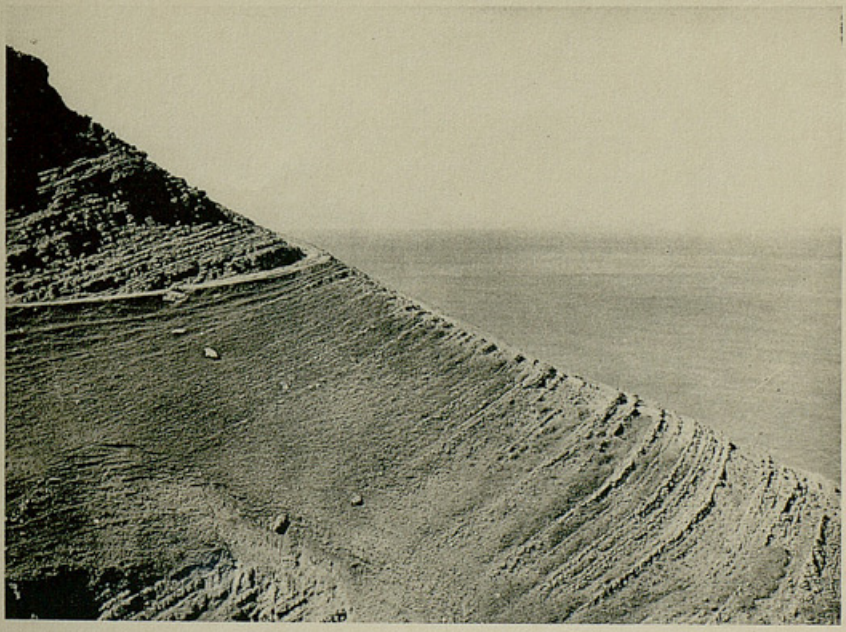
PLANCHE II

Photo 3. Les falaises de calcaire jurassique, un peu au Nord du Cap Mondego. La route qui contourne l'escarpement peut servir d'échelle. On comprend que le développement de toute végétation est impossible sur ce sol mordu par l'érosion, brûlé par la radiation solaire et balayé par le vent du large. — 14 Septembre 1931.

Photo 4. Le sommet des falaises de calcaire liasique de la presqu'île de Peniche. Remarquer, entre les strates, les trous par où l'eau de mer comprimée lors du déferlement des vagues pénètre dans le rocher pour en ressortir plus haut, çà et là, irrègulèriement à l'état de vapeur. La falaise semble alors fumer comme un vulcan. Elle s'éboule trop facilement pour que les Lichens puissent s'y établir. — 20 Septembre 1931.



3. — Les falaises du Cap Mondego.

Photos Ad. Davy de Virville

Bouan, Imp., Paris

4. — Les falaises de la Presqu'île de Peniche.

PLANCHE III

Photo 5. Les vagues rebondissant à plus de 20 m. de hauteur sur les falaises de calcaire liasique, au N. W. de la presqu'île de Peniche. La violence de la houle qui vient presque constamment se briser ainsi contre ces rochers, rend impossible le développement de toute végétation. — 21 Septembre 1933.

Photo 6. Les rochers de Miocène marin à Praia da Rocha. Ces calcaires très tendres, analogues à ceux de Lagos, ont été creusés de gouffres que la mer a ultérieurememnt déblayés, donnant ainsi naissance à un nombre incroyable de grottes ou d'arches analogues à celles que l'on voit ici.— 28 Septembre 1932.

Photos Ad. Davy de Virville

5. — Vagues sur les falaises de Peniche.

Bouan, Imp., Paris

6. — Rochers littoraux, à Praia-da-Rocha.

PLANCHE IV

Photo 7. La zone du *Verrucaria Maura* sur les falaises de calcaire liasique qui bordent une petite crique au Sud de la presqu'île de Peniche. — 22 Septembre 1933.

Photo 8. La zone du *Verrucaria Maura* (en haut) et du *Lichina pygmœa* (en bas), sur les rochers de calcaire lusitanien, près du Phare du Forte do Cavalo, à Cezimbra. — 25 Septembre 1933.

7. — La zone du *Verrucaria Maura*, à Peniche.

Photos AD. DAVY DE VIRVILLE BOUAN, Imp., Paris

8. — Les zones du *Verrucaria Maura* et du *Lichina pygmæa*, à Cezimbra.

PLANCHE V

Photo 9. La zone du *Xanthoria parietina* sur les rochers érodés de calcaire lusitanien, près du Phare du Forte do Cavalo, à Cezimbra. — 25 Septembre 1933.

Photo 10. *Verrucaria Maura* localisé sur toutes les aspérités du calcaire liasique et, en particulier, sur les fossiles épars à la surface de cette roche. Remarquer, à droite, la Bélemnite qui se trouve ainsi dessinée en noir sur le fond blanc plus friable de la roche. Entre les *Verrucaria*, dans les trous creusés par l'érosion: du sable. — Au Nord du Cap St Vincent, au bas d'une crique, 1er Octobre 1932.

9. — La zone du *Xanthoria parietina*, près de Cezimbra.

