl.). = *Tmesipteris tannensis*.
- Ps. heterocarpum* Colenso, Trans. N. Zeal. Inst. 20: 237. 1887 (1888). (New Zealand). = *Ps. nudum*.
- Ps. inerme* Newberry, Ann. New York Lyceum Nat. Hist. 9: 38. 1868; Jongmans, Fossil. Catalogus, II. Plantae, Lyc. III, pars 16: 646. 1930; l. c., Lyc. VI, pars 22: 647. 1937. = *Psilotites inermis* (Newb.) Schimp., 1874.
- Ps. natalensis* Gdgr., Bull. Soc. Bot. Fr. 66: 306. 1919. [Africa austr., Natal (*Zeyher*)]. = *Ps. nudum*.
- Ps. neo-caledonicum* Gdgr., Bull. Soc. Bot. Fr. 66: 306. 1919. [New Caledonia, Koghi (*Franc* 29)]. = *Ps. nudum*.
- Ps. novae-zelandiae* Gdgr., Bull. Soc. Bot. Fr. 66: 306. 1919. [Oceania, Nova Zelandia (*Astor*)]. = *Ps. nudum*.
- Ps. nudum* (L.) Beauv., Prodr. Fam. Aetheog., pp. 106, 112. 1805; Okabe, Sci. Rep. Tohoku Univ., IV, 4: 373-380. 1929; Masamune, Jour. Jap. Bot. 27: 78. 1952; Nagano, Jour. Jap. Bot. 30: 335. 1955; Ninan, La Cellule, 57: 307-318. 1956; Knobloch & Correll, Ferns of Chihuahua, p. 16. 1962; Griseb., Abh. Ges. Wiss. Gottingen, 7: 278.

- 1857; Luer ss., Jour. Mus. Godeffr. 3: 102. 1875; Manton, Probl. Cytol. & Evol. Pteridophyta, p. 235. f. 229. 1950. (Erect plant, tetraploid, n = about 100; triploid, $2 = 156$ plus 3). Pantropical: Florida to South Carolina; Texas and Mexico through Central America to Paraguay and Argentina; West Indies; Ins. Sandwich; Mascarenes; Nova Hollandia; Réunion; Ins. Ascension; Ins. Africa orient. (Bourbon, Mauritius); Madagascar; Ceylon; Penin. Indiae orient.; Penin. Indochina; Malacca; Pulo-pinang; Moluccas; Ins. Societies, Tahiti; Ins. Pitcairn.; Ins. Norfolk; Japan; New Zealand; Australia; Spain. Syn.: *Lycopodium nudum* L., 1753; *Hoffmannia aphylla* Willd., 1789; *Psilotum triquetrum* Sw., 1801; *Bernhardia dichotoma* Willd., 1801; *Psilotum dichotomum* Link, 1833; *Ps. floridanum* Michx., 1803; *Bernhardia novae-hollandiae* K. Müll., 1856; *Psilotum heterocarpum* Colenso, 1888; *P. bernhardi* Hort., Beekman, 1924; *Ps. domingense* Gdgr., 1919; *Ps. flabellatum* Gdgr., 1919; *Ps. natalensis* Gdgr., 1919; *Ps. neo-caledonicum* Gdgr., 1919; *Ps. novae-zelandiae* Gdgr., 1919.
- Ps. nudum* var. *fallacinum* Domin, Bibliotheca Bot. 20: 232, f. 57. 1915. Australia, Queensland, Syn.: *Ps. triquetrum* var. *fallacinum* Domin, 1911.
- Ps. nudum* var. *normale* Domin, Bibliotheca Bot. 20: 132, f. 56. 1915. (Australia, Queensland).
- Ps. oxyphyllum* Hook. fil. in Herb.; Spring, Monogr. Lyc. II: 265 (pro syn.). 1850. = *Tmesipteris tannensis*.
- Ps. pervillei* Decaisne, in Herb. Mus. Paris; Spring, Monogr. Lyc. II: 271 (pro syn.). 1850. = *Ps. flaccida*.
- Ps. triquetrum* Swartz, in Schrad. Jour. Bot. 1800(2): 109. 1801; Syn. Fil., 187. 1806; R. Br., Prodr., 164. 1810; Sprengel, Linne Syst. Veg. 4(1): 11. 1827; Spring, Monogr. Lyc. II: 269. 1850; F. v. Muell., Fragm. 5: 112. 1866; Sec. Cens., 228. 1889; Luer ss., Fil. Graeff., 271. 1871; Benth., Fl. Austr. 7: 681. 1878; Bailey, Fern World Austr., 79. 1881; Syn. Queensl. Fl., 675. 1883; Rep. Govt. Sci. Exped. Bell-Ker Range, 72. 1889; Catal. Pl. Queensl., 58. 1890; Pritzel, Nat. Pfl.-fam. 1(4): 619. 1901 (1902); Cheesem., Man. N. Zeal. Fl., 1041. 1906; J. Wedd et

- C. White, Queensl. Natural. 1: 120. 1910; Griseb., Fl. Brit. West Indian Isls., 648. 1864 (Based on *Lycopodium nudum* L.); Bower, Flora, 118-119: 57. 1925. = *Ps. nudum*.
- Ps. triquetrum* var. *fallacinum* Domin, Fedde Repert. 9: 551. 1911. = *Ps. nudum* var.
- Ps. triquetrum* var. *gracile* Grev. et Hook., Enum. Fil. in Bot. Misc. 2: 362. 1831. (Ins. Penang; Brasilia). = *Ps. nudum*.
- Ps. triquetrum* var. *latum* Desv., Prodr. Fam. Foug., 192. 1827; Spring, Monogr. Lyc. II: 270. 1850. (Nova Hollandia). = *Ps. nudum*.
- Ps. truncatum* R. Br., Prodr. Fl. Nov. Holl., p. 164. 1810; Sprengel, Linne Syst. Veg., 4(1): 11. 1827. = *Tmesipteris*.
- Ps. zollingeri* (K. Müll.) Ces.; Backer et Posthumus, Varen-flora voor Java, p. 286 (pro syn.). 1939. = *Ps. complanatum*.
- Psilotum* sp. nov., Presl, in Herb. Reg. Berolin.; pro syn. in K. Müller, Bot. Zeit. 14: 223. 1856. = *Ps. complanatum*.
- Psygmpophylopsida* Nemejc, Paleobotanika, 2: 225. 1963 (Trida).
- Tmesopteris* Kunze, Index Filicum, in Linnaea 23: 295. 1850 (nomen emend.); Pfeiffer, Nomenclator Botanicus, II, 2: 1422. 1874 (pro syn.).
- Tmesipteridaceae [Bertrand, Arch. Bot. du Nord de la France, 1: 487. 1881. (*Tmesipteridées*, as fam.); Bull. Soc. Bot. France, 30: 157. 1882]; emend. Koidz., Acta Phytotax. et Geobot. 8: 187. 1939; Pichi-Sermolli, Vistas in Botany, Pteridophyta, p. 461. 1959; Nemejc, Paleobotanika, 2: 250. 1963, Riemers in Engler's Syllabus der Pflanzenfam., 1: 281. 1954; Sporne, The Morphology of Pteridophytes, p. 38. 1962.
- Tmesipteridales Koidz., Acta Phytotax. et Geobot. 8: 187. 1939.
- Tmesipterididae Koidz., Acta Phytotax. et Geobot. 8: 179, 186. 1939. (Syn.: *Psilotariae*).
- Tmesipteris Bernh., in Schrad. Jour. Bot. 1800(2): 121, t. 2, f. 5. 1801; Swartz, Syn. Fil., 187. 1806; Willd., Sp. Pl. 5: 56. 1810; Hook. & Grev., Enum. Fil. in Bot. Misc. 2: 363. 1831; Hook., Gen. Fil., t. 86. 1838-42; Ad. Brongniart, Hist. Veget. Foss. 2: 30, t. 13, f. 2. 1836; Endlicher,

- Iconogr., t. 85. 1838; Spring, Monogr. Lyc. II: 265-267. 1850; Sahni, Philos. Trans. Roy. Soc. Lond., Ser. B, 213: 143-170. 1925.
- Tm. allenii* (Lesq.) Hollick, Bull. Torr. Bot. Club, 21: 256, t. 205. 1894; Jongmans, Fossil. Catalogus. II. Plantae, Lyc. VI, pars 22: 1220. 1937. = *Salvinia allenii* (Lesq.) Lesq., 1878. (Tertiary: U. S. A.).
- Tm. billardieri* Endlicher, Prodr. Fl. Norf. 6. 1833; Spring, Enum. Lyc., in Acad. Roy. Brux. 10(3): 234. 1843; Monogr. Lyc. II: 266. 1850; Barber, Victorian Naturalist, 71: 97-99. Oct. 1954. Australia (New South Wales, Mt. Wilson; Victoria, Mt. Drummer); Tasmania (Queens-town, Britton's Swamp, Forth Falls). (Tetraploid, $2n = 408-420$).
- Tm. elongata* Dang., Le Botaniste 2: 186, 213. 1890-1891. = *Tm. tannensis* var.
- Tm. forsteri* Endlich., Prodr. Fl. Norf. 6. 1833; Spring, Enum. Lyc., in Acad. Roy. Brux. Bull. 10(3): 234. 1843. = *Tm. tannensis*.
- Tm. fowerakeri* Barber, Victorian Naturalist, 71: 98-99, figs. 1954. New Zealand (Westland: Type—Longwood Range, South Island). (Diploid, $2n = 204-210$).
- Tm. lanceolata* Dang., Le Botaniste, 2: 204, 214. 1890-1891; Pritzel, Nat. Pfl.-fam. 1(4): 619. 1901 (1902); Bower, Flora, 118-119: 56. 1925. = *Tm. tannensis* var.
- Tm. oblanceolata* Copel., Philipp. Jour. Sci. 60: 99, f. 1. 1936. Solomon Isl. (Guadalcanar, Mt. Tutuve, alt. 1700 m., *Kajewski* 2632).
- Tm. ovata* Wakefield, Victorian Naturalist 60: 143, fig. 1944. Australia (Queensland, MacPherson Range; Victoria, Mt. Drummer). (Tetraploid, $2n = 408-420$).
- Tm. parva* Wakefield, Victorian Naturalist 60: 143, fig. 1944. Australia (New South Wales, Mt. Irvine, Mt. Wilson). (Diploid, $2n = 204-210$).
- Tm. reticulata* (Ettingshausen) Hollick, Bull. Torr. Bot. Club, 21: 256, t. 205. 1894; Jongmans, Fossil. Catalogus, II. Plantae, Lyc. VI, pars 22: 1220. 1937 (Tertiary: Switzerland). = *Salvinia reticulata* (Ett.) Heer, 1859.

- Tm. tannensis* (Spreng.) Bernh., in Schrad. Jour. Bot. 1800 (1): 131, t. 2, f. 5. 1801; Labill., Pl. Nov. Holl. 2: 105, t. 252. 1806; F. v. Muell., Fragm. 5: 112. 1866; l. c., 8: 175. 1874; Sec. Cens., 228. 1889; Benth., Fl. Austr. 7: 680. 1878; Bailey, Fern World Austr., 79. 1881; Syn. Queensl., 675. 1883; Rep. Govt. Sci. Exp. Bell-Ker Range, 72. 1889; Catal. Pl. Queensl., 58. 1890; Queensl. Fl. 6: 1927. 1902; in Meston, Exped. Bell-Ker Parliam. Rep., 17. 1904; Baker, Handb. Fern Allies, 30. 1887; C. Moore, Handb. Fl. N. S. Wales, 498. 1893; Pritzel, Nat. Pfl.-fam. 1(4): 619. 1901 (1902); Turner, Proc. Linn. Soc. N. S. Wales, 310. 1903; Cheesem., Man. N. Zeal. Fl., 1041. 1906; Domin, Bibliotheca Bot. 20: 230. 1915; Manton, Probl. Cytol. & Evol. Pteridophyta, 233-243. 1950. Australia (Queensland, New South Wales, Victoria); Tasmania; New Zealand; Norfolk Isl.; Ins. Tanna, Antarctic Archipelago; Polynesia. (n = over 200). Syn.: *Lycopodium tannense* Spreng., 1799; *Bernhardia tannensis* K. Müller, 1856; *Tmesipteris forsteri* Endl., 1833; *Tm. vieillardii* Dang., 1890-91; *Osmundioides* Forster, in Herb. Sprengel, ex Spring, Enum. Lyc. Acad. Roy. Brux. 10(3): 234. 1843; *Osmundoides* Forster, ex Sprengel, Schrad. Journ. Bot. 2: 267. 1799; *Psilotum oxyphyllum* Hook. fil., in Spring, 1850 (pro syn.).
- Tm. tannensis* Labill., Pl. Nov. Holl. 2: 105, t. 252. 1806. = *Tm. truncata*.
- Tm. tannensis* var. *elongata* (Dang.) Domin, Bibliotheca Bot., 20: 231. 1915; Sahni, Philos. Trans. Roy. Soc. Lond., Ser. B, 213: 164. 1924 (1925). Australia (New South Wales); Tasmania. Syn.: *Tm. elongata* Dang., 1891.
- Tm. tannensis* var. *lanceolata* (Dang.) Domin, Bibliotheca Bot. 20: 232. 1915; Sahni, Philos. Trans. Roy. Soc. Lond., Ser. B, 213: 164. 1924 (1925). New Caledonia; Australia (New South Wales, Queensland). Syn.: *Tm. lanceolata* Dang., 1891.
- Tm. tannensis* var. *normalis* Domin, Bibliotheca Bot. 20: 230. 1915. (Tasmania; Australia, Victoria; New Zealand).
- Tm. tannensis* var. *typica* Sahni, Philos. Trans. Roy. Soc. Lond., Ser. B, 213: 158. 1924 (1925).

- Tm. tanensis* var. *truncata* (R. Br.) Domin, Bibliotheca Bot. 20: 231. 1915. (S. Australia; Norfolk Isl.; New Zealand). = *Tm. truncata*.
- Tm. tannensis* var. *vieillardii* (Dang.) Domin, Bibliotheca Bot. 20: 230. 1915. = *Tm. tannensis*.
- Tm. truncata* (R. Br.) Desv., Prodr., in Ann. Soc. Linn. Paris, 6: 192. 1827; P. A. Dang., Le Botaniste, 2: 200, 214. 1890-1891; Pritzel, Nat. Pfl.-fam. 1(4): 619. 1901 (1902); Wakefield, Vict. Nat. 60: 143. 1944; Barber, Vict. Nat. 71: 97. 1954. Australia (New South Wales, Bulli, Com-madore Hts., Jamieson Valley, Sommersly Falls); Nor-folk Isl., New Zealand; Nova Hollandia. Syn.: *Psilotum truncatum* R. Br., 1810; *Bernhardia truncata* (R. Br.) K. Müller, 1856; *Tmesipteris billardieri* Endlich., 1833; *Tm. tannensis* var. *truncata* (R. Br.) Domin, 1915; *Tm. tannensis* Labill., 1806. (Tetraploid, $2n = 408-420$).
- Tm. tugana* Barber, Victorian Naturalist, 71: 98, fig. 1954. Tasmania (Britton's Swamp; Picton River, Strahan). (Diploid, $2n = 204-210$).
- Tm. vieillardii* Dang., Le Botaniste, 2: 166, 212, t. 9, f. 1-2. 1890-91; Compton, Journ. Linn. Soc. Bot. 45: 462. 1922; Sahni, Philos. Trans. Roy. Soc. Lond., Ser. B, 213: 143. 1924 (1925). = *Tm. tannensis*.
- Tmesopsida*; Reimers, in Engler's Syllabus der Pflanzenfam. 1: 271, 280 (pro syn.). 1954.
- Tristeca* Pal.-Beauvois in Herb. Boiss; Jaume St. Hilaire, Expos. Fam. 1: 39. 1805; Desv., Prodr. Fam. Foug., 1827; Spring, Monogr. Lyc. II: 268-269 (pro syn.). 1850. = *Psilotum*.
- T. aristata* Pal.-Beauv., in Herb. Boiss.; Spring, Monogr. Lyc. II: 269 (pro syn.). 1850. = *Psilotum nudum*.
- T. nuda* (L.) Pal.-Beauv.; Jaume St. Hilaire, Expos. Fam. 1: 39. 1805. = *Psilotum nudum*.
- Viscum capillare* Blume, Bijdr., p. 667. 1825-26; DC., Prodr. 4: 285 (pro. syn.). 1830; Backer & Posthumus, Varen-flora voor Java, 287 (pro. syn.). 1939. = *Psilotum nudum*.
- V. ligulatum* Blume, Bijdr., p. 667. 1825-26; DC., Prodr. 4: 285 (pro syn.). 1830; Backer & Posthumus, Varenflora voor Java, 286 (pro syn.). 1939. = *Ps. complanatum*.

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LINHAS NEGRAS
PRODUZIDAS PELO *SCHIZOPHYLLUM*
COMMUNE FR. EM MADEIRAS DO MAIOMBE *

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INTRODUÇÃO

AS podridões das madeiras produzidas por xilófagos quer parasitas, quer saprófitas têm sido, desde longos anos, objecto do mais cuidadoso estudo.

Realmente, grandes são por vezes os volumes de madeiras inutilizadas quando, como no caso da *Cryptomeria*, se abatem árvores cujo cerne foi destruído pela *Armillaria mellea* (Vahl. ex Fr.) Kummer, até uma altura do tronco que por vezes atinge os dois metros.

Antes, porém, da espectacular cárie, há um período inicial em que a infecção do lenho passa por assim dizer despercebida, não deixando no entanto de ter de ser considerada do mesmo modo como uma madeira doente. Duma maneira geral, este estado incipiente da podridão é patenteado pelas alterações na coloração. Nalgumas árvores os primeiros sintomas consistem no aparecimento de linhas negras, castanhas ou mesmo púrpura, que conferem por vezes às madeiras um aspecto muito decorativo. No entanto, é necessário não as confundir com zonas e linhas de coloração natural que aparecem no lenho de certas espécies florestais.

A utilização de madeiras doentes em caixotaria e mesmo na indústria de marcenaria, além de todos os inconvenientes que podem advir da sua menor duração, constitui grave risco

* Comunicação apresentada à 14.ª Secção do XXVII Congresso Luso-Espanhol para o Progresso das Ciências — Bilbau, 20-24 de Junho de 1964.

quando consideramos que são focos de dispersão em potencial. Qualquer pequeno pedaço de madeira com formação de linhas negras, quando em condições de humidade e temperatura adequadas, pode vir a constituir um grave foco de infecção.

O nosso trabalho consistiu essencialmente na observação microscópica do lenho infectado de essências florestais ultramarinas (Maiombe), no isolamento a partir de linhas negras, no estudo das características culturais das colónias obtidas e na obtenção da carpóforos que permitissem a identificação do xilófago existente nessas madeiras.

Apesar dos provetes utilizados nestes ensaios, e que foram cedidos pela Secção de Madeiras do Laboratório de Engenharia Civil, estarem já armazenados há cerca de quatro anos, ainda conservavam em perfeita vitalidade o fungo que originou as linhas negras.

O estudo das características culturais permitiu-nos a sua identificação — *Schizophyllum commune* Fr. —, confirmada depois numa determinação baseada nas frutificações perfeitamente desenvolvidas em blocos de madeira.

AS LINHAS NEGRAS DAS MADEIRAS

Inúmeros são os fungos que formam «linhas negras» nas madeiras. CAMPBELL (1934) faz referência à *Armillaria mellea* (Vahl.) Quel. e *Xylaria polymorpha* (Pers.) Grev., como responsáveis por essas formações, em tecidos de plantas. Em 1936 o mesmo autor e MUNSON acrescentam o *Polyporus squamosus* à lista destes fungos.

Em madeira de *Cryptomeria japonica*, apresentando estados iniciais de podridão, temos observado com frequência linhas negras, produzidas por *A. mellea*, o mesmo se verificando em cernes nitidamente «brocados» (AZEVEDO, 1958). FERREIRINHA (1961), no estudo da anatomia do lenho desta resinosa, faz referência ao seu aparecimento em madeira com sintomas de podridão incipiente.

FINDLAY (1953), CARTWRIGHT & FINDLAY (1958) e outros autores citam com frequência o aparecimento das linhas negras, de origem micótica, em madeiras de várias espécies florestais.

Na madeira com o referido estado incipiente de infecção, é fácil distinguir um riscado de cor escura que, por vezes, forma desenhos mais ou menos decorativos.

Inicialmente, a posição destas linhas é marcada pelo desenvolvimento intenso de hifas muito finas e hialinas, as quais aumentam progressivamente de volume até atingirem aspecto vesicular, tornando-se depois escuras e ocupando o lúmen dos traqueídeos e fibras. Em fase mais avançada, o desenvolvimento do micélio atinge fiadas de 3 ou 4 traqueídeos, constituindo uma placa micelial negra, com estrutura em paliçada, à qual se convencionou denominar «linha negra».

As linhas negras, que podem ser comparadas às placas escleróticas, diferem no entanto daquelas por terem incluído, no seu tecido micelial, tecido lenhoso do hospedeiro.

Nas células em volta dessas linhas desenvolvem-se abundantes hifas de estrutura normal, que atravessam as células em todas as direcções e têm por função difundir o micélio através do tecido do hospedeiro. Em certas células, porém, estas hifas penetram, desenvolvem-se intensamente, dentro delas, tornam-se mais escuras e apresentam então a típica estrutura *vesicular*.

As observações histopatológicas foram feitas em blocos de Tola, fervidos num balão de refluxo com álcool, glicerina e água destilada, durante 5 horas. Fizemos cortes de 15 μ de espessura em micrótopo de lenho REICHERT e corámo-los com azul de algodão acético e safranina aquosa.

Em estados de podridão muito adiantados a madeira desagrega-se, libertando as linhas negras que se apresentam então como placas pretas de micélio.

Segundo CAMPBELL (1934) a formação das linhas negras representa um estado de excessivo vigor do fungo.

ISOLAMENTOS

Utilizámos nos nossos isolamentos provetes de forma paralelepípedica de «Tola branca» (*Gossweilerodendron balsamiferum* Harms), de «Safukala» (*Dacryodes pubescens* Verm.), de «Muamba preta» (*Enantia affinis* Exell) e de «Lucanga-lenombe» (*Xylopia gilviflora* Exell).

De três blocos diferentes de madeira de Tola isolámos as culturas T_1 , T_2 e T_3 e a K_2 e K_3 de dois blocos diferentes de Safukala.

As culturas puras isoladas das outras espécies apresentavam-se na cor, textura do micélio, etc. muito diferentes da série T e série K, assemelhando-se mais a fungos inferiores, pelo que não foram incluídas no trabalho.

As culturas das séries T e K pareciam ser idênticas quanto a cor, textura e formação de frutificações abortivas. Por este facto sòmente usámos duas nos ensaios que se seguiram, isto é, as culturas T_1 e K_2 .

CARACTERÍSTICAS CULTURAIS

Para caracterização das culturas isoladas das linhas negras, utilizámos as chaves dicotómicas da autoria de MILDREDK NOBLES (1948) e usámos, para determinação da cor a Tabela de cores «Nickerson color Fan».

Fizemos primeiramente culturas base em placas com gelose de agar simples que foram incubadas à temperatura de 25° C durante 13 dias. Em seguida semeámos os dois micélios T_1 e K_2 em placas com meio nutritivo «Difco» malte agar e incubámos a 25° C. Para corte dos inóculos empregámos um «cork borer» de 1 mm.

A observação das culturas definitivas foi feita semanalmente.

Reportando-nos às chaves de identificação de culturas de fungos xilófagos concluímos que as culturas T_1 e K_2 tinham características idênticas. Assim, verificámos que tinham como hospedeiro uma árvore folhosa; micélio inicialmente branco mantendo a mesma coloração durante as 6 semanas do ensaio; formação de uma zona de difusão; ansas regularmente presentes em todas as partes do micélio; sem estruturas especiais; com clamidósporos; sem conídios; sem oídios; crescimento moderadamente rápido, atingindo o diâmetro da placa da 4.^a para a 5.^a semana; sem carpóforos; não se verificando a alteração da cor, ou sòmente não escurecendo mais que um amarelo de mel, durante as seis semanas do ensaio. Micélio erecto, lanoso; clamidósporos com paredes levemente espessadas, com $6.0-15.0 \times 4.5-7.5 \mu$.

As características miceliais acima apontadas são idênticas em todas as culturas e condizem com as que foram apresentadas por NOBLES para o *Schizophyllum commune* Fr.

TENTATIVA DE OBTENÇÃO DE CARPÓFOROS EM LABORATÓRIO

Embora tivéssemos determinado a espécie a que pertencia o xilófago que produzia as «linhas negras» nas madeiras do Maiombe, havia, porém, que proceder à confirmação, tentando obter carpóforos em meio laboratorial a partir das culturas existentes. Para isso, ensaiámos os dois métodos de cultura, que a seguir descrevemos, e com os quais obtivemos bons resultados.

1.º método

Fez-se a sementeira numa cultura (T_1) e da (K_2) em tubos com gelose de malte, pusemos a incubar em estufa a 25° C e passados oito dias retirámo-las da incubadora e foram colocadas às escuras à temperatura ambiente. Após quinze dias de desenvolvimento, formaram-se frutificações abortivas do tipo «stag's horn», idênticas às que FINDLAY (1953) descreveu para o *Lentinus lepideus* Fr.

Colocadas as culturas à temperatura ambiente, mas com luz solar, deu-se então o aparecimento de pequenos cogumelos que, embora com as características da espécie, apresentavam menores dimensões.

2.º método

O segundo método, um pouco mais complicado, consiste na sementeira dos micélios das culturas T_1 e K_2 em meio constituído e preparado do seguinte modo:

- a) Substrato sólido, que é formado por uma mistura de serraduras, de 4 ou 5 espécies entre folhosas e resinosas, seca ao ar.
- b) A cada 100 gr. desta mistura juntámos:

Farinha de milho	2,5 gr.
Farinha de ossos	1,5 gr.
Amido de batata	0,75 gr.
Levedura seca	0,2 gr.



- c) Preparámos em seguida um líquido de rega que continha:

Extracto de malte	0,5 gr.
Caseína hidrolisada	0,175 gr.
Tiamina hidrocloreica	0,0033 gr.
Água	necessária à saturação

Deitámos as substâncias em pó e a serradura, depois de bem misturadas, em frascos que foram completamente cheios e depois regados com a solução nutritiva até à saturação. Após 24 horas foram tapados e esterilizados a 120° C durante 1/2 hora.

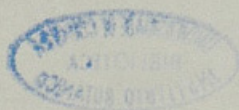
Os frascos foram então semeados com as culturas a ensaiar, tapados com papel celofane e incubados a 25° C em luz difusa e ambiente húmido, até se obter vigoroso desenvolvimento micelial. Então, a cobertura de celofane foi retirada e colocaram-se sobre a boca dos frascos blocos de Tola, Safukala, Muamba preta e Pinheiro com as dimensões de 9 × 9 × 5,8 cm, escavados no centro.

Os blocos devem ter dimensões que não excedam o diâmetro da boca dos frascos e devem ser colocados de maneira que a superfície inferior contacte perfeitamente com a parte superior da cultura do fungo.

O bloco foi protegido com uma manga de polietileno esterilizada e atado no gargalo do frasco, para evitar contaminações.

As culturas foram novamente colocadas em estufa, à temperatura de 25° C, sendo necessário manter um alto teor de humidade. Quando o fungo atingiu o bloco, retirámos a manga protectora e colocámos os frascos em condições de meio ambiente. Mantivemos a humidade regando os blocos periodicamente.

As frutificações agora obtidas apresentavam, além das características da espécie, as dimensões dos cogumelos formados na natureza o que nos permitiu confirmar que as linhas negras eram produzidas por um fungo da família das Agaricáceas, o *Schizophyllum commune* Fr. (RAMSBOTTOM, BRESADOLA, FERGUS).



Idênticas frutificações foram encontradas em madeira com casca enviada do Maiombe, Angola, o que confirmou em absoluto ser este fungo o responsável pela formação das linhas negras nestas madeiras.

O *Schizophyllum*, considerado por alguns autores como um fungo xilófago, ataca com mais frequência as folhosas e só raramente as resinosas, produzindo uma cárie castanha na madeira (GOIDANICH, 1963).

Segundo CARTWRIGHT e FINDLAY (1958), aparece com frequência em madeiras tropicais, após o abate das árvores.

Em Portugal Continental é observado com frequência em muitas espécies florestais e, tal como nas madeiras do Ultramar, embora não produza uma rápida decomposição da madeira não deixa no entanto de a alterar, promover a sua desvalorização pelo aspecto que lhe confere e diminuir a sua durabilidade.

SUMÁRIO

Em condições laboratoriais tentou-se o isolamento, cultura pura e identificação de fungos produtores de «linhas negras» nalgumas espécies tropicais provenientes do Maiombe, província de Angola.

Das zonas negras das amostras de madeira de: *Dacryodes pubescens* Verm. (Safukala), *Gossweilerodendron balsamiferum* Harms (Tola branca), *Enantia affinis* Exell (Muamba preta) e *Xylopia gilviflora* Exell (Lucanga-lenombe), obtivemos algumas culturas puras, com características culturais diferentes.

Os isolamentos obtidos de Safukala e Tola, mesmo em gelose de malte, formaram, inicialmente, frutificações abortivas e, após uns meses de cultura, carpóforos perfeitamente bem diferenciados.

Ensaando métodos especiais de cultura, principalmente o de TAMBLYN and DA COSTA (1958) utilizando blocos de madeira sã, passados 5 meses eram perfeitos e numerosos os carpóforos desenvolvidos nas culturas obtidas de Safukala e Tola. Estes carpóforos permitiram a identificação do agente produtor de «linhas negras»: o *Schizophyllum commune* Fr.

Amostras de madeira enviadas do Maiombo apresentavam, na casca, frutificações do mesmo fungo.

Trabalhámos mais intensamente com as madeiras de Tola e Safukala, devido à maior importância económica que representam, principalmente a primeira, pelo seu crescente emprego na indústria de marcenaria. As «linhas negras» da madeira duma e doutra espécie são produzidas pelo mesmo fungo: o *Schizophyllum commune* Fr.

SUMMARY

The black lines pattern on tropical woods from Maiombe Angola

As a contribution to identify the mycological agents of the black lines presented by some tropical species — *Dacryodes pubescens* Verm. (Safukala), *Gossweilerodendron balsamiferum* Harms (Tola branca), *Enantia affinis* Exell (Muamba preta) and *Xylopia gilviflora* Exell (Lucanga-lenombe) — a series of experiments have been carried out. From the diseased dark zones of those woods we have obtained some isolates with different cultural characteristics.

Under laboratorial condition and applying special media of culture the isolates from Safukala and Tola are tested in a incubation room at 25° C. A few months after the inoculations, the isolates mentioned had formed some perfect carpophores on the experimental wood blocks.

So it was possible to classify these black lines fungi as *Schizophyllum commune* Fr.

In the experiments we have used more intensely Tola and Safukala woods, due the greatest economical importance they represent, especially the first one on account of its increasing use in furniture industry. The «black lines» observed in the wood of the two species above mentioned, are produced by the same fungus: the *Schizophyllum commune* Fr.

AGRADECIMENTOS

Em conclusão deste breve trabalho compete-nos agradecer, em primeiro lugar, ao Sr. Eng. TOMÁS J. E. MATEUS, chefe da Secção de Madeiras do Laboratório de Engenharia

Civil, e seus colaboradores, o material que tão gentilmente nos cederam.

Ao Sr. Prof. Dr. PINTO LOPES o nosso reconhecimento pela ajuda prestada na confirmação da diagnose do fungo.

A todo o pessoal do Laboratório de Patologia Florestal que interferiu nos nossos ensaios, o maior reconhecimento pela valiosa ajuda e interesse com que sempre acompanhou os trabalhos em curso.

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ESTAMPAS

ESTAMPA I

Fig. 1.—Linhas negras em madeira de *Gossweilerodendron balsamiferum* Harms.

The «black lines» pattern of the *Gossweilerodendron balsamiferum* Harms.

Fig. 2.—Aspecto de manchas miceliais na mesma madeira.
Micelial matts formed on the same woods.

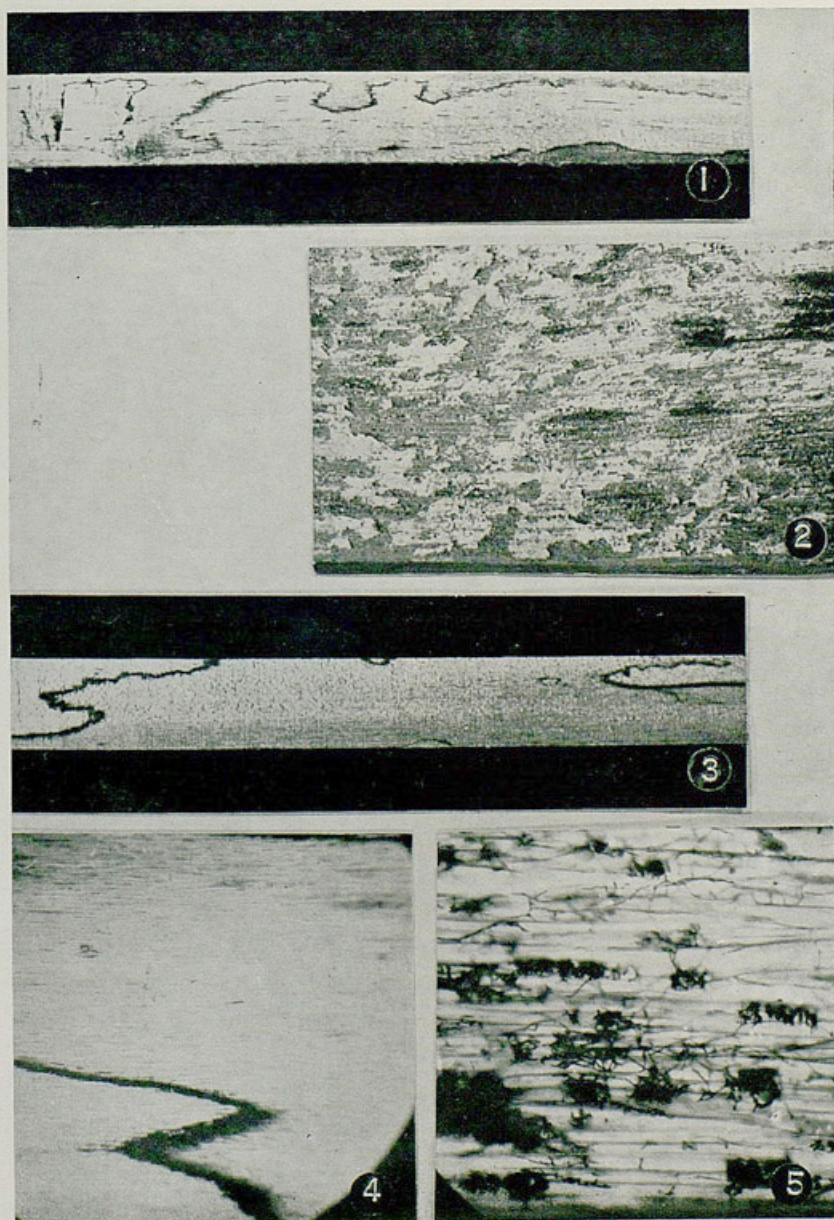
Fig. 3.—Aspecto das linhas negras de *Dacryodes pubescens* Verm.

Wood of *Dacryodes pubescens* Verm. showing «black lines».

Fig. 4.—Corte transversal em madeira com linhas negras.
Transversal section showing the dark zones.

Fig. 5.—Pormenor do tecido do hospedeiro, vendo-se hifas vesiculadas e normais.

Detail of the histological structure of the foregoing photograph.





ESTAMPA II

Fig. 1 e 2.—Formações abortivas em culturas isoladas de Safukala (K).

Abortive fructifications formed by Safukala isolates.

Fig. 3 e 4.—Carpóforos da cultura formados em gelose de malte.

Carpophores of the Safukala isolates obtained in Malte agar.

ESTAMPA III

Fig. 1.—Frutificações da cultura T de *Schizophyllum commune* Fr. em bloco de madeira.

Fructifications of one the *Schizophyllum commune* Fr. isolates.

Fig. 2.—Pormenor do carpóforo.

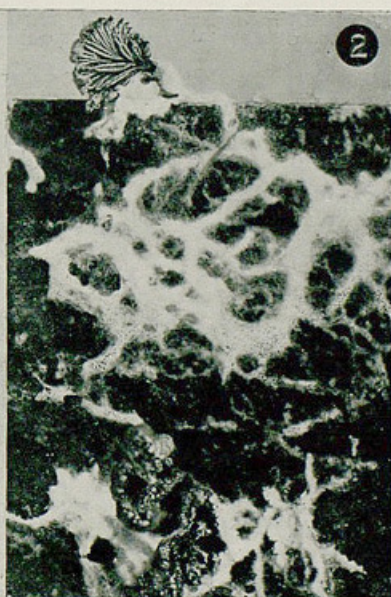
Detail of the photograph 1.

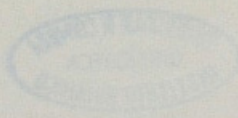
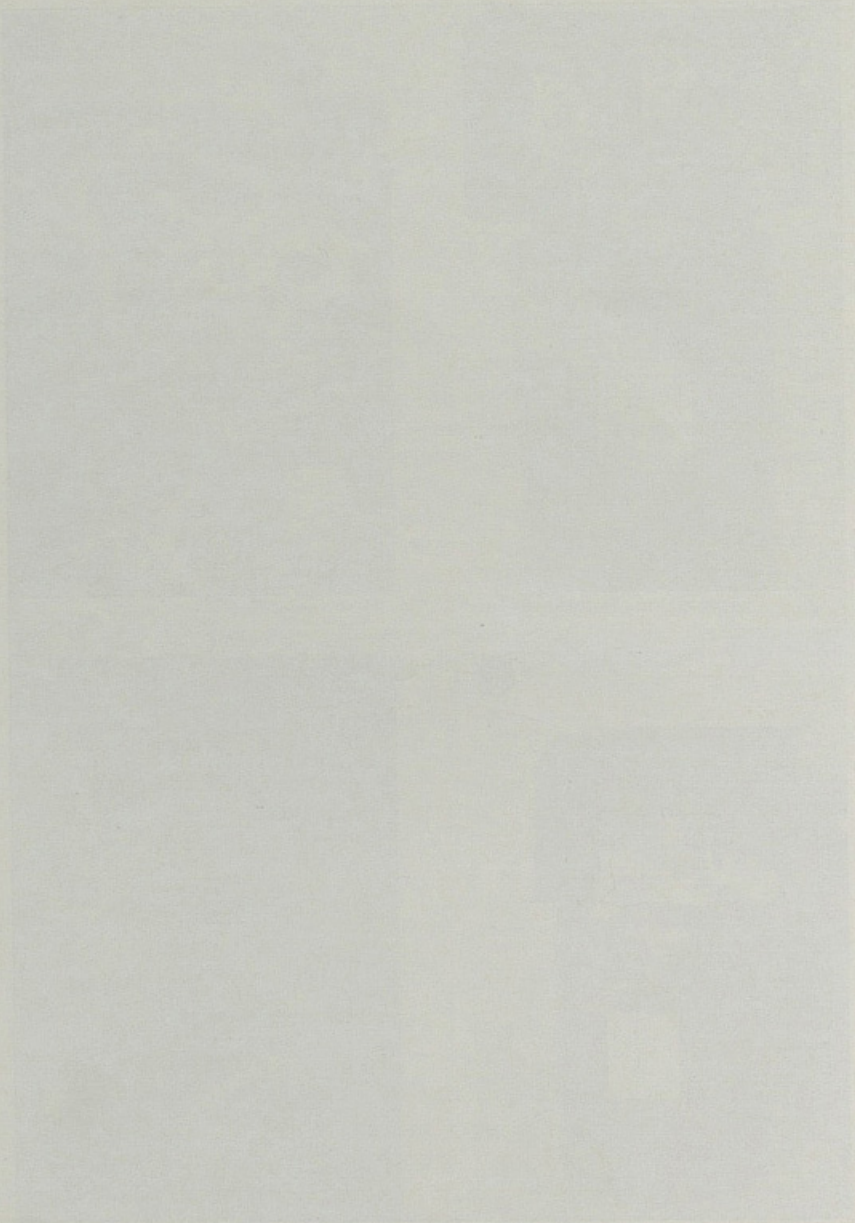
Fig. 3.—Cultura K no frasco à direita.