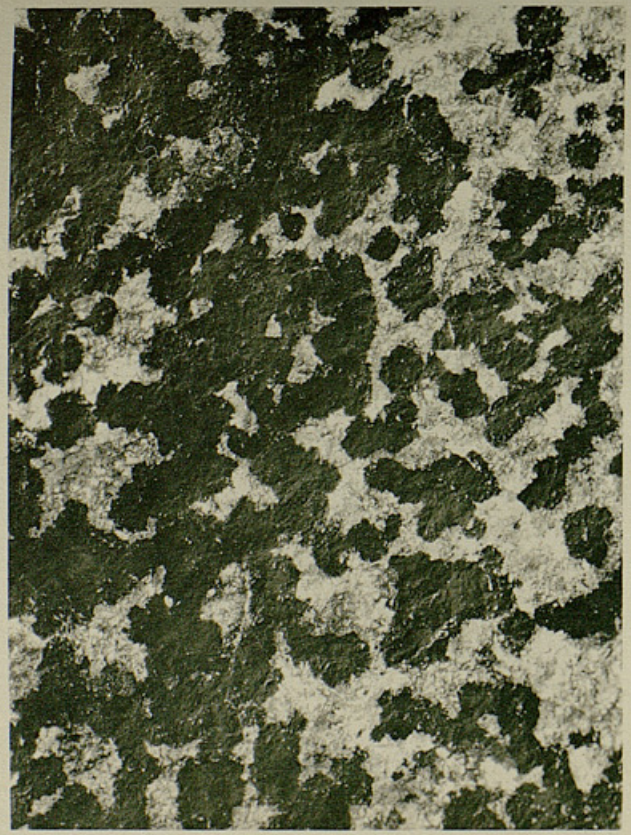
Photos Ad. Davy de Virville Bouan, Imp., Paris

10. — *Verrucaria Maura* sur les fossiles et les aspérités du rocher au Cap Saint-Vincent.

PLANCHE VI

Photo 11. Thalles épars de *Verrucaria Maura* sur une bloc rocheux granitique, et, entre les *Verrucaria: Caloplaca marina.* — Moledo do Minho, 13 Octobre 1931.

Photo 12.— Rochers de calcaire jurassique sur lesquels les touffes de *Lichina confinis* réfugiées dans toutes les anfractuosités des strates, seuls points où elles peuvent se fixer, forment une zone de 2 à 3 m. de hauteur. — Un peu au Sud du Cap Mondego, 14 Septembre 1931.



Photos Ad. Davy de Virville

11. — *Verrucaria Maura* et *Caloplaca marina*, à Moledo-do-Minho.

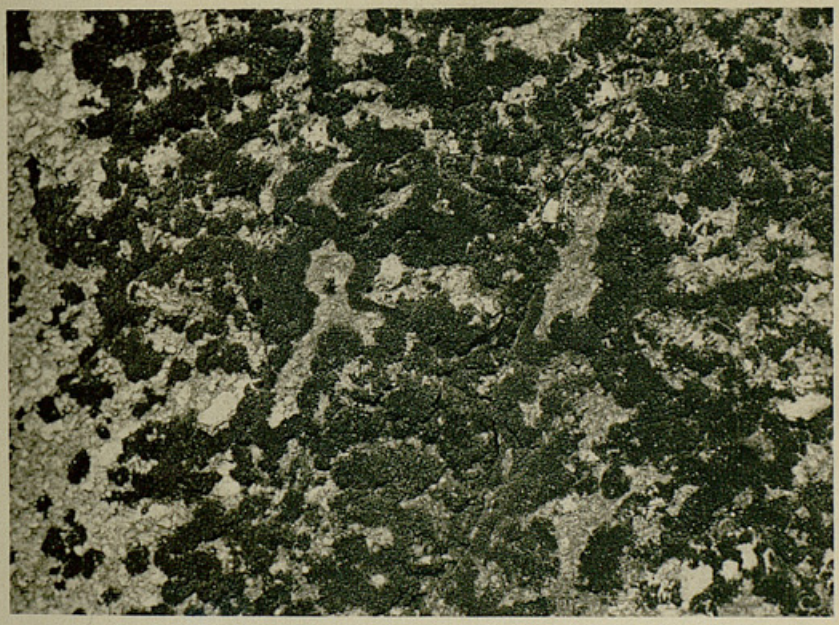
Bouan, Imp., Paris

12. — La zone du *Lichina confinis*, au Cap Mondego.

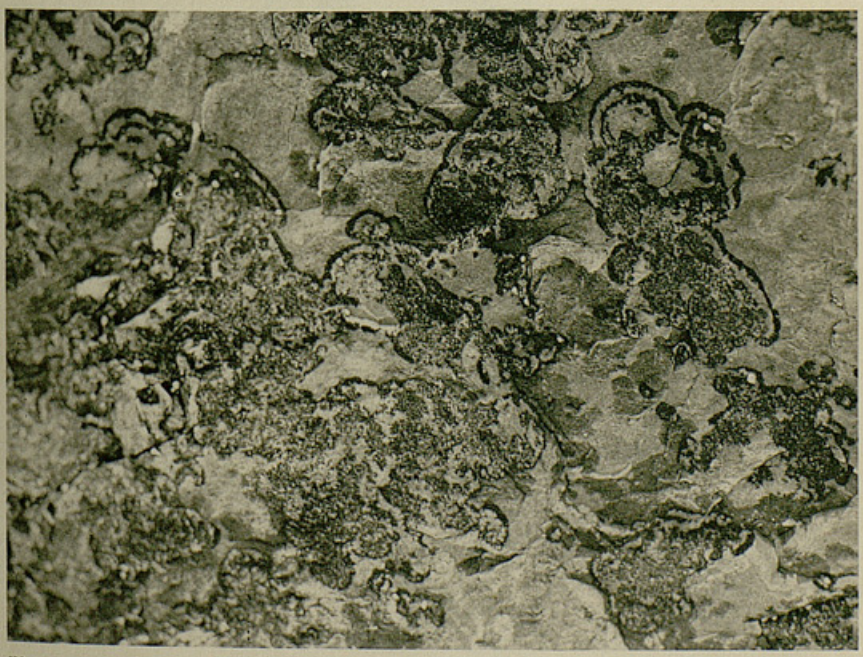
PLANCHE VII

Photo 13. La zone du *Lichina confinis* entre le Port et le Phare de Leixões, au Nord du Portugal, sur les rochers granitiques. Le lichen a ici le même aspect que sur les côtes du Massif armoricain. — 29 Septembre 1931.

Photo 14. La zone du *Lichina confinis* au pied des falaises lusitaniennes, près du Cap St Vincent, dans l'anse, entre les Pointes de Sagres et de Atalaia, 3 Octobre 1932. — Les thalles disloqués du lichen dont le bord seul est encore vivant, ont un aspect tout différent de celui qu'ils présentent sur les côtes Nord du Portugal. Comparer avec la photo ci-dessus).



13. — La zone du *Lichina confinis* au Nord du Portugal.



Photos Ad. Davy de Virville Bouan, Imp., Paris

14. — La zone du *Lichina confinis* au Sud du Portugal.

PLANCHE VIII

Photo 15. La zone du *Lichina pygmœa* dans le Nord du Portugal sur un gros rocher granitique battu, entre Viana do Castelo et le Vieux Fort, 9 Septembre 1931. — Le lichen a ici le même aspect que sur les côtes du Massif armoricain.

Photo 16. La zone du *Lichina pygmœa* dans le Sud du Portugal, sur les gros blocs de calcaire lusitanien éboulé des falaises, près du Cap St Vincent, entre les Pointes de Sagres et de Atalaia, 3 Octobre 1932. — Ici également les thalles plus petits et plus épars du Lichen ont un aspect tout différent de celui qu'ils présentent sur les côtes Nord du Portugal et surtout sur celles du Massif armoricain. (Comparer avec la photo ci-dessus).

15. — La zone du *Lichina pygmæa* au Nord du Portugal.

Photos Ad. Davy de Virville

Bouan, Imp., Paris

16. — La zone du *Lichina pygmæa* au Sud du Portugal.

SUR QUELQUES FUCACÉES DE LA CÔTE DU PORTUGAL ET LEUR RÉPARTITION

par

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DANS deux notes antérieures, nous avons déjà indiqué les grands traits de la répartition géographique des principales algues marines sur la côte portugaise. Cette côte comprend deux divisions principales, d'une part la côte atlantique proprement dite d'orientation générale Nord--Sud, entre l'embouchure du rio Minho et le cap Saint--Vincent, d'autre part la côte Sud de l'Algarve, partie Nord du golfe de Gibraltar, entre le cap Saint-Vincent et l'embouchure du rio Guadiana, d'orientation générale Ouest--Est, dont les caractères océanographiques, plus homogènes que ceux de la côte atlantique, sont bien différents.

La côte atlantique portugaise s'étend sur près de 5 degrés de latitude (37° N à 41,50° N). Elle comporte des parties rocheuses séparées par des régions sableuses étendues constituant des obstacles à l'extension des algues pour lesquelles un substratum solide est nécessaire. En ce qui concerne les caractères océanographiques de ce littoral, cette partie de la côte, soumise directement à l'action des vents forts et fréquents du secteur Ouest et à celle des houles provenant de l'Atlantique, appartient au mode battu de DE BEAUCHAMP. Seuls des estuaires peu nombreux, mais bien développés, et de rares baies, quelque peu protégées par des caps, sont les parties du littoral appartenant au mode abrité. La salinité y est un peu plus élevée dans la partie sud, ainsi que la température de l'eau. En outre, au Nord la côte du Minho s'apparente, en ce qui concerne la nébu-

losité, à la Galice espagnole. L'éclairement moyen y est plus faible que sur le restant méridional de la côte et l'état hygrométrique de l'air plus élevé.

Ce sont les valeurs absolues de la salinité, de la température, de l'humidité de l'air, et de l'éclairement et leurs variations, relativement importantes et rapides en égard à la longueur de cette côte, qui y localisent la limite méridionale de l'aire de plusieurs espèces nordiques.

Parmi les Fucacées septentrionales dont la limite sud de l'extension se situe sur la côte atlantique portugaise, *Pelvetia canaliculata* (L.) Dcn. et Thur., que nous étudions plus loin, s'arrête avant le Tage. *Ascophyllum nodosum* Le Jol., s'étend moins loin et ne dépasse pas le Lima.