Carpophores of another *Schizophyllum* isolates.

Fig. 4.—Pormenor do carpóforo.

Detail of the foregoing photograph.





HOMOLOGIAS CROMOSSÓMICAS NO GÊNERO *GOSSYPIUM**

por

A. QUINTANILHA e A. CABRAL

O gênero *Gossypium* compreende hoje vinte e quatro espécies, distribuídas, segundo as suas afinidades citogenéticas, por seis grupos diferentes:

ESPÉCIES

GENÓMIOS

Asiáticas e africanas (n = 13)

{ <i>G. herbaceum</i>	A ₁
{ <i>G. arboreum</i>	A ₂
{ <i>G. anomalum</i>	B ₁
{ <i>G. triphyllum</i>	B ₂
{ <i>G. barbosanum</i>	B ₃
{ <i>G. stocksii</i>	E ₁
{ <i>G. somalense</i>	E ₂
{ <i>G. areysianum</i>	E ₃
{ <i>G. incanum</i>	E ₄
{ <i>G. longicalyx</i>	E ₅

Australianas (n = 13)

{ <i>G. sturtii</i>	C ₁
{ <i>G. robinsonii</i>	C ₂
{ <i>G. australe</i>	C ₃

Americanas (n = 13)

{ <i>G. thurberi</i>	D ₁
{ <i>G. armorianum</i>	D ₂₋₁
{ <i>G. harknessii</i>	D ₂₋₂
{ <i>G. klotzschianum</i>	D ₃ K
{ <i>G. klotzschianum</i> var. <i>Davidsonii</i>	D _{3-D}
{ <i>G. aridum</i>	D ₄
{ <i>G. raimondii</i>	D ₅
{ <i>G. gossypoides</i>	D ₆
{ <i>G. lobatum</i>	D ₇

* Trabalho apresentado às «Jornadas de Genética», Oeiras, 1965.

Americanas (n = 26)*G. hirsutum*(AD)₁*G. barbadense*(AD)₂*Arquipélago de Hawai* (n = 26)*G. tomentosum*(AD)₃

Cruzamentos entre espécies de grupos diferentes, ou são inviáveis, ou, quando viáveis, são, por via de regra, estéreis. Cruzamentos entre espécies do mesmo grupo são normalmente viáveis, mas, ou são estéreis, ou têm uma fertilidade reduzida.

SKOVSTED (1934) notou que no híbrido entre uma espécie cultivada americana [*G. hirsutum*, por exemplo, (AD)₁] e uma espécie selvagem americana (*G. thurberi*, por exemplo, D₁) se formavam, na primeira divisão meiótica, treze bivalentes e treze univalentes, sendo estes últimos os cromossomas maiores. E que num híbrido entre a mesma espécie cultivada americana (AD)₁ e uma espécie cultivada asiática (A₁ ou A₂) se formavam, na primeira divisão meiótica, também treze bivalentes e treze univalentes, sendo estes últimos agora os cromossomas mais pequenos. Daqui deduziu que as espécies americanas com 52 cromossomas devem ter sido originadas por um híbrido entre uma espécie cultivada asiática (A₁ ou A₂) e uma espécie selvagem americana (D), que tivesse duplicado espontaneamente o seu número de cromossomas, tornando-se assim fértil.

Mais tarde, BEASLEY (1940) e HARLAND (1940) conseguiram, independentemente, duplicar o número de cromossomas de um híbrido entre uma espécie cultivada asiática e uma espécie selvagem americana (pelo tratamento com a colquicina), tornando-o assim fértil. E verificaram depois que esse híbrido, quando cruzado com uma espécie cultivada americana, produzia híbridos férteis, e que mostravam, na primeira divisão meiótica, 26 bivalentes.

Estava, assim, demonstrada a hipótese de SKOVSTED.

Nos nossos trabalhos de citogenética no género *Gossypium* temos obtido muitos híbridos interespecíficos que, tratados pela colquicina, se tornam férteis. Assim, por exemplo,

do cruzamento do *G. hirsutum* (AD)₁ com o *G. armorianum* (D₂) obtivemos um híbrido triplóide estéril que mostrava um emparelhamento regular dos dois genómos D (13 bivalentes) e 13 univalentes do genótipo A (Fig. 1 e 2, Est. I).

Duplicado o número de cromossomas pela colquicina, obtivemos um híbrido fértil, hexaplóide, com 78 cromossomas, emparelhando regularmente nas divisões de redução (Fig. 3, Est. I).

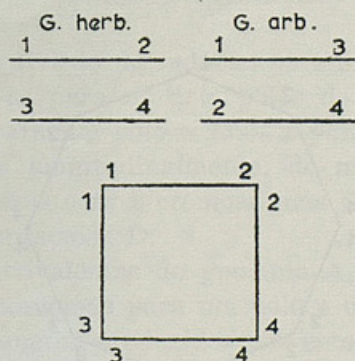


Fig. text. 1. — Esquema de uma translocação recíproca entre dois cromossomas de *G. herbaceum* para darem os dois cromossomas de *G. arboreum*, o que explicaria a formação de um quadrivalente no híbrido entre as duas espécies.

Este híbrido hexaplóide comporta-se agora como uma espécie sintética e permite cruzamentos com as espécies asiáticas cultivadas, dando híbridos tetraplóides férteis que são cruzáveis com as variedades cultivadas do *G. hirsutum*. Por tais processos é possível transmitir caracteres de umas espécies para outras, mesmo quando os híbridos entre as espécies em questão sejam estéreis.

No cruzamento do *G. herbaceum* var. *africanum* (A₁) com o *G. arboreum* (A₂) obtêm-se híbridos relativamente férteis, com um emparelhamento regular de cromossomas (13 bivalentes), ou com 11 bivalentes e um quadrivalente.

GERSTEL (1953) explicou a formação deste quadrivalente admitindo a hipótese de uma translocação recíproca entre os cromossomas um e dois das duas espécies.

Sendo assim, quando duplicarmos o número de cromossomas do híbrido, havemos de obter um novo híbrido com 52 cromossomas, 26 do genómio A_1 e 26 do genómio A_2 . Destes cromossomas, 44 ($2 \times 11 A_1 + 2 \times 11 A_2$) são homólogos 4 a 4. Devem, pois, formar 11 quadrivalentes na primeira divisão meiótica, ou 22 II, ou um número intermediário de II e IV.

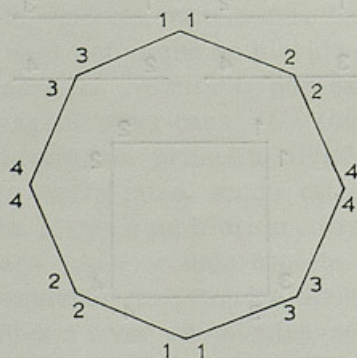


Fig. text. 2. — Esquema explicando a formação do octovalente da Fig. 4, Est. I.

Quanto aos cromossomas um e dois, devem poder formar um octovalente, ou dois quadrivalentes, ou um número intermediário de combinações (p. ex., 1 VII e 1 I, 1 VI e 1 II, 1 V e 1 III, etc.). De facto, nunca obtivemos mais de um octovalente, em cadeia fechada ou aberta, e 11 quadrivalentes, o que está de acordo com a hipótese de GERSTEL (Fig. 4, Est. I e fig. text. 2).

Cruzando agora este híbrido tetraplóide ($A_1 A_1 A_2 A_2$) com variedades do *G. hirsutum* (A A D D), este progenitor deve fornecer um gameto AD, enquanto que o outro progenitor deve fornecer gametos com a constituição $A_1 A_1$ ou $A_2 A_2$ ou $A_1 A_2$. O híbrido formado deve, pois, ter a constituição A A A D, representando por A indistintamente o genómio A_1 , A_2 ou A.

Este híbrido deve, pois, apresentar nas divisões de redução um mínimo de 13 univalentes (do genótipo D) e um máximo de 13 trivalentes (do genótipo A). O número de univalentes pode, porém, ser superior a 13, se não se formarem 13 trivalentes do genótipo A, mas sim 12 III, 1 II e 1 I, ou 11 III, 2 II e 2 I, etc.

As observações condizem perfeitamente com os resultados teoricamente previstos, ainda que, por vezes, seja muito difícil de distinguir nas preparações os bivalentes dos trivalentes.

Na primeira divisão de redução os univalentes do genótipo D repartem-se para os dois pólos da célula ao acaso, x cromossomas para um pólo e $13 - x$ para o outro. Na segunda dividem-se longitudinalmente, de modo a formarem quatro gametos, dois com x cromossomas D e os outros dois com $13 - x$ cromossomas D.

Quanto aos trivalentes do genótipo A, dividem-se marchando dois cromossomas para um pólo e um para o outro.

Assim, os gametos produzidos por este híbrido terão no máximo 13 cromossomas do genótipo D (se x for igual a zero) e 26 cromossomas de genótipo A, se todos os trivalentes tiverem contribuído com 2 cromossomas. E, no mínimo, nenhum cromossoma D e 13 cromossomas A.

Retrocruzando agora sucessivamente este híbrido com variedades do *G. hirsutum*, os cromossomas do genótipo D do híbrido vão emparelhando, nas sucessivas gerações, com um número cada vez maior de cromossomas do mesmo genótipo do *G. hirsutum*, até restabelecerem os 13 bivalentes. E os cromossomas em excesso do genótipo A vão-se perdendo pelo caminho até se restabelecerem as condições de equilíbrio com 13 bivalentes A.

Por este processo, ao cabo de três ou quatro retrocruzamentos temos de novo exemplares compensados, com 26 bivalentes, 13 do genótipo D e 13 do genótipo A.

Mas se a selecção tiver sido cuidadosamente feita, podemos incorporar no híbrido resultante genes do *G. herbaceum* ou do *G. arboreum*.

As observações feitas condizem perfeitamente com os resultados teoricamente esperados.

É curioso, porém, notar que SKOVSTED (1934) obteve um híbrido sensivelmente com a mesma constituição cromossômica que o nosso ($G. arboreum \times G. herbaceum$) $F_1 \times [G. hirsutum \times G. barbadense] \times G. barbadense$], mas estéril.

RESUMO

Por cruzamento entre variedades do *Gossypium hirsutum* e espécies selvagens americanas é possível obterem-se híbridos triploides (ADD) estéreis que, tratados pela colquicina, se tornam hexaploides (AADDDD) e férteis. Estes, cruzados com espécies cultivadas asiáticas, dão híbridos tetraploides férteis e susceptíveis de serem cruzados com variedades do *G. hirsutum*.

Num híbrido entre o *G. herbaceum* e o *G. arboreum*, tratado pela colquicina ($A_1 A_1 A_2 A_2$) vêem-se 52 cromossomas que, no máximo emparelhamento, formam um octovalente e onze quadrivalentes. Cruzado sucessivamente com variedades do *G. hirsutum* vão-se restabelecendo pouco a pouco os treze bivalentes do genótipo D e, por perdas sucessivas de cromossomas, os treze bivalentes do genótipo A. Deste modo é possível obter por fim formas férteis, com 26 bivalentes, cruzáveis com variedades cultivadas do *G. hirsutum*, mas com características do *G. herbaceum* ou do *G. arboreum*.

SUMMARY

Through crossings between varieties of *Gossypium hirsutum* and wild American species, sterile triploid hybrids (ADD) can be obtained, which treated with colchicine become hexaploid (AADDDD) and fertile. These, crossed with Asiatic cultivated species, give origin to fertile tetraploid hybrids, susceptible of being crossed with varieties of *G. hirsutum*.

In a colchicine treated hybrid from a cross between *G. herbaceum* and *G. arboreum* ($A_1 A_1 A_2 A_2$), 52 chromosomes may be seen which at maximum pairing form one octovalent and eleven quadrivalents. The thirteen bivalents of genome D are gradually recovered by successive crossings with *G. hirsutum* varieties while for genome A recovery is

effected by successive losses of chromosomes. Thus, it is finally possible to obtain fertile forms with 26 bivalents, which can be crossed with cultivated varieties of *G. hirsutum* but keep characteristics from *G. herbaceum* and *G. arboreum*.

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of the reaction of the acid with the base. It is found that the reaction is very rapid and that the products are the same as those obtained from the reaction of the acid with the base. The reaction is also very exothermic and the heat of reaction is about 10,000 calories per mole.

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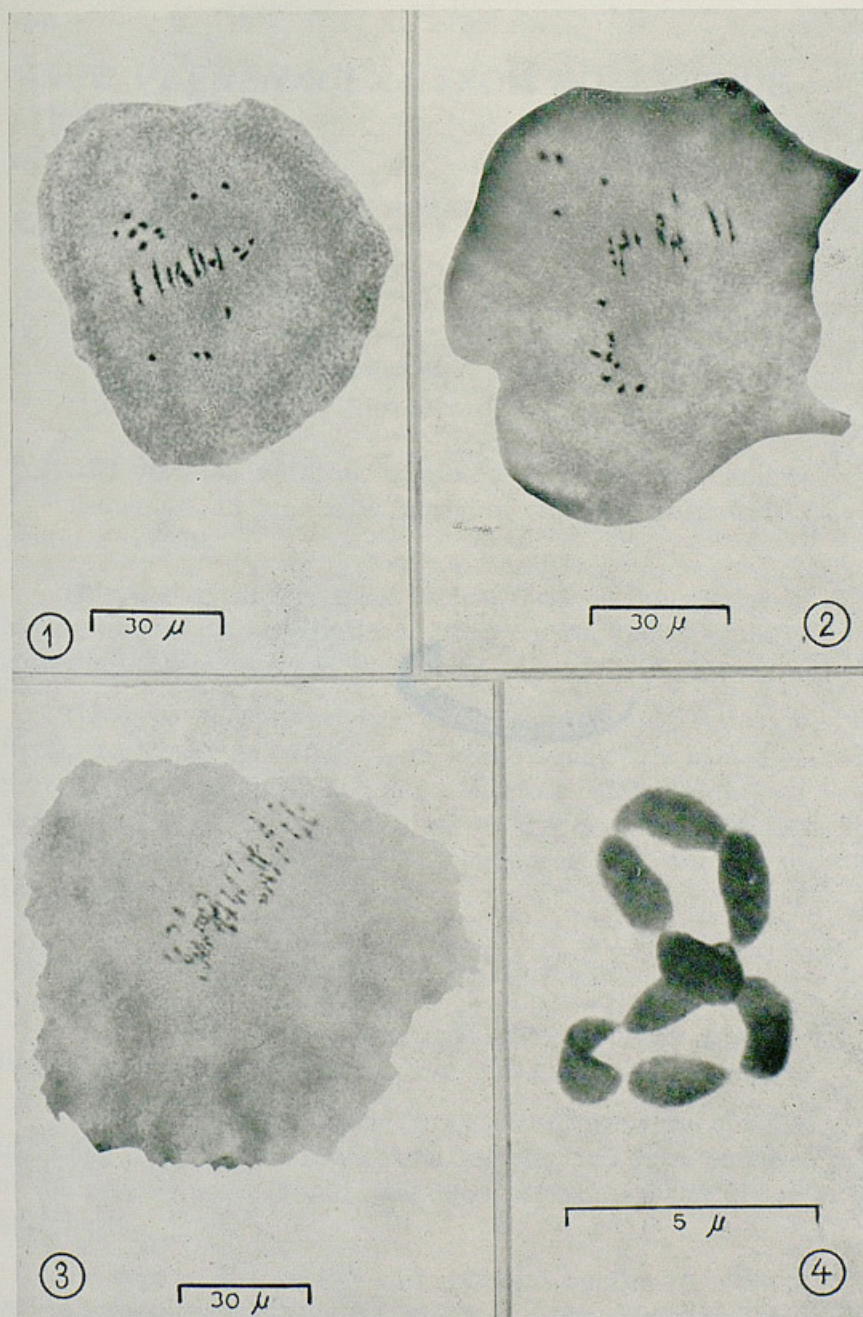
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ESTAMPA

ESTAMPA I

- Fig. 1 e 2. — Metafases da primeira divisão das células-mães de grãos de pólen de um cruzamento entre *Gossypium hirsutum* e *G. armorianum*, mostrando 13 univalentes.
- Fig. 3. — Idem, depois da duplicação do número de cromossomas pela colquicina, mostrando um emparelhamento regular dos cromossomas.
- Fig. 4. — Um octovalente em cadeia fechada, obtido num híbrido entre *G. herbaceum* e *G. arboreum*, em que foi duplicado o número de cromossomas pelo tratamento com a colquicina.



INSTITUTO BUTANICO

NEW VERBENACEAE FROM MOZAMBIQUE

by

HAROLD N. MOLDENKE

Chascanum schlechteri var. *torrei* Moldenke,
var. nov.

HAEC varietas a forma typica speciei foliorum laminis usque ad 12 mm. latis margine superne irregulariter dentatis recedit.

This variety differs from typical form of the species in having its leaf-blades elliptic, to 12 mm. wide, and irregularly spreading-dentate toward the apex.

The type of the variety was collected by Dr. ANTÓNIO ROCHA DA TORRE (n.º 7039) — in whose honor it is named — near Chobela, Magude, Lourenço Marques, Moçambique, on January 3, 1948, and is deposited in the herbarium of the Centro de Botânica, Junta de Investigações do Ultramar, in Lisbon (LISC).

Premna holstii var. *glandulifera* Moldenke, var. nov.

Haec varietas a forma typica speciei ramulis pedicellis calicibusque pilis capitato-glandulosis ornatis recedit.

This variety differs from the typical form of the species in having the youngest branchlets, pedicels, and outer surface of the calyxes covered with glandular-capitate shortly divergent hairs.

The type of the variety was collected by Dr. FRANCISCO DE ASCENSÃO MENDONÇA (n.º 1654) at Goba, Maputo, Lourenço Marques, Moçambique, on December 6, 1942, and is

deposited in the herbarium of the Centro de Botânica, Junta de Investigações do Ultramar, in Lisbon (LISC).

***Vitex oxycuspis* var. *mossambicensis* Moldenke,
var. nov.**

Haec varietas a forma typica speciei recedit ramulis breviter fulvo-puberulis, petiolis usque ad 11 cm. longis, foliolis ellipticis subtus minute fulvo-puberulis, pedunculis usque ad 1.5 cm. longis dense breviter pubescentibus, ramulis inflorescentiorum calicibusque dense breviterque pubescentibus, dentibus calicis magnis triangularibus.

The type of this variety was collected by Dr. ANTÓNIO ROCHA DA TORRE (n.º 6323, in part) in sandy soil in dense deciduous forest of *Brachystegia* at Dondo, Cheringoma, Manica e Sofala, Moçambique, on December 31, 1943, and is deposited in the herbarium of the Centro de Botânica, Junta de Investigações do Ultramar, in Lisbon (LISC).

***Holmskioldia subintegra* Moldenke, sp. nov.**

Arbor; ramis sarmentosis prominente lenticellatis novellis dense griseo-pubescentibus; laminis foliorum obovatis vel obovato-ellipticis pergamentaceis utrinque breviter pubescentibus integris vel subintegris ad apicem breviter cuspidatis, ad basin acutis, sessilibus vel subsessilibus.

Tree, 5-7 m. tall, apparently much-branched; branchlets twiggy, conspicuously lenticellate with elevated lenticels, the youngest parts densely short-pubescent with gray hairs; principal internodes much abbreviated, 1-4 cm. long; leaves decussate-opposite or approximate, sessile or subsessile; leaf-blades firmly chartaceous or parchment-like, brunnescent in drying, lighter beneath, obovate or obovate-elliptic, usually widest above the middle, acute to short-cuspidate at the apex, entire or subentire-repand along the margins, acute at the base, rather densely short-pilose or -pubescent above, more densely so beneath especially along the venation; secondaries about 6 per side, practically indiscernible above, prominulous

beneath; inflorescence axillary, usually shorter than or equaling the subtending leaves; peduncles very slender, 2-3 cm. long, densely short-pubescent; cyme-branches 2 or 3, shorter than the peduncle, short-pubescent, divergent in fruit; calyx firmly chartaceous, rotate, distinctly 5-lobed, conspicuously venose, pinkish, 2.5-3 cm. wide, puberulent.

The type of this species was collected by EDUARDO CAMPOS DE ANDRADA (n.º 1755) near Furancungo, Macanga, Tete, Moçambique, on July 14, 1949, and is deposited in the herbarium of the Centro de Botânica, Junta de Investigações do Ultramar, in Lisbon (LISC).

***Holmskioldia tettensis* f. *alba* Moldenke, f. nov.**

Haec forma a forma typica speciei corollis albis recedit.

This form differs from the typical form of the species having white corollas.

The type of the form was collected by Dr. ANTÓNIO ROCHA DA TORRE (n.º 2015) near Goba, Maputo, Lourenço Marques, Moçambique, on November 15, 1940, and is deposited in the herbarium of the Centro de Botânica, Junta de Investigações do Ultramar, in Lisbon (LISC).

hairs on the sides of the head, and a few on the sides of the thorax. The head is small, the eyes are large, and the mouthparts are small. The antennae are short, and the legs are long. The wings are small, and the body is slender. The color is brown, and the texture is smooth.

The type of this species was collected by Ricardo Cano in the mountains of the Cordillera de la Neblina, near the town of Parí, in the state of Bolívar, Venezuela, on July 12, 1950. It is deposited in the collection of the Entomological Society of America, in Washington, D. C.

This form differs from the typical form in the shape of the head, and in the color of the body. It is a new form, and is named in honor of the collector, Ricardo Cano.

The type of the form was collected by Dr. Ricardo Cano in the mountains of the Cordillera de la Neblina, near the town of Parí, in the state of Bolívar, Venezuela, on July 12, 1950. It is deposited in the collection of the Entomological Society of America, in Washington, D. C.

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CYTOTAXONOMIC REVISION
OF THE *AXONOPUS COMPRESSUS* (SW.)
BEAUV. COMPLEX

by

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THE carpet-grasses of the genus *Axonopus* Beauv. constitute a complex of forms originally attributed to the species *A. compressus* (Sw.) Beauv. Now occurring throughout the tropics and some subtropics (Pl. I), they are all undoubtedly derived from material of American or West Indian origin (GLEDHILL, 1965). The following have been recognised as components of the complex:

A. affinis Chase, J. Washington Acad. Sci. 28, 4: 178-182, 1938.

A. compressus v. *affinis* (Chase) Henderson, Malayan Wild Fl. Monoc., Mal. Nat. Soc.: 339, 1954.

This differs from *A. compressus* in having more slender culms and stolons, narrower leaves and shorter, obtuse to sub-acute spikelets.

Gulf States of America, West Indies, Brazil, Paraguay, Venezuela, temperate S. America (Alemania and Tolxa), Singapore, Malaysia, Australia, Japan and Pacific Islands.

A. flexuosus (Peter) Hubbard ex Troupin, Exploration du Parc Nat. Garamba 1, 4: 18-19, 1956.

Digitaria flexuosa Peter, Fl. von Deutsche Ostafrika in Fedde Rep. 40, 1: 165, 1930.

A. compressus v. *jesuitica* Araujo, Bol. Secret Est. Negoc. Ind. & Com. Porto Alegre, 100: 36, 1943.



A. compressus subsp. *congoensis* Henrard, Blumea 5: 529, 1945.

A. compressus v. *congoensis* (Henrard) Black, Adv. Front. Pl. Sci. 5: 1-186, 1963.

This differs from *A. compressus* in being much taller, having longer and sometimes wider leaves and longer spikelets and racemes.

Guinea, Sierra Leone, Liberia, Ivory Coast, Ghana, Nigeria, Congo, Kenya, Uganda, Tanzania, Zambia.

Type specimens seen: *de Saeger* 1336, Congo, *Hens* 162, Congo.

A. compressus subsp. *brevipedunculatus* Gledhill, Phytomorphology 12, 4: 412-418, 1962.

A. compressus v. *australis* Black, Adv. Front. Pl. Sci. 5: 1-186, 1963.

This was described to circumscribe robustly stoloniferous material with broad leaves, hairy above, longer and hairy spikelets and short peduncles.

Guinea, Sierra Leone, Liberia, Ghana, Nigeria, Fernando Po, Congo, Angola, Zambia, Honduras, Cuba, Puerto Rico, Jamaica, Windward Islands, Trinidad, Paraguay, Assam, Ceylon, Malaysia, Java and Australia.

Type: *Gledhill* 54 (SL). (Isotype K).

A. compressus v. *itirapinensis* Black, Adv. Front. Pl. Sci. 5: 1-186, 1963.

This differs in having a few short hairs on the rachis of the racemes. It is restricted to a single locality in Brazil.

A. compressus v. *macropodius* Black, Adv. Front. Pl. Sci. 5: 1-186, 1963.

Paspalum macropodium Steud., Syn. Pl. Glum. 1: 19, 1854.



This differs in having longer pedicels (up to 1 mm) and racemes often aggregated at the summit of the peduncles. It is restricted to the foothills of the Andean Cordillera.

Type specimen seen: *Jameson* 556, Ecuador.

A specimen, numbered 916, in the Botanische Staatssammlung, Munich, was collected by O. SWARTZ in Jamaica. It bears the name *Milium compressum* and is here cited as the type for *Axonopus compressus* (Sw.) Beauv. and, together with SWARTZ' descriptions (1788 and 1797) serves as the basis for this revision.

An extensive study of material in Kew, Edinburgh, Munich, Leiden, Ghana and Sierra Leone herbaria, and of living material derived from many parts of Africa, has led to the proposal of the following new taxa.

A. brevipedunculatus D. Gledhill, spec. nov.

A. compressus ssp. *brevipedunculatus* D. Gledhill, pro parte a *A. compressus* pedunculo folii terminalis quam vagina raro multo longiore, inflorescentiis strictis, spiculis latioribus, subacutis, pilosis, stolonibus crassioribus, foliorum vaginis et laminis latioribus, laminis atroviridibus, supra pilis rigidiusculis laxè dispositis, apice saepe rubidis, folio terminale longitudine reducta differt.

Type: *Gledhill* 225, Hastings Village, Sierra Leone (SL). Isotype K.

Perennial up to 16 cm tall, forming a dense, tufted turf with strongly rooting stolons and short, stout rhizomes. Stolon internodes up to 3 cm long, 2.2 mm wide, compressed and shallowly double keeled adjacent to the innovation below. Culms robust, terminal and solitary or in extravaginal groups from the innovations. Sheaths up to 6 mm wide, strongly compressed, with scattered long hairs on the margins and below the insertion of the blades. Lower sheaths 2.5 cm long, crowded, flabellate, smooth, striate, persistent. Blades (3.5-) 12(-20) cm long, up to 13.5 mm wide, ovate-lanceolate from a rounded base, asymmetrically rounded at the apex, dark green or anthocyanosed, hispid on the upper surface and often

corrugated between the nerves; margins undulate, ciliate with hairs 1.5 mm long on hyaline bases; the hairs replaced by forward pointing teeth towards the apex. Nodes hairy; the hairs up to 1.8 mm long, white to pale mauve. Inflorescences 2, 3 or 4, each with 2 or 3 spike-like racemes. Peduncles 0.8 mm diameter, triquetrous, glabrous, seldom as long as the ultimate leaf-sheath. Racemes up to 6 cm long, strict, dark green or anthocyanosed. Rachis triquetrous, glabrous except for a collar of hairs at the base, scaberulous at the margins. Spikelets 2.3-2.8 mm long, 1.1 mm wide, broadly ovate-lanceolate, sub-acute, green or anthocyanosed, becoming stramineous, long silky hair; the hairs white to pale mauve, up to 1 mm long. Second glume corresponding in size and shape to the spikelet, sub-acute, with hyaline teeth towards the apex. Sterile lemma sub-similar to the glume but embraced by it marginally. Fertile lemma and palea sub-similar, 1-8 mm long, 0.8 mm wide, the former with a much reduced apical tuft of hairs and embracing the latter marginally. Anthers 0.6 mm long, yellow, becoming contorted and compressed by the growth of the caryopsis, seldom exerted and then becoming crescentiform. Stigmas white to pale mauve. Caryopsis 1.4 mm long, 0.8 mm wide, elliptic-obtuse; the embryo occupying the lower half of the grain. Hilum small, oval.

This is an apomictic species, as is indicated by the setting of fruit in unopened spikelets; even in those which remain confined within the ultimate leaf-sheath. The incidence of apomixis in carpet grasses has not been previously reported but, as will be shown, it is a common feature of some of the African representatives. The possibility of there being agamic complexes amongst these grasses is suggested by the facts that herbarium material from several geographic areas possess fruiting spikelets with the anthers still confined within the fertile floret, and that it is possible to distinguish such material on the basis of minor morphological characters. All show the short peduncle character, usually together with short ultimate leaves.

Morphological variability has been investigated under wet and dry season conditions and under wet, shaded and dry, exposed conditions. In Table I, the dry season (Jan.) means of 120 measurements for each of three culm characters, and 100 measurements for spikelet length, are compared with the means of corresponding wet season (Oct.) measurements. The figures were accumulated by repeated samples of 20 measurements, on plants in experimental beds, taken during the period 1957 to 1963. Values of Student's *t* less than 3.29 have probabilities greater than 1 in 1000 that the

TABLE I
Seasonal variation in dimensions
of *A. brevipedunculatus*

		Mean	t
Culm length	Jan.	18.5	13.49
	Oct.	24.3	
Culm sheath	Jan.	10.2	13.32
	Oct.	13.6	
Culm leaf	Jan.	3.5	16.12
	Oct.	5.8	
Spikelet	Jan.	2.5	23.58
	Oct.	2.8	

variation could be due to sampling error. Higher values indicate significant seasonal variation in size.

A high degree of linear correlation ($r = 0.77$ in Jan. and 0.94 in Oct.) has been determined for the relative lengths of the culm and culm-sheath. This served to confirm that the short peduncle character is genetically determined and not, as is common in *A. compressus*, an induced modification.

Most important amongst the seasonal variations is that of spikelet length. This dimension has been widely used in the taxonomy of the whole genus and has caused some difficulty in distinguishing between *A. compressus* and *A. affinis* in several areas. Under wet, shaded conditions *A. brevipedunculatus* produced spikelets up to 3.4 mm in length, and also become more strongly stoloniferous and less hairy on

the upper leaf surface. Its leaves grew up to 30 cm long and were spirally twisted. Under dry, exposed conditions material from the same clone produced short, very hairy spikelets, short, many-noded stolons and short, broad, hairy leaves which showed little tendency to wilt.

The spikelets of the African taxa are compared in Pl. II with those of SWARTZ' Jamaican specimen.

Cytologically, the material examined has all been tetraploid, with 40 chromosomes (Pl. III, *b*). Only one population contained plants with two additional chromosomes. Pairing during PMC meiosis is complete, as 20 bivalents.

A. arenosus D. Gledhill, spec. nov.

A. compresso pedunculo folii terminalis quam vagina raro multo longiore; inflorescentis strictis vel subpatulis; spiculis longioribus, 3-3.5 mm longis, subacutis, glabris vel rarissimo pilo; nodis glabris; stolonibus crassioribus; foliorum vaginis et laminis latioribus; laminis glabris, pallenti viriditate; folio terminale longitudine reducta differt.

Type: *Gledhill* 226, Hamilton, Sierra Leone (SL).

Perennial up to 20 cm tall, forming an open, tufted and stoloniferous turf on shaded, sandy soils. Stolon internodes up to 5 cm long, 2.7 mm wide, slightly compressed and acutely but shallowly double keeled. Culms robust, ascending or erect. Sheaths 6 mm wide, compressed, glabrous, striate, widely flabellate. Blades (2.5-)11(-25) cm long, 15 mm wide, linear-lanceolate to oblong-lanceolate, from a rounded base, symmetrically rounded at the apex, light green, glabrous or with remote adpressed hairs, the margins with few, short hairs but with hyaline teeth. Nodes glabrous. Inflorescences 3 or 4, each with 2 or 3 strict or slightly spreading spike-like racemes. Peduncles 0.8 mm diameter, triquetrous, glabrous, the longest not much longer than the ultimate leaf-sheath. Racemes up to 8.5 cm long, straight, light green. Rachis triquetrous, glabrous, smooth or slightly scaberulous at the margins. Spikelets 3-3.5 mm long, 1.1 mm wide, broadly ovate-lanceolate, obtuse at the apex, green, glabrous or with

few, short, adpressed hairs towards the base. Second glume corresponding in size and shape to the spikelet, obtuse, with hyaline teeth towards the apex, mid-nerve conspicuous. Sterile lemma sub-similar to the glume but embraced by it marginally. Fertile lemma and palea sub-similar, 1.9 mm long, 1 mm wide, the former without an apical tuft of hairs or the tuft very much reduced, and embracing the latter marginally. Anthers brownish mauve. Stigmas mauve. Caryopsis 1.7 mm long, 0.9 mm wide, elliptic-obtuse; the embryo occupying the lower half of the grain. Hilum small, oval.

As with the previous species, this is capable of apomictic seed production. Normal anthesis has been observed, however, and it seems likely that this is facultatively apomictic.

It is confined to a few localities in which shaded, sandy soils immediately behind a beach, comparable with grey dunes, are prevented from progressing to coastal thicket vegetation by man's interference. It is found at Hamilton and Sussex, both on the Freetown peninsula. It is difficult to maintain under cultivation on non-sandy soils, on which it produces broader leaves with undulating margins. Under dry, exposed conditions plants become tufted and only shortly stoloniferous, and show little susceptibility to wilting. Leaf folding occurs along three principal veins and severe dehydration causes terminal leaf lesions.

All the plants examined have been hexaploid, with 60 somatic chromosomes (Pl. III, c). PMC pairing is regular and results in the production of over 95 % good pollen.

A. brevipedunculatus* × *compressus* D. Gledhill, *hyb. nov.

A. compressus subsp. *brevipedunculatus* D. Gledhill pro parte.

Est inter *A. brevipedunculatum* et *A. compressum* sed foliis et stolonibus et spiculis infusis rubore et omnino sterilis.

Type: *Gledhill* 227, Gloucester Village, Freetown (SL).

This is very common in Sierra Leone in open, disturbed habitats. It is intermediate in most characters between its putative parents. The ultimate culm-leaf is longer, on the average, than in either parent, the stolon internodes thicker

and racemes longer. The inflorescences are short peduncled and the racemes usually remain partially enclosed in the apex of the ultimate leaf-sheath.

All the material examined has been found to have the tetraploid somatic number of 40 and to have irregular meiosis in the PMCs. Some 30 % of pollen grains stain with aceto-carmines but the ovaries in mature spikelets are always collapsed. Normal anthesis has not been observed and populations can only spread by stoloniferous growth.

A. compressus × **flexuosus** D. Gledhill, *hyb. nov.*

A. flexuosus (Peter) Hubbard ex Troupin pro parte.

Est inter *A. compressum* et *A. flexuosum* sed omnini sterilis.

Type: *Gledhill* 229, Leiceester Village, Sierra Leone (SL).

Forms a deep matted growth due to initial arching of the stolons, in wet, shaded habitats. It is intermediate between its putative parents but the leaves are longer (up to 40 cm) and the ultimate leaf is, on the average, longer. The inflorescences are long exserted and the racemes flexuous. The average number of spikelets per culm is high (422, as compared with 210 in *A. compressus* and 370 in *A. flexuosus*).

Spikelet length is variable. Under dry, exposed conditions the average length was 2.7 mm, under wet, shaded conditions some basal spikelets attained lengths up to 4 mm, and the average lengths in January and October were 2.8 mm and 3.0 mm respectively.

The tiller leaves withstand dry conditions well, remaining rigid but folding along the principal veins.

The materials examined have been found to vary in somatic chromosome number. Two Sierra Leone populations contained plants whose chromosome numbers varied between 48 and 54 (Pl. III, e). One Ghana population was apparently homogeneous at the pentaploid level. PMC meiosis was found to be irregular and only 17 % of pollen grains stained with aceto-carmines. All the ovaries which have been examined have been collapsed but occasional seedlings have

been raised to the 4-leaf stage from bulk sewing of naturally abscissed spikelets. Normal anthesis has been observed but reproduction is probably confined to stoloniferous fragmentation.

A. compressus (Sw.) Beauv.

West African *A. compressus* (Pl. IV) is a sexual tetraploid, $2n = 40$ (Pl. III, a), characteristically inhabiting road verges and footpaths under a forest or thicket canopy. It is of smaller stature than West Indian material but this is not regarded as being taxonomically significant.

The character of aggregation of the racemes at the summit of the peduncle has been noted in some populations, but it appears to be a simple genetic phenomenon since it is present in only a small proportion of plants. BLACK's use (1963) of varietal status for long pedicelled, subumbellate plants, as *A. compressus* v. *macropodius*, would therefore seem appropriate.

Morphological variability in *A. compressus* has been investigated. The first biometric comparison with *A. affinis* Chase produced the surprising result that West African *A. compressus* had a shorter spikelet length than the plants of *A. affinis*, which had been grown from American seed. The figures obtained were 2.2 ± 0.020 mm for *A. compressus* and 2.3 ± 0.023 for *A. affinis*. A later comparison, using *A. affinis* which had been grown on for two years, gave a more reliable comparison. This, and the seasonal comparison of culm dimensions are shown in Table II.

The seasonal variation in spikelet length in *A. affinis* is significant, but there was no detectable seasonal variation in the length of *A. compressus* spikelets. However, under wet, shaded conditions, *A. compressus* had an average spikelet length of 2.3 mm; significantly greater than the lengths in the table. Under these same conditions, it produced leaves up to 20 cm in length and fewer, shorter stolons.

The seasonal variation in culm dimensions shown, in Table II, are significant, and correlations between the culm and sheath lengths were found for both these species. For

A. compressus, the correlation coefficient r was 0.58 in January and 0.73 in October, and for *A. affinis* r was 0.91 in January and 0.85 in October. The dimensions of *A. compressus* are greatly modified by mowing. Cutting with a cylinder lawn mower stimulates lateral spread and consolidation into

TABLE II

Seasonal variation in culm dimensions
of *A. compressus* and *A. affinis*

			Mean	t
<i>A. compressus</i>				
Culm length	Jan.		27.2	3.25
	(cm)	Oct.	28.7	
Culm sheath	Jan.		8.1	4.77
	(cm)	Oct.	8.9	
Culm leaf	Jan.		6.4	9.18
	(cm)	Oct.	7.7	
Spikelet	Jan.		2.1	1.40
	(mm)	Oct.	2.1	
<i>A. Affinis</i>				
Culm length	Jan.		22.8	8.21
	(cm)	Oct.	27.9	
Culm sheath	Jan.		9.1	12.92
	(cm)	Oct.	11.5	
Culm leaf	Jan.		2.9	10.37
	(cm)	Oct.	3.9	
Spikelet	Jan.		1.9	4.07
	(mm)	Oct.	2.0	

a turf, when the production of long stolons is inhibited and plants become more strongly rhizomatous. Leaf sheaths and blades become narrower and fewer culms are produced. Those culms which are formed are inclined, rather than erect, and have shorter leaves and inflorescences. In these respects they look rather like the culms of *A. brevipedunculatus*, but flowering is free and occurs as the spikelets emerge from the culm-sheath. The basal leaves often decrease in width to 5 mm; *A. affinis* leaf widths may rise to 12 mm in October, and

caution is required in using leaf width to distinguish between these two species. When a turf, which has been maintained by mowing, is neglected the modifications which were caused by mowing quickly disappear.

A. flexuosus (Peter) Hubbard ex Troupin

The remaining African species, *A. flexuosus*, is a tall, robust plant forming a deep, matted sward of stoloniferous growth in habitats experiencing at least seasonal flooding. One of the conspicuous features of this species is the arching of the stolons. These are at first erect, but the long internodes (up to 30 cm) arch downwards and may root at the nodes. There are seldom more than 4 internodes.

The leaf blades may be up to 30 cm long and 20 mm wide. They have a conspicuous mid-vein but are without marginal hairs (only the hyaline bases are present). The inflorescences are long exserted from the ultimate leaf sheath and each may support up to five, flexuous, spike-like racemes. The racemes are up to 16 cms long.

Spikelet lengths up to 4 mm have been recorded but the average length is 3.3 mm. The fertile floret occupies only the lower 2 mm of the spikelet and causes a slight but conspicuous distension of the lower part of the spikelet (see Pl. II). Like the nodes, leaves and rachis of the racemes, the spikelets are glabrous or inconspicuously adpressed silky-hairy.

Seasonal variation in *A. flexuosus* is very pronounced, being related to the drying out of the habitat. During the dry season, the production of culms and stolons ceases and, as the matted, stoloniferous growth is reduced by decay and termite action, the deep matted sward degenerates to an open turf. This persists throughout the dry season and may consolidate by rhizomatous growth. With the onset of the wet season, stoloniferous growth and culm production recommence.

All the material examined has been found to have the hexaploid chromosome number, $2n = 60$ (Pl. III, d) and to be meiotically regular. Normal anthesis has been observed,

as also has the production of fruits in unopened spikelets. Emasculation experiments gave some indication that fruits can be produced apomictically, but this has not been confirmed cytologically. It is probable that this species is primarily sexual in the wild state.

Key for the West African taxa

Peduncles not much longer than the ultimate leaf-sheath.

Leaves, nodes and spikelets with $\pm$ spreading hairs; spikelets up to 3 mm long.

At least the first raceme becoming fully exerted from the ultimate leaf-sheath; ultimate leaf about as long as its sheath, often anthocyanosed

. *A. brevipedunculatus* $\times$ *compressus*

Racemes seldom fully emerging from the apex of the ultimate leaf-sheath but often protruding from it laterally; ultimate leaf less than half as long as its sheath, dark green; leaves with remote rigid hairs above; anthers yellowish-brown; stigmas pale mauve; fertile lemma with a reduced apical tuft of hairs ,

. *A. brevipedunculatus*

Leaves, nodes and spikelets glabrous or with remote adpressed hairs; spikelets 3-3.5 mm long; ultimate leaf about $\frac{1}{3}$ as long as its sheath; anthers brown; stigmas mauve; fertile lemma with an inconspicuous apical tuft of hairs

. *A. arenosus*

Peduncles much longer than the ultimate leaf-sheath.

Spikelets over 2.7 mm long, glume much longer than the fertile floret; racemes more than 9 cm long, flexuous.

Stolon internodes over 12 cm long, stout, nodes glabrous; leaves up to 2 cm wide, midrib conspicuous, marginal hairs absent or represented by hyaline bases; ultimate leaf about $\frac{1}{3}$ as long as its sheath; lower spikelets contiguous; anthers and stigmas dark mauve; fertile lemma with a conspicuous apical tuft of hairs

. *A. flexuosus*

Stolon internodes up to 10 cm long, slender, nodes hairy; leaves up to 1.5 cm wide, margins remotely ciliate

towards the base, ultimate leaf about $\frac{1}{2}$ as long as its sheath; lower spikelets remote; anthers orange-brown with darker punctate marks on margins; stigmas dark mauve; fertile lemma with a conspicuous apical tuft of hairs *A. compressus* $\times$ *flexuosus*

Spikelets up to 2.7 mm long, glume not conspicuously much longer than the fertile floret; racemes less than 9 cm long, stiffly ascending.

Peduncles straight; leaves lanceolate, herbaceous, asymmetrically sub-acute, margins ciliate, ultimate leaf more than $\frac{1}{2}$ the length of its sheath; stolon internodes up to 7 cm long; spikelets narrowly ovate, obtuse to sub-acute; anthers pale mauve; stigmas white to pale mauve; fertile lemma with a conspicuous apical tuft of hairs *A. compressus*

Peduncles flexuous; leaves linear, sub-succulent, abruptly obtuse, with few, widely spaced marginal hairs, ultimate leaf less than $\frac{1}{2}$ the length of its sheath; stolon internodes less than 5 cm long; spikelets ovate-elliptic, obtuse; anthers mauve; stigmas dark mauve; fertile lemma without or with a very much reduced apical tuft of hairs *A. affinis*

EXPERIMENTAL CROSSES

Hybrids have been synthesised between *A. compressus*, used in each case as the maternal parent, *A. flexuosus*, *A. arenosus* and *A. brevipedunculatus*. Meiosis in the pollen mother cells of all the hybrids was found to be irregular. In *A. compressus* $\times$ *flexuosus* artificial hybrids complex multivalents and few univalents suggested that the parental chromosomes, although having segmental homology, differ greatly in their linear structure. Only 20 % of the pollen grains examined stained with aceto-carmine and all the ovaries examined were collapsed dorsio-ventrally.

No univalents were observed in the artificial *A. compressus* $\times$ *arenosus* hybrids, but complex multivalents, together with less than 10 % stainable pollen and all the ovaries being collapsed, suggest that the parents differ in chromosome structure as well as number.

The cross between *A. compressus* and *A. brevipedunculatus* was between parents having the same chromosome number, $2n = 40$. The artificial hybrids had quadrivalents and trivalents but no univalents. This again suggests segmental interchange differences between the two parents. 32% of the pollen grains examined stained with aceto-carmin but all the ovaries were found to be collapsed.

The most significant difference between the artificial and natural hybrids is that the latter produce a fairly high proportion of bivalents. Such a condition might be due to selection in the wild state for seed fertility (and, hence, for functional meiotic products) over a greater length of time than in the artificial hybrids.

DISCUSSION

The variation in morphology, chromosome number, breeding mechanism and ecology of the components of the *A. compressus* complex suggest a state of evolutionary dynamism. The presence of the complex in areas other than the tropical American area probably dates from about 1800 (GLEDHILL, 1965). The process of adaptation to the environment of a new geographical area is initially dependent upon phenotypic plasticity. The colonisation of new habitats requires physiological modifications and these are dependent upon cytological modifications. The carpet grasses, like many other subspontaneous and semi-useful plants of the tropics, are seldom cultivated, in the strict sense. They are seldom used selectively by man but usually persist as ruderal or even aggressal weeds. The formation of morphologically distinguishable variants under such circumstances is a relatively rapid process but the variants are selected genotypes. Nevertheless, it seems reasonable to suppose that extension into new, man made habitats, and spatial discontinuities arising as a result of regeneration of, say, thicket and forest, is accompanied by cytological changes and speciation.

Morphological modifications have given rise to taxonomic confusion in Australia (McLENNAN, 1936; CROSS, 1938), Malaya (JAGOE, 1940) and South Africa (CHIPPINDAL, 1954).

In the first two of those areas the dates of introduction were known and that knowledge probably contributed to the failure of recognition that both quantitative and qualitative differences existed between the plants in those areas and *A. compressus* of the West Indian type area. The dimensions of spikelets and leaves, characters which have been used extensively as diagnostic criteria, are known to be very variable. The taxonomy of the genus as a whole has been dictated by the recognition of narrowly endemic taxa of the tropical American area, on the one hand, and the lumping together of widely distributed taxa, on the other. Few attempts have been made to discover characters, other than those of gross morphology, which provide reliable distinguishing features at various taxonomic levels. This is shown in BLACK's (1963) monograph, which generalises anther colour as constantly dark purple, and lodicule shape as 'apparently somewhat obtuse' and admits to the examination of the caryopsis only in *A. furcatus* (Flügge) Hitch. JAGOE (1940) listed a number of characters, which included the colours of anthers and stigmas, by which *A. affinis* and *A. compressus* could be distinguished. In doing so he made a descriptive departure from the diagnosis of the latter species, by referring to it as having short peduncles. This is not strictly true of all Malayan material, only that which has since been circumscribed by the writer (1962) as *A. compressus* subsp. *brevipedunculatus* (BLACK's var. *australis*).

The African taxa can be defined precisely in terms of their morphological characters and the distinctions so made are supported by their cytology. Three levels of polyploidy are found within the complex, tetraploid, hexaploid and octoploid. The diploid number has been recorded in two species not included in the complex (see Table III). It is of interest to note that variation in somatic number has been detected in South American *A. compressus* which is of a similar nature to that found amongst the African taxa described above. The functionally diploid nature of tetraploids, hexaploids and octoploids, and the occurrence of sterile hybrids, confirms that cytological differentiation has taken

place within the complex. This has been confirmed by the synthesis of artificial hybrids.

The extension of *A. arenosus* into sandy, saline soils and of *A. flexuosus* into habitats subject to flooding, is

TABLE III

Published chromosome numbers of *Axonopus* spp.

<i>A. argentinus</i> Parodi	n = 15	PARODI, 1938
— <i>v. genuinus</i>	n = 18	—
— <i>v. glabriflorus</i>	n = 19	—
— <i>v. glabripes</i>	n = 19	—
— <i>v. hirsutus</i>	n = 18	—
<i>A. hagenbachianus</i> (Ktze.) Parodi	n = 21	—
<i>A. longicilius</i> (Hack.) Parodi	n = 22	—
<i>A. pressus</i> (Nees) Parodi	n = 23	—
<i>A. suffultus</i> (Mik) Parodi	n = 23	—
—	2n = 40	DEWET & ANDERSON, 1956
— <i>v. pubiflorus</i>	n = 23	PARODI, 1938
<i>A. scoparius</i> (Flügge) Kuhlman	2n = 20	DEDECCA, 1956
<i>A. iridaceus</i> (Mez) Rojas	2n = 20	NUÑEZ, 1946
—	2n = 20	DELAY, 1950
<i>A. compressus</i> (Sw.) Beauv.	2n = 40	JANAKI AMMAL, 1945
—	2n = 56, 60	NUÑEZ, 1946
—	2n = 40, 50, 60	DELAY, 1950
<i>A. furcatus</i> (Flügge) Hitchc.	2n = 40	BROWN, 1950
<i>A. affinis</i> Chase	2n = 80	BURTON, 1942
—	2n = 80	BROWN, 1948
—	2n = 54*	CARNAHAM & HILL, 1961

* This was an error, apparently due to faulty card indexing, and should have read 2n = 80.

comparable with the extension of *A. affinis* into sub-tropical North America. *A. affinis* is a functionally diploid species (Pl. III, f) at the octoploid level. Its evolution in the Gulf States area of America suggests that there is a definite relationship between the colonisation of a new area and the attainment of the octoploid condition. Its success in tropical areas, into which it has been introduced, further suggests that the higher polyploid condition has also been accompanied by an increase in vigour, when compared with *A. compressus*.

A. arenosus and *A. flexuosus* have evolved in habitats which are very distinct from those occupied by *A. compressus*. Both species are hexaploid and functionally diploid.

The apomictic reproduction in *A. brevipedunculatus* is the mechanism which has enabled this species to evolve in more exposed and rigorous habitats than those occupied by *A. compressus*. Its distinctive morphology and the sterility of its hybrids with *A. compressus* are sufficient ground for its being recognised as a separate species.

It appears likely that apomixis will be discovered in members of the complex in other geographical areas, where extension of habitat range has taken place, probably with the adoption of morphological changes such as the short peduncle, but not necessarily accompanied by change in chromosome number.

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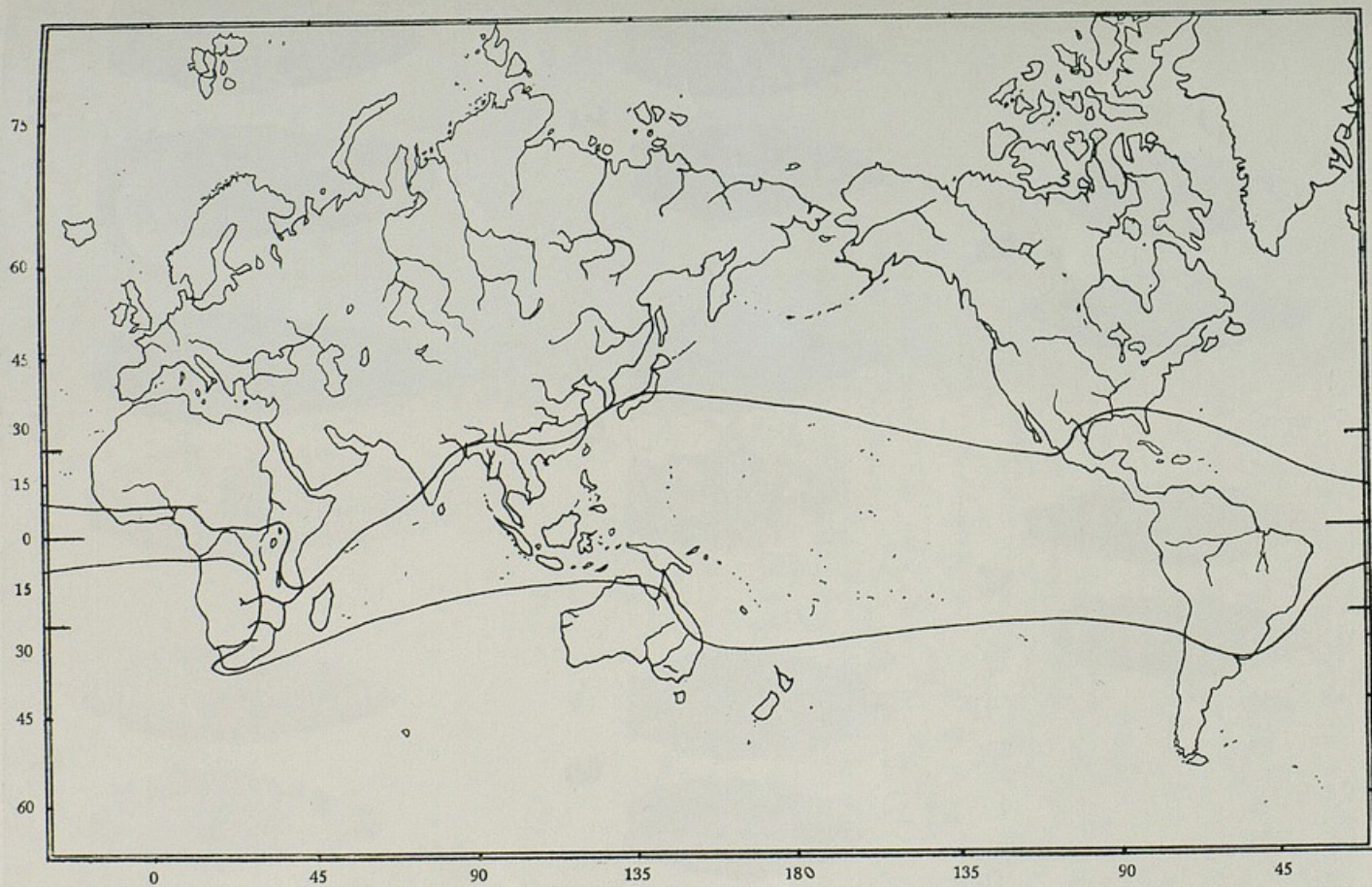
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PLATES

PLATE I

World distribution of the *Axonopus compressus* complex
of carpet grasses.



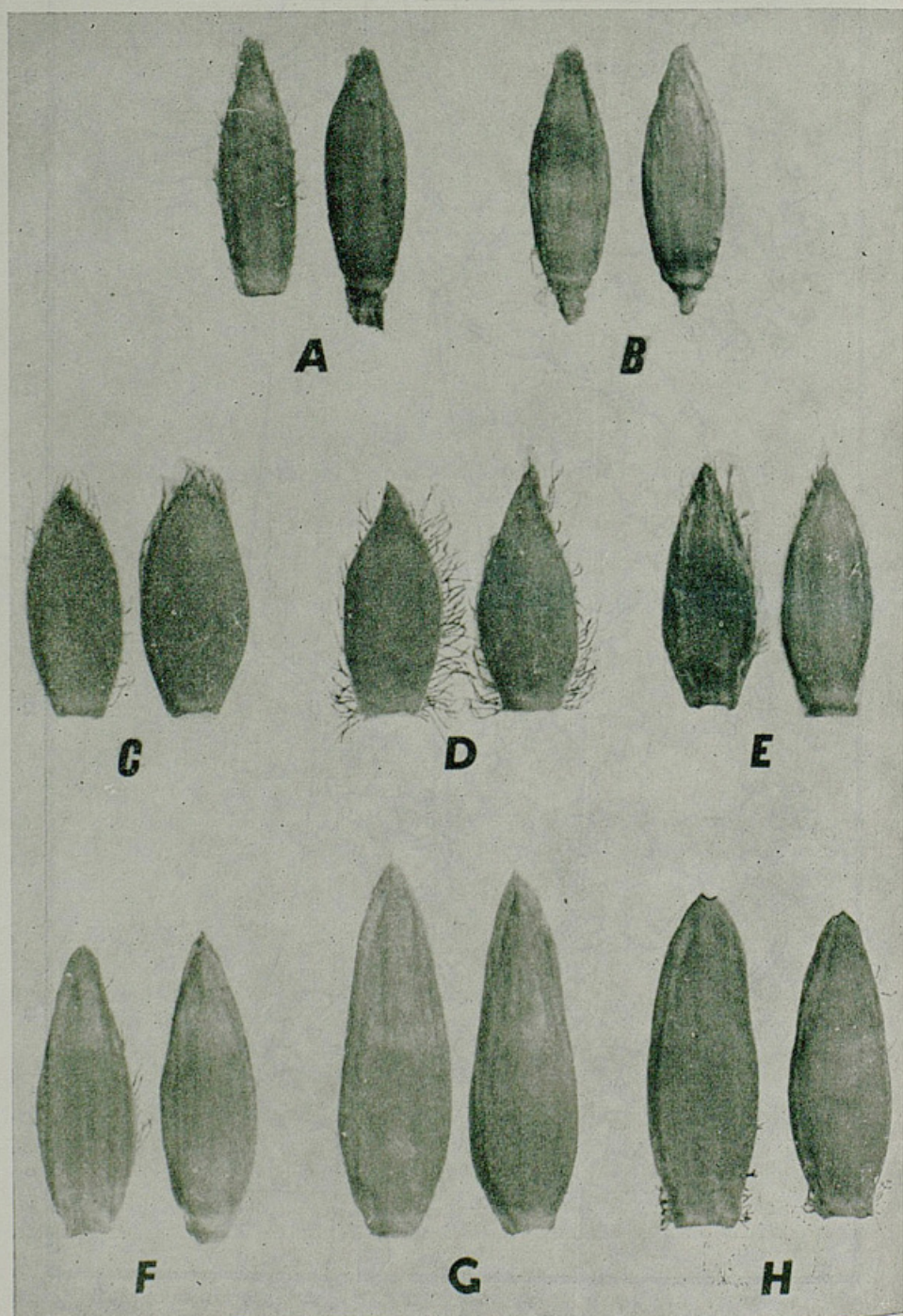


PLATE II

Spikelets of seven *Axonopus* taxa

- A. Jamaican *A. compressus* (Sw.) Beauv.
- B. West African *A. compressus* (Sw.) Beauv.
- C. *A. affinis* Chase
- D. *A. brevipedunculatus* D. Gledhill
- E. *A. brevipedunculatus* $\times$ *compressus* D. Gledhill
- F. *A. compressus* $\times$ *flexuosus* D. Gledhill
- G. *A. arenosus* D. Gledhill
- H. *A. flexuosus* (Peter) Hubbard ex Troupin

PLATE III

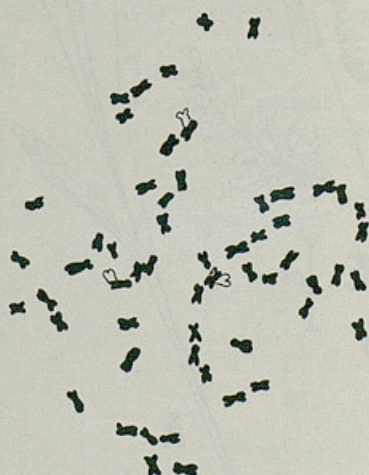
Root tip chromosomes, pretreated with α -monobromonaphthalene, of *A. compressus* (Sw.) Beauv. (a), *A. brevipedunculatus* D. Gledhill (b), *A. arenosus* D. Gledhill (c), *A. flexuosus* (Peter) Hubbard ex Troupin (d), *A. compressus* $\times$ *flexuosus* D. Gledhill (e) and *A. affinis* Chase (f).



a



b



c

15 μ



d



e



f

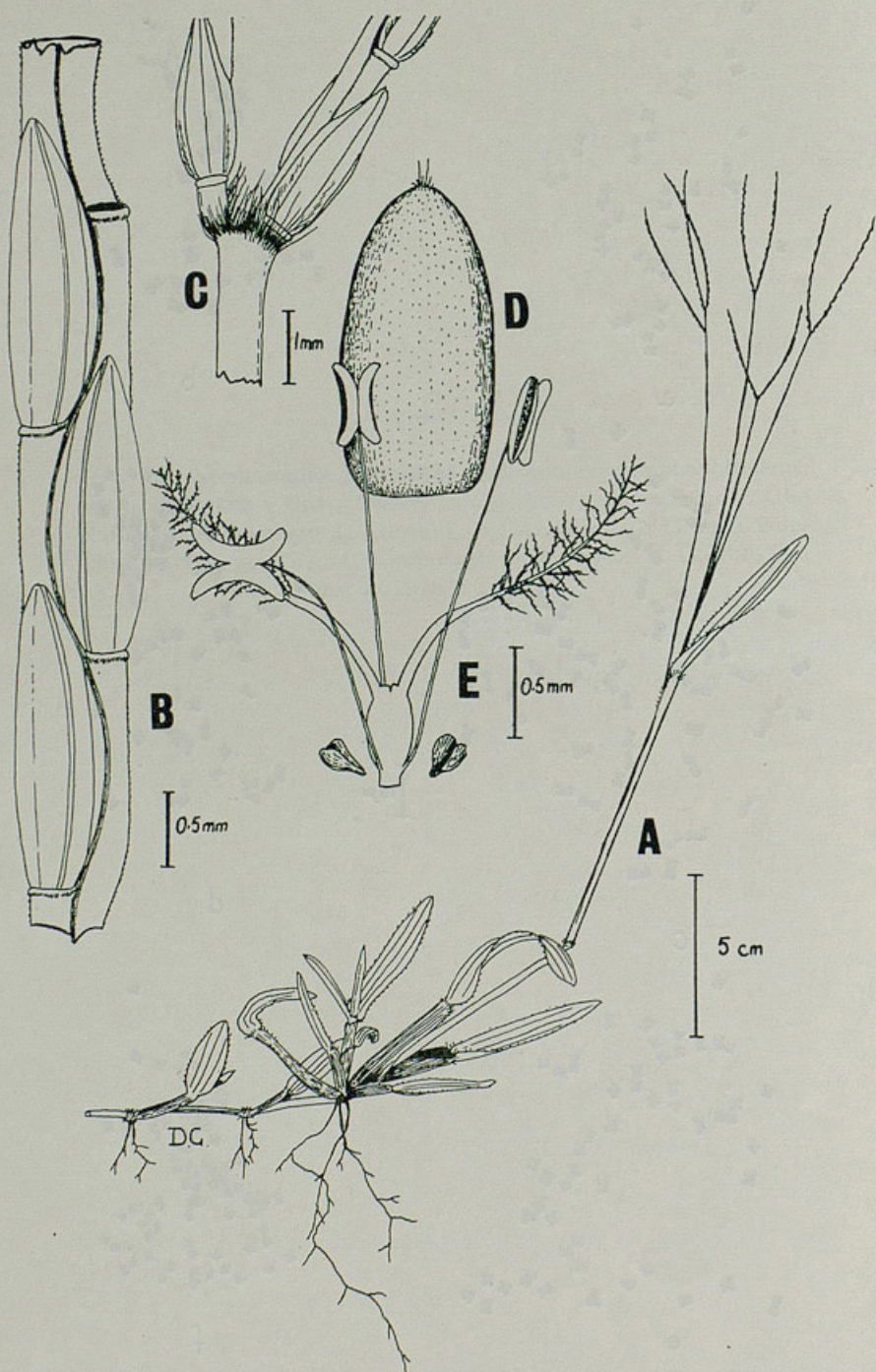


PLATE IV

West African *A. compressus* (Sw.) Beauv.

- A. Habit.
- B. Portion of raceme, abaxial aspect.
- C. Junction of two upper racemes with the rachis of the inflorescence.
- D. Fertile lemma.
- E. The lodicules and essential organs.

THE *PTERIDOPHYTA* OF GORONGOSA MOUNTAIN, SOUTHERN MOZAMBIQUE

by

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ABSTRACT

The *Pteridophyta* collected on an expedition to Gorongosa Mountain, comprising 70 species, are treated systematically with full synonymy. *Hymenophyllum polyanthos* var. *mossambicense* is described as new and two new combinations are proposed.

DURING the course of preliminary work on the *Pteridophyta* of Southern Africa it became clear from the few ferns that had been collected on Gorongosa Mountain that this massif should support a varied pteridophyte flora. This contention was supported by reports of «altimontane» forest on this isolated mountain which rises up to 5800 feet (1770 m.) from the southern Mozambique plain. Consequently an expedition to the eastern districts of Rhodesia was extended to include an ascent of this mountain during July 1955.

The mountain was approached from Vila Paiva d'Andrade and the first camp was established on the southern slopes at the Morambodzi Waterfall at an altitude of 2700 ft. (825 m.) in riverine forest. After porters were assembled, the ascent was begun and the lower limit of the forest proper reached at 4000 ft. (1220 m.). In the afternoon of the same day we emerged at about 5700 ft. (1740 m.) through a narrow belt of *Philippia* scrub on to the rim of the saucer-shaped summit plateau. This plateau was largely under grasslands with some open *Protea* savannah and occasional forest patches in sheltered depressions. A high camp was eventually pitched close to Gogogo Peak (5800 ft.; 1770 m.), the highest

point of the mountain. It is worth recording that the summit was periodically enveloped in mist during the expedition's stay although this was the dry season.

The expedition is greatly indebted to Snr. PEIXE, the Administrador de Circunscrição at Vila Paiva d'Andrade for his hospitality and help in obtaining porters. Thanks are also due to the South African Council for Scientific and Industrial Research and to the University of Cape Town for research grants which made the expedition possible.

LYCOPODIACEAE

Lycopodium verticillatum L. f., Suppl.: 448 (1781). Type from Réunion.

Urostachys verticillatus (L. f.) Hert. ex Nessel, Bär-lappgew.: 121 (1939).

Huperzia verticillata (L. f.) Rothm. in Fedde, Rep. Sp. Nov., 54: 60 (1944).

Lycopodium setaceum Lam., Encycl. Méth. Bot., 3: 653 (1789). Type from Mascarene Is.

Gorongosa Mtn., Gogogo Peak, locally common on shaded rocks in streambank forest, 5600 ft., 6.VII.1955, *Schelpe* 5528.

Lycopodium dacrydioides Bak., Fern Allies: 17 (1887). Type from South Africa.

Urostachys dacrydioides (Bak.) Hert. ex Nessel, Bär-lappgew.: 188 (1939).

Gogogo Peak, occasional low-level epiphyte in shade in forest, 5800 ft., 5.VII.1955, *Schelpe* 5517.

Lycopodium gnidioides L. f., Suppl.: 448 (1781). Type from Mauritius.

Plananthus gnidioides (L. f.) Beauv., Prodr. Aeth.: 110 (1805).

Urostachys gnidioides (L. f.) Hert. ex Nessel, Bär-lappgew.: 187 (1939).

Huperzia gnidioides (L. f.) Rothm. in Fedde, Rep. Sp. Nov., 54: 61 (1944).

Lycopodium funiculosum Lam., Encycl. Méth. Bot., 3: 649 (1789).

Lepidotis funiculosa (Lam.) Beauv., Prod. Aeth.: 108 (1805).

Lycopodium flagelliforme Schrad. in Gött. gel. Anz., 1818: 920 (1818). Type from South Africa.

Lycopodium ambiguum Schrad. in Gött. gel. Anz., 1818: 920 (1818). Type from South Africa.

Lycopodium pinifolium Kaulf., Enum. Fil.: 7 (1824) non Blume (1828).

Lycopodium strictum Bak. in Journ. of Bot., 1882: 271 (1882). Type from Madagascar.

Gogogo Peak, occasional on humus covered rocks in shade on forest margin, 5800 ft., 5.VII.1955, *Schelpé* 5515.

Lycopodium ophioglossoides Lam., Encycl. Méth. Bot., 3: 646 (1789). Type from Mauritius.

Urostachys ophioglossoides (Lam.) Hert. ex Nessel, Bärlappgew.: 238 (1939).

Huperzia ophioglossoides (Lam.) Rothm. in Fedde, Rep. Sp. Nov., 54: 62 (1944).

Lepidotis longifolia Beauv., Prodr. Aeth.: 109 (1805). Type from Mascarene Is.

Lycopodium longifolium (Beauv.) Sw., Syn. Fil.: 177 (1806).

Gogogo Peak, occasional low-level epiphyte and lithophyte on mossy rocks in shade in forest, 5800 ft., 5.VII.1955, *Schelpé* 5516. Gorongosa Mtn., S. sector, occasional on shaded rock faces at lower edge of Juniper forest, 5300 ft., 3.VII.1955, *Schelpé* 5490.

Lycopodium carolinianum L. var. *grandifolium* Spring in Mém. Acad. Belg., 24: 46 (1850). Type from South Africa.

Lycopodium sarcocaulon A. Br. & Welw. ex Kuhn, Fil. Afr.: 210 (1868). Syntype from Angola and South Africa.



Near Gogogo Peak, occasional in marshy grassland, 5600 ft., 6.VII.1955, *Schelpe* 5538.

SELAGINELLACEAE

Selaginella abyssinica Spring in Mém. Acad. Belg., 24: 99 (1850). Type from Ethiopia.

Selaginella kirkii Bak. in Journ. of Bot., 23: 176 (1885). Type from Usagura Mtns. (probably Uluguru Mtns., Tanzania).

Selaginella goetzei Hieron. in Bot. Jahrb., 30: 265 (1901). Type from Kinga Mtns. (i. e. Livingstone Mtns., Tanzania).

Selaginella whytei Hieron. in Engl. & Prantl, Nat. Pflanzenfam., 1 (4): 697 (1901). Type from Malawi.

Selaginella preussi Hieron. in Engl. & Prantl, Nat. Pflanzenfam., 1 (4): 686 (1901). Type from Cameroons.

Selaginella bueensis Hieron. in Hedwigia, 43: 20 (1904). Type from Nigeria.

Gorongosa Mtn., S. sector, Morambodzi Falls, locally frequent in shaded rock crevices around waterfall, 2700 ft., 2.VII.1955, *Schelpe* 5454.

Selaginella kraussiana (Kunze) A. Br., Ind. Sem. Hort. Berol., 1860, App.: 22 (1860).

Lycopodium kraussianum Kunze in Linnaea, 18: 114 (1844). Type from South Africa.

Gogogo Peak, common on forest floor, 5800 ft., 5.VII.1955, *Schelpe* 5500.

Selaginella mittenii Bak. in Journ. of Bot., 21: 81 (1883). Type from Tanganyika.

Selaginella welwitschii Bak. in Journ. of Bot., 21: 81 (1883). Type from Angola.

Selaginella mackenii Bak. in Journ. of Bot., 22: 89 (1884). Type from South Africa.



Selaginella cooperi Bak. in Journ. of Bot., 22: 89 (1884). Type from South Africa.

Selaginella tectissima Bak. in Journ. of Bot., 22: 89 (1884). Type from South Africa.

Gorongosa Mtn., S. Sector, Morambodzi Falls, locally frequent on moist shaded rock faces in streambank forest, 2900 ft., 3.VII.1955, *Schelte* 5477. Gogogo Peak, locally abundant in sheltered crevices on rock outcrop, 5800 ft., 5.VII.1955, *Schelte* 5502.

OSMUNDACEAE

Osmunda regalis L., Sp. Pl., 2: 1065 (1753). Type from Europe.

Struthiopteris regalis (L.) Bernh. in Schrad. Journ. 1800 (2): 126 (1801).

Osmunda capensis Presl, Suppl.: 63 (1845) non L. (1771). Type from South Africa.

Osmunda regalis L. var. *capensis* (Presl) Milde, Fil. Europ.: 63 (1867).

Osmunda obtusifolia Willd. ex Kaulf., Enum. Fil.: 43 (1824). Type from Mascarene Is.

Osmunda regalis L. var. *obtusifolia* (Willd. ex Kaulf.) Milde, Fil. Europ.: 63 (1867).

Gorongosa Mtn., S. sector, Morambodzi Falls, locally common on lightly shaded streambank above waterfall, 2900 ft., 2.VII.1955, *Schelte* 5467.

SCHIZAEACEAE

Lygodium kerstenii Kuhn, Fil. Deck.: 28 (1867). Syntypes from Madagascar and Kenya.

Lygodium subalatum Bojer ex Kuhn, Fil. Afr.: 170 (1868). Type from Comoro Is.

Lygodium brycei Bak. in Kew Bull., 1901: 138 (1901). Type from Rhodesia.

Gorongosa Mtn., S. sector, Morambodzi Falls, abundant climbing twiner in forest, 2700 ft., 2.VII.1955, *Schelpe* 5465.

Mohria caffrorum (L.) Desv. in Mém. Soc. Linn., Par., 6: 198 (1827).

Polypodium caffrorum L., Mantissa: 307 (1771).
Type from South Africa.

Adiantum caffrorum (L.) L. f., Suppl.: 447 (1887).

Lonchitis caffrorum (L.) Bernh. in Schrad. Journ., 1800 (2): 124 (1801).

Colina caffrorum (L.) E. L. Green in Erythea, 1: 247 (1893).

Osmunda marginalis Sav. in Lam., Encycl. Méth. Bot., 4: 655 (1797). Type from Mascarene Is.

Osmunda thurifera Sw. in Schrad. Journ., 1800 (2): 105 (1801). Type from South Africa.

Osmunda thurifraga Bory, Voyages, 1: 348 (1804).
Type from Mascarene Is.

Mohria thurifraga (Bory) Sw., Syn. Fil.: 159, 385, t. 5 (1806).

Mohria crenata Desv. in Mag. Ges. Naturf. Berl., 5: 307 (1811). Type from Mascarene Is.

Cheilanthes fuscata Bl., Enum. Pl. Jav.: 116 (1828).
Type erroneously cited as from Java, most probably from South Africa.

Mohria achilleifolia Lowe, New Ferns: t. 42B (1862).

Mohria vestita Bak. in Trans. Linn. Soc., Lond., Bot., 2: 355 (1887). Type from Kilimanjaro.

The material of this species from the eastern parts of Southern Africa, including that from Gorongosa Mountain, exhibits stouter and shorter rhizomes and less markedly crenate sterile segments than in the typical form from the south-western Cape Province.

Gorongosa Mtn., S. sector, Morambodzi Falls, locally frequent on the margin of streambank forest, 2900 ft., 3.VII.1955, *Schelpe* 5475. Gogogo Peak, locally frequent on forest margin, 5800 ft., 5.VII.1955, *Schelpe* 5527.

Mohria lepigera (Bak.) Bak. in Ann. of Bot., 5: 498 (1891).

Nothoclaena lepigera Bak. in Journ. of Bot., 1884: 53 (1884). Type from Malawi.

Gogogo Peak, frequent on cyperaceous mats on rock outcrop, 5800 ft., 4.VII.1955, *Schelpé* 5493.

HYMENOPHYLLACEAE

Trichomanes erosum Willd. var. **aerugineum** (v. d. Bosch) Bonap., Not. Pterid., 13: 165 (1929).

Trichomanes aerugineum v. d. Bosch in Ned. Kruid. Arch., 5: 3, 201 (1863). Type from Fernando Po.

Trichomanes palmicola v. d. Bosch ex Goddijn in Med. Rijksherb., 17: 32, fig. 19 (1913). Type from West Africa.

Trichomanes chamaedrys Taton in Bull. Soc. roy. Bot. Belg., 78: 29, t. 2, figs. K, L (1946). Type from Congo.

Gorongosa Mtn., S. W. sector, locally abundant on deeply shaded vertical rock faces in forest, 5300 ft., 7.VII.1955, *Schelpé* 5594.

Trichomanes pyxidiferum L. var. **melanotrichum** (Schlechtend.) Schelpé in Journ. S. Afr. Bot., 30: 181 (1964).