Nous n'avons observé personnellement *Himanthalia lorea* Lyngb., en place, que dans l'avant-port de Leixões et sur la roche Leixão Grande actuellement détruite par l'agrandissement du port. Plus au Sud, elle existe probablement à l'embouchure du rio Mondego, puis, d'après les échantillons de l'herbier de l'Institut Botanique de Lisbonne, à S. Martinho et à l'entrée du Tage maritime, localité où nous n'avons pu la retrouver en place et qu'elle ne semble pas dépasser vers le Sud.

Fucus platycarpus L. forme *typica* se rencontre partout en plus ou moins grande abondance et, contrairement à ce que l'on observe sur les côtes de France où il n'occupe que la partie supérieure de la zone des Fucacées littorales, sur la côte portugaise il occupe souvent à lui seul toute cette zone et il y supporte une agitation de l'eau bien plus grande que sur les côtes françaises ou anglaises. Par contre, *Fucus vesiculosus*, type ou variétés, ne coexiste avec le *Fucus platycarpus* que sur la côte du Minho; plus au Sud, il se réfugie dans les estuaires ainsi que, d'après G. MANGENOT, il le fait au Maroc, où la limite de son extension doit être cherchée. Des formes variées, fixées ou non, de *Fucus* affines à *F. lutarius* Kütz et à *F. axillaris* J. Ag., sont communes dans les lagunes et les régions vaseuses des estuaires. Elles y présentent des variations désordonnées qui en rendent la détermination fort délicate. Des formes analo-

gues se rencontrent plus au Sud, dans de semblables conditions écologiques, jusqu'au Maroc.

Fucus serratus L. est aussi une Fucacée nordique dont l'aire s'étend depuis la Norvège, l'Ecosse et l'entrée de la Baltique, jusqu'au Nord du Portugal. Nous ne l'avons rencontré qu'aux environs de Viana do Castelo, assez commun, en petits individus voisins de la f. *minor* déjà observée en Espagne, à Rivadeo, par C. SAUVAGEAU en 1895. G. HAMEL ne l'a pas rencontré dans les environs de Vigo et la station de Viana semble la plus méridionale pour cette espèce, la station de Cadix indiquée par DE TONI est probablement une erreur.

Toutes ces Fucacées présentent des formes et des variétés bien marquées et plus nombreuses que sur les côtes de France. Nous estimons que les conditions écologiques, trop extrêmes pour certaines espèces, provoquent l'apparition de formes diverses et même de variétés stables nouvelles. Nous décrirons ci-après quelques-unes d'entre elles.

Pelvetia canaliculata (L.) Dcn. et Thur.

var. **acutilobata** nov. var. et f. **interposita** n. f.

L'aire de répartition du *Pelvetia canaliculata*, qui ne peut vivre dans les endroits trop battus, s'étend de l'Atlantique Nord (Baie de Baffin, Groenland, Foeroé) jusqu'au littoral atlantique du Portugal où semble se trouver la limite sud de son extension.

Nous avons rencontré des individus de la forme type de l'espèce sur toutes les roches abritées de la côte entre l'embouchure du Minho et celle du Lima. Vers le Sud, il devient plus sporadique, tant à cause du manque de roches abritées que de la présence d'espaces sableux où il ne peut se fixer. Nous l'avons récolté à Leixões, en dedans du môle, et M. J. DE BARROS nous en a communiqué des exemplaires rencontrés par lui dans la baie abritée de S. Martinho do Porto. La station des Iles Berlengas, indiquée par DAVEAU et par DE BARROS, nous semble douteuse; les quelques échantillons de cette localité que nous avons pu voir n'étaient

que des individus non mamilleux de *Gigartina mamillosa* J. Ag.

Il est fort peu probable qu'il existe plus au Sud, bien que dans l'herbier de BORY DE SAINT-VINCENT existent deux échantillons de BEDEAU (1830) portant *«rarement rejeté à la côte de Cadix»* alors que d'autres échantillons, d'origine bretonne, du même herbier portent *«inconnu sur celles* (côtes) *des environs de Cadix»*. Cette espèce ne figure pas dans le catalogue des algues du Maroc par GATTEFOSSÉ et WERNER, ni dans la liste de celles étudiées par RAPHÉLIS.

Le type de l'espèce existe, plus ou moins abondant, dans toutes ces localités mais, dans la région de Viana do Castelo, une variété bien caractérisée est dominante et, çà

Fig. 1. — Extrémité fertile de *Pelvetia canaliculata* var. *typica*, de la Manche (Ile Chausey).

Fig. 2. — Extrémité fertile de *Pelvetia canaliculata* var. *acutilobata* nob., de Viana do Castelo. (Ces deux figures de grandeur naturelle).

et là, est souvent seule. Non encore décrite, nous pensons devoir la figurer et la signaler sous le nom d'*acutilobata*.

Pelvetia canaliculata var. *acutilobata* nob. diffère de la forme type par la terminaison en pointe effilée des extrémités, fertiles ou non, du thalle, extrémités simples bi- ou trifides. Les extrémités fertiles ne constituent pas des réceptacles obtus, boursouflés et portant de nombreux conceptacles comme dans le type, ils sont au contraire plus ou moins aplatis et ne portent que relativement peu de conceptacles; la pointe qui les termine est généralement dépourvue

de tout conceptacle (fig. 1 et 2). Cette variété se rencontre aussi, en dehors du Portugal, sur la côte nord de la Péninsule; l'herbier THURET-BORNET en possède des exemplaires récoltés dans les Asturies, par DURIEU en 1835, et à la Corogne, par C. SAUVAGEAU en 1895.

Il peut arriver que la croissance terminale du thalle de cette espèce se continue après la différenciation des conceptacles et que, par suite, la partie du rameau déjà différenciée en réceptacle devienne intercalaire. Cette forme, que nous n'avons jamais rencontrée que dans des échantillons de la région du Minho, où elle n'est pas rare, avait déjà été rencontrée non loin de là, en Galice, par G. HAMEL, en 1927. Nous la signalons ici sous le nom de forme *interposita* nov. f. Après la différenciation d'un tel réceptacle intercalaire, l'extrémité végétative peut se diviser et même produire à ses extrémités de nouveaux réceptacles (fig. 1, Pl. I). Nous avons même observé un exemplaire présentant trois réceptacles successifs. Cette forme doit trouver son origine dans une perturbation de la croissance et est sans doute d'origine écologique. Elle ne paraît cependant pas produite par les conditions d'une année exceptionnelle, l'ayant rencontrée, tout aussi commune, pendant les deux séjours que nous avons faits en automne à Viana do Castelo.

Ascophyllum nodosum (L.) le Jol.

var. **lusitanica** nov. var.

L'aire de l'*Ascophyllum nodosum* s'étend de l'Atlantique Nord (Groenland, Norvège, Foeroé, entrée de la Mer Baltique) jusqu'au Nord du Portugal.

Dans la partie Nord de son aire on rencontre des formes particulières de petite taille, f. *furcata* et f. *scorpioides*, non vésiculifères, à ramifications, dichotomiques, aux axes et rameaux subcylindriques. Ces formes sont d'eau quelque peu saumâtre et de localités plus ou moins vaseuses. Sur la plus grande partie de son aire, *Ascophyllum nodosum* est une grande plante atteignant plus d'un mètre de long, aux divisions de section ovale et portant de nombreuses et volumineuses vésicules. Ce type est aussi commun dans

les endroits assez abrités de la côte nord de la Péninsule ibérique.

Sur les rochers abrités de la rive droite de l'entrée du Lima, en avant du port de Viana do Castelo, sur la côte au Nord de cet estuaire, nous avons observé, en abondance dans la zone moyenne de la marée, une variété très particulière d'*Ascophyllum nodosum*. Du disque basal s'élève un petit nombre d'axes aplatis, relativement larges, atténués à la base et au sommet, aux rameaux régulièrement pennés, jamais dichotomes, très rarement munis, sur l'axe, d'une ou deux vésicules petites et très marginées. La longueur du thalle ne dépasse pas 30 centimètres et n'atteint généralement que 15 centimètres (Pl. I, fig. 2). Cette variété a été aussi rencontrée, par G. HAMEL, sur la rive espagnole du Minho, mais n'a pas été rencontrée plus au Nord, en Galice. Dans les herbiers du Laboratoire de Cryptogamie, aucune forme analogue ne figure. Il ne nous paraît pas que cette variété ne soit qu'une forme écologique du type de l'espèce, car les conditions du milieu sont trop voisines de celles où se rencontre la forme type. On pourrait, croyons-nous, la considérer presque comme une espèce distincte, mais, n'ayant pu en suivre la végétation aux différentes saisons, nous ne la signalerons ici que comme variété nouvelle, var. *lusitanica* nob., rappelant ainsi le pays où elle est la plus abondante.

Fucus vesiculosus L.,

var. **angustifolius** Turn. et var. **aestuarii** nov. var.

L'aire du *Fucus vesiculosus* L. et de ses variétés est fort étendue. Dans l'Atlantique, elle s'étend du Groenland et de la Norvège, jusqu'au Maroc et au Canaries. Ce *Fucus* se rencontre sur tout le littoral du Portugal, mais ses stations y sont quelque peu sporadiques et il n'y présente jamais une éxubérance végétative comparable à celle qu'il a en France ou en Angleterre. Dans le Nord du littoral portugais, entre le Minho et le Douro, il est fréquent sur la côte. Plus au Sud, il disparaît presque totalement de la côte ouverte et se localise dans les estuaires et les baies.

Sur la côte de l'Algarve, nous ne l'avons plus jamais rencontré sur la côte, mais, uniquement, sur les pierrailles et les ouvrages d'art, dans les lagunes et les estuaires. L'abandon de la côte et la localisation dans les estuaires par ce *Fucus* a été également signalé par G. MANGENOT pour la côte du Maroc.

Dans cette espèce, il a été signalé un nombre considérable de variétés, en dehors même des *Fucus* vasicoles qui nous paraissent spécifiquement différents. Rien que sur le petit littoral de la Belgique, J. KICKS en a décrit 27 variétés! A notre avis, dans le *Fucus vesiculosus* saxicole sont confondues plusieurs espèces différentes. Malheureusement de multiples formes de passage, dont le plus grand nombre sont probablement des hybrides, rend très incertaine la séparation de ces espèces qu'une étude chromosomique comparée pourrait faciliter.