Trichomanes melanotrichum Schlechtend., Adumbr.: 56 (1825). Type from South Africa.

Vandenboschia melanotricha (Schlechtend.) Pic. Serm. in Webbia, 12: 127 (1955).

Trichomanes frappieri Cordem. in Bull. Soc. Sci. Art. Réunion, 1890-91: 37 (1891). Type from Réunion.

Gorongosa Mtn., S. sector, Morambodzi Falls, locally frequent on shaded rocks near waterfall, 2700 ft., 2.VII.1955, *Schelpé* 5456. Gogogo Peak, occasional low-level epiphyte in deep shade in forest, 5800 ft., 4.VII.1955, *Schelpé* 5496.

Trichomanes borbonicum v. d. Bosch in Ned. Kruid. Arch., 7: 158 (1861). Type from Réunion.

Trichomanes goetzei Hieron. in Bot. Jahrb., 28: 339 (1900). Type from Tanzania.

Near Gogogo Peak, occasional on shaded boulder in forest, 5600 ft., 6.VII.1955, *Schelpe* 5540a.

Hymenophyllum capense Schrad. in Gött. gel. Anz., 1818: 919 (1818). Type from South Africa.

Hymenophyllum natalense v. d. Bosch in Ned. Kruid. Arch., 4: 386 (1859). Type from South Africa.

Hymenophyllum zeyheri v. d. Bosch in Ned. Kruid. Arch., 4: 388 (1859). Type from South Africa.

Hymenophyllum tabulare v. d. Bosch in Ned. Kruid. Arch., 4: 397 (1859). Type from South Africa.

Hymenophyllum parvum C. Chr. in Perrier, Cat. Pl. Madag., Ptérid.: 18 et in Dansk Bot. Ark., 7: 8, t. 2, figs. 1-3 (1932). Type from Madagascar.

This plant has previously been referred incorrectly to *H. fumarioides* Willd.

Gogogo Peak, locally abundant on sheltered rock faces, 5800 ft., 4.VII.1955, *Schelpe* 5495.

Hymenophyllum polyanthos Sw. var. *kuhnii* (C. Chr.) *Schelpe* comb. nov. et stat. nov.

Hymenophyllum kuhnii C. Chr., Ind. Fil.: 363 (1905)-basionym. Type from Kilimanjaro.

Mecodium kuhnii (C. Chr.) Copel. in Philipp. Journ. Sci., 67: 19 (1938).

Hymenophyllum meyeri Kuhn in Phys. Abh. Koning. Acad. Berl., 2: 94, et in Engl., Hochgebirgsfl. trop. Afr.: 95 (1892) non Presl (1843). Type from Kilimanjaro.

Hymenophyllum henkelii Sim in S. Afr. Journ. Sci., 20: 309, t. 9 (1923). Type from Rhodesia.

Two segregates of the *H. polyanthos* complex can be distinguished in Southern Africa, but it has not been possible

to distinguish these African segregates clearly from other segregates of this complex elsewhere in the world.

Gorongosa Mtn., S. sector, locally frequent low to mid-level epiphyte in forest, 4500 ft., 3.VII.1955, *Schelte* 5488. Gogogo Peak, locally frequent mid-level epiphyte in forest, 5800 ft., 5.VII.1955, *Schelte* 5501. Near Gogogo Peak, locally abundant low to mid-level epiphyte in forest, 5600 ft., 6.VII.1955, *Schelte* 5541.

Hymenophyllum polyanthos Sw. var. **mossambicense** Schelte var. nov.

Differt a varietate typico frondibus angustis ellipticis vel lanceolatis, non triangularis, segmentis ultimis longioribus.

Rhizome filiform, bearing fronds 1-4 cm. apart. Stipe filiform 1-2.5 cm. long, narrowly winged in the upper half. Lamina narrowly elliptic to lanceolate with the basal pinnae usually reduced, up to 9 cm. long and 2.5 cm. broad. Rachis narrowly winged. Pinnae remote, rarely overlapping, up to 1.3 cm. long and 0.8 cm. broad, pinnatifid to bipinnatifid into up to ten linear entire rounded lobes, each up to 6 mm. long and c. 1 mm. broad. Sori borne on the acroscopic basal segments of the pinnae, very broadly obconic with ovate-acute entire indusial valves 1.5-1.8 mm. broad.

VARIETAL TYPE: Mozambique, Gorongosa Mtn., locally frequent on shaded boulder in streambank forest, 5600 ft., 6.VII.1955, *Schelte* 5540 (holotype in BOL; isotype in BM).

This variety is easily distinguishable from the var. *kuhnii* by its smaller fronds and more open frond pattern.

Hymenophyllum tunbridgense (L.) Sm. in Sowerby, Engl. Bot.: t. 162 (1794).

Trichomanes tunbridgense L., Sp Pl. 2: 1098 (1753). Syntypes from England and Italy.

Hymenophyllum dregeanum Presl, Hymenoph.: 32, 52 (1843). Type from South Africa.

Hymenophyllum thomassetii C. H. Wright in Kew Bull., 1906: 170 (1906). Type from Malawi.

Gogogo Peak, locally common on very sheltered rock face on outcrop, 5800 ft., 4.VII.1955, *Schelpe* 5494.

CYATHEACEAE

Cyathea dregei Kunze in Linnaea, 10: 551 (1836). Type from South Africa.

Cyathea burkei Hook., Sp. Fil., 1: 23, t. 17, fig. b (1844). Type from Transvaal, South Africa.

Cyathea angolensis Welw. ex Hook., Syn. Fil.: 22 (1865). Type from Angola.

Gorongosa Mtn., S. sector, above Morambodzi Falls, occasional in open forest near waterfall, 2900 ft., 2.VII.1955, *Schelpe* 5468. Near Gogogo Peak, occasional on forest margin and along stream, 5700 ft., 6.VII.1955, *Schelpe* 5537. Near Gogogo Peak, occasional among boulders in open grassland, 5800 ft., 6.VII.1955, *Schelpe* 5545.

DENNSTAEDTIACEAE

Hypolepis sparsisora (Schrad.) Kuhn, Fil. Afr.: 120 (1868).

Cheilanthes sparsisora Schrad. in Gött. gel. Anz., 1818: 918 (1818). Type from South Africa.

Phegopteris sparsisora (Schrad.) Keys., Pol. Cyath. Hb. Bung.: 51 (1873).

Cheilanthes anthriscifolia Schlechtend., Adumbr.: 52, t. 32 (1832) ined. non Willd. (1810).

Hypolepis anthriscifolia Presl, Tent. Pterid.: 162 (1836) nom. nud.

Cheilanthes aspera Kaulf. in Linnaea, 6: 186 (1831). Type from South Africa.

Hypolepis aspera (Kaulf.) Presl, Tent. Pterid.: 162 (1836).

Cheilanthes commutata Kunze in Linnaea, 10: 542 (1836) nom. illegit.

Gorongosa Mtn., S. W. sector, locally abundant, forming thickets in a forest glade, 4000 ft., 7.VII.1955, *Schelpe* 5596.

Pteridium aquilinum (L.) Kuhn in v. Deck., Reisen, 3 (3)
Bot.: 11 (1879).

Pteris lanuginosa Bory ex Willd. in L., Sp. Pl.,
ed. IV, 5: 403 (1810). Type from Réunion.

Allosorus lanuginosus (Bory ex Willd.) Presl, Tent.
Pterid.: 154 (1836).

Pteris capensis Thunb., Prodr. Pl. Cap.: 172 (1800).
Type from South Africa.

Allosorus capensis (Thunb.) Pappe & Raws., Syn.
Fil. Afr. Austr.: 32 (1858) non Presl (1836).

Pteridium capense (Thunb.) Krasser in Ann. Hof-
mus. Wien, 15: 6 (1900).

Gogogo Peak, locally common on forest margins, 5800 ft.,
5.VII.1955, *Schelpé* 5507.

Blotiella glabra (Bory) Tryon in Contrib. Gray Herb.,
191: 99 (1962).

Lonchitis glabra Bory, Voyages, 1: 321 (1804). Type
from Réunion.

Pteris glabra (Bory) Mett., Fil. Hort. Bot. Lips.: 59
(1856).

Lonchitis stenochlamys Fée, Mém. Fam. Foug., 5:
142 (1852). Type from South Africa.

Gogogo Peak, occasional in shade on forest floor, 5800
ft., 5.VII.1955, *Schelpé* 5505.

VITTARIACEAE

Vittaria isoetifolia Bory, Voyages, 2: 325 (1804). Type
from Réunion.

Oetosis isoetifolia (Bory) Greene in Pittonia, 4: 103
(1900).

Vittaria gueinzii Trev. in Atti Ist. Veneto, II, 2:
167 (1851). Type from South Africa.

Vittaria coccygocarpa Trev. in Atti Ist. Veneto, II,
2: 167 (1851) nom. nud. Type from South Africa.

Vittaria sarmentosa Ruiz ex Fée, Mém. Fam. Foug., 3: 17 (1852). Syntypes from South Africa.

Vittaria tenera Fée, Mém. Fam. Foug., 3: 17 (1852). Type from South Africa.

Vittaria longidentata K. Müll. in Bot. Zeit., 1854: 546 (1854). Type from South Africa.

Pteropsis angustifolia Pappe & Raws., Syn. Fil. Afr. Austr.: 43 (1857) non Desv. (1827). Type from South Africa.

Gogogo Peak, occasional epiphyte in *Philippia* scrub, 5800 ft., 5.VII.1955, *Schelpe* 5525.

Vittaria volkensii Hieron. in Bot. Jahrb., 53: 428 (1915). Type from Tanzania.

Gorongosa Mtn., S. sector, occasional mid to high level epiphyte in forest, 4500 ft., 3.VII.1955, *Schelpe* 5485. Gogogo Peak, occasional mid-level epiphyte in streambank forest, 5600 ft., 6.VII.1955, *Schelpe* 5531. Gorongosa Mtn., S. W. sector, occasional mid-level epiphyte in forest, 4300 ft., 7.VII.1955, *Schelpe* 5589.

ADIANTACEAE

Pteris catoptera Kunze in Linnaea, 18: 119 (1844). Type from South Africa.

Gorongosa Mtn., S. sector, Morambodzi Falls, frequent in forest undergrowth, 2700 ft., 2.VII.1955, *Schelpe* 5459. Gorongosa Mtn., S. W. sector, occasional in Acanthaceous undergrowth on forest floor, 4900 ft., 7.VII.1955, *Schelpe* 5585. Gorongosa Mtn., S. W. sector, occasional on forest floor in *Dracaena*-Acanthaceous undergrowth, 4100 ft., 7.VII.1955, *Schelpe* 5587. Gorongosa Mtn., S. W. sector, occasional among *Hypolepis* thickets in open glade in forest, 4000 ft., 7.VII.1955, *Schelpe* 5591.

Notholaena buchanani Bak., Syn. Fil.: 373 (1868). Type from South Africa.

Near Gogogo Peak, occasional around seasonally moist boulder bases on exposed sandstone outcrop, 5600 ft., 6.VII.1955, *Schelte* 5542.

Cheilanthes bergiana Schlechtend., Adumbr.: 51 (1832). Type from South Africa.

Cheilanthes elata Kunze in Linnaea, 10: 542 (1836). Type from South Africa.

Cheilanthes streetiae Bak. in Journ. of Bot., 1880: 327 (1880). Type from Madagascar.

Gorongosa Mtn., S. sector, Morambodzi Falls, occasional on earthbank in shade in forest, 2700 ft., 2.VII.1955, *Schelte* 5464.

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 refracta Pappe & Raws., Syn. Fil. Afr. Austr.: 34 (1858). Type from South Africa.

Cheilanthes madagascariensis Bak. in Journ. Linn. Soc., Lond., 16: 198 (1877). Type from Madagascar.

Adiantopsis madagascariensis (Bak.) C. Chr., Ind. Fil.: 22 (1905).

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

Cheilanthes horizontalipinnata Bonap., Not. Pterid., 16: 87 (1925). Type from Madagascar.

Gogogo Peak, occasional among boulders on margin of *Philippia* scrub, 5800 ft., 5.VII.1955, *Schelte* 5521.

Pellaea quadripinnata (Forsk.) Prantl in Bot. Jahrb., 3: 420 (1882).

Pteris quadripinnata Forsk., Fl. Aegypt. Arab.: 186 (1775). Type from Yemen.

Allosorus quadripinnatus (Forsk.) Presl, Tent. Pterid.: 154 (1836).

Cheilanthes quadripinnata (Forsk.) Kuhn, Fil. Afr.: 74 (1868).

Pteridella quadripinnata (Forsk.) Mett. ex Kuhn in v. Deck., Reisen, 3 (3), Bot.: 16 (1879).

Pteris consobrina Kunze in Linnaea, 10: 526 (1836). Syntypes from South Africa.

Pellaea consobrina (Kunze) Hook., Sp. Fil., 2: 145 (1858).

Allosorus consobrinus (Kunze) Pappe & Raws., Syn. Fil. Afr. Austr.: 31 (1858).

Cheilanthes triangula Kunze in Linnaea, 10: 536 (1836). Syntypes from South Africa.

Cheilanthes atherstonei Hook., Sp. Fil., 2: 107 (1852). Type from South Africa.

Cheilanthes firma Moore in Hook. Journ. of Bot., 5: 225 (1853). Type from South Africa.

Cheilanthes linearis Moore in Hook. Journ. of Bot., 5: 226 (1853). Type from South Africa.

Gorongosa Mtn., S. sector, Morambodzi Falls, occasional on forest margin, 2700 ft., 2.VII.1955, *Schelpe* 5453. Gogogo Peak, occasional on forest margin, 5800 ft., 5.VII.1955, *Schelpe* 5520. Near Gogogo Peak, occasional around boulder bases on sandstone outcrop, 5600 ft., 6.VII.1955, *Schelpe* 5532.

GRAMMITIDACEAE

Grammitis molleri (Bak. ex Henriq.) Schelpe comb. nov.

Polypodium molleri Bak. ex Henriq. in Bol. Soc. Brot., 4: 154, t. 2, fig. B (1887) — basionym. Type from São Tomé.

Gogogo Peak, occasional mid-level epiphyte among mosses in forest, 5800 ft., 6.VII.1955, *Schelpe* 5536.

POLYPODIACEAE

Pyrrosia rhodesiana (C. Chr.) Schelpe in Journ. S. Afr. Bot., 18: 126 (1952).

Cyclophorus rhodesianus C. Chr. in Dansk. Bot. Ark., 7: 161 (1932). Type from Rhodesia.

Gorongosa Mtn., S. sector, Morambodzi Falls, occasional lithophyte in streambank forest, 2700 ft., 2.VII.1955, *Schelpe* 5452. Above Morambodzi Falls, occasional mid-level epiphyte and lithophyte in streambank forest, 2900 ft., 3.VII.1955, *Schelpe* 5473. Gorongosa Mtn., S. W. sector, rare mid-level epiphyte in forest, 4300 ft., 7.VII.1955, *Schelpe* 5588.

Belvisia spicata (L. f.) Mirbel, Hist. Nat. de Pl., 4: 65 (1803).

Acrostichum spicatum L. f., Suppl.: 444 (1781). Type from Mauritius.

Hymenolepis spicata (L. f.) Presl, Epim. Bot.: 159 (1849).

Gorongosa Mtn., S. sector, Morambodzi Falls, locally frequent low-level epiphyte and occasional lithophyte in streambank forest near waterfall, 2700 ft., 2.VII.1955, *Schelpe* 5469.

Loxogramme lanceolata (Sw.) Presl, Tent. Pterid.: 215 (1836).

Grammitis lanceolata Sw. in Schrad. Journ., 1800 (2): 18 (1801). Type from Mascarene Is.

Antrophyum lanceolatum (Sw.) Blume, Fl. Jav. Fil.: 84 (1826).

Selliguea lanceolata (Sw.) Fée, Mém. Fam. Foug. 5: 177 (1852).

Gymnogramma lanceolata (Sw.) Hook., Sp. Fil., 5: 156 (1864).

Grammitis coriacea Kaulf. ex Spreng. in L., Syst. Veg., ed. XVI, 4: 41 (1827). Type from Mascarene Is.

Selliguea coriacea (Kaulf. ex Spreng.) Fée, Mém. Fam. Foug., 5: 177 (1852).

Polypodium coriaceum (Kaulf. ex Spreng.) Mett., Polypod.: 112 (1857).

Polypodium loxogramme Mett., Farngattungen, Polypod.: 112 (1857). Type from Mascarene Is.

Gymnogramma abyssinica Bak., Syn. Fil.: 517 (1874). Type from Ethiopia.

Loxogramme suberosa Christ in Ann. Mus. Congo, sér. 5, 3: 37 (1909). Type from Congo.

Polypodium suberosum (Christ) C. Chr., Ind. Fil., Suppl.: 62 (1913).

Loxogramme africana Copel. in Philipp. Journ. Sci., 11: 45 (1916). Type from Angola.

Gorongosa Mtn., S. sector, Morambodzi Falls, locally frequent on streamside boulder in shade in forest, 2700 ft., 2.VII.1955, *Schelpe* 5451. Gogogo Peak, frequent low-level epiphyte in forest, 5800 ft., 5.VII.1955, *Schelpe* 5513.

Polypodium polypodioides (L.) Hitch. subsp. *ecklonii* (Kunze) Schelpe in Journ. S. Afr. Bot., 30: 189 (1964).

Polypodium ecklonii Kunze in Linnaea, 10: 498 (1836). Type from South Africa.

Gorongosa Mtn., S. sector, Morambodzi Falls, occasional mid-level epiphyte in streambank forest, 2900 ft., 3.VII.1955, *Schelpe* 5470.

Pleopeltis macrocarpa (Bory ex Willd.) Kaulf., Enum. Fil.: 240 (1824).

Polypodium macrocarpum Bory ex Willd. in L., Sp. Pl., ed. IV, 5: 127 (1810). Type from Mascarene Is.

Drynaria macrocarpa (Bory ex Willd.) Fée, Mém. Fam. Foug., 5: 270 (1852).

Polypodium lanceolatum L., Sp. Pl., 2: 1082 (1753). Type from San Domingo.

Polypodium marginale Bory ex Willd. in L., Sp. Pl., ed. IV, 5: 149 (1810). Type from Mascarene Is.

Pleopeltis marginalis (Bory ex Willd.) Kaulf., Enum. Fil.: 246 (1824).

Polypodium adpersum Schrad. in Gött. gel. Anz., 1818: 915 (1818). Type from South Africa.

Pleopeltis ensifolia Carm. ex Hook., Exot. Fl., 1: t. 62 (1823). Type from South Africa.

Pleopeltis lanceolata Kaulf., Enum. Fil.: 245 (1824). Type from South Africa.

Polypodium lepidotum Willd. ex Schlechtend., Adumbr.: 17, t. 8 (1825). Type from South Africa.

Pleopeltis lepidota (Willd. ex Schlechtend.) Presl, Tent. Pterid.: 193 (1836).

Drynaria lepidota (Willd. ex Schlechtend.) Fée, Mém. Fam. Foug., 5: 270 (1852).

Pleopeltis kaulfussiana Presl, Tent. Pterid.: 193 (1836). nom. illegit.

Gorongosa Mtn., S. sector, occasional mid-level epiphyte in streambank forest, 3000 ft., 3.VII.1955, *Schelte* 5483. Gogogo Peak, occasional mid-level epiphyte in forest and *Philippia* scrub, 5800 ft., 5.VII.1955, *Schelte* 5526.

Pleopeltis schraderi (Mett.) Tardieu, Fl. Madag., Polypod., 2: 110 (1960).

Polypodium schraderi Mett., Farngattungen, Polypod.: 98, n. 179 (1857). Type from South Africa.

Niphobolus schraderi (Mett.) Keys, Pol. Cyath. Hb. Bung.: 39 (1873).

Polypodium lineare Thunb. var. *schraderi* (Mett.) Sim, Ferns S. Afr., ed. II: 276 (1915).

Polypodium elongatum Schrad. in Gött. gel. Anz., 1818: 915 (1818) non Aiton (1789). Type from South Africa.

Phymatodes elongata (Schrad.) Pappe & Raws., Syn. Fil. Afr. Austr.: 41 (1858).

Polypodium gueintzii Mett., Farngattungen, Polypod.: 91, no. 161 (1857). Type from South Africa.

Gorongosa Mtn., above Morambodzi Falls, occasional mid-level epiphyte in streambank forest, 2900 ft., 3.VII.1955, *Schelte* 5472.

Pleopeltis excavata (Bory ex Willd.) Sledge in Bull. Brit. Mus. Nat. Hist., 2: 138 (1960).

Polypodium excavatum Bory ex Willd. in L., Sp. Pl., ed. IV, 5: 158 (1810). Type from Mascarene Is.

Phymatodes excavata (Bory ex Willd.) Presl, Tent. Pterid.: 196 (1836).

Drynaria excavata (Bory ex Willd.) Fée, Mém. Fam. Foug., 5: 270 (1852).

Polypodium simplex Sw. in Schrad. Journ., 1800 (2): 19 (1801) non Burm. (1768). Type from Mascarene Is.

Phymatodes simplex (Sw.) Presl, Tent. Pterid.: 196 (1836).

Pleopeltis simplex (Sw.) Beddome, Handb. Ferns Brit. India: 347 (1883).

Gogogo Peak, abundant low to mid-level epiphyte and lithophyte in forest, 5800 ft., 5.VII.1955, *Schelpe* 5508.

DAVALLIACEAE

Arthropteris monocarpa (Cordem.) C. Chr. in Perrier, Cat. Pl. Madag., Pterid.: 32 (1931).

Nephrodium monocarpum Cordem. in Bull. Soc. Sci. Art. Réunion, 1890-91: 74 (1891). Type from Réunion.

Gorongosa Mtn., S. sector, Morambodzi Falls, locally frequent in shaded rock crevices near waterfall, 2700 ft., 2.VII.1955, *Schelpe* 5455. Gogogo Peak, frequent low to mid level epiphyte, and lithophyte on shaded mossy boulders, in forest, 5800 ft., 5.VII.1955.

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 thoningii Schumach. in Kongl. Dansk Vid. Selsk., Nat. & Math. Afh., 4: 229 (1829). Type from West Africa.

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

Gorongosa Mtn., S. sector, Morambodzi Falls, locally common epiphyte on fallen log in forest, 2700 ft., 2.VII.1955, *Schelpé* 5466.

Oleandra distenta Kunze in Bot. Zeit., 1851: 347 (1851). Type from South Africa.

Oleandra densifrons Kunze in Bot. Zeit., 1851: 347 (1851). Type from South Africa.

Aspidium articulatum Willd. in L., Sp. Pl., ed. IV, 5: 212 (1810) non Sw. (1801). Type from Mauritius.

Oleandra africana Bonap., Not. Pterid., 14: 257 (1923). Type from Mauritius.

Gorongosa Mtn., S. sector, high level epiphyte in forest, 4500 ft., 4.VII.1955, *Schelpé* 5491.

ASPLENIACEAE

Asplenium gemmiferum Schrad. in Gött. gel. Anz., 1818: 916 (1818). Type from South Africa.

Asplenium macrolobium A. Peter in Fedde, Rep. Sp. Nov., Beih. 40: 77, descr. 6 (1929). Type from Tanzania.

Gorongosa Mtn., S. W. sector, rare on humus covered boulder in forest, 4400 ft., 7.VII.1955, *Schelpé* 5590.

Asplenium anisophyllum Kunze in Linnaea, 10: 511 (1836). Type from South Africa.

Asplenium geppii Carr., Cat. Welw. Pl., 2: 269 (1901). Type from Angola.

Gogogo Peak, occasional in deep shade on forest floor, 5800 ft., 5.VII.1955, *Schelpe* 5503. Gorongosa Mtn., S. W. sector, occasional low level epiphyte or lithophyte in forest, 5000 ft., 7.VII.1955, *Schelpe* 5584.

Asplenium christii Hieron. in Engl., Pflanzenw. Ost.-Afr., C: 82 (1895). Type from Tanzania.

Asplenium amaurophyllum A. Peter in Fedde, Rep. Sp. Nov., Beih. 40: 73, descr. 5 (1929).

Gorongosa Mtn., S. W. sector, locally frequent on forest floor, 4000 ft., 7.VII.1955, *Schelpe* 5593.

A putative hybrid between *A. christii* and *A. anisophyllum* (*Schelpe* 5593a), intermediate in characters between these two species, was found in this population.

Asplenium inaequilaterale Willd. in L., Sp. Pl., ed. IV, 5: 322 (1810). Type from Réunion.

Asplenium brachyotus Kunze in Linnaea, 10: 512 (1836). Type from South Africa.

Asplenium suppositum Hieron. in Bot. Jahrb., 46: 353 (1911). Type from Angola.

Gorongosa Mtn., S. W. sector, rare, on forest floor among undergrowth, 4100 ft., 7.VII.1955, *Schelpe* 5595.

Asplenium lobatum Pappe & Rawson, Syn. Fil. Austr. Afr.: 22 (1858). Type from South Africa.

Asplenium gracile Pappe & Rawson, Syn. Fil. Austr. Afr.: 22 (1858) non Don (1825). Type from South Africa.

Asplenium pappei Moore, Ind.: 152 (1859). Type from South Africa.

Asplenium lunulatum Sw. var. *gracile* (Pappe & Rawson) Sim, Ferns S. Afr., ed. I: 139 (1892).

Gogogo Peak, occasional on forest floor, 5800 ft., 5.VII.1955, *Schelpe* 5499. Gorongosa Mtn., S. W. sector, occasional on forest floor, 4000 ft., *Schelpe* 5597.

These specimens from Gorongosa are of the tripinnatifid form of this variable species.

Asplenium quintasii Gandoger in Bull. Soc. Bot. Fr., 66: 305 (1919). Type from São Tomé.

Asplenium sphenolobium Zenker ex Kunze var. *usambarense* Hieron. in Wiss. Ergeb. Deutsche Zentral-Afr. Exped., 2, Bot.: 14 (1911). Varietal type from Ruwenzori, Uganda.

Asplenium usambarense (Hieron.) Hieron. in Hedwigia, 60: 227 (1918) nom. invalidum.

Gorongosa Mtn., S. W. sector, occasional to locally frequent in forest undergrowth, 4800 ft., 7.VII.1955, *Schelppe* 5586.

Asplenium protensum Schrad. in Gött. gel. Anz., 1818: 916 (1818). Type from South Africa.

Gogogo Peak, locally frequent on boulders in deep shade in forest, 5800 ft., 5.VII.1955, *Schelppe* 5504.

Asplenium friesiorum C. Chr. in Notizbl. Bot. Gart. Berlin, 9: 181 (1924). Type from Kenya.

Tarachia friesiorum (C. Chr.) Momose in Journ. Jap. Bot., 35: 321, figs. 33, 34 (1960).

Asplenium serra Langsd. & Fisch. var. *natalensis* Bak., Syn. Fil., ed. II: 485 (1883).

Asplenium pseudoserra Domin in Preslia, 8: 6 (1929). Type from Tanzania.

Asplenium monilisorum Domin in Preslia, 8: 7 (1929). Type from South Africa.

Gogogo Peak, frequent on forest floor, 5800 ft., 5.VII.1955, *Schelppe* 5510.

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

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

Asplenium adiantoides Lam., Encycl. Méth. Bot., 2: 309 (1786). Type from South Africa.

Asplenium furcatum Thunb., Prodr. Pl. Cap.: 172 (1800). Type from South Africa.

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

Asplenium falsum Retz., Obs. Bot., 6: 38 (1791). Type from South Africa.

Asplenium gueinzianum Mett. ex Kuhn, Fil. Afr.: 103 (1868). Type from South Africa.

Gogogo Peak, locally frequent lithophyte on boulders and low-level epiphyte in shade in forest, 5800 ft., 5.VII.1955, *Schelpe* 5514. Gogogo Peak, locally common in *Widdringtonia-Philippia* scrub, 5800 ft., 6.VII.1955, *Schelpe* 5535.

Asplenium sandersonii Hook., Sp. Fil., 3: 147, t. 179 (1860). Type from South Africa.

Asplenium vagans Bak., Syn. Fil.: 195 (1867). Syntypes from São Tomé and Madagascar.

Asplenium debile Mett. ex Kuhn, Fil. Afr.: 101 (1868) non Fée (1865). Type from Comoro Is.

Asplenium melleri Mett. ex Kuhn, Fil. Afr.: 106 (1868). Type from Madagascar.

Asplenium punctatum Mett. ex Kuhn, Fil. Afr.: 114 (1868). Type from São Tomé.

Asplenium hanningtonii Bak. in Journ. of Bot., 1883: 245 (1883). Type from Tanzania.

Asplenium comorense C. Chr., Ind. Fil.: 103 (1906). Type from Comoro Is.

Gogogo Peak, frequent low-level epiphyte in forest, 5800 ft., 5.VII.1955, *Schelpe* 5509.

Asplenium mannii Hook., Second Cent. Ferns: t. 60 (1861). Type from Fernando Po.

Gogogo Peak, locally abundant low-level epiphyte in forest, 5800 ft., 4.VII.1955, *Schelpe* 5497. Gorongosa Mtn., S. W. sector, frequent low-level epiphyte in forest, 5500 ft., 7.VII.1955, *Schelpe* 5581.

Asplenium dregeanum Kunze in Linnaea, 10: 517 (1836).
Type from South Africa.

Asplenium brachypterum Kunze ex Houlst. & Moore
in Gard. Mag. Bot., 3: 260 (1851). Type from Sierra
Leone.

Asplenium gracile A. Peter in Fedde, Rep. Sp. Nov.,
Beih., 40: 73, t. 5, fig. 2 (1929) non Don (1825) nec Fée
(1852) nec Pappe & Rawson (1858). Type from Tanzania.

Gorongosa Mtn., S. W. sector, locally abundant lithophyte
on boulders in forest in shade, 5000 ft., 7.VII.1955, *Schelte*
pe 5583.

Asplenium preussii Hieron. in Wiss. Ergeb. Deutsche Zen-
tral-Afr. Exped., 2, Bot.: 9, t. 1, fig. D (1910). Syntypes
from Cameroons and Fernando Po.

Gorongosa Mtn., S. W. sector, locally frequent on deeply
shaded boulders in forest, 4100 ft., 7.VII.1955, *Schelte*
pe 5592.

Asplenium rutaefolium (Berg.) Kunze var. **bipinnatum**
(Forsk.) Schelpe in Journ. S. Afr. Bot., 30: 194 (1964).

Lonchitis bipinnata Forsk., Fl. Aegypt. Arab.: 184
(1775). Type from Yemen.

Asplenium bipinnatum (Forsk.) C. Chr. in Hieron.,
Wiss. Ergeb. Deutsche Zentral-Afr. Exped., 2, Bot.: 11
(1910) non Roxb. (1844).

Caenopteris furcata Berg. in Acta Petropol., 1782
(2): 249, t. 7, fig. 1 (1789). Type from Réunion.

Darea furcata (Berg.) Willd. in L., Sp. Pl., ed. IV,
5: 297 (1810).

Adiantum borbonicum Jacq., Coll., 3: 286, t. 21,
fig. 1 (189). Type from Réunion.

Asplenium borbonicum (Jacq.) Hook., Sp. Fil., 3:
207 (1860).

Darea disticha Kaulf., Enum. Fil.: 180 (1824). nom.
illegit. Type from Yemen.

Caenopteris disticha (Kaulf.) Spreng. in L., Syst.
Veg., ed. XVI, 4: 91 (1827).

Asplenium distichum (Kaulf.) Mett. ex Salomon, Nomenclator: 84 (1883).

Darea stans Bory in Belanger, Voy. Bot., 2: 53 (1833). Type from Mascarene Is.

Asplenium stans (Bory) Kunze in Linnaea, 10: 521 (1836).

Asplenium linearilobum A. Peter in Fedde, Rep. Sp. Nov., Beih., 40: 80, t. 2, figs. 7-8 (1929). Type from Tanzania.

Gorongosa Mtn., Morambodzi Falls, occasional low-level epiphyte in streambank forest, 2900 ft., 3.VII.1955, *Schelpe* 5471. Gogogo Peak, occasional mid-level epiphyte in forest, 5800 ft., *Schelpe* 5498.

Asplenium theciferum (H. B. K.) Mett. var. *concinnum* (Schrad.) C. Chr. in Dansk Bot. Ark., 7: 104 (1932).

Davallia concinna Schrad. in Gött. gel. Anz., 1818: 918 (1818). Type from South Africa.

Loxoscaphe concinnum (Schrad.) Moore in Journ. of Bot., 5: 227 (1853).

Asplenium concinnum (Schrad.) Kuhn, Fil. Afr.: 99 (1868).

Davallia campyloptera Kunze in Linnaea, 10: 544 (1836). Type from South Africa.

Gogogo Peak, occasional low-level epiphyte in forest, 5800 ft., 5.VII.1955, *Schelpe* 5512.

THELYPTERIDACEAE

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.

Gorongosa Mtn., Morambodzi Falls, occasional among boulders near waterfall in shade in forest, 2700 ft., 2.VII.1955, *Schelpe* 5461.

Thelypteris gueintziana (Mett.) Schelpe in Journ. S. Afr. Bot., 31: 262 (1965).

Aspidium gueintzianum Mett., Farngattungen, Pheg. u. Asp.: 83 (1858). Type from South Africa.

Lastrea gueintziana (Mett.) Moore, Ind.: 93 (1858).

Nephrodium gueintzianum (Mett.) Hieron. in Bot. Jahrb., 28: 341 (1900).

Gorongosa Mtn., Morambodzi Falls, occasional in shaded wet rock crevices near waterfall, 2700 ft., 2.VII.1955, *Schelpe* 5458. Morambodzi Falls, occasional in streambank forest, 2700 ft., 2.VII.1955, *Schelpe* 5463.

LOMARIOPSIDACEAE

Elaphoglossum acrostichoides (Hook. & Grev.) Schelpe in Journ. S. Afr. Bot., 30: 196 (1964).

Vittaria acrostichoides Hook. & Grev., Icon. Fil.: t. 186 (1830). Type from South Africa.

Drymoglossum acrostichoides (Hook. & Grev.) Moore, Ind.: 31 (1857).

Elaphoglossum preussii Hieron. in Bot. Jahrb., 46: 402 (1911). Type from West Africa.

Gogogo Peak, occasional mid-level epiphyte in *Philippia* scrub, 5800 ft., 5.VII.1955, *Schelpe* 5524. Near Gogogo Peak, locally frequent on rocks on forest margin, 5600 ft., 6.VII.1955, *Schelpe* 5543.

Elaphoglossum lastii (Bak.) C. Chr., Ind. Fil.: 309 (1905).

Acrostichum lastii Bak. in Ann. of Bot., 5: 491 (1891). Type from Mozambique or Tanzania.

Acrostichum volkensisii Hieron. in Engl., Pflanzenw. Ost-Afr., C: 81 (1895). Type from Tanzania.

Elaphoglossum volkensisii (Hieron.) C. Chr., Ind. Fil.: 318 (1905).

Elaphoglossum obtusum A. Peter in Fedde, Rep. Sp. Nov., Beih., 40 (1), App.: 2 (1929). Type from Tanzania.

Gorongosa Mtn., S. sector, frequent high to mid-level epiphyte in forest, 4500 ft., 4.VII.1955, *Schelpe* 5489. Near Gogogo Peak, locally frequent high to mid-level epiphyte in forest, 5600 ft., 6.VII.1955, *Schelpe* 5529. Gorongosa Mtn., S. W. sector, occasional high-level epiphyte in forest, 5400 ft., 7.VII.1955, *Schelpe* 5582.

Elaphoglossum hybridum (Bory) Brack. in U. S. Expl. Exped., 16: 69 (1854).

Acrostichum hybridum Bory, Voy., 3: 95 (1804). Type from Mascarene Is.

Olfersia hybrida (Bory) Presl, Tent. Pterid.: 235 (1836).

Acrostichum ciliatum Desv. in Mag. Ges. Naturf. Berl., 5: 310 (1811). Type from Réunion.

Acrostichum ciliare Carm. in Trans. Linn. Soc. Lond., 12: 510 (1818) non Thouars (1804). Type from Tristan da Cunha.

Acrostichum tricholepis Bak. in Journ. of Bot., 1891: 5 (1891). Type from Madagascar.

Elaphoglossum tricholepis (Bak.) C. Chr., Ind. Fil.: 317 (1905).

Gogogo Peak, occasional around boulder bases in scrub, 5800 ft., 5.VII.1953, *Schelpe* 5523. Near Gogogo Peak, occasional in deep shade in streambank forest, 5600 ft., 6.VII. 1955, *Schelpe* 5530. Gorongosa Mtn., S. W. sector, locally frequent lithophyte and low-level epiphyte in tall *Philippia* scrub, 5800 ft., 7.VII.1955, *Schelpe* 5580.

Elaphoglossum aubertii (Desv.) Moore, Ind.: 5 (1857).

Acrostichum aubertii Desv. in Mag. Ges. Naturf. Berl., 5: 309 (1811). Type from Réunion.

Acrostichum boivinii Mett. ex Kuhn, Fil. Afr.: 43 (1868). Type from Mauritius.

Gorongosa Mtn., S. sector, occasional on shaded boulders in forest, 4500 ft., 4.VII.1955, *Schelpé* 5486. Gogogo Peak, locally frequent on mossy boulders in *Philippia* scrub, 5800 ft., 5.VII.1955, *Schelpé* 5522.

Elaphoglossum chevalieri Christ in Journ. de Bot., sér. 2, 2: 23 (1909). Type from São Tomé.

Gorongosa Mtn., S. sector, rare on boulder in dense shade in forest, 4000 ft., 4.VII.1955, *Schelpé* 5484. Near Gogogo Peak, locally common on shaded boulders in streambank forest, 5600 ft., 6.VII.1955, *Schelpé* 5539.

ASPIDIACEAE

Dryopteris inaequalis (Schlechtend.) O. Kuntze, Rev. Gen. Pl., 2: 813 (1891).

Aspidium inaequale Schlechtend., Adumbr.: 23, t. 12 (1825). Type from South Africa.

Lastrea inaequalis (Schlechtend.) Presl, Tent. Pterid.: 77 (1836).

Nephrodium inaequale (Schlechtend.) Hook., Sp. Fil., 4: 125 (1862) non Schrad. (1824).

Polystichum inaequale (Schlechtend.) Keys., Polypod. Cyath. Hb. Bung.: 44 (1873).

Lastrea pentagona Moore in Hook. Journ. of Bot., 5: 227 (1853). Type from South Africa.

Nephrodium pentheri Krasser in Ann. Hofmus. Wien, 15: 5, t. 2, figs. 1-5 (1900). Type from South Africa.

Dryopteris pentheri (Krasser) C. Chr., Ind. Fil.: 284 (1905).