De nombreuses variétés existent sur la côte portugaise que nous nous réservons d'étudier ultérieurement. Nous ne signalerons ici que deux d'entre elles résultant de variations assez opposées du type.

A Foz do Douro, sur la rive droite de l'entrée du fleuve, une digue de maçonnerie, puis de blocs de pierre entassés, s'avance dans la mer et porte une végétation de *Fucus* assez abondante sauf à l'extrémité trop battue. Dans cette station, la salinité varie, en octobre, suivant la marée, de 15,4 à 30,81 pour 1000. La dessalure que produit le Douro y est donc bien marquée.

Successivement on observe, en avançant sur cette digue, de petits *Fucus ceranoides* L., puis des *Fucus vesiculosus* L. normaux remplacés brusquement, vers le millieu de la digue par des *Fucus* nettement différents.

Ce *Fucus* robuste, de teinte foncée, atteint 25 à 30 centimètres; le port en est quelque peu dressé. Les divisions du thalle sont étroites (3 à 5 mm), relativement épaisses, avec une nervure relativement large mais peu marquée. La partie basale de la fronde, subfiliforme, plus mince que les divisions, le demeure jusqu'au isque de fixation. Les vésicules manquent. Les réceptacles terminaux simples ou bifides, sont étroits, allongés et acuminés. Ces plantes sont dioïques.

Ce *Fucus* correspond parfaitement à la description de la forme *angustifolius* Turner = *Fucus angustifolius* With. (non *Fucus angustifolius* Turn. qui est *Sargassum angustifolium* Ag.) et nous croyons devoir lui attribuer ce nom (Pl. II, fig. 1).

Cette variété nous paraît nettement différer de la var. *evesiculosus* Cotton des côtes françaises par l'épaisseur des ailes du thalle, par l'étroitesse constante de la partie basale de la fronde et par l'étroitesse plus marquée des réceptacles. Chez la var. *evesiculosus*, en effet, la base est toujours épaisse, conique, plus grosse que les premières divisions et la nervure est très marquée.

Sur les côtes portugaises, nous n'avons observé cette variété que dans cette station. Nous avons cependant rencontré dans l'Herbier général du Laboratoire de Cryptogamie des échantillons extrêmement voisins, et non nommés, récoltés par C. SAUVAGEAU près de San Vicente de la Barquera (Espagne) en 1896. Certains portent quelques rares vésicules, mais tous leurs autres caractères sont très semblables à ceux de Foz do Douro.

Pendant un séjour à Figueira da Foz, notre ami, M. TABORDA DE MORAIS avait bien voulu attirer notre attention sur le rev tement de *Fucus* qui garnit les quais du rio Mondego. Ce revètement qui, outre les *Fucus*, comprend principalement *Enteromorpha compressa* Grev. et dans le bas *Catenella Opuntia* Grev., y atteint une hauteur d'environ 1,35 m.; sa limite supérieure est à environ 30 cm. au-dessous du niveau moyen des marées de vive eau. A première vue, il semble composé d'une zone supérieure étroite de *Fucus* rappelant le port de *Fucus platycarpus* var. *limitaneus* et plus bas de *Fucus vesiculosus* L. malingres mais typiques. En septembre, dans cette station, nous avons observé une variation de la salinité suivant la marée de 27,28 à 18,61 pour 1000. La dessalure y est donc très marquée.

En réalité, la zone supérieure est composée de *Fucus* de petite taille (6 à 8 centimètres), ramifiés par dichotomie ou, quelquefois, presque flabellés; leurs divisions, relativement larges, sont minces et possèdent une nervure étroite

mais bien marquée. De rares individus possèdent une ou deux vésicules axillaires. Leurs réceptacles terminaux, simples ou bifides, sont relativement larges, peu renflés et non marginés. Ces plantes sont dioïques (Pl. II, fig. 2). Tous ces caractères les rapprochent de *Fucus vesiculosus*. Les *Fucus* situés plus bas présentent les mêmes caractères, sauf leur taille plus grande qui atteint 20 à 30 cm. et la présence de vésicules axillaires ou latérales moins rares, mais cependant pas aussi nombreuses que dans les formes d'eau tranquille du *F. vesiculosus* type. Ces *Fucus* diffèrent du *F. vesiculosus* type par leur taille plus exigüe, la minceur des ailes de leur thalle, la rareté de leurs vésicules, leur teinte plus noirâtre et enfin par leur localisation dans les estuaires ou les lagunes. Nous estimons légitime de les écarter du *Fucus vesiculosus*, sous le nom de var. *aestuarii*, tant à cause de leurs caractères morphologiques que de leur caractère physiologique qui les astreint à une localisation particulière.

C'est cette variété que nous avons observée le plus souvent dans les estuaires et les lagunes des côtes portugaises depuis le Mondego jusqu'à la Guadiana.

* * *

C'est avec émotion que, pour terminer ce travail, nous adressons un souvenir affectueux et reconnaisant à la mémoire du Professeur L. W. CARRISSO. Nous n'oublierons jamais la délicatesse et l'inlassable complaisance avec les quelles il nous fît faire la connaissance de son pays et les conseils si judicieux qu'il nous donna pour rendre plus fructueux nos séjours en Portugal.

Nous sommes heureux de pouvoir remercier aussi ici tous nos amis de l'Institut Botanique, M. M. les Professeurs A. FERNANDES, TABORDA DE MORAIS et A. MENDONÇA pour l'aide si amicale qu'ils nous ont apportée pendant nos séjours à Coimbra.

Nos remerciements vont aussi à tous les Portugais, éminents Professeurs ou simples marins, pour les nom-

breux services de tous ordres que, toujours et partout, ils nous ont aimablement rendus pendant nos séjours sur les côtes de leur beau pays.

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Fig. 1. — *Pelvetia canaliculata* (L.) Dec. et Thur. f. *interposita* n. f. — Leixoes.
(Légèrement grossi)

R. Lami, Phot. Bouan, Imp., Paris

Fig. 2. — *Ascophyllum nodosum* (L.) Le Jol. var *lusitanica* n. v. — Viana do Castelo.
(Réduit au 1/3)

Fig. 1. — *Fucus vesiculosus* L. var *angustifolius* With. — Foz do Douro.
(Réduit au 1/3)

R. LAMI, Phot. BOUAN, Imp., Paris

Fig. 2. — *Fucus vesiculosus* L. f. *aestuarii* n. f. — Quai de Figueira da Foz.
(Réduit aux 2/3)

DIE WIRKUNG VON ROENTGENSTRAHLEN AUF DIE MEIOTISCHEN CHROMOSOMEN DER *VICIA FABA* L.

von

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1. EINLEITUNG

DAS Grundproblem der Vererbungslehre ist, die Natur des Gens festzulegen und zu erforschen, auf welche Weise es seine Wirkung ausuebt oder inwieweit es zu dem Aufbau des Individuum beitraegt.

Man vermutet, dass man die Taetigkeit des Gens mit Hilfe der Kenntnis seines Aufbaus verstehen kann, und dass es moeglich ist, diesen Aufbau durch das genaue Bild der zu erforschenden chromosomischen Beschaffenheit festzustellen. Es ist deshalb verstaendlich, dass viele Biologen dieses Problem durch das Studium der chromosomischen Elemente, ihrer wechselseitigen Beziehungen, der Rueckwirkung ihrer Veraenderlichkeit auf das Individuum und der Reaktionen, die sie gewissen Behandlungen gegenueber zeigen, zu loesen suchen.

Nach den Darlegungen Mullers ueber die Transmutation des Gens, wurde ein so grosses Interesse, besonders fuer den Einfluss der Bestrahlung auf die Chromosomen erweckt, dass sich heute schon viele Elemente zur Erforschung des Erbfaktors angehaeuft haben; jedoch aller dieser Arbeiten und Beitraege zum Trotz ist man weit davon entfernt, den Aufbau und die Zusammensetzung des Gens zu kennen.

Um zur Kenntnis des Gens zu gelangen, ist es erforderlich, zunaechst das Chromosom genau zu erforschen.

Es scheint vor allen Dingen wichtig zu sein, die Veraenderungen nach einer Behandlung mit Roentgenstrahlen festzustellen, und zu untersuchen, ob dieselben zu der Veraenderlichkeit des Gens parallel verlaufen oder nicht.

Die Versuche, die man zum Studium der quantitativen Analyse mit Hilfe der von Muller und seinen Nachfolgern angewandten Technik ueber den Positionseffect (Translokation und Segment-Austausch) oder ueber die eigenartigen Erscheinungen der Genvariabilitaet anstellte, haben zu den erfolgreichsten Resultaten gefuehrt. Die Arbeiten von STADLER (1930-32), TIMOFÉEFF-RESSOWSKY (1934-35 e 37) und MULLER (1928-34) — um nur einige anzufuehren—, haben den Verdienst, mit einem nicht zu unterschaetzenden Grad von Genauigkeit den Prozess der Genvariation darzulegen.

Die Schlussfolgerungen dieser Autoren sind von höcbstem Interesse, sodass die Bereitwilligkeit der Cytologen, mit allen verfuegbaren Mitteln die Wirkungen dieser Kraft auf die Cromosomen zu studieren, verständlich ist.

Heute schon ist es moeglich eine ziemlich grosse Anzahl von Arbeiten aus diesem Gebiet aufzuzaehlen, die wir GOODSPEED (1929), LEWITSKY (1931), MATHER STONE (1933), LEVAN (1935), RILLEY (1935) und MARSHAK (1937) verdanken. Was uns selbst anbelangt, so haben wir durch aufeinanderfolgende Arbeiten (CAMARA 1936, a, b, c, und 38) Beitraege ueber Fragmentationen, Translokationen und Spiralstrukturen veroeffentlicht, mit denen wir die Mechanik dieser Variationen und die Tragweite, die dieselben fuer das bessere Verstaendnis der Chromosomen haben koennen, zu erklaeren suchten.

In allen diesbezueglichen Arbeiten gibt es noch viele komplexe Fragen, und so scheint es erforderlich, dass die Cytologen nicht den Weg verlassen, der fuer die Genetiker zu so wichtigen Resultaten fuehren kann, indem sie weiter die durch die Roentgenstrahlen verursachten Variationen erforschen. Wir bringen deshalb noch einen Beitrag ueber das Resultat unserer Beobachtungen der Meiose von bestrahlten Pflanzen der *V. Faba*.