Gorongosa Mtn., Morambodzi Falls, occasional in forest undergrowth, 2700 ft., 2.VII.1955, *Schelpe* 5462.

Dryopteris kilemensis (Kuhn) O. Kuntze, Rev. Gen. Pl., 2: 813 (1891).

Aspidium kilemense Kuhn, Fil. Deck.: 24 (1867) (err. *kilmense*). Type from Tanzania.

Nephrodium kilmense (Kuhn) Bak., Syn. Fil.: 498 (1874).

Nephrodium lastii Bak. in Ann. of Bot., 5: 324 (1891). Type from Mozambique.

Aspidium lastii (Bak.) Hieron. in Engl., Pflanzenw. Ost-Afr., C: 85 (1895).

Dryopteris lastii (Bak.) C. Chr., Ind. Fil.: 274 (1905).

Gorongosa Mtn., S. sector, rare in forest undergrowth, 4500 ft., 4.VII.1955, *Schelpe* 5487. Gogogo Peak, occasional in forest, 5800 ft., 5.VII.1955, *Schelpe* 5519.

Polystichum ammifolium (Poir.) C. Chr., Cat. Pl. Madag., Pterid.: 31 (1932).

Polypodium ammifolium Poir., Encycl. Méth. Bot., 5: 554 (1804). Type from Mascarene Is.

Gogogo Peak, occasional in shade near forest margin, 5800 ft., 5.VII.1955, *Schelpe* 5518.

Ctenitis cirrhosa (Schum.) Ching in Sunyatsenia, 5: 250 (1940).

Aspidium cirrhosum Schum. in Kongel. Dansk Vid. Selsk., Nat. & Math. Afh., 4: 231 (1827). Type from West Africa.

Nephrodium cirrhosum (Schum.) Bak., Syn. Fil.: 472 (1868).

Dryopteris cirrhosa (Schum.) O. Kuntze, Rev. Gen. Pl., 2: 812 (1891).

Aspidium comorense Kuhn, Fil. Afr.: 128 (1828).
nom. nud.

Nephrodium crinobulbon Hook., Sp. Fil., 4: 92, t. 224
(1862). Type from São Tomé.

Lastrea crinobulbon (Hook.) J. Sm., Hist. Fil.: 214
(1875).

Dryopteris crinobulbon (Hook.) C. Chr., Ind. Fil.,
Suppl. 3: 84 (1934).

Ctenitis crinobulbon (Hook.) Ching in Sunyatsenia,
5: 250 (1940).

Nephrodium spekei Bak., Syn. Fil.: 263 (1868). Type
from Comoro Is.

Dryopteris spekei (Bak.) O. Kuntze, Rev. Gen. Pl.,
2: 813 (1891).

Thelypteris spekei (Bak.) Ching in Bull. Fan Mem.
Inst. Biol. Bot., 10: 254 (1941).

Nephrodium welwitschii Bak., Syn. Fil.: 274 (1868).
Type from Angola.

Dryopteris pulvinata C. Chr. in Bonap., Not. Pterid.,
16: 177, t. 6, fig. a (1925). Type from Madagascar.

Dryopteris nimbaensis Tardieu in Not. Syst.: 13:
370 (1948). Type from Guinea.

Gorongosa Mtn., Morambodzi Falls, occasional in shaded
rock crevices near waterfall, 2700 ft., 2.VII.1955, *Schelpe* 5457.

Tectaria gemmifera (Fée) Alston in Journ. of Bot., 77:
228 (1939).

Sagenia gemmifera Fée, Mém. Fam. Foug., 5: 313
(1852). Type from Madagascar.

Aspidium coadunatum Wall. ex Hook. var. *gemmi-
fera* (Fée) Mett. ex Kuhn, Fil. Afr.: 128 (1868).

Gorongosa Mtn., Morambodzi Falls, frequent in forest
undergrowth, 2700 ft., 2.VII.1955, *Schelpe* 5460.

BLECHNACEAE

Blechnum attenuatum (Sw.) Mett. var. *giganteum* (Kaulf.) Bonap. in Sarasin & Roux, Nova Caledonia, 1: 43 (1914).

Lomaria gigantea Kaulf., Enum. Fil.: 150 (1824).
Type from South Africa.

Blechnum giganteum (Kaulf.) Schlechtend., Adumbr.: 36, t. 20, 22, fig. 1 (1827).

Lomaria heterophylla Desv. in Mag. Ges. Naturf. Berl., 5: 330 (1811). Type from South Africa.

Blechnum heterophyllum (Desv.) Schlechtend., Adumbr.: 37 (1827).

Lomaria hamata Kaulf., Enum. Fil.: 150 (1824).
Type from South Africa.

Lomaria decipiens Pappe & Raws., Syn. Fil. Afr. Austr.: 29 (1858). Type from South Africa.

Gorongosa Mtn., above Morambodzi Falls, occasional among boulders in streambank forest, 2900 ft., 3.VII.1955, *Schelpe* 5474. Near Gogogo Peak, locally frequent on floor of streambank forest, 5600 ft., 6.VII.1955, *Schelpe* 5534.

Blechnum capense (L.) Schlechtend., Adumbr.: 34, t. 18 (1825).

Osmunda capensis L., Mantissa Pl. Alt.: 306 (1771).
Type from South Africa.

Onoclea capensis (L.) Sw., Syn. Fil.: 111 (1806).

Lomaria capensis (L.) Willd. in L., Sp. Pl., ed. IV, 5: 291 (1810).

Spicanta capensis (L.) O. Kuntze, Rev. Gen. Pl.: 821 (1891).

Near Gogogo Peak, occasional in clearing in streambank forest, 5600 ft., 6.VII.1955, *Schelpe* 5533.

Blechnum tabulare (Thunb.) Kuhn, Fil. Afr.: 94 (1868).

Pteris tabularis Thunb., Prodr. Pl. Cap.: 171 (1800).
Type from South Africa.

Lomaria tabularis (Thunb.) Mett. ex Bak., Fl. Brasil, 1 (2): 418 (1870).

Lomaria coriacea Schrad. in Gött. gel. Anz., 1818: 916 (1818). Type from South Africa.

Lomaria gueinzii Moug. ex Fée, Mém. Fam. Foug., 5: 69 (1852). Type from South Africa.

Lomaria cycadoides Pappe & Raws., Syn. Fil. Afr. Austr.: 28 (1858). Type from South Africa.

Blechnum cycadoides (Pappe & Raws.) Kuhn, Fil. Afr.: 91 (1868).

Lomaria dalgairnsiae Pappe & Raws., Syn. Fil. Afr. Austr.: 27 (1858). Type from South Africa.

Blechnum dalgairnsiae (Pappe & Raws.) Kuhn, Fil. Afr.: 92 (1868).

Gorongosa Mtn., near Gogogo Peak, occasional around boulders and rock outcrops in *Protea* savannah, 5800 ft., 6.VII.1955, Schelpe 5544.

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NOTES ON THE *CHRYSOBALANACEAE* OF ANGOLA

by

G. T. PRANCE

BETWEEN 1960 and 1963 I was engaged on a revision (PRANCE, 1963) on a world-wide basis of the *Chrysobalanaceae* at generic level. This will be published shortly (PRANCE, in press). Besides re-examining traditional morphological features I also studied the secondary xylem and floral anatomy, the pollen grain and germination and seedling characters of a large number of species. It was found that most of the larger genera could be justifiably maintained, sometimes after minor emendations, but that *Parinari* is an artificial and heterogeneous assemblage. *Parinari* is unique within the family in having its carpels partitioned by a false septum. This character has been used to define the genus since it was originally described by AUBLET in 1775. Visual inspection indicates that some members are more closely related to genera outside *Parinari* than to the rest of *Parinari*; detailed analysis confirms this.

One old-world group of species originally described as *Maranthes* Bl. but usually treated as the section or subgenus *Sarcostegia* of *Parinari* differs from *Parinari sensu stricto* not only in nearly all important characters including method of germination but is actually more closely related to the South American genus *Couepia* than to any other group of species within *Parinari sensu lato* and must be reinstated as a genus.

In my opinion the genus *Magnistipula* Engl. as defined by GRAHAM (1960) should be maintained, but one species from the old *Parinari*, *P. tessmannii* Engl., which has bilocular carpels but no other important characters in common

with *Parinari* sens. str. should be transferred to it. It is sufficiently distinct within *Magnistipula* to be placed in its own subgenus.

Since four of the new combinations will be needed for the next part of the *Conspectus Florae Angolensis* which is likely to appear before my revision, they are published here in advance of the main work together with a conspectus of the Angolan genera.

Conspectus of the Angolan genera

1. Ovary inserted at or near the base of the receptacle; endocarp with 4-8 distinct longitudinal ridges corresponding to the lines of fracture that allow the seedling to escape *Chrysobalanus*
- 1a. Ovary inserted laterally or at the mouth of the receptacle:
 2. Endocarp with two small basal «plugs» or «stoppers» that allow the seedlings to escape, surface rough and fibrous; bracts and bracteoles enclosing flowers in small groups; leaf-undersurface with small stomatal cavities filled with hairs; germination hypogeal *Parinari*
 - 2a. Endocarp without basal plugs but sometimes dehiscent at germination by means of two large lateral plates; bracts and bracteoles not enclosing the flowers in groups; leaf-undersurface without hair-filled stomatal cavities:
 3. Endocarp with two lateral plates; carpels bilocular; receptacle not ventricose; stamens 20-60, not ligulately connate; germination epigeal *Maranthes*
 - 3a. Endocarp without lateral plates or other visible lines of weakness; carpels unilocular (except in *Magnistipula tessmannii*); germination hypogeal:
 4. Stamens 10-65, filaments ligulately connate for most of length; receptacle not ventricose *Acioa*

- 4a. Stamens (fertile) 5-9, only slightly connate at the base, grouped on one side of the receptacle; staminodes inserted opposite the stamens, free or united to form a short comb or an elevated tongue; receptacle oblique, ventricose
. *Magnistipula*

New combinations

MARANTHES Bl.

Maranthes Bl., Bijdr. Fl. Nederl. Ind.: 89 (1825).

Parinarium Sectio *Sarcostegia* Benth. in Hook., Niger Fl.: 335 (1849).

Small to large trees with hermaphrodite flowers 9-40 mm. long. *Leaf-undersurface* glabrous or with a dense woolly tomentum which is easily rubbed off. *Petioles* usually with 2 glands, rarely eglandular. *Bracts* and *bracteoles* eglandular, not enclosing the young flowers in groups. *Receptacle* of varied shape but narrowed to the base, solid or nearly solid (or rarely hollow, elongate and curved), glabrous inside at base; calyx-lobes rounded. *Stamens* 23-60, exserted far beyond calyx-lobes, often forming a complete circle, or a small part of the circle and the rest of the circle staminodial. *Ovary* of 1 (2-3) carpels, inserted laterally at the mouth of the receptacle; carpels bilocular. *Fruit* a fleshy drupe; epicarp smooth, usually without warts or rarely with a few; endocarp very hard, fibrous with a roughish exterior, with two lateral plates which break away during germination and allow the seedling to escape. *Germination* epigeal, first leaves opposite.

Distribution: mainly African but with one species widely distributed in the East (Malaysia, New Guinea and Australia).

Type species: *Maranthes corymbosa* Bl.

Maranthes gabunensis (Engl.) Prance, comb. nov.

Parinarium gabunense Engl., Bot. Jahrb. 17: 87 (1893).

Typus: *Soyaux* 45, fl. Gabon (κ, isotype).

From Cameroun to Cabinda.

This is the only species of *Maranthes* with a truly hollow receptacle.

Maranthes glabra (Oliv.) Prance, comb. nov.

Parinarium glabrum Oliv., Fl. Trop. Afr. 2: 370 (1871).

Parinarium gillettii De Wild. in Ann. Mus. Cong., Bot. Sér. 5, 1: 245, t. 59 (1906).

Typus: *Mann* 1832, fl. Rio Muni (κ, holotype).

Maranthes polyandra (Benth.) Prance, comb. nov.

Parinarium polyandrum Benth. in Hook., Niger Fl.: 333 (1849).

Typus: *Vogel* 3, fl. Nigeria (κ, holotype).

From Ghana, Togo and Dahomey to the Sudan.

Subsp. **floribunda** (Bak.) Prance, comb. nov.

Parinarium floribundum Bak. in Bull. Misc. Inf. Kew 1897: 265 (1897).

Parinari polyandra subsp. *floribunda* (Bak.) R. Grah. in Kew Bull. 1957: 229 (1957).

Typus: *Whyte* s. n., fl. Malawi (κ, holotype).

Congo, Angola, Zambia, Rhodesia, Malawi, Tanzania.

MAGNISTIPULA Engl.

Magnistipula Engl., Bot. Jahrb. 36: 226 (1905); Hauman in Bull. Jard. Bot. Brux. 21: 173 (1951); R. Grah. in Kew Bull. 1957: 230 (1957).

Hirtella L. Subgen. *Afrohirtella* Hauman, tom. cit.: 178 (1951).

Trees, shrubs or suffrutices with hermaphrodite flowers 5-22 mm. long. *Leaf-undersurface* glabrous or with a few strigose, rust-coloured hairs, never with a dense tomentum. *Petioles* eglandular. *Stipules* large and persistent in some species only. *Bracts* and *bracteoles* occasionally with a few sessile glands. *Inflorescence* usually of panicles, rarely of racemes. *Receptacle* of characteristic shape, gibbous, ventricose or obliquely campanulate, hairy or glabrous inside; calyx-lobes acute, usually tomentose. *Fertile stamens* 5-9, included or slightly exserted, arcuate, grouped towards one side of receptacle; staminodes inserted opposite the stamens, free or united to form a short comb or an elevated tongue. *Ovary* inserted at the mouth of the receptacle; carpels unilocular (bilocular in *M. tessmannii*). *Style* slightly exserted, $\pm$ arcuate. *Fruit* a fleshy drupe; epicarp with a dense rusty tomentum (smooth and glabrous in *M. fleuryana*); endocarp hairy inside, usually soft and consisting of a few fibres only, and breaking up in no special way on germination; hard and smooth in *M. tessmannii*. *Germination* hypogeal, first leaves opposite.

Distribution: Africa with most species in Cameroun, Gabon and Congo.

Type species: *M. conrauana* Engl.

Subgenus *Pellegriniella* (Hauman) Prance, comb. nov.

Parinari subgenus *Pellegriniella* Hauman in Bull. Bot. Brux. 21: 188 (1951) pro parte quoad *P. tessmannii* tantum.

Magnistipula tessmannii (Engl.) Prance, comb. nov.

Parinarium tessmannii Engl., Bot. Jahrb. 46: 139 (1911).

Typus: *Tessmann* 81, fl., Gabon (K, P, isotypes).

Subgenus *Pellegriniella* differs from subgenus *Magnistipula* in having bilocular carpels and a thick, hard smooth endocarp. HAUMAN based his diagnosis of *Parinari* subgenus *Pellegriniella* on *P. tessmannii* which he clearly regarded as

an anomalous member of *Parinari*. He associated two anomalous South American species with it, *P. coriacea* Benth. and *P. gardneri* Hook. f. They have no important features in common with *P. tessmannii* and belong to an undescribed genus.

* * *

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ACACIA ALBIDA DEL. IN AFRICA

by

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THE description of *Acacia albida* by DELILE (1813) was based on a specimen from Egypt collected by NECTOUX. BENTHAM (1842) recognised var. *senegalensis* within *A. albida* citing Roberts s. n. and Brunner 72 from Senegal. The variety apparently differed chiefly in having 5-7 pinna pairs as opposed to the 2-4 pairs in typical *A. albida*. BENTHAM (l. c.) described *A. saccharata* from a specimen collected by Heudelot in the Cayor. BENTHAM's description follows fairly closely his description of *A. albida* and, although his notes on *A. saccharata* carry the comment «an *A. albidæ* var. *subinermis*?», it is perhaps surprising that he created the new species. OLIVER (1871), and later BENTHAM (1875) himself, regarded *A. saccharata* as a synonym of *A. albida*. *A. gyrocarpa*, which was described by HOCHSTETTER from Abyssinia, was also regarded as a synonym by OLIVER and by BENTHAM (1846; 1875).

LINNAEU'S (1753) comment that *Mimosa senegal* [= *Acacia senegal* (L.) Willd.] was easily distinguished by its white bark has, in the past, led to the confusion of this species with *A. albida* which frequently has white or ashen bark.

BOLLE (1861) described *A. mossambicensis* from Portuguese East Africa noting that the species differed from *A. albida* in its spinelessness and in its pubescence. OLIVER (1871) referred *A. mossambicensis* to *A. albida* with some doubt noting «I do not observe any character in the published description by which it differs, excepting in the absence of spines. This, however, occurs occasionally in *A. albida*». As

mentioned by BRENNAN (1956), the name *A. mossambicensis* has in the past been incorrectly applied to *A. goetzei* Harms. Certain Natal plants which form part of the *A. burkei* Benth. complex have also been confused with *A. mossambicensis* (HENKEL, 1934, 1937).

OLIVER's (1871) description of *Prosopis* ? *Kirkii* from Portuguese East Africa followed closely that of *A. albida*. The species was regarded as a synonym of *A. albida* by BENTHAM (1875), a view upheld by subsequent authors.

DE WILDEMAN (1925) recognised var. *microfoliolata* and var. *variofoliolata* within *A. albida*, citing as type specimens *Delevoy 443* and *Delevoy 227* respectively both from the Congo. The type of var. *microfoliolata* is a sterile spiny shoot bearing reduced leaves and small leaflets plus a detached fruit, whilst that of var. *variofoliolata* is a fruiting specimen, the leaves of which exhibit great variation in number of pinna pairs. BAKER (1930) considered var. *variofoliolata* to be «hardly separable from the type».

A. albida displays a number of unusual characters, some of which are peculiar to this species alone amongst the African Acacias. *A. albida* differs in having leaves with eglandular petioles, stamen filaments which are shortly connate basally (also in *A. eriocarpa* Brenan and in *A. ogadensis* Chiov.), large anthers which are eglandular even when in bud, and a typically falcate or spirally coiled, indehiscent legume. CHEVALIER (1934) considered the species sufficiently distinct from all others to transfer it to the monotypic genus, *Faidherbia*. Although CHEVALIER was followed by GILBERT and BOUTIQUE (1952), the differences enumerated above were not considered sufficient by subsequent workers to warrant separating the species from the genus *Acacia*.

BRENNAN (1959) mentioned the presence of «two well-defined geographical races» within *A. albida*: race A having glabrous young branchlets, inflorescence axes, calyces and corollas, and small leaflets which are glabrous apart from the ciliolate margins, whilst race B is characterised by an overall pubescence and larger leaflets which are also pubescent. BRENNAN (l. c.) found that whilst most specimens from tropical east Africa could be referred to either one race or to

the other in certain other parts of the species range intermediates between the two occur quite frequently. Consequently an attempt was made to determine the range of this morphological variation and to establish the distributional range of the species in Africa.

DISTRIBUTION, HABIT AND HABITAT

The known distribution of *A. albida* in Africa is shown in Fig. 1. Information given in this figure is based on field observations and an examination of herbarium specimens, each dot representing a known population or an authenticated herbarium specimen.

A. albida is one of the most widespread species in Africa extending from Senegal and Senegambia in the west across to Egypt in the north, Ethiopia and Somaliland in the north east, and southwards to Natal. In the north specimens have been recorded from Syria, Palestine and island of Cyprus but it is unknown whether the species is indigenous to Cyprus or not. Although no specimens have been examined from the Ivory Coast, Togo or Dahomey the occurrence of the species there is reported by AUBRÉVILLE (1950).

Plants are usually arborescent although in some of the drier habitats occupied by the species in South West Africa shrubs have been recorded. Trees grow up to ninety feet in height and in some areas, especially in southern Africa, are one of the largest, if not the largest, representatives of the genus. Young trees frequently have a spindly growth form and are extremely spinescent in contrast to the large spreading or rounded, drooping crown of mature trees. On some mature trees spines are found mainly on the young coppice shoots whilst on the terminal branches they may be very much reduced in size or sometimes completely absent. The tips of the spines, especially the young ones, are frequently tinged with orange or light brown.

Plants grow most commonly on seasonally inundated alluvial floodplains, colluvial fan slopes, in riverine fringing vegetation, marginal to lakes and swamps, in woodland or, in more arid localities along dry watercourses or where a

fairly high water table exists. Plants grow either singly or in communities. In Tanzania in the Wami basin trees up to ninety feet in height and forming a forest component together

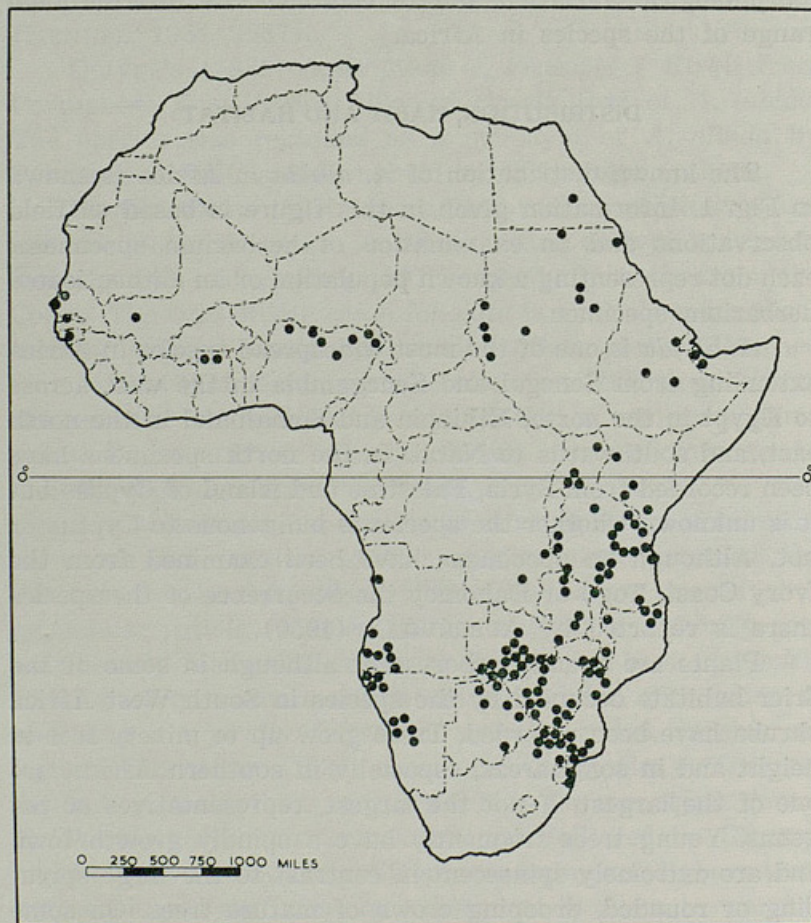


Fig. 1. — The known distribution of *Acacia albida* in Africa.

with *Chlorophora excelsa* (Welw.) Benth. & Hook. f. and *Sterculia appendiculata* K. Schum. have been noted.

The bark, which varies in colour from brown to greenish-grey or ashen, is frequently coarsely fissured (see Fig. 2) and may be slightly cork-like whilst on the younger branches it is smoother and greenish white.



Fig. 2. — Close up of the ashen to light greyish-brown, rough bark of *Acacia albida*. Natal, Ndumu Game Reserve, Usutu floodplain, 26 Feb., 1964.



MORPHOLOGICAL VARIATION

In Natal *A. albida* is confined to the Ingwavuma district, and plants are nowhere common within this area. Consequently only seven trees, from two populations or perhaps in reality one continuous population, were sampled according to the method of GORDON-GRAY (1965). Insufficient parameters were obtained to present detailed information but the results nevertheless formed a foundation for further work and comparison. The field samples were supplemented by an examination of numbers of herbarium specimens, the morphological parameters of which were measured in the same way as those of leaves constituting the field samples. For most localities herbarium specimens had to be relied upon exclusively which, as mentioned (ROSS, 1967), is unsatisfactory. Until such time as populations have been sampled throughout the species range it is hoped that the following information will contribute towards a better understanding of *A. albida*.

In *A. albida* primary and secondary leaves occur. The former develop between the paired stipular spines and occur singly whilst the latter are fascicular and arise from dwarfed lateral shoots. The two types differ mainly in size, the primaries tending to be larger.

Parameters obtained for all measurable morphological characters throughout the species range revealed continuous variation, as was the case within the populations sampled in Natal. Leaf size varies on a single plant and from plant to plant within a population. Frequently the rachilla on one side of the rachis is unequal in length to the corresponding member on the opposite side so that the leaf develops asymmetrically. Although exceptions abound, observations suggest that the overall tendency is for petiole length to be positively correlated with rachis and rachilla length, whilst number of pinna pairs and number of leaflet pairs are positively correlated with rachis length and rachilla length respectively. In contrast to nearly all other species the petiolar gland is absent, but there is usually a gland between each pinna pair.



The maximum number of pinna pairs recorded in *A. albida* was twelve.

Many authors have commented on the leafless state of plants in summer in different parts of the species range. However, field observations do not support FEELY's (1965) statement that plants at the southern end (south of the Limpopo River) of the species range behave «as do other deciduous woody plants by flowering, fruiting and bearing foliage in the spring and summer», whilst north of the Limpopo River the active season is in winter. In Natal in the Ndumu Game Reserve one tree was found in full leaf and flowering profusely in late summer (see Fig. 3) whilst others a few hundred yards away were completely leafless (see Fig. 4). Trees north of Otoboteni on the Tongaland plain which were leafless in summer were later observed in full leaf and flower at the beginning of winter. In Natal, at least, trees usually come into leaf at the end of the rainy season and remain green during the dry season, finally shedding their leaves at the onset of the rainy season. In the Lindi district of Tanzania trees were found in full leaf and fruit in mid-summer whilst some trees at Mahiwa were observed never to be deciduous at any stage of the year. It appears that the behaviour of plants varies from locality to locality and that in any one locality at the same time it is frequently possible to find both leafless and leaf bearing plants.

Pod size and especially pod shape vary considerably on a single plant, the latter being perhaps the most variable character exhibited by the species. Pod size is apparently unrelated to any other measurable morphological character.

Inflorescences are normally produced singly between the paired spines or in the axil of a leaf, the inflorescences collectively forming a terminal panicle. Occasionally inflorescences are attacked by insects which results in galls similar to those found in *A. caffra* (Thunb.) Willd. (Ross, 1965). *A. albida* is the only species in southern Africa having straight or only slightly curved spines and a spicate inflorescence, all other species with spicate inflorescences having strongly recurved prickles. However, other species combining



Fig. 3.—Tree 55 feet in height with rounded crown in full leaf and flower. *Ficus sycamorus* L. in background. To the right of the mature tree a young, irregularly branched, spindle-like specimen of *Acacia albida* is visible. *Phragmites communis* Trin., *Themeda triandra* Forsk. and *Panicum maximum* Jacq. form a dense sward in the foreground. (The roof a Land Rover is visible beneath the mature tree in the centre of the photograph).

Ndumu Game Reserve, Usutu floodplain, late summer, 26 Feb., 1964.



Fig. 4. — Completely leafless tree 53 feet in height growing with *Pluchea dioscorides* DC., *Sclerocarya caffra* Sond., *Vernonia colorata* (Willd.) Drake and, in right background, *Ficus sycamorus*. Grass cover of *Themeda triandra* and *Panicum maximum*. Ndumu Game Reserve, Usutu floodplain, late summer, 26 Feb., 1964.

straight spines and a spicate inflorescence occur elsewhere in Africa.

DISCUSSION AND TAXONOMIC CONCLUSIONS

The characters typifying each of BRENAN's races are not necessarily correlated appearing more as inconsistent tendencies so that, as mentioned by BRENAN, intermediates possessing attributes of both races are common. Such plants cannot be referred to either race with any degree of certainty. On some specimens from southern Africa some of the leaflets are glabrous abaxially whilst others on the same specimen are appressed-pubescent. Leaflet size varies on a single specimen and specimens have been observed on which the small leaflets are appressed-pubescent ab- and/or adaxially and on which the larger leaflets are glabrous. Sometimes the calyx and corolla are glabrous and the leaflets appressed-pubescent, whilst in other specimens it is the calyx and corolla that are pubescent. With the exception of a few doubtful specimens all specimens from the southern part of the species range are referable to race B which concurs with BRENAN's finding that this is the exclusive race south of central Tanzania.

In northern Tanzania, Uganda and Kenya race A is recorded whilst further north and in west Africa both races plus intermediates occur. A number of specimens from the Sudan, Ethiopia and west Africa have leaflets which are small as in race A but pubescent as in B, whilst in others the leaflets are glabrous but large. B appears the commoner of the two races in the west.

None of the infraspecific categories previously recognised within *A. albida* are maintained as not one has any distinguishing character. For example, var. *variofoliolata* is based on a specimen which exhibits a range in variation from 2-10 pinna pairs so that any specimen on which pinna pair number varies could be referred to the variety. Similarly, var. *microfoliolata* is based on a sterile, spiny shoot with reduced leaves and leaflets so that young coppice shoots off a plant could be referred to this variety and mature shoots off the same plant to another.

A. albida, which displays a number of characters peculiar to it alone, has no close relatives within the genus.

A. albida Del., Fl. Egypt.: 142, t. 52, fig. 3 (1813); DC. in Prodr. 2: 459 (1825); Benth. in Lond. Jour. Bot. 1: 505 (1842); Rich. in Tent. Fl. Abyss. 1: 241 (1847); Niger Fl.: 127 (1849); Schweinf. in Linnaea XXXV: 358 (1867); Oliv. in F. T. A. 2: 339 (1871); Boiss. in Fl. Or. 2: 637 (1872); Grant in Trans. Linn. Soc. 29: 67 (1873); Benth. in Trans. Linn. Soc. 30: 515 (1875); Marloth in Trans. S. Afr. Phil. Soc.: 271 (1893); Engl. in Bot. Jahrb. 10: 20 (1888); Engl. in Hochgebirgsflora Tropischen Afrika: 240 (1892); Schinz in Mém. Herb. Boiss. 1: 104 (1900); Harms in N. B. G. B. 4: 198, fig. 2 (1906); Pax in Engl. Bot. Jahrb. 39: 624 (1907); Sim in For. and For. Fl. P. E. A.: 54, t. 34 (1909); Dinter in Fl. Deutsch-Südwest-Afrika: 74 (1909); Muschler in Man. Fl. Egypt. 1: 459 (1912); Dinter in Veg. Veldkost Deutsch-Südwest-Afrikas: 32 (1912); Engl. in Pflanzenw. Afr. 3 (1) (Engl. & Drude, Veg. der Erde, 9): 376, fig. 220 (1915); Glover in Ann. Bol. Herb. 1: 146 (1915); F. W. T. A. ed. 1, 1: 361 (1927); Crowfoot in Fl. Pl. Northern and Central Sudan: fig. 71 (1928); Baker in L. T. A.: 825 (1930); Burt Davy in Man. Fl. Pl. Tvl.: 335 (1932); Pönnighaus in Jour. S. W. Afr. Sci. Soc. 6: 12-13 (1933); Boss in Pflanzenleben Südwestafrika's: 30 (1934); Henkel in Woody Pl. of Natal and Zululand: 232 (1934); T. S. K.: 67 (1936); Eggeling in Indigenous Trees of Uganda Prot.: 110 (1940); Roberty in Candollea 11: 140 (1948); T. T. C. L.: 330 (1949); Bogdan in Nature in E. Afr., ser. 2, No. 1: 13 (1949); Aubréville in For. Fl. Soud. Guin.: 280 (1950); Codd in Trees and Shrubs Kruger N. Park: 38 (1951); I. T. U. ed. 2: 205, fig. 47a (1952); Miller in Jour. S. Afr. Bot. 18: 18 (1952); Andrews in Fl. Pl. Anglo-Egyptian Sudan 2: 133, fig. 55 (1952); Wild in Rhodesian Dict. of Bot. Names: 46 (1953); Young in Candollea 15: 89-93 (1955); Consp. Fl. Angol. 2: 272 (1956); F. W. T. A. ed. 2, 1: 499 (1958); Brenan in F. T. E. A. Legum.-Mimos.: 78 (1959); Dale and Greenway in Kenya Trees and Shrubs: 284 (1961); Palmer and Pitman in Trees of South Africa: 148-50, t. 5 (1961); White in For. Fl. N. Rhodesia: 82,

fig. 17 b, c (1962); Mitchell in *The Puku*, 1: 103 (1963).
Type: Egypt, above Philae, *Nectoux* (MPU, holo.).

Syn.: *A. albida* Del. var. *senegalensis* Benth. in Hook.
Lond. Jour. Bot. 1: 505 (1842). Types: Senegal,
Robert s. n., *Brunner* 72 (K).

A. saccharata Benth. in Hook. Lond. Jour. Bot. 1:
505 (1842). Type: the Cayor, *Heudelot* 391 (K).

A. gyrocarpa Hochst. in Schimp. Pl. Abyss. n. 1333;
Rich. in Tent. Fl. Abyss. 1: 241 (1847).

A. mossambicensis Bolle in Peters Reise Mossamb.
Bot. 1: 5 (1861); non Baker in L. T. A.: 831 (1930);
non Henkel in Woody Pl. Natal and Zululand: 233
(1934); non Henkel in Ecology of Hluhluwe Game
Reserve: 17, t. 6 (1937).

Prosopis ? *Kirkii* Oliv. in F. T. A. 2: 332 (1871)
cited specim. of *Dr. Kirk* from Shire R., Zambesi
land.

Acacia albida Del. var. *microfoliolata* De Wild., Pl.
Bequaert. 3: 56 (1925); de Wild. in Contrib. à
l'étude de la Fl. du Katanga, Suppl. 1: 17 (1927);
Baker in L. T. A.: 825 (1930). Type: Congo,
Katanga Prov., Kala, 6 Dec. 1921, *Delevoy* 443
(BR, holo.; K, photo.).

A. albida Del. var. *variofoliata* De Wild., op. cit.:
57 (1925); De Wild., op. cit.: 17 (1927). Type:
Congo, Lubaye, 1921, *Delevoy* 227 (BR, holo.;
K, photo.).

Faidherbia albida (Del.) A. Chev. in Rev. Bot.
Appliq. 14: 876 (1934); Gilb. & Bout. in F. C. B.
3: 169 (1952).

Tree to 30 m., crown rounded, branches spreading and
frequently drooping to the ground in mature trees, young
plants often irregularly branched and spindle-like, trunk to
2 m. in diameter (occasionally to 6 m., WHITE, 1962, p. 82).
Bark greenish grey or ashen to dark grey or brown, rough
sometimes cork-like. Young branchlets greenish white or
ashen, subglabrous, puberulous or pubescent. Stipules in

pairs, spinescent, up to 3.2 (1.2 ± 0.7) cm. long, straight or slightly curved, occasionally absent, especially on older branches, greenish-white to light grey-brown, tips often reddish-brown when young; no prickles below nodes. Leaf: petiole 0.5-3.7 (1.5 ± 0.8) cm. long, subglabrous or puberulous, adaxial gland absent; rachis 1.3-7.5 (4.5 ± 1.5) cm. long, subglabrous, puberulous or villous, channelled adaxially, abaxial surface without recurved prickles, single conspicuous gland between each pinna pair, round to oval, yellow or reddish-brown to black; pinnae 2-12 (6 ± 2) pairs; rachillae 1.5-8.9 (4.0 ± 1.5) cm. long, subglabrous, puberulous or pubescent; leaflets grey-green, 6-23 (15 ± 4) pairs, 2.5-13.0 (7.5 ± 2.5) mm. long, 0.75-5.0 (2.5 ± 0.6) mm. wide, linear, linear-oblong to slightly obovate-oblong, base oblique, midrib excentric at base, apex rounded to sub-acute or mucronate, veins prominent abaxially, margin with or without white ciliolate hairs, glabrous or sparingly to densely appressed-pubescent ab- and/or adaxially. Inflorescence spicate, produced singly between the paired spines or in the axil of a leaf, collectively forming terminal panicle, flowers sessile or to 0.5-2.0 (1.0 ± 0.5) mm. pedicellate, yellowish-white to pale cream; spike 3.5-15.7 (9.5 ± 2.0) cm. long; peduncle 0.8-6.3 (3.0 ± 1.0) cm. long, terete, olive-green, subglabrous, puberulous or pubescent; calyx yellow, campanulate, glabrous, subglabrous, puberulous or pubescent, tube 0.5-1.8 (1.0 ± 0.4) mm. long, lobes 5, triangular, 0.3-0.7 (0.4 ± 0.1) mm. long; corolla yellow, often a delicate pink inside basally, tubular, spreading, lobes divided almost to the base, glabrous, subglabrous, puberulous or pubescent, tube 0.8-2.5 (1.4 ± 0.5) mm. long, lobes 5, triangular, up to 3.0 (1.8 ± 0.6) mm. long, alternating with calyx lobes; stamen filaments shortly connate basally, up to 7.5 mm. long, yellow; anthers 0.2-0.4 mm. across, eglandular even in bud; ovary pilose, shortly stipitate, 0.7-1.4 mm. long, style glabrous or subglabrous, up to 7.5 mm. long, yellow or often a delicate pale pink. Legume bright-orange to reddish-brown, falcate, curled into a circular coil or variously twisted, when flattened out 6.0-35.0 (16.0 ± 7.0) cm. long, 1.4-4.5 (3.0 ± 0.6) cm. wide, apex acute or rounded, indehiscent, coriaceous to chartaceous, often brittle, glabrous or very rarely

puberulous. Seeds light to dark brown, elliptic-lenticular, 6.0-12.0 mm. long, 4.0-8.0 mm. wide, areole distinct, large, elliptic-lenticular $7.0-9.0 \times 4.0-6.0$ mm.

SPECIMENS EXAMINED

Herbarium specimens from the distributional range of *A. albida* in Africa were examined but in view of the number involved only one specimen from each magisterial district has been cited. Herbarium abbreviations are those listed by LANJOUW and STAFLEU (1964).

CAPE VERDE ISLANDS. between Pto. Praia and Trinidades, 6 Feb. 1866, *Lowe s. n.* (K).

SENEGAL. no locality, *Perrottet* 268 (BM); in insulae St. Yags montosis, *Brunner* 72 (K).

GAMBIA. common in Fondi country, *Dawe* 80 (K).

PORTUGUESE GUINEA. Bissau, 11 Jan. 1945, *E. Santo* 1634 (K).

FRENCH SUDAN. Kita, 15 Feb. 1939, *Dubois* 213 (K).

GHANA. Wogu village, 6.3 miles E. of Fian, 2 Nov. 1958, *Rose Innes* H 30795 (GC, PRE); N. Territory, Navrongo, Nov. 1938, *Vigne* 4658 (K).

NIGERIA. BAUCHI PROV.: Kaltungo (Gombe-Numan rd.), Jan. 1958, *Charter* H 36998 (FHI, K). KANO DISTR.: common in Kano distr., 1909, *Dudgeon* 4 (K). KATAGUM DISTR.: *Dalziel* 53 (K). SOKOTO DISTR.: *Dalziel* 314 (K). roadside nr. Katsina town, *Meikle* 1214 (K).

BRITISH CAMEROONS. Dikwa Division, Bama, 24 Dec. 1954, *McClintock* 116 (K).

EGYPT. Asswan, 14 Nov. 1916, *Walsingham* 35, 36 (K).

SUDAN. BLUE NILE DISTR.: Wad Medani, 5 Nov. 1901, *Muriel* L/4 (K). DARFUR PROV.: between Korunga and crater of Marra Mts., 9 Jan. 1934, *Dandy* 193 (BM); N. Distr., Djebd Meideb, 14 Oct. 1958, *Rossetti* 123 (BM); S. Distr., Wabi Kubbum, 30 Oct. 1947, *Harrison* 149 (K). KHARTOUM DISTR.: N. W. Khartoum, opposite Gordon's Tree, 28 Nov. 1930, *Alymer* 88 (K). KORDOFAN: Bir-Sodari, 4 Oct. 1875, *Pfund* 17 (K). NUBIA: sea coast between 3000-4000', *Bent* 1896 (K).

RED SEA PROV.: common in Red Sea Prov., 13 Jan. 1928, *Newberry* 103 (BM).

ETHIOPIA. Jimma rd., 6 miles from Addis Ababa, 15 Dec. 1953, *Mooney* 5106 (K). HARAR PROV.: Idli valley, 45 km. E. S. E. of Harar on rd. to Djigdjigga (Jijica), 21 July 1961, *Burger & Amare Getahun* 34 (K).

ERITREA. BORAMO DISTR.: Tug side at Dila on Boramo-Hargeisa rd., 14 Jan. 1945, *Glover & Gilliland* 579 (BM, K); 18 miles E. of Buramo, Tug Mendesa, 10 Jan. 1933, *Gillett* 4839 (K).

CONGO. Parc National de l'Upemba, Mabwe, Mar. 1949, *van Meel in G. de Witte* 5759 (K).

UGANDA. ANKOLE DISTR.: nr. Gayaza, Ruampara, Oct. 1932, *Eggeling* 634 (K). BUKOBA DISTR.: 5 miles from Kyaka, on Kagera plain, Jan. 1958, *Procter* 795 (K). KARAMOJA DISTR.: Kangole, 22 May 1940, *Thomas* 3476 (K).

KENYA. NAIVASHA DISTR.: Naivasha, Sept. 1933, *v. Someren* 2721/5142 (BM). NAROK DISTR.: Kalemma on the Endosapia R. about 8 miles W. of bridge on Uasonyiro R. on Magadi-Oloibortoto rd., 26 Feb. 1963, *Glover & Cooper* 3521 (K). TEITA DISTR.: Teita Hills, *Grenfell s. n.* (K). WEST SUK DISTR.: Kongelai, 50 miles N. of Kitale, 28 Mar. 1958, *Knight* 137 (K).

TANZANIA. BAGAMOYA DISTR.: Nguru, 130 km. von der Küste, 25 July 1933, *Schlieben* 4202 (BM). DODOMA DISTR.: Dodoma, 23 July 1956, *Semsei* 2439 (K). IRINGA DISTR.: nr. Iringa, bridge over Little Ruaha R., 2 Mar. 1932, *Lynes P. r.* 8 (K). KIGOMA DISTR.: Zibwesa Point, Lake Tanganyika, 8 July 1958, *Juniper & Jefford* 50 (K). KISARAWA DISTR.: football ground, Ilala, Dar es Salaam township, Sept. 1953, *Semsei* 1368 (K, PRE). KONDOA DISTR.: Kondoa-Irangi, 12 Nov. 1927, *Burt* 720 (BM, K). LINDI DISTR.: Mahiwa, 12 Dec. 1962, *Ross* 14 (EA, NU). MBEYA DISTR.: Chimala, 12 Sept. 1949, *Carmichael* 9 (K). MBULU DISTR.: Mbulu, at the farm Mbulu, 17 May 1954, *Matalu* 3131 (K). MOROGORO DISTR.: ? Mtibwoa Forest Reserve, Aug. 1952, *Semsei* 8914 (K). MOSHI DISTR.: Kilimanjaro, near Moshi, 2 July 1926, *Peter* 42210 (K). MPWAPWA DISTR.: Mpwapwa, 30 Apr. 1929, *Hornby* 118 (K). MWANZA DISTR.: Mwanza, lake shore, 10 Jan. 1935, *Lindeman* 59 (BM).



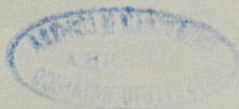
PARE DISTR.: Kisiwani, 5 Feb. 1930, *Greenway 2164* (K). SAME DISTR.: Same-Gonja rd., 19 Feb. 1957, *Wilson 25* (K). UFIPA DISTR.: Kasanga, Lake Tanganyika, 16 June 1957, *Richards 10137* (K).

ANGOLA. BENGUELA DISTR.: neighbourhood of Benguela, Mar. 1907, *Gossweiler 3624* (BM, K). HUILA DISTR.: Calculuvar R., nr. Humbe, 7 June 1937, *Exell & Mendonça 2713* (BM). LUANDA DISTR.: 12 Dec. 1939, *Gossweiler 3624 b* (BM). MOÇÂMEDES DISTR.: prope Cavalheiros, July 1859, *Welwitsch 1824* (BM, K).

SOUTH WEST AFRICA. KAKOVELD RESERVE: Ombazu, 32 miles N. of Ohopoho on rd. to Swartboordsdrift, 28 May 1957, *de Winter & Leistner 5895* (K, PRE). KARIBIB DISTR.: Usakos, river bed, 15 Aug. 1919, *Pole Evans H 19303* (PRE). OUTJO DISTR.: bed of Ugab R. at Sorris-Sorris nr. Brandberg, 11 Apr. 1955, *de Winter 3151* (K, PRE). REHOBOTH DISTR.: in Kuiseb Namib, 6 July 1950, *Strey 2635* (K, PRE). WINDHOEK DISTR.: along Windhoek Swakop R., at farm Otjisewa, 28 Dec. 1947, *Wiss & Kinges 750* (PRE).

BECHUANALAND. NGAMILAND: Chobe Distr., near Nyungwe Hot Springs, 2 Aug. 1950, *Robertson & Elffers 100* (K, PRE, SRGH). SOUTH EASTERN PROV.: Mochudi, 1914, *Harbor 6610* (BOL, K, KMG, PRE).

ZAMBIA. BAROTSELAND: Caprivi Strip, Lisikili, 15 miles E. of Katima Mulilo, 17 July 1952, *Codd 7100* (K, PRE); SESHEKE DISTR.: Sesheke, *Gairdner 75* (K). CENTRAL PROV.: Zambesi valley, 3 miles downstream from Chirundu Bridge, 12 Aug. 1957, *Angus 1653* (FHO, K, PRE); LUSAKA DISTR.: Mt. Makulu, near Makulu stream, *Cole 16* (K). NORTHERN PROV.: riverine areas in Luangwa valley, 17 June 1957, *Savory 190* (K, SRGH); MPOROKOSO DISTR.: Lake Tanganyika at Sumbu, 6 July 1957, *Savory 200* (K, SRGH). SOUTHERN PROV.: CHOMA DISTR.: Lower Kariba valley, ? Saragongwe area, 14 May 1963, *Lawton 1072* (NDO); GWEMBE DISTR.: Vwa's village on Zongwe R., 1 Apr. 1952, *White 2388* (BM, FHO, K, NDO); LIVINGSTONE DISTR.: Livingstone, Mar. 1932, *Trapnell 1019* (K); MAZABUKA DISTR.: Monze, 15 Apr. 1963, *v. Rensburg K. B. S. 1923* (K); NAMWALA DISTR.: Maala, 20 miles E. of Namwala, 24 Apr. 1954, *Robinson 732* (K, NDO).



MALAWI. NORTHERN PROV.: Kondowe to Karonga, *Whyte s. n.* (K). SOUTHERN PROV.: at Shire R., 6 June 1938, *Pole Evans & Erens 576* (K, PRE, SRGH).

RHODESIA. BIKITA DISTR.: at pan, Sabi A Sec. Devuli Ranch, 24 July 1958, *Chase 6963* (BM, LISC, PRE, SRGH). BULAWAYO DISTR.: Kennedy Siding, 15 May 1953, *Hodgson 2/53* (SRGH). GWANDA DISTR.: Buby R. near Buby Ranch homestead, 3 May 1958, *Drummond 5543* (K, LISC, SRGH). LOWER SABIE DISTR.: W. bank, 2 Feb. 1948, *Wild 2488* (K). NDANGA DISTR.: Chitsa's kraal, 6 June 1950, *Wild 3369* (K, LISC, PRE, SRGH). NYAMANDHLOVU DISTR.: Gwaai Nature Reserve, Oct. 1959, *Armitage 110/59* (SRGH). SEBUNGWE DISTR.: Sisami R., rd. from Simkoma's to Gokwe, 12 Sept. 1949, *West 3029* (SRGH). URUNGWE DISTR.: confluence of Nyaodza and Sanyati rivers at Kariba, 23 July 1956, *McGregor 35/56* (K, LISC, SRGH).

MOZAMBIQUE. LOURENÇO MARQUES PROV.: entre Magude e Xinavane, 12 May 1941, *Torre 2647* (LISC). NIASA PROV.: Cabo Delgado, Macondes, entre Mueda e Nairoto, 20 Sept. 1948, *Barbosa 2227* (BM, K, LISC, PRE). SUL DO SAVE PROV.: nr. Limpopo R., Guijá to Mapai, 6 May 1944, *Torre 6581* (K, LISC, PRE). TETE PROV.: Mutarara, entre Ancuaze e Pandocane, 19 June 1949, *Andrada 1608* (LISC). ZAMBÉSIA PROV.: Massingire, região de Murire, 21 May 1943, *Torre 5349* (LISC).

TRANSVAAL. BARBERTON DISTR.: Barberton, Lebombo flats near Swazi border, Aug. 1926, *Keet 1495* (PRE). LETABA DISTR.: 50 miles N. of Gravelotte station on bank of Great Letaba R., 3 Aug. 1934, *Galpin 13533* (BOL, K, PRE). PIETERSBURG DISTR.: 20 miles N. of Pietersburg on Kalkbank rd., 4 Dec. 1946, *Story 1557* (PRE). POTGIETERSRUST DISTR.: 9 miles N. W. of Potgietersrust on rd. to Zaaiplaats, 5 June 1948, *Codd 4185* (K, PRE). ZOUTPANSBERG DISTR.: Chipese Hotspring on N. side of mts., 20 Dec. 1938, *Smuts & Gillett 4000* (SRGH).

NATAL. INGWAVUMA DISTR.: Ndumu Game Reserve, Usutu valley, 28 Aug. 1957, *Ward 3151* (NH, NU, PRE).

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SUMMARY

The history of *Acacia albida* Del. and the distributional range of the species in Africa were dealt with. The parameters obtained from a limited number of plants sampled in Natal, although insufficient to present detailed information of the range of morphological variation within, and among, populations, nevertheless formed a basis for further work and comparison. Herbarium specimens from the species range in Africa were examined and the nature of the morphological variation presented. The occurrence of BRENAN's two races within the species was discussed. No infraspecific categories are recognised within *A. albida*.

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**NOUVELLES ÉTUDES CARYOLOGIQUES
SUR LA SECTION *JONQUILLA* DC.
DU GENRE *NARCISSUS* L.**

par

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INTRODUCTION

LA caryologie de la section *Jonquilla* DC. du genre *Narcissus* L. a fait l'objet de deux de nos travaux antérieurs (FERNANDES, 1939a, b). Cependant, depuis 1939 jusqu'à ce jour, de nouvelles données ont été rassemblées concernant non seulement la caryologie d'une nouvelle espèce, *N. Fernandesii*, découverte au Portugal par GOMES PEDRO en 1947, mais aussi celle de quelques populations spontanées au Portugal de *N. jonquilla* L. et de *N. Willkommii* (Samp.) A. Fernandes (= *N. jonquilloides* Willk.) qui n'avaient pas encore été examinées. Particulièrement remarquable a été le résultat obtenu par l'étude d'une population de *N. Willkommii* trouvée aux alentours de Loulé, puisque cette étude nous a amené à faire la révision de ce que nous avons écrit (FERNANDES, 1939a) au sujet de l'origine de cette espèce.

D'autre part, avec HERBERT (1837), nous avons constaté que les caractères des graines des espèces de *Narcissus* présentaient des caractères qui pourraient être employés pour améliorer la classification du genre. Nous essayons donc ici à utiliser ces caractères en connexion avec les données caryologiques pour éclaircir la taxonomie du groupe.

De cette façon, ce travail a été envisagé dans le but d'amplifier et de corriger en quelques points nos deux travaux ci-dessus mentionnés.

MATÉRIEL ET TECHNIQUE

La liste ci-dessous, où les chiffres indiquent les numéros dans nos cultures, montre la provenance des plantes employées dans nos observations:

N. jonquilla L.

- N.^{os} 464, 1477, 1478 — Barca de Alva, lit et rives du fleuve Douro, dans les fentes des schistes remplies d'un sédiment aréno-argileux.
N.^o 1539 — Pr. Minas do Lousal, lit de la rivière Corona, dans les fentes des roches schisteuses.
N.^o 1541 — Entre Ferreira do Alentejo et Aljustrel, dans les fentes des roches schisteuses du lit de la rivière dite do Roxo.
N.^{os} 1554 à 1557 — Alentours de Castro Verde, pr. route Almodôvar-Castro Verde, dans les fentes des roches du lit et dans les herbages des rives de la rivière de Terres.

N. Willkommii (Samp.) A. Fernandes (= N. jonquilloides Willk.)

- N.^{os} 1528, 1551 et 1552 — Alentours de Loulé, auprès de la route Loulé-Barranco do Velho, sur sol marécageux argilo-calcaire très compact.

N. Fernandesii G. Pedro

- N.^o 489 — Vila Franca de Xira, alluvions du Tage, legit *Gomes Pedro*, 20.III.1943.
N.^{os} 556 et 583 — Ribatejo, Samora Correia, Monte da Adema, Pé de Galinha, sur sol argileux humide, legit *Bento Rainha*, 7.III.1946.
N.^{os} 1175, 1184 et 1531 — Ribatejo, pr. Estação do Caminho de Ferro de Reguengo, prairie humide.

Les bulbes, cultivés dans des pots au Jardin Botanique de Coimbra, nous ont fourni les méristèmes radiculaires et les anthères, matériaux sur lesquels nous avons fait nos observations.

Les préparations des pointes végétatives des racines ont été obtenues par l'emploi de la méthode classique de l'enrobage à la paraffine, en utilisant comme fixateur le liquide de Navachine (modification de Bruun). Les coupes transversales, d'une épaisseur de $18\ \mu$, ont été colorées au violet de gentiane.

Pour l'étude de la méiose des cellules-mères des grains de pollen, les anthères ont été fixées à l'alcool-acétique (3:1) et dissociées ensuite dans des gouttes de carmin-acétique. Les préparations ont été rendues permanentes au moyen de la technique décrite par LA COUR (1937).

OBSERVATIONS

1. *Narcissus jonquilla* L.

En 1939 (FERNANDES, 1939b), nous avons étudié la var. *Henriquesii* Samp. de cette espèce, ainsi que les formes horticoles connues sous les noms de *Jonquille simple odorante* et *Jonquille double odorante*, et nous avons constaté que toutes

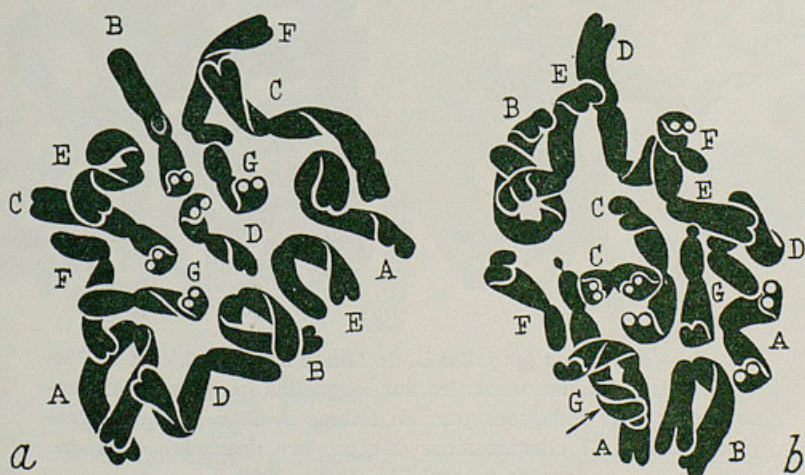


Fig. 1. — *Narcissus jonquilla* L. de Barca de Alva. a, Plaque équatoriale dans une cellule du méristème racinaire, montrant la garniture normale. b, Idem présentant un chromosome satellitifère (flèche) plus long que l'autre élément de la paire. Les 7 paires chromosomiques sont indiquées par les lettres A-G.

× ca. 3000.

ces plantes possédaient des idiogrammes semblables. Les 7 paires chromosomiques ont été alors décrites en détail (vide

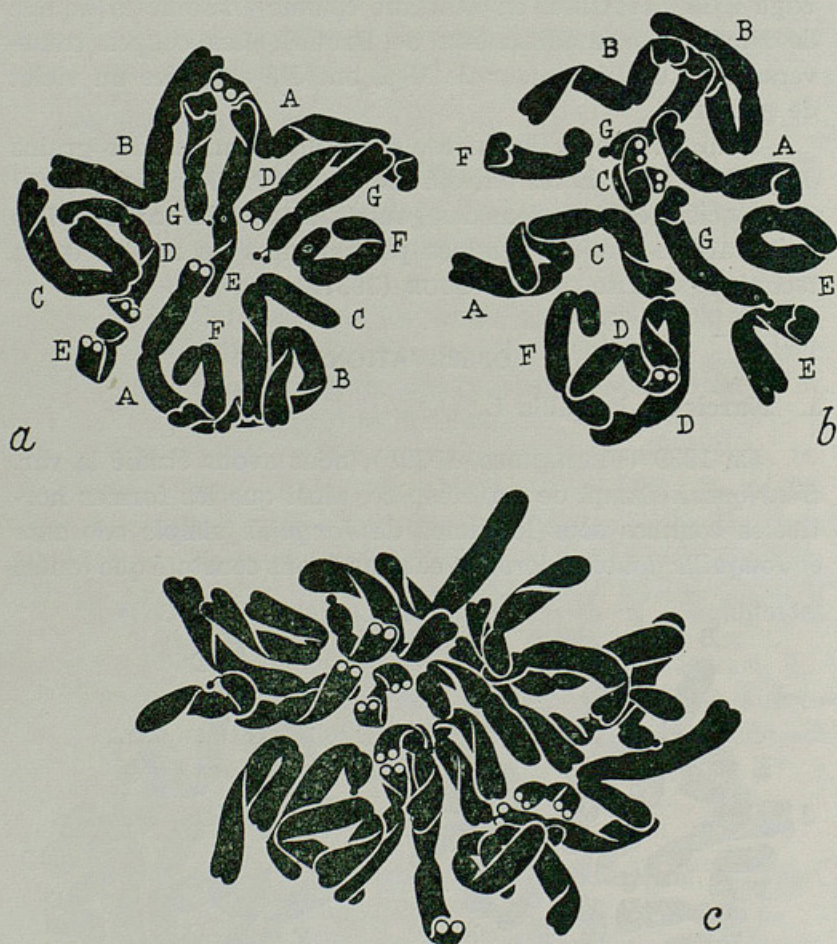


Fig. 2. — *Narcissus jonquilla* L. de Minas do Lousal. *a* et *b*, Plaques métaphasiques normales sur lesquelles les paires chromosomiques sont indiquées par les lettres A-G. *c*, Plaque tétraploïde (seuls 27 chromosomes ont pu être dessinés) dans une racine mixoploïde. $\times$ ca. 3000.

FERNANDES, loc. cit.: 496 et 497) et leur morphologie peut être traduite par la formule suivante: $2n = 14 = 2 \text{ Ll(A)} + 2 \text{ Ll(B)} + 2 \text{ Lm(C)} + 2 \text{ Lp(D)} + 2 \text{ li(E)} + 2 \text{ lp(F)} + 2 \text{ lp'(G)}$. Cette formule s'accorde avec celle établie par KURITA (1955).

L'étude des plantes de Barca de Alva (fig. 1a), Minas do Lousal (fig. 2a, b), rivière do Roxo (fig. 3a, b, c) et alentours

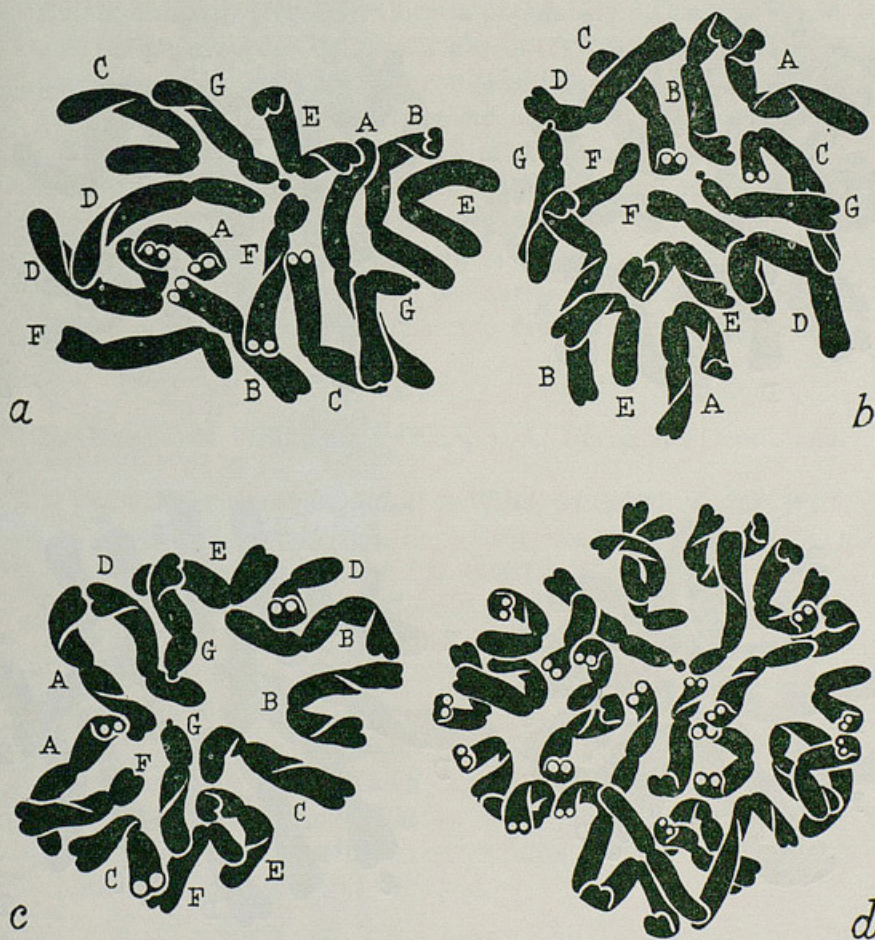


Fig. 3. — *Narcissus jonquilla* L. de la rivière do Roxo. a-c, Plaques équatoriales normales sur lesquelles les paires chromosomiques sont indiquées par les lettres A-G. Remarquer la variabilité de la taille des satellites. d, Plaque tétraploïde dans une racine mixoploïde. $\times$ ca. 3000.

de Castro Verde (fig. 4a, b, c) nous a montré qu'elles sont pourvues d'idiogrammes semblables à celui de la variété et des formes horticoles ci-dessus mentionnées.

Cependant, chez la population de Barca de Alva, nous avons rencontré une plante dont la paire satellitifère (G) était hétéromorphe, puisqu'un des éléments était bien plus



Fig. 4. — *Narcissus jonquilla* L. des alentours de Castro Verde. a-c, Plaques équatoriales normales sur lesquelles les paires chromosomiques sont indiquées par les lettres A-G. d, Plaque dans une plante pourvue d'un fragment. $\times$ ca. 3000.

long que l'autre (fig. 1b). Ce chromosome a été sans doute engendré par suite d'une translocation.

Chez la population de Minas do Lousal, nous avons identifié une plante possédant une racine mixoploïde dans laquelle les cellules tétraploïdes (fig. 2c) formaient une rangée verti-

cale située à peu près au milieu du périlème. Des racines mixoploïdes à cellules placées en files verticales à la périphérie du périlème ont été aussi rencontrées chez la population de la rivière do Roxo (fig. 3d). Chez la population de Castro Verde, une racine avec des cellules à garniture normale et d'autres pourvues d'un fragment chromosomique a été rencontrée (fig. 4d). Il semble que ce fragment possédait une constriction cinétique. Malgré cela, il était éliminé assez souvent pendant les mitoses. Quelques observations ont suggéré que ce fragment serait de nature hétérochromatique. Cependant, une conclusion définitive n'a pas été obtenue.

Des cas d'hétéromorphie des satellites (l'un plus gros et l'autre plus petit) ont été observés fréquemment chez toutes les populations (fig. 2b, 3a).

2. *Narcissus Willkommii* (Samp.) A. Fernandes, stat. nov.

Narcissus jonquilloides Willd. ex Schult. f. var. *Willkommii* Samp. in Bol. Soc. Brot. sér. 2, 7: 127 (1931); Fl. Portuguesa, ed. 2: 129 (1947).

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Narcissus jonquilla L., Sp. Pl. 1: 417 (1753) pro parte. — Brot., Fl. Lusit. 1: 551 (1804) pro parte.

Narcissus jonquilla L. var. *jonquilloides* (Willk.) P. Cout., Fl. Portugal, ed. 2: 168 (1939) excl. forma *Henriquesii* (Samp.) P. Cout.

L'étude de 150 individus de la population des alentours de Loulé nous a montré qu'elle était constituée seulement par des diploïdes, puisque nous n'avons réussi à rencontrer aucune plante polyploïde. L'examen de plusieurs plaques métaphasiques (fig. 5a, b, c) nous a montré 7 paires chromosomiques correspondant à celles que nous avons trouvées chez *N. jonquilla* L. L'idiogramme de ces deux espèces est donc semblable.

Bien que nous n'avons rencontré aucun polyploïde, des plantes avec des racines à secteurs tétraploïdes ont été iden-

tifiées. D'autre part, nous avons dénombré 15 chromosomes sur une plaque (fig. 5d) d'une racine, correspondant le surnuméraire probablement à un chromosome G. Par le fait

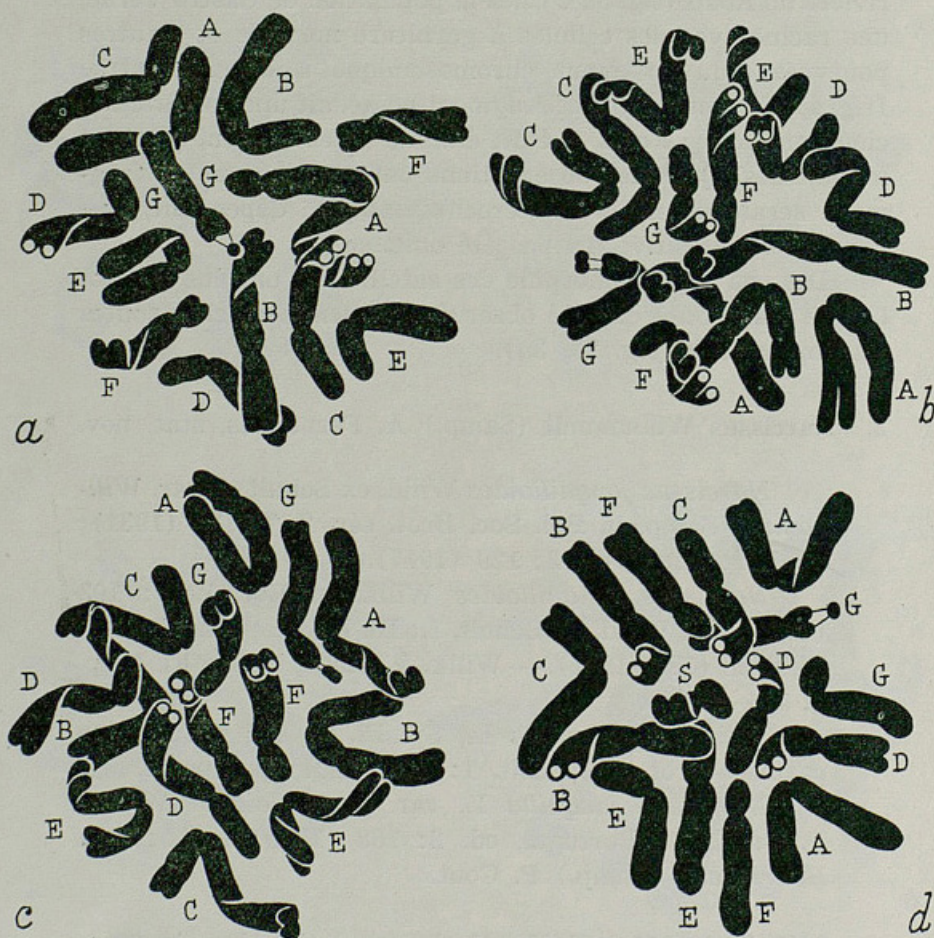


Fig. 5. — *Narcissus Willkommii* (Samp.) A. Fernandes. a-c, Plaques métaphasiques dans des cellules de méristèmes radiculaires, montrant 7 paires chromosomiques indiquées par les lettres A-G. d, Plaque à 15 chromosomes dont le surnuméraire semble être un chromosome G. $\times$ ca. 3000.

qu'une seule métaphase avec ce nombre a été identifiée dans la racine, nous croyons qu'elle a été engendrée par non-disjonction.

Des plaques montrant simultanément les deux satellites chez la paire G n'ont pas été observées.

Au diplotène et à la diacinèse, 7 bivalents ont été identifiés. Dans quelques-unes de ces figures, nous avons constaté l'existence de deux nucléoles, à chacun desquels un bivalent était attaché. Il semble donc qu'il y en aura dans cette espèce deux paires de chromosomes nucléolaires. Cependant, ce point n'a pas été éclairci.

La méiose découle presque sans anomalies, car nous avons trouvé 89 % de pollen bien conformé.

3. *Narcissus Fernandesii* G. Pedro

Cette espèce a été décrite par J. GOMES PEDRO en 1947. L'auteur a eu l'amabilité de nous faire parvenir des bulbes de sa récolte originelle, qui a eu lieu dans une localité dénommée Pé de Galinha, appartenant au Monte da Adema, situé aux alentours de Samora Correia. Nous avons dénombré 14 chromosomes (fig. 6a-d) dans les méristèmes radiculaires de ces plantes et une étude soigneuse nous a amené à conclure que l'idiogramme de cette espèce est semblable à celui de *N. jonquilla*. Tout d'abord, il nous a semblé que les paires A et B étaient isobrachiales, que la paire F possédait des bras plus longs et que la paire G était aussi plus longue, mais l'examen de plusieurs plaques et leur comparaison avec celles de *N. jonquilla* nous a montré que ces différences se trouvent comprises dans les limites de variation résultant d'un raccourcissement plus ou moins intensif provoqué vraisemblablement par les conditions de la fixation.

L'observation de plantes récoltées plus tard dans la même localité par BENTO RAINHA a amené GOMES PEDRO à ajouter à la description de l'espèce: «*planta haec variat statura robustiore, bulbo ad 15 mm lato, foliis ad 45 cm longis et versus basin latioribus (2-3,5 mm), scapo altiore (16-20 cm), crassiore (3-4,5 mm prope basin), spatha ad 4-floram, perigonio 24-30 mm longo*».

Dans les pointes végétatives des racines de ces plantes, nous avons dénombré 28 chromosomes. Il s'agit donc d'individus tétraploïdes, comme leurs plus grandes dimensions le

suggéraient déjà. Cependant, l'étude attentive des chromosomes nous a montré que, dans la plupart des plantes, en outre les chromosomes appartenant aux types trouvés chez

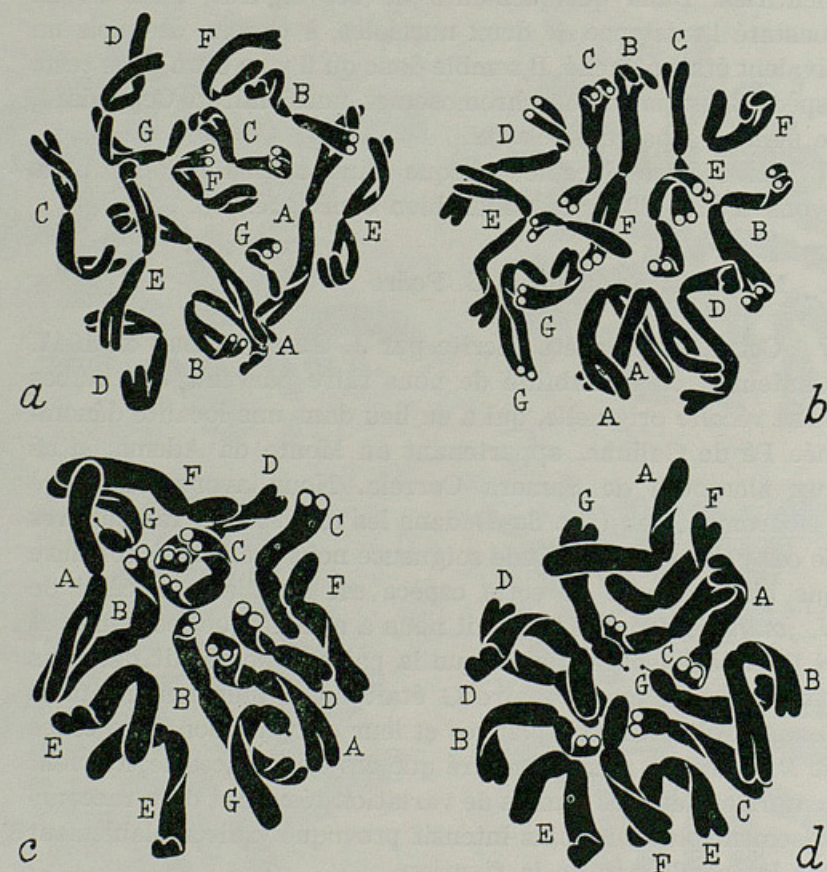


Fig. 6. — *Narcissus Fernandesii* G. Pedro. a-d, Plaques métaphasiques dans des cellules de méristèmes radiculaires de plantes appartenant à la récolte originelle de GOMES PEDRO. a et b, avec les chromosomes non raccourcis. c et d, avec les chromosomes raccourcis. Les paires sont indiquées par les lettres A-G.

× ca. 3000.

les diploïdes, il y avait 2 chromosomes MP, 2 Pp et 2 M. (les éléments indiqués par les flèches sur les figs. 7 et 9). Dans une plante de la même récolte, les éléments MP étaient substitués par des chromosomes satellitifères PP' et un chro-

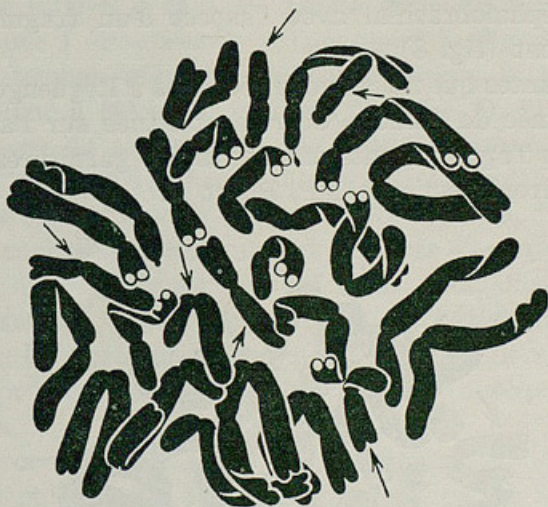


Fig. 7. — *Narcissus Fernandesii* G. Pedro. Plaque métaphasique dans une plante ramassée par BENTO RAINHA au Monte da Adema, montrant 28 chromosomes dont 2 MP, 2 Pp et 2 M. (flèches).

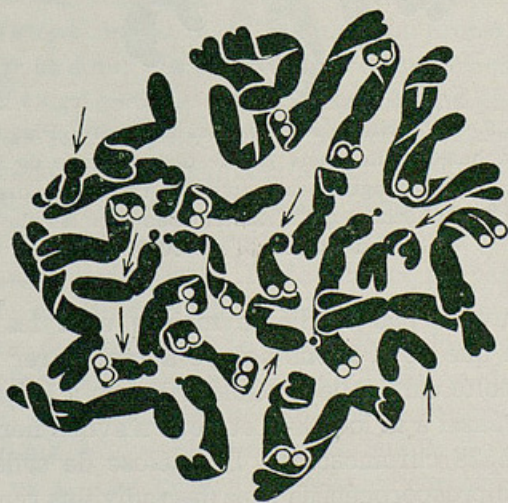


Fig. 8. — *Narcissus Fernandesii* G. Pedro. Plaque métaphasique dans une autre plante sur laquelle, en outre les éléments caractéristiques des diploïdes, on peut remarquer la présence de 2 PP', 2 Pp, 2 M. et 1 p. (fragment) indiqués par les flèches.

× ca. 3000.

mosome céphalobrachial avec l'aspect d'un fragment était aussi présent (fig. 8).

Les plantes que nous avons récoltées à Reguengo, localité assez éloignée de Samora Correia et située sur l'autre rive (droite) du Tage, présentaient toutes des garnitures (fig. 9) à paires chromosomiques MP, Pp et M.



Fig. 9. — *Narcissus Fernandezi* G. Pedro. Plaque métaphasique dans une plante des environs de la gare de Reguengo. Remarquer les types de chromosomes (flèches) qui n'existent pas chez les plantes diploïdes. $\times$ ca. 3000.

Nous n'avons pas étudié la méiose chez les diploïdes, puisque, bien que nous avons essayé à rencontrer la population où la récolte originelle de GOMES PEDRO a été faite, nous n'avons pas réussi à la localiser et nous n'avons herborisé que des plantes à 28 chromosomes. La méiose de celles-ci a été étudiée à la microsporogénèse chez des individus ramassés aux alentours de la gare de Reguengo. Nous avons constaté que, dans la plupart des cellules, les divisions réductrices découlaient d'une façon régulière, avec la formation de 14 bivalents. Ceux-ci ont été identifiés au diplotène, à la diacinèse (figs. 1 et 2, Pl. I), à la prométaphase (figs. 3 et 4, Pl. I) et à la

métaphase I (figs. 5 et 6, Pl. I). La disjonction normale de ces bivalents a été observée à l'anaphase I (fig. 7, Pl. I) et le comportement régulier des chromosomes à la division homéotypique a été aussi vérifié (figs. 8 et 9, Pl. I). Donc, de la méiose de ces cellules, des tétrades normales et des grains de pollen à 14 chromosomes en résultent.

Toutefois, la méiose n'a pas toujours lieu d'une façon normale, car nous avons mis en évidence l'existence d'irrégularités dans quelques cellules. Les anomalies résultent particulièrement de la cytomixie et de l'existence d'inversions dans les garnitures chromosomiques. Nous analyserons tout d'abord les irrégularités qui sont la conséquence de la cytomixie.

Le processus qui aboutit à la séparation des cellules-mères du pollen peut être achevé avant ou au moment du commencement de la méiose. Quand cela arrive, les pachytènes (fig. 1, Pl. II) se présentent avec un aspect normal et les cellules-mères subissent des divisions réductrices normales.

Quelquefois, cependant, dans quelques anthères ou dans quelques régions des sacs polliniques, le processus de cloisonnement peut subir des retards plus ou moins considérables, probablement par suite de certaines conditions physiologiques régnant dans le tissu sporogène. Il peut arriver aussi que, à cause, peut-être, de l'augmentation de la pression osmotique (voir KATTERMANN, 1932-33) dans le cytoplasme de certaines cellules, le noyau soit poussé vers la périphérie des cellules, comme la fig. 2, Pl. II, le montre au pachytène.

Dans le cas du délai de la formation de la cloison et la poussée des noyaux vers la périphérie des cellules avoir lieu simultanément dans une certaine région des loges des anthères, il pourra arriver que des portions de noyaux pénètrent dans le cytoplasme de la cellule ou des cellules adjacentes et y demeurer. Des images correspondant à ce phénomène ont été souvent observées au pachytène (figs. 1, 2 et 3, Pl. III).

Étant donné que la méiose avance et que le cloisonnage avance aussi, plusieurs cas pourront s'envisager, par le fait

que la séparation peut finir plus tôt ou plus tard ou n'avoir pas même lieu jusqu'à la fin de la méiose.

Dans le cas de la séparation n'être pas achevée au pachytène, la cloison avance à travers les filaments chromosomiques (figs. 1-3, Pl. III) qui subissent alors une distension plus ou moins considérable qui amène sans doute à leur rupture. Par suite de ce processus, la matière chromatique d'un noyau peut demeurer distribuée entre deux (cas le plus fréquent) ou parmi un nombre supérieur de cellules. Les portions chromatiques séparées du noyau et demeurant dans la cellule adjacente se transforment en des globules plus ou moins volumineux qui gagnent un aspect pycnotique (figs. 1 et 2, Pl. IV).

Par le fait que les chromosomes pachyténiques sont très longs, il est peu probable que des bivalents entiers puissent se passer d'une cellule dans les cellules voisines (fig. 3, Pl. III) si la formation de la cloison a lieu pendant ce stade. Toutefois, si cela arrive, ils continueront à être le siège des phénomènes de la méiose et ils pourront se déplacer et se mettre plus tard ensemble avec les autres bivalents de la cellule qu'ils ont envahi. On devra s'attendre à que les portions pourvues de centromères de bivalents fracturés se pourront comporter d'une façon comparable. Cependant, la distinction entre les bivalents et les fragments transférés dans les cellules adjacentes pendant le pachytène et les bivalents transférés pendant les stades ultérieurs n'est pas possible.

On trouve assez souvent au pachytène beaucoup de corpuscules pycnotiques situés près ou en contact avec les cloisons (figs. 1 et 2, Pl. IV). Ils correspondent sans doute à des portions de bivalents fragmentés qui seront résorbés plus tôt ou plus tard. Il est à remarquer que ces corpuscules peuvent se rencontrer aux stades plus avancés, comme par exemple aux diacinèses, placés vers la périphérie des cellules (fig. 1, Pl. V). Quelquefois, nous avons constaté leur présence non seulement à la périphérie, mais aussi à l'intérieur de quelques cellules (fig. 2, Pl. V).

Il est à présumer que les cellules ayant perdu de la chromatine contenant des gènes indispensables à la vie subiront la dégénérescence (fig. 2, Pl. V). Étant donné qu'il s'agit de

plantes tétraploïdes, le nombre de cellules dans ces conditions doit être inférieur à celui qui pourrait s'attendre chez un diploïde.

Il peut arriver qu'une partie d'un bivalent reste dans une cellule et l'autre dans la voisine, les deux portions demeurant reliées par des filaments traversant la cloison. Dans ces cas, comme MENDES & RIJO (1951) l'ont vérifié, les deux portions sont le siège des phénomènes de la méiose et elles peuvent toutes les deux atteindre l'aspect métaphasique. Il est probable que, par suite de l'attachement à la cloison, ces bivalents se transformeront plus tard en des micronoyaux qui seront résorbés.

La séparation complète des cellules peut n'avoir lieu que pendant le diplotène, la diacinèse ou même la métaphase II. Dans ces cas, des bivalents d'une cellule peuvent se trouver dans le cytoplasme d'une adjacente et la cloison passer au delà de ces bivalents, à travers une région où aucun chromosome ne se trouve placé. Au moyen de ce processus, une cellule gagne des bivalents et l'autre les perd. Ainsi, le diplotène avancé de la fig. 3, Pl. V, montre 16 bivalents, les diacinèses des figs. 4 et 5, Pl. V, présentent 15 et les métaphases I des figs. 6, 7, 8 et 9, Pl. V, possèdent, respectivement, 15, 15, 16 et 16. Sur les figs. 6 et 7, Pl. V, les bivalents issus des cellules voisines ont pu être identifiés, puisqu'ils se trouvaient encore près de la périphérie des cellules. L'identification n'a pas été possible sur les autres figures.

Des images à nombres chromosomiques plus élevés que 14 ont été aussi trouvées aux anaphases I et II (figs. 1 et 2, Pl. VI).

Dans d'autres cas, la cloison peut passer même à travers les bivalents et ceux-ci subissent alors une distension plus ou moins considérable qui peut amener à leur despiralisation (figs. 3 et 4, Pl. VI) ou à leur rupture (fig. 1, Pl. VII). Un cas remarquable est montré sur la fig. 2, Pl. VII, qui correspond à un début d'anaphase I, où on peut voir un bivalent situé dans la région de la cloison et qui a été endommagé par celle-ci sans doute avant ce stade. Néanmoins, ce bivalent accompagne les autres dans les modifications de l'aspect et dans les mouvements anaphasiques.

La rupture des chromosomes ayant lieu pendant les stades de la prophase méiotique est mise en évidence par l'apparition de ponts non accompagnés de fragments soit à l'anaphase I (fig. 3, Pl. VII), soit à l'anaphase II (figs. 4 et 5, Pl. VII). Le pourcentage de ces ponts a été de 0,56 % à l'anaphase I et de 4,57 % à l'anaphase II. Le pourcentage plus élevé de ponts à l'anaphase II pourra peut-être signifier que le plus souvent un seul chromosome du bivalent est coupé.

L'anaphase II montrée sur la fig. 6, Pl. VII, est sans doute digne de remarque. On voit, dans une des cellules, deux chromatides inégaux s'acheminant vers les pôles, tandis qu'un fragment, correspondant à la partie qui manque au chromatide plus court, se situe dans l'autre cellule, un peu au delà de la région où la cloison va se former. Cette image pourrait être engendrée par suite de la rupture d'un seul des 4 chromatides d'un bivalent. Cependant, un autre mécanisme pourra être envisagé: rupture de deux chromatides non frères suivie de la formation de pont accompagné de fragment à l'anaphase I, ensuite rupture du pont à la télophase I et, finalement, séparation des deux paires de chromatides inégaux à l'anaphase II (il faut admettre que, dans la cellule située à droite, les chromatides, aussi inégaux, ont été déjà incorporés dans les noyaux-fils). Soit dans la première, soit dans la deuxième hypothèse, nous devons supposer que la rupture du chromatide ou des deux chromatides non frères a été faite de telle façon, que le fragment ou les fragments dépourvus de centromère ont demeuré dans la cellule à laquelle appartenait le bivalent.

Nous croyons plus probable la première explication, car il est plus facile de concevoir le processus au moyen duquel un chromatide a été coupé en demeurant le fragment au dedans de la même cellule. En effet, il suffit d'admettre que le bivalent était courbé vers l'intérieur à la limite de la cellule et que seul un chromatide a été rompu par la cloison.

L'anaphase II représentée sur la fig. 7, Pl. VII, montre un pont court, accompagné de chromatides longs égaux, dans une cellule et un fragment acinétique dans l'autre. Comme dans le cas antérieur, deux hypothèses pourront aussi être suggérées dans le but d'expliquer la formation de cette image:

1) clivage de deux chromatides frères par la cloison, dans une position telle que le fragment¹ a demeuré dans la cellule à laquelle appartenait le bivalent rompu; 2) crossing-over dans une inversion située sur le bras plus court d'un chromosome.

Lorsque la formation de la cloison devient tardive, des groupes de cellules (syncytia) se trouvent soit à la diacynèse (figs. 1, 2 et 3, Pl. VIII), soit à la métaphase I (fig. 4, Pl. VIII; fig. 1, Pl. IX), soit même à l'anaphase II (figs. 2 et 3, Pl. IX). Quelquefois, les cellules du syncytium sont en synchronisme (figs. 1-4, Pl. VIII; figs. 1 et 3, Pl. IX), mais, dans quelques cas, le synchronisme n'a pas lieu (figs. 2 et 4, Pl. IX). La fig. 3, Pl. VIII montre trois cellules reliées à la diacynèse, mais on peut constater que le mécanisme de la formation des cloisons avance. On remarque, particulièrement dans la cellule inférieure à droite, des portions chromosomiques placées tout près de la paroi, qui ont été engendrées par suite de la rupture de chromosomes survenue aux stades antérieurs. On peut remarquer aussi que ces portions, bien que correspondant à des parties de chromosomes, présentent un aspect comparable à celui des chromosomes intacts. Étant donné le trajet suivi par les cloisons, chacune des cellules, même celle à gauche dans laquelle un des bivalents est assez écarté des autres, demeurera avec 14 bivalents. Quelquefois, cependant, lorsque la cloison se développe au delà d'un chromosome ainsi placé, une cellule gagnera un bivalent et l'autre le perdra (fig. 1, Pl. VIII). Ce qui arrive avec un bivalent peut arriver avec un nombre plus grand et, de cette façon, on comprend l'apparition de figures à 15 et à 16 bivalents (voir ci-dessus). Il est évident que ces cellules pourront engendrer des grains de pollen avec ces mêmes nombres chromosomiques.

La fig. 2, Pl. VIII, montre aussi trois cellules reliées à la diacynèse, mais ici la séparation est plus proche de s'accomplir. Un des bivalents de la cellule supérieure a été saisi par la cloison et il sera probablement laissé au dehors de la

¹ Nous ne devons pas oublier que, dans ce cas, le fragment pourrait résulter d'un autre chromosome, appartenant soit à la même cellule, soit à une autre adjacente.

cellule qui demeurera seulement avec 13 bivalents. Il est à remarquer que, malgré sa situation, le bivalent se présente avec un aspect comparable aux autres qui sont au dedans des cellules.

En outre les irrégularités décrites, d'autres ont été encore trouvées. Ce sont des ponts à l'anaphase I accompagnés de fragments. Deux types ont été identifiés: ponts longs accompagnés de fragments très courts (fig. 1, Pl. X) et ponts longs accompagnés de fragments à taille moyenne (figs. 2, 3 et 4, Pl. X). Des ponts accompagnés de fragments ont été aussi identifiés à l'anaphase et à la télophase II (fig. 5, Pl. X).

Bien qu'il s'agit de plantes à nombre chromosomique tétraploïde, nous n'avons pas réussi à identifier avec certitude des trivalents ou des tétravalents. Cependant, il est probable que ces associations se formeront, bien que très rarement. D'accord avec ce point de vue, nous avons trouvé une anaphase I montrant une image qui semble correspondre à la ségrégation d'un trivalent (fig. 6, Pl. X).

Une seule métaphase I à deux univalents petits a été rencontrée (fig. 7, Pl. X). Ces univalents se comportent de la façon bien connue (fig. 8, Pl. X). Il est probable que, quelquefois, des univalents soient aussi formés par les chromosomes longs. Ils peuvent se diviser à l'anaphase I (fig. 1, Pl. XI) et apparaître comme des retardataires à l'anaphase II (fig. 2, Pl. XI). Parfois, nous ne savons pas si les retardataires, comme ceux montrés sur la fig. 3, Pl. XI, correspondent à des univalents qui se sont divisés à la première division ou à des fragments. Des fragments indubitables ont été quelquefois observés à la télophase II (fig. 4, Pl. XI).

Un chromosome d'une longueur tout à fait extraordinaire a été identifié dans une anaphase II (fig. 5, Pl. XI). Il est probable qu'il ait été engendré par suite de translocation survenue après la rupture de deux chromosomes fracturés par la cloison.

DISCUSSION

Bien que nous ayons étudié beaucoup d'individus appartenant à plusieurs populations, nous n'avons réussi à trouver aucune plante polyploïde chez *N. jonquilla* L.

En écrivant la notice qui accompagne la planche 159 des Liliacées de REDOUTÉ, DE CANDOLLE (1807) remarque que cette espèce, bien qu'elle ait engendré des formes à fleur double, a peu varié dans la culture et la même constatation est faite par BOWLES (1934). Ce manque de variabilité pourra être en rapport avec le manque de polyploïdie qui caractérise aussi d'autres espèces du genre, telles que *N. triandrus*, *N. scaberulus*, *N. rupicola*, *N. calcicola*, *N. Watieri* et *N. gaditanus*. Cependant, on constate que la polyploïdie est très fréquente chez *N. bulbocodium* ($x = 7$), *N. pseudonarcissus* ($x = 7$), *N. tazetta* ($x = 5$), etc., espèces qui sont extrêmement polymorphes, formant des complexes dont la taxonomie est très difficile à éclaircir.

Il semble donc qu'il y a chez le genre *Narcissus* des espèces qui supportent très bien la polyploïdie, tandis que d'autres ne la supportent pas. Peut-être s'agit-il d'une condition génétiquement contrôlée, comme RESENDE (1949) l'a suggéré chez les *Aloineae* à propos du genre *Aloe*.

Le manque de variabilité de *N. jonquilla* est mis en évidence par le fait que peu de taxa infraspécifiques ont été distingués. En ce qui concerne le Portugal, SAMPAIO (1901, 1931) a décrit la var. *Henriquesii*, caractérisée, d'après l'auteur, par le bulbe petit, feuilles de 1-2 mm larges et périanthe à tube très étroit et à couronne d'hauteur égale ou supérieure à $\frac{1}{3}$ de la longueur des tépales.

SAMPAIO (loc. cit.: p. 127) attribue à cette variété des plantes récoltées à Castelo de Vide et à Torrão et indique l'Alentejo comme aire de distribution de cette variété. Les plantes que nous avons ramassées sur les lits des rivières Corona (pr. Minas do Lousal), do Roxo (entre Ferreira do Alentejo et Aljustrel) et rivière de Terres (environs de Castro Verde) possèdent des feuilles plus larges (jusqu'à 4 mm), plus canaliculées et plus rigides que celles de la rivière Xarama (Torrão). De cette façon, les plantes des trois premières localités appartiennent plutôt au type de l'espèce qu'à la var. *Henriquesii*. Il est donc probable que les spécimens mentionnés par ROZEIRA et MALATO-BELIZ (1956) — rives du fleuve Corona, entre Beja et Serpa et Castro Verde — correspondent aussi à la var. *jonquilla*.



Les fleurs sont un peu variables quant aux dimensions et au degré d'imbriqué des divisions périgonales, hauteur et forme de la couronne. Nous n'avons pas remarqué des différences entre les fleurs de la var. *Henriquesii* et celles du type.

Le *N. Willkommii* se distingue nettement de *N. jonquilla*, puisque chez la première espèce le diamètre du périgone est moindre, les tépales sont plus petites, le tube est beaucoup plus court et la couronne est proportionnellement plus haute.

N. Willkommii rappelle la var. *Henriquesii* de *N. jonquilla* en ce qui concerne les feuilles, puisque celles-ci sont presque cylindriques et assez étroites chez les deux taxa. Cependant, elles s'en distinguent par sa couleur qui est d'un vert glauque chez le premier et d'un vert foncé chez le deuxième. D'autre part, on constate que l'habitat des deux espèces n'est pas le même, car *N. jonquilla* croît entre les fentes des pierres des lits des rivières, tandis que *N. Willkommii* croît dans les terrains argilo-calcaires marécageux.

Dans sa «Flora de Portugal», PEREIRA COUTINHO (1939) considère *N. Willkommii* (= *N. jonquilloides* Willk.) comme variété de *N. jonquilla* L. et la var. *Henriquesii* Samp. de cette dernière espèce comme forme de la var. *jonquilloides*. D'après les différences que nous venons de signaler, on constate que les points de vue de PEREIRA COUTINHO ne peuvent pas se maintenir.

Étant donnée l'analogie morphologique et caryologique existante entre *N. jonquilla* et *N. Willkommii* et encore que la deuxième espèce habite dans le bord de l'aire de la première, nous considérons très vraisemblable l'idée de que *N. Willkommii* est issu de *N. jonquilla*.

En 1931, Monsieur F. A. MENDONÇA, ancien naturaliste à l'Institut Botanique de Coimbra, a récolté en Algarve, aux environs de Silves, un Narcisse qui a été identifié comme *N. jonquilloides* Willk. En étudiant les chromosomes somatiques et la méiose, nous avons été amenés à conclure (FERNANDES, 1939a, b) que ces plantes étaient des hybrides issus du croisement d'un gamète diploïde de *N. jonquilla* avec un autre haploïde de *N. gaditanus*, puisque nous avons identifié dans les plaques métaphasiques de leurs méristèmes radi-



culaires 21 chromosomes, dont 14 correspondaient à deux garnitures de *N. jonquilla* et 7 à une de *N. gaditanus*. La méiose, que nous avons étudié en détail (FERNANDES, 1939a), nous a montré, le plus souvent, 7 bivalents et 7 univalents à la diacinèse et à la métaphase I. Quelquefois, des trivalents ont été observés. Par suite de la formation d'univalents et de trivalents, le cours de la méiose était irrégulier et l'analyse du pollen a mis en évidence qu'à peu près 40 % des grains étaient dégénérés (fig. 2, Pl. XII).

Étant donné l'identification des trois garnitures chromosomiques, le cours de la méiose et le fait que les plantes avaient été déterminées comme *N. jonquilloides* Willk., nous avons admis que cette espèce avait été engendrée au moyen du croisement d'une forme tétraploïde de *N. jonquilla* et d'une forme diploïde de *N. gaditanus*. La distribution géographique des trois taxa était aussi d'accord avec ce point de vue.

Au début du printemps de 1964, nous avons fait une exploration botanique à travers l'Alentejo et l'Algarve dans le but de ramasser des Narcisses. Toutes les tentatives faites afin de rencontrer la localité où Monsieur MENDONÇA a herborisé les plantes à Silves ont échoué. De même, nous n'avons réussi à trouver aucune population de *N. gaditanus*.

Heureusement, Monsieur JORGE PAIVA, actuel naturaliste à l'Institut Botanique de Coimbra, avait rencontré l'année précédente, aux alentours de Loulé, une colonie d'un *Narcissus* dont il nous a signalé l'existence et procuré des bulbes. Nous nous sommes rendus à la localité indiquée et nous avons eu l'opportunité de pouvoir examiner une très jolie population d'un Narcisse qui, d'après les caractères de la morphologie externe, correspondait à la description du *N. jonquilloides* Willk. L'étude caryologique nous a montré qu'il s'agissait d'une plante diploïde à 14 chromosomes (voir ci-dessus), pourvue d'une garniture semblable à celle de *N. jonquilla*.

Étant donné les ressemblances entre les plantes de Silves et celles de Loulé et que, d'après la description de WILLKOMM, les deux populations pourraient être rangées dans la même espèce, le problème suivant s'est posé: quelles sont en réalité

les plantes correspondant à l'espèce de WILLKOMM? Les diploïdes ou l'hybride?

Dans le but de résoudre ce problème, nous avons examiné le pollen du type de l'espèce de WILLKOMM conservé à l'herbier de Coimbra, celui des plantes de Loulé et celui des plantes de Silves. Les résultats obtenus ont été les suivants:

	Grains parfaits
Type de l'espèce de WILLKOMM	92,2 %
Plantes de Loulé	89 % (fig. 1, Pl. XII)
Plantes de Silves	60 % (fig. 2, Pl. XII)

Ces résultats montrent, d'une façon assez nette, que sont les plantes de Loulé celles qui correspondent au type de l'espèce de WILLKOMM. Celle-ci est donc un taxon diploïde et pas un hybride.

Les plantes de Silves représentent en réalité un hybride de *N. Willkommii* (= *N. jonquilloides* Willk.) et *N. gaditanus*. Par le fait qu'elles possèdent deux garnitures de *N. Willkommii* et une seule de *N. gaditanus*, il y a dominance des caractères de la première espèce, ce qui a amené MENDONÇA à identifier l'hybride comme *N. Willkommii*. L'influence de *N. gaditanus* ne se manifeste que sur les feuilles qui sont plus grêles et d'un vert plus foncé.

Il y a donc en l'Algarve l'hybride

***N. Willkommii* × *gaditanus*, hyb. nov.**

Ad *N. Willkommii* accedit, sed a foliis cylindricis, angustioribus (usque ad 2 nec 2-2,5 mm latis) et atro-viridibus differt.

Habitat pr. Silves, in paludosis, 1931, *Mendonça* s. n. (COI, holotypus).

Au Jardin Botanique de Coimbra, où elle est cultivée depuis 1931, la plante s'est manifesté stérile et elle produit peu de fleurs. Cependant, elle se multiplie intensivement par la formation de caïeux.

Comme nous l'avons remarqué, nous n'avons réussi à trouver qu'une seule population de *N. Willkommii* et nous avons constaté qu'elle était constituée seulement par des indi-

vidus diploïdes. Nous ne savons donc pas s'il y a chez cette espèce des formes polyploïdes. Si ces formes n'existent pas, l'hybride a été engendré au moyen de la copulation d'un gamète à $2n$ chromosomes issu d'une plante diploïde de *N. Willkommii* avec un gamète haploïde de *N. gaditanus*. S'il y a des populations ou tout au moins des individus tétraploïdes de la première espèce, l'hybride pourrait avoir comme un de ses parents une plante tétraploïde de *N. Willkommii*.

Étant donné l'analogie entre *N. Willkommii* et *N. jonquilla*, il est probable que des formes polyploïdes n'existent pas aussi chez la première espèce. De cette façon, nous considérons la première hypothèse la plus probable.

Chez *N. Fernandesii*, des formes diploïdes et d'autres à $2n = 28$ existent à l'état spontané. Les premières semblent être rares, puisque nous n'avons pas réussi à les trouver, tandis que des populations tétraploïdes ont été rencontrées à plusieurs reprises. Il est donc probable que les formes tétraploïdes, mieux adaptées aux conditions du milieu, termineront par substituer les diploïdes qui seraient en voie d'extinction.

La comparaison de l'idiogramme des formes diploïdes avec celui des tétraploïdes montre l'existence chez les dernières de types chromosomiques qui n'existent pas à l'état diploïde. D'autre part, nous avons constaté qu'il y avait sous ce point de vue deux types de plantes: celles à $2n = 28$ dans lesquelles les chromosomes nouveaux étaient 2 Mp, 2 Pp et 2 M. et celles à $2n = 29$ dans lesquelles ces chromosomes étaient 2 PP', 2 Pp, 2 M. et 1 p. (ce dernier élément était un fragment pourvu de centromère, mais, malgré cela, il était éliminé assez souvent et, par ce fait, il n'a été rencontré que sur peu de figures).

Il est à remarquer aussi que la méiose a lieu avec la formation presque constante de 14 bivalents. Ce fait et celui rapporté ci-dessus, concernant l'existence de types chromosomiques différents de ceux existant à l'état diploïde, sembleraient montrer que nous étions en présence d'un amphidiploïde.

Cependant, étant donné que les plantes à $2n = 28$ ne s'écartent des diploïdes que par les plus grandes dimensions, c'est à dire par des caractères quantitatifs, et que nous ne

pouvons pas reconnaître parmi les 28 chromosomes une garniture correspondant à celle de la forme diploïde de *N. Fernandesii* et une autre appartenant à quelque autre espèce, nous sommes amenés à conclure que les formes à $2n = 28$ ne sont pas des amphidiploïdes. À notre avis, les diploïdes ont engendré des tétraploïdes qui, à son tour, ont donné origine aux plantes trouvées. Il nous faut donc éclaircir les processus au moyen desquels les nouveaux types de chromosomes ont pris naissance.

La cytomixie qui, d'après GATES (1911), consiste dans le passage de la chromatine d'une cellule-mère du pollen à travers des connexions cytoplasmiques dans une cellule adjacente¹, est un phénomène bien connu (voir VAARAMA, 1941; LÖVE, 1944; TISCHLER, 1951; MENDES & RIJO, 1951; SARVELLA, 1958; DE NETTANCOURT & GRANT, 1964; etc.).

D'après quelques auteurs (ROSENBERG, 1909; SAKAMURA, 1916; YASUI, 1921; SINÔTO, 1922; BÖCHER, 1938; MESQUITA-RODRIGUES, 1954; LINNERT, 1955; etc.), la cytomixie résulterait d'un artifice dû à l'action des liquides fixateurs. D'autres (DIGBY, 1909, 1910; WEST & LECHEMERE, 1915; GATES & REES, 1921; CAMPIN, 1925; CHURCH, 1919; KATTERMANN, 1932-33; MENSINKAI, 1939; MÜNTZING & PRAKKEN, 1941; VAARAMA, 1941; MENDES & RIJO, 1951; SARVELLA, 1958; KAMRA, 1960; DE NETTANCOURT & GRANT, 1964; etc.), par contre, la considèrent comme un phénomène ayant lieu dans les conditions naturelles, bien qu'elle puisse être influencée par les facteurs du milieu, en particulier par les variations de la température (INARIYAMA, 1929). D'après KATTERMANN (1932-33), la cytomixie peut être provoquée soit par l'endommagement des organes au moyen de blessures, soit par l'action des fixateurs, soit par l'action de la température, soit encore par les conditions internes des plantes (pression osmotique, inactivation du tapetum, irrégularités dans l'équilibre électrostatique, action d'hormones, etc.). MÜNTZING & PRAKKEN (1941) ont constaté que, chez *Secale*, la cytomixie peut avoir

¹ Par extension, on donne à présent ce nom à la migration de chromatine d'une cellule quelconque dans une autre contiguë, quel que soit le tissu.

une intensité plus grande dans quelques fleurs ou même dans quelques anthères ou loges que dans d'autres. Nous avons fait des constatations semblables chez *N. Fernandesii* et nous avons vérifié même que le phénomène est plus ou moins fort selon les régions des loges des anthères. Nous croyons donc, avec INARIYAMA (1929) et KATTERMANN (1932-33), que la cytomixie peut résulter de l'action soit de facteurs du milieu ambiant, soit de facteurs internes, parmi lesquels la pression osmotique doit jouer un rôle important, puisque les images du pachytène des régions des loges où la cytomixie est plus intense montrent les noyaux poussés contre la périphérie des cellules.

Chez *Hordeum*, KAMRA (1960) a constaté que le pourcentage des cellules-mères du pollen subissant la cytomixie varie selon les lignées, ce qui semble montrer que le phénomène peut être influencé par la constitution génétique des plantes. D'autre part, on constate aussi, d'après la liste de KAMRA (1960), que le phénomène est fréquent chez les hybrides.

Le fait qu'on trouve chez *N. Fernandesii* des diacinèses et des métaphases I à 15 et à 16 bivalents, ainsi que des anaphases II à 15 chromosomes et, encore, l'apparition de ponts non accompagnés de fragments aux anaphases I et II témoignent, d'une façon assez nette, que la cytomixie est un phénomène qui a lieu dans les conditions naturelles (voir aussi MÜNTZING & PRAKKEN, 1941; MENDES & RIJO, 1951; SARVELLA, 1958; KAMRA, 1960).

MESQUITA-RODRIGUES (1954) remarque qu'il n'a jamais observé des irrégularités qu'on devrait attendre si la cytomixie aurait de la réalité. Cependant, il pourra arriver que, chez *Cistus Palhinhae*, l'espèce étudiée par l'auteur, les écarts de l'état normal amènent à la mort des cellules, raison par laquelle il n'a pas observé des irrégularités.

SARVELLA (1958) et KAMRA (1960) signalent que, bien que la cytomixie puisse avoir lieu plus fréquemment à la prophase, elle a été mise en évidence aussi à des stades ultérieurs. Nos observations confirment celles des deux auteurs ci-dessus mentionnés.

En ce qui concerne le mécanisme de la cytomixie, nous avons déjà mentionné que GATES (1911) attribuait le phénomène à la migration de la chromatine à travers les connexions cytoplasmiques et ce point de vue a été suivi par la majorité des auteurs.

Après avoir étudié le phénomène chez *Aloe*, MENDES & RIJO (1951) sont amenés à considérer la cytomixie comme «an effect of spontaneous chromatic agglutination leading to the formation of anaphasic inter-polar connections (pseudo-bridges, bridges by asymmetric distension and bridges by fusion) which do not break down during the differentiation of the membrane that isolates P. M. C. immediately before meiosis begins».

Cette hypothèse a été déjà critiquée par SARVELLA (l. c.: pag. 21). Aux arguments invoqués par cet auteur, nous pourrions ajouter encore celui soulevé par l'observation des figs. 3, 4 et 6 de MENDES & RIJO qui montrent des bivalents constitués par deux parties, une au dedans de la cellule et l'autre au dehors, reliées par deux filaments minces. D'après l'hypothèse de MENDES & RIJO, les parties qui demeureraient dans la cloison et dans la cellule adjacente devraient, par suite de la formation de pseudo-ponts, ponts, etc., présenter un aspect d'univalents, puisqu'on ne peut pas comprendre facilement comme ces parties pourraient s'accoupler avec leurs homologues. Le fait que les parties placées soit dans les cellules adjacentes, soit au dehors des cellules présentent des aspects de bivalents, c'est à dire des aspects semblables à ceux des bivalents qui ont persisté toujours à l'intérieur des cellules, montre que le passage de la cloison ou bien le mécanisme de la séparation des cellules-mères a eu lieu tout au moins au pachytène et non pendant la division pré-méiotique.

MESQUITA-RODRIGUES (1954) remarque que, chez *Cistus Palhinhae*, il y a assez souvent un retard de la formation de la cloison après la division qui amène à la formation des cellules-mères du pollen, de telle façon que quelques cellules persistent reliées par des connexions qui peuvent être plus ou moins larges. Chez *N. Fernandesii*, nous avons constaté le même phénomène. Par suite donc du délai de la formation

de la cloison, il y a assez souvent de larges connexions entre les cellules qui peuvent être occupées par des portions de noyaux qui sont ensuite séparées (coupées ou non) par l'action de la cloison. Les cellules peuvent se séparer plus tôt ou plus tard et des cas ont été trouvés dans lesquels les liaisons persistaient encore à la télophase II. Le point de vue de SARVELLA, d'après lequel «Cytomixis in cotton appears to be a mechanical process which depends on defective cell wall formation» est exact, mais les défauts de la formation de la cloison avaient été déjà mis en évidence par MESQUITA-RODRIGUES.

Quelques auteurs (v. BÖCHER, 1950 et littérature citée; FERNANDES & MESQUITA, 1963) ont décrit l'apparition de syncytia à la méiose des cellules-mères du pollen. Dans les syncytia, les groupes chromosomiques correspondant à chaque cellule peuvent se maintenir séparés. Quelquefois, cependant, des chromosomes appartenant à une certaine cellule peuvent se déplacer et se joindre aux groupes correspondant à d'autres cellules. Dans ces cas, des nombres aneuploïdes de chromosomes en résultent. Plus souvent, les fuseaux se fusionnent et alors des groupes à nombres chromosomiques doubles, triples, quadruples, etc. s'engendrent. De cette façon, les syncytia sont souvent responsables de l'apparition de gamètes aneuploïdes ou polyploïdes.

D'après KATTERMANN (1932-33), la cytomixie peut amener aux résultats suivants: 1) formation de cellules hypoploïdes qui en général dégénèrent; 2) formation de corpuscules de chromatine qui dégénèrent dans le cytoplasme; 3) formation de cellules syndiploïdes; et 4) fragmentation de chromosomes.

MENDES & RIJO (1951) signalent la résorption des masses pycnotiques, la digestion des portions des chromosomes incluses dans les parois cellulaires et la conséquente formation de ponts par suite de la rupture, ainsi que la formation de déficiences et de duplications.

En combinant les conclusions obtenues par KATTERMANN (1932-33) et MENDES & RIJO (1951) avec les résultats de nos observations, nous pourrions dire que les conséquences de la

cytomixie dans les cellules-mères du pollen peuvent être les suivantes:

- 1) Augmentation du nombre de bivalents.
- 2) Diminution du nombre de bivalents.
- 3) Formation d'univalents.
- 4) Formation de fragments chromosomiques plus ou moins longs qui peuvent persister dans les cellules ou bien dégénérer plus tôt ou plus tard dans le cytoplasme ou au dehors des cellules.
- 5) Formation de ponts soit à l'anaphase I, soit à l'anaphase II, par suite de la rupture des chromosomes.
- 6) Production d'altérations structurelles des chromosomes (déficiences, duplications, inversions et translocations) en conséquence des ruptures de types divers (de chromosomes ou de chromatides) qui peuvent survenir soit au leptotène, soit aux états ultérieurs de la méiose.
- 7) Formation de chromatides inégaux.
- 8) Formation de syncytia constitués par un nombre plus ou moins élevé de cellules, accompagnée ou non de la réunion de groupes chromosomiques.
- 9) Dégénérescence de chromosomes qui peuvent demeurer au dehors des cellules.
- 10) Dégénérescence de cellules qui ont perdu de la chromatine indispensable à leur vie.

Les cellules affectées par la cytomixie sont sans doute soumises à une rigoureuse sélection et le plus souvent seules les cellules normales pourront survivre. Ceci explique le fait que les anomalies attendues soient peu fréquentes aux derniers stades de la méiose. Les résultats de MESQUITA-RODRIGUES (1954) chez *Cistus Palhinhae* peuvent trouver une explication dans cette particularité.

Si nous admettons que la cloison coupe les chromosomes de telle façon que les portions dépourvues de centromères demeurent au dehors des cellules, nous devrions attendre à voir apparaître des ponts non accompagnés de fragments soit à la division I, soit à la division II. Ces ponts pourraient se distinguer de ceux engendrés par les inversions par suite

du manque de fragment. Cependant, il pourra arriver que les fragments formés par suite de la cytomixie demeurent au dedans des mêmes cellules à lesquelles les chromosomes coupés appartenaient ou encore que les fragments seraient venus d'une cellule adjacente. Dans ces cas, des ponts résulteront accompagnés de fragments qui ne pourront pas se distinguer de ceux formés en conséquence d'inversions.

Chez *N. Fernandesii*, il y a certainement des ponts engendrés par suite d'inversions, puisque l'aspect des ponts et la position des fragments (figs. 1-5, Pl. X) semblent caractéristiques de ce type de formations.

Comme nous l'avons signalé, la cytomixie pourra donner lieu à des inversions. Toutefois, celles-ci ne pourront manifester leur effet à la méiose pendant laquelle elles ont pris naissance, au moins qu'elles aient été engendrées au leptotène. Bien que certains ponts pourront résulter de ces inversions, d'autres seront la conséquence d'inversions formées pendant le pachytène ou le diplotène de quelque méiose précédente. De cette façon, on pourra, en dernière analyse, attribuer à la cytomixie tous les types de ponts rencontrés. Nous sommes donc amenés à conclure que tous les nouveaux types chromosomiques identifiés chez les plantes de *N. Fernandesii* à $2n = 28$ (MP, PP', Pp, M. et p.) pourront avoir été engendrés au moyen de la cytomixie. Il est à remarquer que la guérison des extrémités coupées par la cloison a probablement joué aussi son rôle dans la formation de tous ou de quelques-uns de ces chromosomes.

Par suite de la cytomixie, toutes les altérations structurales des chromosomes peuvent prendre naissance, ce qui montre que le phénomène doit avoir une grande importance au point de vue évolutif, bien que nombre de cellules soient amenées à la mort. Par le fait qu'il s'agit de tétraploïdes dans lesquels une altération léthale subie par une paire chromosomique peut être sauvée en conséquence de l'autre paire n'avoir pas éprouvé de modification, quelques gamètes à combinaisons viables et avantageuses relativement aux types antérieurs pourront se former et engendrer de nouvelles formes plus aptes que les anciennes.

Les faits montrent que l'origine des formes de *N. Fernandesii* à $2n = 28$ est due à la tétraploïdie accompagnée d'altérations structurelles engendrées par la cytomixie. Nous devons donc remarquer que les plantes réussissent à tirer profit d'anomalies provoquées par la cytomixie qui, à la première vue, sembleraient être seulement la cause de la mort de cellules.

Il serait très intéressant d'étudier les garnitures du plus grand nombre possible de populations de cette espèce, car il est à prévoir l'apparition de plantes à 29, 30, 31, 32, etc. chromosomes, soit des mêmes types de ceux des plantes diploïdes, soit d'autres. L'existence de plantes à $2n = 28$ possédant des types chromosomiques différents de ceux que nous avons déjà trouvé est encore à prévoir.

Le phénomène de l'apparition de nouveaux types de chromosomes dans les polyploïdes, mis en évidence chez *N. Fernandesii*, a aussi lieu chez *N. serotinus* (FERNANDES, sous presse). En effet, la garniture diploïde de cette espèce correspond à la formule

$$2n = 10 = 2 LL + 2 l + 2 'Ll + 2 LP + 2 L.$$

Cependant, chez les hexaploïdes ($2n = 30$) nous trouvons des chromosomes des types P', P. et p. qui ne se rencontrent pas chez les formes diploïdes et qui ont été probablement engendrés aussi au moyen de la cytomixie.

Étant donné que *N. jonquilla* et *N. Fernandesii* se ressemblent beaucoup au point de vue de la morphologie externe; que les deux espèces possèdent des idiogrammes semblables; et que *N. Fernandesii* se trouve au bord occidental de l'aire de distribution de *N. jonquilla*, il est vraisemblable que les formes diploïdes de la première espèce aient été issues de la deuxième. Les formes diploïdes ont engendré ensuite celles à $2n = 28$.

En ce qui concerne le mécanisme de la différenciation de ces dernières plantes, trois hypothèses pourront se formuler:

- 1) Une plante autotétraploïde (ne tenant pas compte des possibles différences existantes entre les deux

garnitures) s'est tout d'abord engendrée par suite de la fusion de deux gamètes diploïdes. À partir de cette plante tétraploïde, les autres pourvues de nouveaux types chromosomiques, produits par la cytomixie, auraient pris naissance.

- 2) Un hybride structurel diploïde, possédant dans sa garniture 11 chromosomes normaux et 1 MP, 1 Pp et 1 M. (les nouveaux types chromosomiques produits probablement par suite de la cytomixie) se serait tout d'abord engendré. Chez cette plante, en conséquence de la fusion de deux noyaux ou au moyen de l'endomitose, un secteur à 28 chromosomes se serait formé. Ce secteur aurait donné naissance à une hampe florale, dans les fleurs de laquelle les cellules-mères auraient subi une méiose normale, avec la formation de gamètes mâles et femelles régulièrement pourvus des nouveaux types chromosomiques. La fusion de ces gamètes aurait donné naissance aux plantes trouvées.
- 3) L'hybride structurel mentionné dans l'hypothèse antérieure aurait une méiose irrégulière avec la formation de gamètes de restitution. La fusion de deux de ces gamètes aurait engendré les plantes.

Ce que nous avons dit à propos de ces plantes s'applique aussi à celles dans lesquelles la paire MP se trouve substituée par une PP'. D'ailleurs, les garnitures de ces plantes sont assez semblables, car elles ne diffèrent que dans une paire chromosomique.

Tout d'abord, la troisième hypothèse semble la plus probable par les raisons suivantes:

- a) Nous n'avons rencontré aucune plante dépourvue de chromosomes appartenant aux nouveaux types, tandis que leur existence serait à attendre si la première hypothèse était exacte.
- b) Chez toutes les plantes examinées, des paires de chromosomes des nouveaux types existaient.
- c) L'établissement des plantes dans les conditions naturelles serait très difficile à comprendre s'elles au-

- raient été engendrées d'accord avec la première hypothèse, puisque les hasards des croisements amèneraient le plus souvent à la formation d'individus à garnitures dissemblables (hybrides structuraux).
- d) La formation de secteurs tétraploïdes donnant des hampes florales est un mécanisme complexe, ayant, par conséquence, moins de probabilités d'arriver que celui prévu dans l'hypothèse 3.

Malgré ces arguments, nous devons avouer que la troisième hypothèse a un point faible qui réside dans le fait que les chromosomes MP, PP', Pp et M. doivent être déficients, puisqu'ils sont plus courts que quelque autre élément de la garniture normale. De cette façon, on pourra avoir des doutes concernant la viabilité de l'hybride structurel dont nous avons supposé l'existence.

En admettant que les nouveaux types chromosomiques se sont engendrés chez une plante autotétraploïde, cette difficulté disparaît, car la présence de chromosomes déficients serait supportée par l'existence de paires normales.

D'autre part, il est probable que les deux garnitures de la forme diploïde qui ont subi la duplication seraient déjà tout ou moins un peu différentes au point de vue structurel et encore que la formation des nouveaux types chromosomiques ait été accompagnée d'altérations structurelles dans d'autres chromosomes. De cette façon, les croisements entre des gamètes plus semblables donneraient naissance à des plantes dans lesquelles le nombre de tri- et tétravalents serait inférieur à celui des plantes originelles. La fusion de gamètes possédant chacun les chromosomes 1 MP, 1 Pp et 1 M., ainsi que d'autres éléments structurellement altérés de la même façon, engendrerait des plantes ayant une méiose régulière et produisant, par conséquent, des graines en plus grande quantité. Ces plantes seraient plus favorisées dans la lutte pour la vie et elles finiraient par éliminer les autotétraploïdes.

Il est difficile de choisir entre ces deux hypothèses, puisque toutes les deux expliquent parfaitement la formation presque constante (sinon constante) de 14 bivalents dans

les plantes à 28 chromosomes¹. Par le fait que la formation de chromosomes déficients peut s'expliquer plus facilement en admettant qu'ils se sont engendrés chez les plantes tétraploïdes, nous considérons plus probable la première hypothèse.

La plante à 29 chromosomes dont l'élément surnuméraire est un fragment pourvu de centromère est sans doute issue d'une autre à 28 par suite de cytomixie.

Bien que ne connaissant pas la caryologie de l'espèce, GOMES PEDRO (1947) est amené à distinguer les plantes à 28 chromosomes des diploïdes par suite des plus grandes dimensions des premières. Étant donné que ces plantes présentent une méiose comparable à celle des individus diploïdes, qu'elles sont stables et fertiles et encore qu'elles présentent un idiogramme distinct de celui des formes autotétraploïdes, nous croyons qu'elles doivent être séparées du type dans une variété nouvelle.

***Narcissus Fernandesii* G. Pedro var. *major*, nov. var.**

A typo foliis usque ad 68 cm longis et basin versus 1,5-4,5 nec 1-1,5 mm latis, supra profundius canaliculatis, scapo altiore (16-20 nec ca. 10 cm) et crassiore (3-4,5 nec 1,5 mm diam. ad basin) et perigonii tubo longiore (15-22 nec 14-18 mm) praecipue differt.

Reguengo, pr. Estação do C. F., a poente da via férrea, 10-III-1956, A. Fernandes, J. Matos & A. Santos 5734 (COI); Reguengo, pr. Estação do C. F., a nascente da via férrea, 10-III-1956, A. Fernandes, J. Matos & A. Santos 5735 (COI, holotypus); Samora Correia, Monte da Adema, 10-III-1956, A. Fernandes, J. Matos & A. Santos 5736 (COI); entre Vale da Pedra e a estação de Reguengo, 30-III-1954, J. Matos, A. Matos & A. Santos 4663 (COI); entre a estação de Reguengo e As Virtudes, ao longo da via férrea, 30-III-1954, J. Matos,

¹ Nous pourrions supposer qu'il y a chez ces plantes un mécanisme génétique empêchant la formation de tri- et tétravalents. Cependant, étant donné la diversification entre les deux garnitures que nous avons constaté, nous croyons plus probable que des altérations structurelles soient les responsables de cette diversification.

A. Matos & A. Santos 4664 (COI); entre As Virtudes e Azambuja, 30-III-1954, J. Matos, A. Matos & A. Santos 4675 (COI); Ribatejo, Samora Correia, Monte da Adema, Pé de Galinha, 7-III-1946, Bento Rainha 903 (COI; LISE).

La section *Jonquilla* DC., telle que nous l'avons délimitée dans un travail antérieur (FERNANDES, 1951), est un taxon hétérogène au point de vue caryologique. En effet, *N. rupicola* Duf., *N. Watieri* Maire, *N. scaberulus* Henriq. et *N. calcicola* Mendonça appartiennent à un caryotype défini par la formule $n = 1 LL + 2 Ll + 1 Lp + 1 li + 1 lp + 1 Pp'$, tandis que les autres espèces — *N. jonquilla* L., *N. Fernandesii* G. Pedro, *N. Willkommii* (Samp.) A. Fernandes (= *N. jonquilloides* Willk.), *N. viridiflorus* Schousb., *N. Requierii* Roem. (= *N. juncifolius* Requier in Lag.), *N. gaditanus* Boiss. et Reut. et *N. minutiflorus* Willk. — appartiennent à un autre dans lequel les chromosomes longs isobrachiaux manquent¹.

Il est curieux de remarquer que ces deux groupes peuvent se distinguer aisément en ce qui concerne les caractères de la morphologie externe. Ainsi, au premier correspondent des plantes à feuilles glauques, canaliculées supérieurement et pourvues à la page inférieure de 2-3 côtes saillantes, à spathe à 1-4 fleurs avec les fleurs blanches ou jaunes, presque sessiles ou plus ou moins pédicellées et légèrement odorantes et à graines sphériques ou ellipsoïdes, d'un noir brillant et à strophiole très développé. Par contre, chez les plantes du deuxième groupe, les feuilles sont vertes, cylindrique-jonciformes ou parfois canaliculées à la face supérieure et toujours légèrement striées à la page inférieure, à spathe à 1-6 fleurs avec les fleurs jaunes, toujours pédicellées et très odoriférantes, et à graines anguleuses, d'un noir terne et dépourvues de strophiole.

Étant donné que nos dernières recherches montrent qu'on doit attribuer à la présence ou à l'absence de strophiole une

¹ Il est vrai que les idiogrammes de *N. Requierii*, *N. gaditanus* et *N. minutiflorus* s'écartent de celui de *N. jonquilla* en ce qui concerne certaines particularités. Ce fait signifie, peut-être, que ce groupe devra être divisé en deux sous-groupes.

certaine importance au point de vue taxonomique, nous proposons que le premier groupe soit élevé à la catégorie de section. De cette façon, on aura:

Sect. **Jonquilla** DC. emend. A. Fernandes

Folia viridia, erecta vel $\pm$ prostrata, cylindrico-junciformia vel interdum supra canaliculata, infra semper leviter striata. Spatha 1-6-flora, floribus $\pm$ longe pedicellatis, luteis, valde odoratis. Semina angulosa, 2,5-3 mm diam., nigra, opaca, astrophiolata. $x = 7$; idiogrammata: 2 Ll + 1 Lm + 1 Lp + 1 h + 1 lp + 1 lp' vel 2 Ll + 2 Lp + 1 h + 1 Pp + 1 Pp' vel 2 Ll + 1 Lp' + 1 Lp + 1 h + 1 Pp + 1 P.; polyploidia in *N. Fernandesii* et *N. viridifloro* cognita.

N. jonquilla L.

N. Fernandesii Pedro

N. Willkommii (Samp.) A. Fernandes

N. viridiflorus Schousb.

N. Requienii Roem.

N. gaditanus Boiss. et Reut.

N. minutiflorus Willk.

Sect. **Apodanthae** A. Fernandes

Sect. *Queltia* sensu Willk. & Lange, Prodr. Fl. Hisp. 1: 152 (1861) non Haw.

Folia glaucescentia, erecta vel $\pm$ prostrata, supra canaliculata, infra 2-3-costata. Spatha 1-4-flora, floribus fere sessilibus vel $\pm$ longe pedicellatis, albis vel luteis, leviter odoratis. Semina sphaerica vel ellipsoidea, nigra, nitida, 2,5-3 mm diam., conspicue strophiolata. $x = 7$; idiogramma: 1 LL + 2 Ll + 1 Lp + 1 h + 1 lp + 1 Pp'; polyploidia non cognita.

N. rupicola Duf.

var. *Marvieri* Jah. & Maire

N. Watieri Maire

N. scaberulus Henriq.

N. calcicola Mendonça

RÉSUMÉ ET CONCLUSIONS

1. D'accord avec les observations de DE CANDOLLE, BOWLES et les nôtres, *N. jonquilla* L. est une espèce peu variable. Si nous pensons à ce qui arrive chez *N. bulbocodium* et *N. pseudonarcissus*, ce manque de variabilité est certainement dû, tout au moins en partie, à l'absence de polyploïdie. En effet, toutes les populations examinées — Barca d'Alva, Torrão, Minas do Lousal, rivière do Roxo et alentours de Castro Verde — étaient constituées exclusivement par des plantes diploïdes dont la garniture peut se traduire par la formule suivante:

$$2n = 14 = 4 \text{ Ll} + 2 \text{ Lm} + 2 \text{ Lp} + 2 \text{ li} + 2 \text{ lp} + 2 \text{ lp'}$$

2. Les spécimens des Minas do Lousal, de la rivière do Roxo et des alentours de Castro Verde correspondent plutôt au type de l'espèce qu'à la var. *Henriquesii* Samp. qu'on trouve sur le lit de la rivière Xarrama, aux environs de Torrão. De cette façon, l'aire géographique (Alentejo) indiquée par SAMPAIO pour sa variété semble n'être pas exacte, puisque ce taxon possède une distribution plus restreinte.

3. Le nom *N. jonquilloides* Willk. ne peut pas s'utiliser par le fait que l'épithète avait été déjà attribué à une autre espèce (*N. jonquilloides* Willd. ex Schult. f.). Par ce fait, nous appelons l'espèce correspondant à celle décrite par WILLKOMM *N. Willkommii* (Samp.) A. Fernandes.

Cette espèce possède un idiogramme composé de 14 chromosomes semblables à ceux de *N. jonquilla* L. et elle se comporte d'une façon comparable à ce taxon en ce qui concerne la polyploïdie, puisque, bien que nous ayons étudié 150 individus d'une population croissant aux alentours de Loulé, nous n'avons trouvé aucun polyploïde. Cependant, des secteurs tétraploïdes ont été rencontrés dans quelques racines.

4. Contrairement à la conclusion à laquelle nous avons été amenés en 1939 (FERNANDES, 1939a) de que *N. Willkommii* (Samp.) A. Fernandes (= *N. jonquilloides* Willk.) serait un hybride issu du croisement d'une forme tétraploïde de *N. jonquilla* et d'une forme diploïde de *N. gaditanus* Boiss. et Reut.,

nous avons mis ici en évidence que *N. Willkommii* est une espèce diploïde à 14 chromosomes. En Algarve on trouve aussi à Silves un hybride (que nous avons étudié en 1939), engendré au moyen du croisement d'un gamète diploïde de *N. Willkommii* avec un autre haploïde de *N. gaditanus*. Comme il était à prévoir, cet hybride ressemble fort *N. Willkommii* et il n'a rien d'étonnant qu'il ait été considéré comme appartenant à cette espèce. L'examen du pollen du type de l'espèce, montrant qu'il possède seulement ca. 7,8 % de grains dégénérés, révèle que la plante de WILLKOMM ne correspond pas à l'hybride chez lequel le pourcentage de pollen dégénéré est de ca. 40 %, mais à la plante diploïde de Loulé, chez laquelle le pourcentage de pollen dégénéré est 11 %, c'est à dire du même ordre de grandeur que chez le type.

5. Il est probable que l'hybride *N. Willkommii* $\times$ *N. gaditanus* ait été engendré par suite du croisement d'un gamète à 2n chromosomes produit par une plante diploïde de la première espèce avec un gamète haploïde de *N. gaditanus*.

6. P. COUTINHO considère *N. jonquilloides* Willk. comme une variété de *N. jonquilla* L. et *N. jonquilla* L. var. *Henriquesii* Samp. comme une forme de *N. jonquilloides* Willk. Ces points de vue ne sont pas d'accord avec les faits, car *N. jonquilloides* se distingue très bien de *N. jonquilla* particulièrement par la moindre longueur du tube du périgone et la var. *Henriquesii* appartient à *N. jonquilla* L.

7. Étant donnée la ressemblance existant entre *N. jonquilla* et *N. Willkommii* et que les deux espèces présentent des idiogrammes semblables, il est presque certain que la deuxième s'est engendrée à partir de la première au moyen de mutation de gènes. La distribution géographique se montre d'accord avec ce point de vue.

8. Chez *N. Fernandesii* il y a, à l'état spontané, des plantes à $2n = 14$ et d'autres à $2n = 28$. La garniture des dernières ne correspond pas à la duplication de celle des premières, car on y trouve des chromosomes des types MP, PP', Pp et M. qu'on ne rencontre pas chez les plantes diploïdes. Sous ce point de vue, il y a encore deux catégories de plantes:

1) celles dans lesquelles les chromosomes nouveaux sont 2 MP, 2 Pp et 2 M.; 2) et celles dans lesquelles les chromosomes nouveaux sont 2 PP', 2 Pp et 2 M. Il est à remarquer que ces deux types de garnitures ne diffèrent que par une paire chromosomique. Chez une plante du deuxième type, des plaques équatoriales ont été trouvées possédant, en dehors des 28 chromosomes, un fragment pourvu de centromère, qui était éliminé fréquemment.

Il semble qu'à présent les formes diploïdes sont rares et qu'elles se trouvent en voie d'extinction, tandis que les formes à $2n = 28$ se répandent, bien qu'éprouvant des difficultés par suite des cultures. La récolte originelle de GOMES PEDRO correspond à des plantes à $2n = 14$ et l'holotype est donc diploïde. Les plantes à $2n = 28$ ont été séparées dans la var. *major* ici décrite.

9. La cytomixie est fréquente chez les cellules-mères du pollen des formes à $2n = 28$ de *N. Fernandesii*. Le phénomène, qui est décrit en détail, résulte, d'accord avec MESQUITA-RODRIGUES (1954), du retard de la formation de la cloison après la division qui amène à la formation des cellules-mères des grains du pollen. La séparation complète des cellules peut avoir lieu plus tôt ou plus tard, des cas ayant été rencontrés dans lesquels la séparation n'était pas achevée à la télophase II.

10. Dans la majorité des cellules-mères du pollen, la méiose chez les plantes à $2n = 28$ découle normalement, avec la formation presque constante de 14 bivalents. Ce fait est certainement dû à ce que les 4 garnitures réunies se sont diversifiées deux à deux par suite d'altérations structurelles, point de vue qui est d'accord avec l'apparition de nouveaux types chromosomiques.

11. Les conséquences de la cytomixie sont discutées en détail et on souligne les difficultés qu'il y a à distinguer entre des ponts engendrés par suite de la cytomixie et ceux provenant d'inversions.

12. Les données de la morphologie externe et de la distribution géographique montrent que les formes diploïdes

de *N. Fernandesii* sont certainement issues de *N. jonquilla*. Les formes diploïdes ont engendré ensuite des tétraploïdes et la naissance des nouveaux types chromosomiques qu'on trouve chez ces plantes est attribuée à la cytomixie. La diversification des garnitures qui a amené à la presque exclusive formation de bivalents est attribuée non seulement au fait que l'ancêtre diploïde était un hybride structurel, mais aussi à la cytomixie, survenue chez les tétraploïdes, laquelle a intensifié les altérations structurelles. Les plantes issues de la fusion de gamètes très semblables se comporteraient comme des diploïdes et elles seraient stables et fertiles. Par suite de leur plus grande fertilité, elles auraient éliminé les vrais tétraploïdes.

13. Étant donné que la cytomixie peut amener à l'accroissement ou à la diminution des nombres chromosomiques et à la naissance de tous les types d'altérations structurelles des chromosomes connues, nous pouvons considérer comme démontrées les suggestions de MENDES & RIJO (1951) et de KAMRA (1960), d'après lesquelles le phénomène aurait d'importance en ce qui concerne l'évolution.

14. La section *Jonquilla* DC., telle qu'elle a été délimitée par nous en 1951, est divisée en deux sections — *Jonquilla* et *Apodanthae* — d'après les caractères caryologiques et ceux de la morphologie externe, en particulier la présence ou l'absence de strophiole dans les graines.

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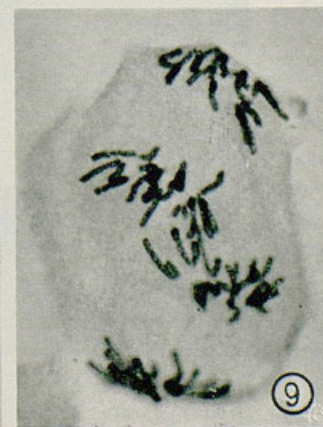
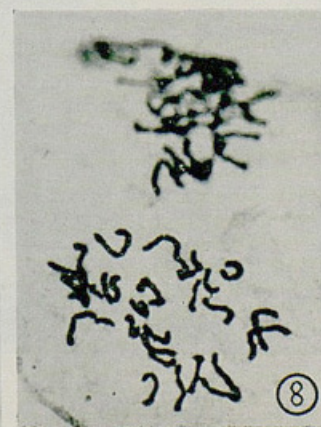
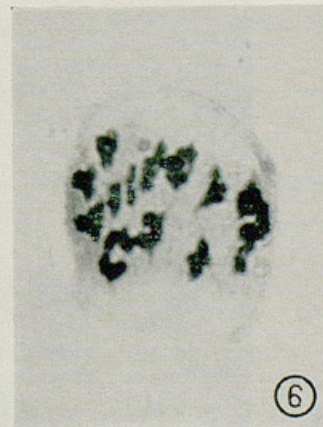
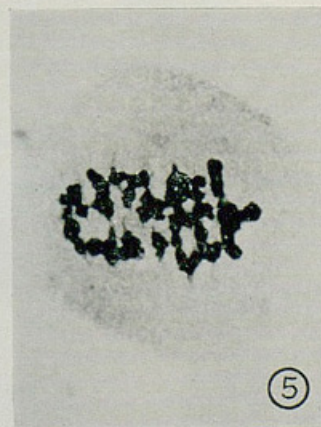
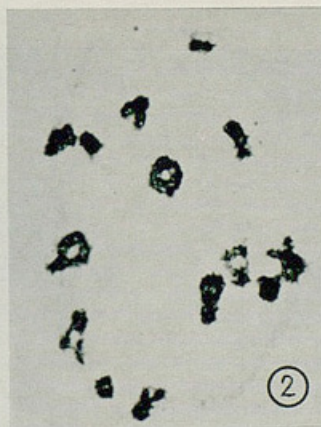
PLANCHES

PLANCHE I

Narcissus Fernandesii G. Pedro

- Figs. 1 et 2. — Cellules-mères du pollen à la diacinèse, montrant 14 bivalents.
- Figs. 3 et 4. — Prométaphases à 14 bivalents.
- Figs. 5 et 6. — Métaphases I aussi à 14 bivalents.
- Fig. 7. — Anaphase I montrant une disjonction régulière (14 chromosomes s'acheminant vers chaque pôle).
- Fig. 8. — Début de l'anaphase II où on peut voir deux groupes de 14 chromosomes qui viennent de se séparer.
- Fig. 9. — Stade de l'anaphase II plus avancé que celui montré sur la figure antérieure.

× 850



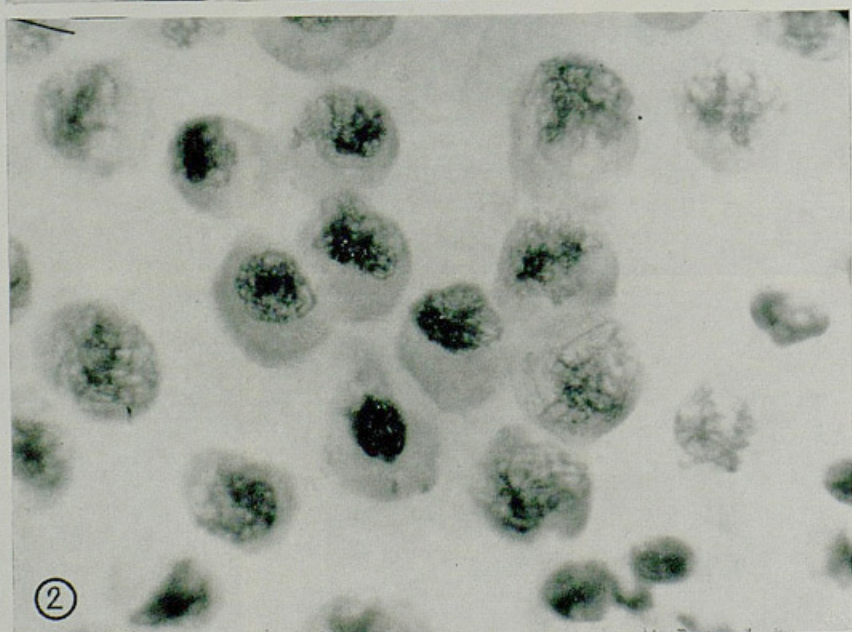
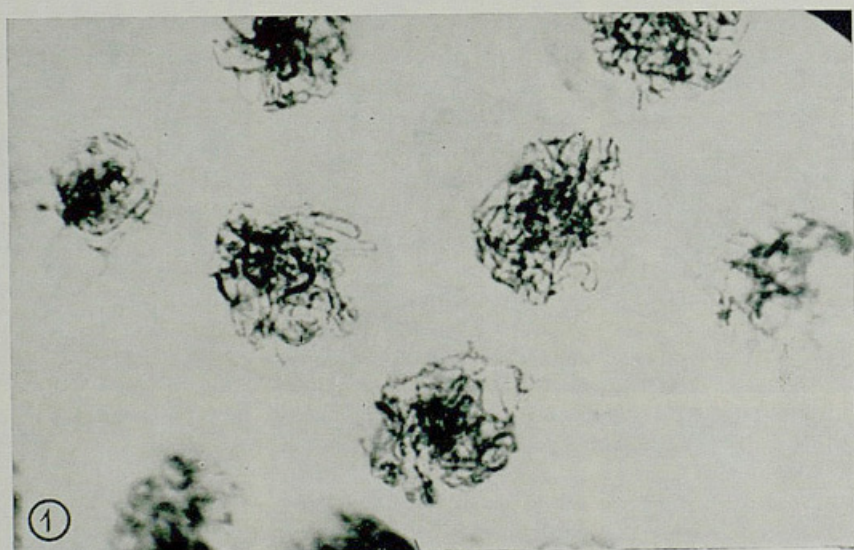


PLANCHE II

Narcissus Fernandesii G. Pedro

Fig. 1. — Pachytènes normaux.

Fig. 2. — Cellules-mères du pollen pas encore séparées, avec les filaments pachyténiques poussés vers la périphérie des cellules.

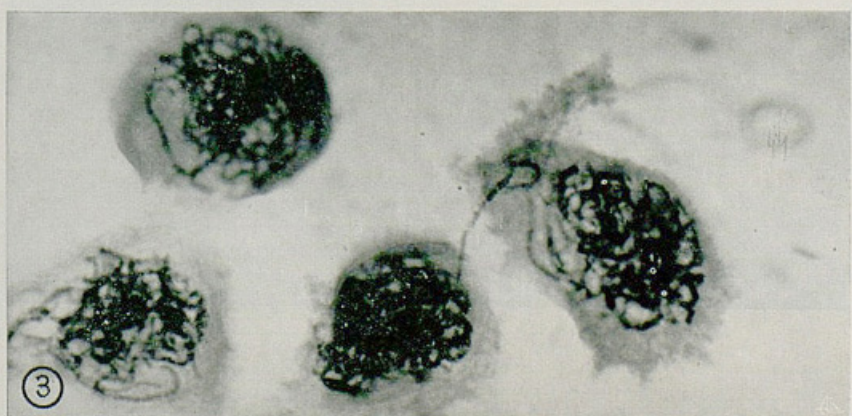
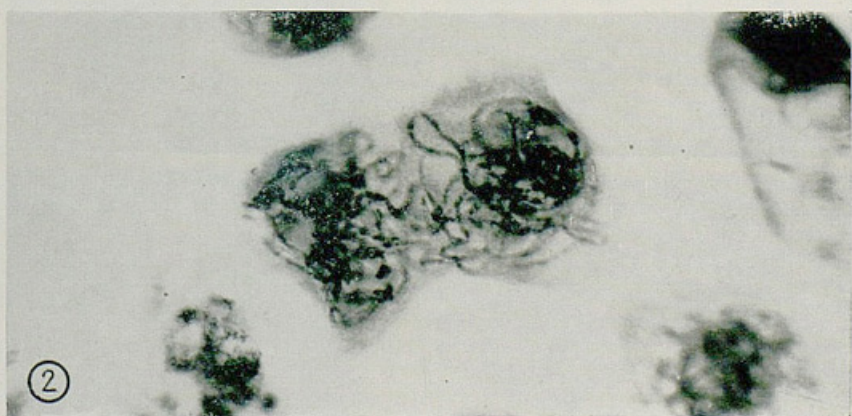
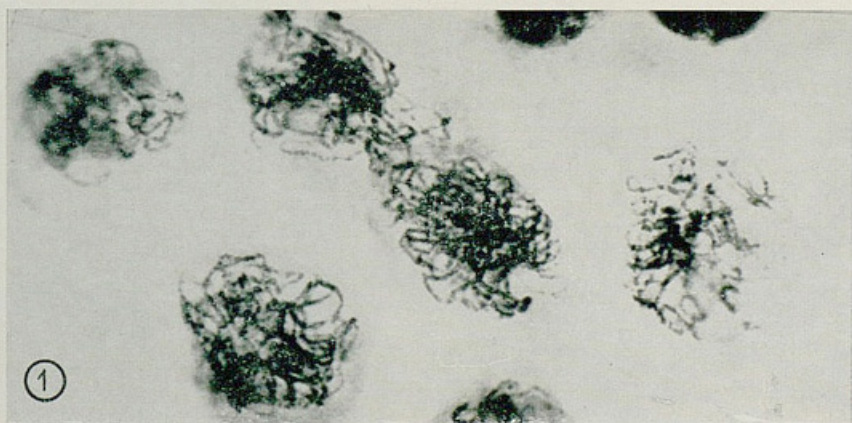
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PLANCHE III

Narcissus Fernandesii G. Pedro

- Fig. 1. — Cellules-mères du pollen dont deux montrent les filaments pachyténiques mêlés dans la région où le mécanisme du cloisonnage fonctionnera.
- Fig. 2. — Idem.
- Fig. 3. — Filament pachyténique réunissant deux cellules-mères du pollen à travers la région de la cloison. L'écartement des cellules pourra être, tout au moins en partie, conséquence de la pression exercée sur le couvre-objet pendant l'exécution de la préparation.

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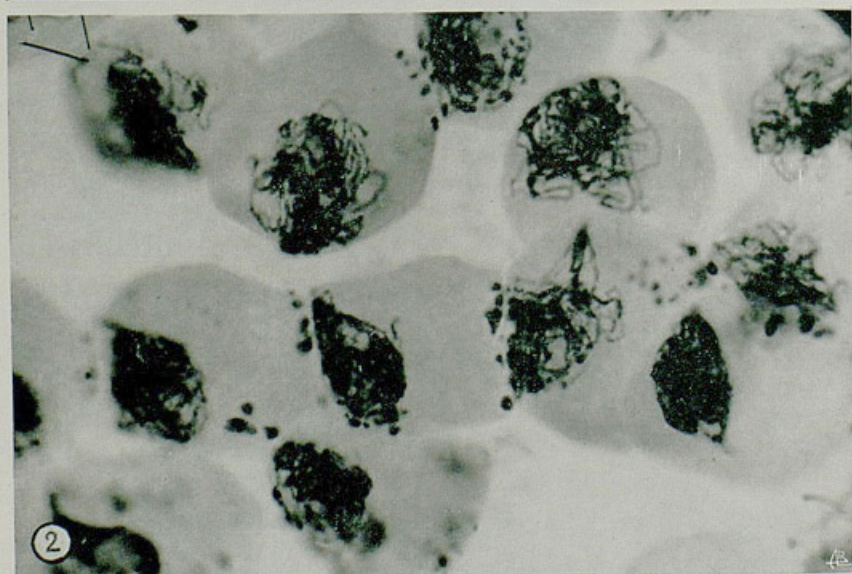
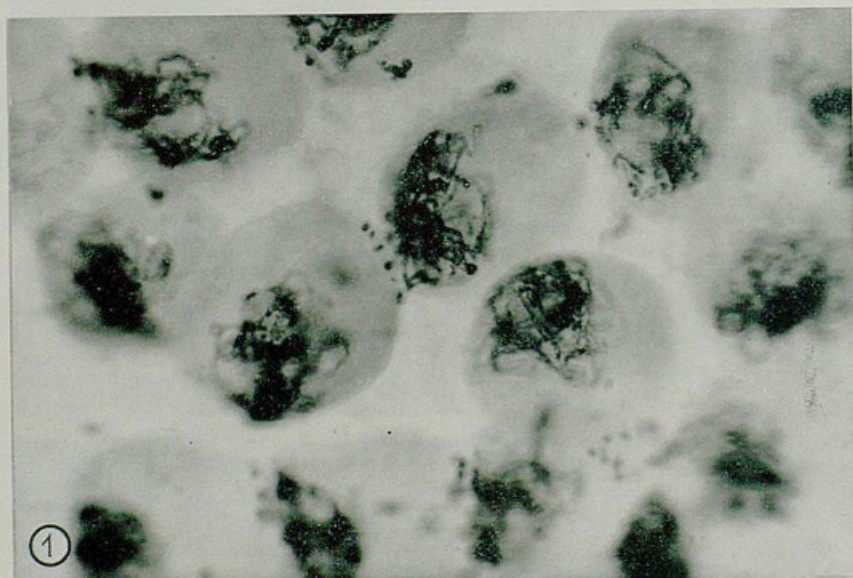


PLANCHE IV

Narcissus Fernandesii G. Pedro

Figs. 1 et 2. — Cellules-mères du pollen, montrant assez nettement des phénomènes de cytomixie. Remarquer les globules d'aspect pycnotique engendrés par suite du passage de la cloison à travers les filaments pachyténiques.

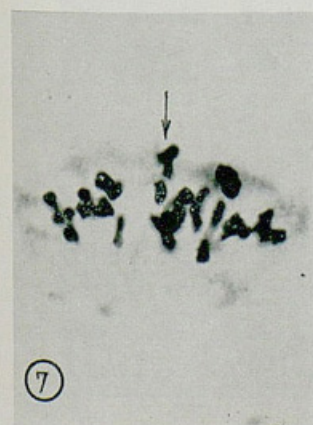
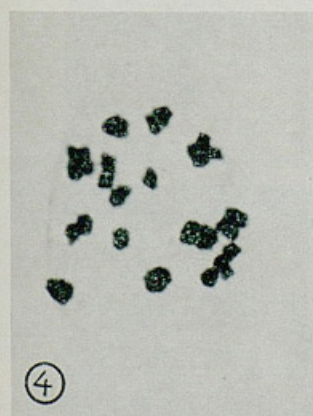
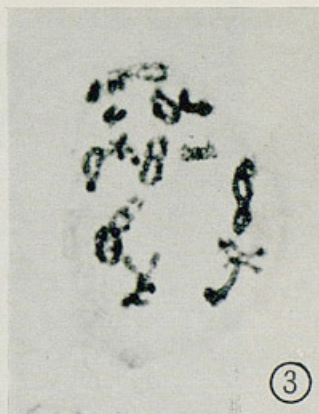
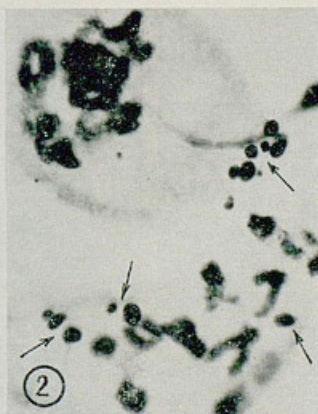
× 500

PLANCHE V

Narcissus Fernandesii G. Pedro

- Fig. 1. — Diacinèse à 14 bivalents, montrant à la périphérie deux corpuscules (flèche) résultant de la fragmentation de bivalents.
- Fig. 2. — Deux cellules-mères du pollen: la supérieure, qui semble être en voie de dégénérer, montre des corpuscules à la périphérie (flèche) et l'inférieure les présente à la périphérie et au dedans (flèches).
- Fig. 3. — Stade avancé du diplotène montrant 16 bivalents.
- Figs. 4 et 5. — Diacinèses où l'on peut dénombrer 15 bivalents.
- Figs. 6 et 7. — Métaphases I à 15 bivalents. Les flèches indiquent les bivalents situés près de la périphérie qui sont rentrés dans ces cellules par suite de la cytomixie.
- Fig. 8. — Métaphase I à 16 bivalents.
- Fig. 9. — Idem.

× 850



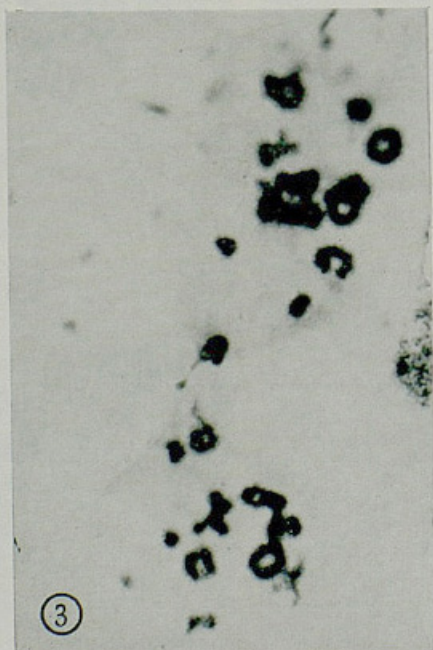
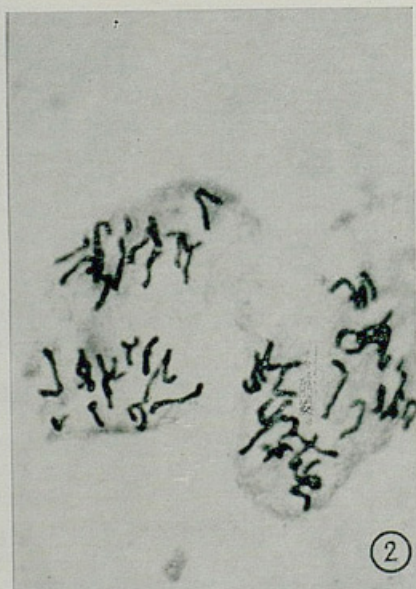
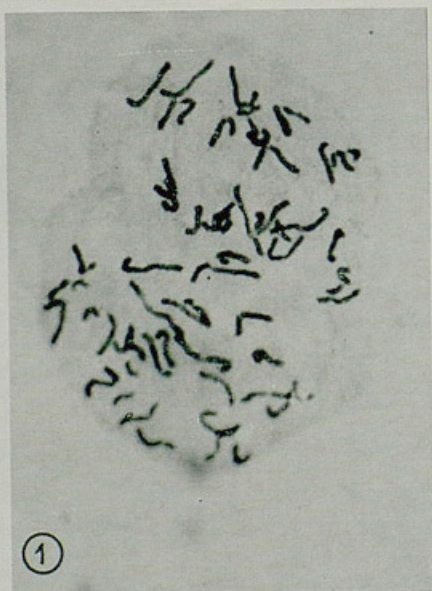


PLANCHE VI

Narcissus Fernandesii G. Pedro

- Figs. 1 et 2. — Anaphases II à 15 chromosomes.
Fig. 3. — Diacinèses montrant deux bivalents avec une portion despiralisée et en voie d'être fracturé, située dans la région de la cloison.
Fig. 4. — Métaphase I. Remarquer que le bivalent indiqué par la flèche montre un long filament hors de la cellule. Ce filament doit avoir été engendré par despiralisation rendue plus poussée par suite de la technique de l'écrasement.

× 850

PLANCHE VII

Narcissus Fernandesii G. Pedro

- Fig. 1. — Diacinèse montrant, à la périphérie, des bivalents fragmentés (flèche) par la cloison.
- Fig. 2. — Début de l'anaphase I: la flèche indique un bivalent à demi au dehors de la cellule dont un des chromosomes montre nettement l'endommagement provoqué par la cloison.
- Fig. 3. — Anaphase I présentant un pont non accompagné de fragment.
- Figs. 4 et 5. — Ponts à l'anaphase II non accompagnés de fragments.
- Fig. 6. — Anaphase II, montrant la séparation de deux chromatides inégaux dans une cellule et un fragment (flèche) dans la cellule-soeur.
- Fig. 7. — Anaphase II. Pont court dans une cellule et fragment (flèche) dans la cellule-soeur.

× 850