2. METHODEN

Wir haben Bluetenknospen von *V. Faba* mit Dosen von 64 kv. 5mA auf 30 cm. Entfernung ohne Filter waehrend Perioden von 15-20 Minuten bestrahlt.

Nach Verlauf von 24 Stunden, 2, 3, 4 und 5 Tagen wurden die Pollenmutterzellen nach Flemming fixiert. Es wurde die gewoehnliche Quetschmethode angewandt und immer mit Gentianviolett nach Newton gefaerbt. Obgleich Mather (1934) behauptet dass es nicht ratsam sei die Quetschmethode an *V. Faba* anzuwenden, sind wir mit dieser Methode sehr zufrieden gewesen (Foto 1).

Die Fixierungen der vorgeschrittenen Meta-und Anaphasen der ersten und zweiten Teilungen waren immer ordnungsgemaess. Dagegen liessen die Fixierungen in der Prophase viel zu wuenschen uebrig. Aber da das von uns vorgesehene Studium nur fortgeschrittene Phasen beruecksichtigen sollte, hielten wir es nicht fuer notwendig unsere Fixierungsmethode zu aendern.

3. BEOBACHTUNGEN

Man beobachtete wiederholt die hochinteressanten meiotischen Chromosomen von *Vicia Faba*. Da sie relativ gross und in den fortgeschrittenen Stadien leicht zu fixieren sind, ist es verstaendlich, dass sich die Cytologen seit langem mit dem Studium und den Erklaerungen ihrer verschiedenen Erscheinungen befasst haben.

Die somatischen Chromosomen haben gut bekannte Eigenschaften: 5 sind asymetrisch und von sehr aehnlicher Groesse, waehrend eines symetrisch, und mit einer sekundaeren Einschnuerung ausgestattet ist. (HEITZ 1928).

Das symetrische Chromosom ist groesser und wird mit *M* bezeichnet, die asymetrischen mit m 1, m 2, m3, m4 und m5.

Die Forscher MAEDA (1930), MATHER (1934), und SAX (1935) stellten fest, dass die Meiose normal verlaeuft. Es bilden sich 6 Bivalente (5 kleine mit einer veraenderlichen

Summe von Chiasmen, die nach Sax zwischen 10 und 18 schwankt und ein grosses, mit einer zwischen 5 und 11 schwankenden Chiasmatazahl).

Die verschiedenen Autoren geben uebrigens nicht die gleiche Zahl fuer die Chiasmata an. Wir glauben jedoch, dass diese Differenzen nicht wichtig sind, besonders weil die Milieubedingungen, in denen der Cytologe arbeitet, dieselben entscheidend beeinflussen koennen.

Mather hat z. B. folgende Mittelwerte der Chiasmata fuer jedes Bivalent gefunden:

fuer die Chromosomen	*m*	3,42
» » »	*M*	7,09

Sax hat fuer dieselben Chromosomen folgende Mittelwerte vorliegen:

fuer die Chromosomen	*m*	2,6
» » »	*M*	6,7

Bei unsern Zaehlungen, die wir in mehreren Jahren aus Neugierde machten, fanden wir die schwankenden Zahlen, die wir im folgenden wiedergeben:

	1. Zaehlung	2. Zaehlung.	3. Zaehlung
Chromosom: *m*	2,4	2,6	2,9
» *M*	6,5	6,9	7,02

Es handelt sich um Material von Vicia Faba, dass in sehr verschiedenen Zeitepochen gepflueckt wurde.

Die gelaeufige Verbindung ist interstizial. Jedoch haben die kleinen Chromosomen haeufig, nahe bei den Zentromeren, Terminalisierungen der Chromatiden.

4. BESTRAHLUNGSRESULTATE

Da sich das ganze Studium auf das Verhalten der Chromosomen in der Meta-und Anaphase der 1. und 2. Teilung stuetzt, ohne dass man, aus den schon dargelegten Gruenden, ausfuehrliche Betrachtungen der Veraenderun-

gen der Chromosomen in der Prophase anstellen konnte, muss ein Teil unserer Erklaerungen als Vermutungen betrachtet werden. Man muss daher die folgenden Ausfuehrungen mit Vorbehalt betrachten, da die Fixierungen es nicht zuliessen, die Pachytaen-und Diplotaenstadien eingehend zu studieren.

Viele Zellen, die 24 Stunden nach der Bestrahlung fixiert wurden, zeigten zahlreiche chromosomische Veraenderungen, so z. B. a) Fragmentationen, Translokationen,

Abb. 1

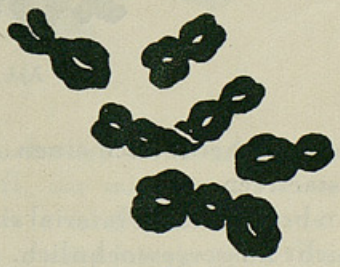

Abb. 2

Segmentenaustausch und b) Polysonnien und Polyploidien.

Den groessten Eindruck machten auf den ersten Blick zweifellos die Fragmentationen. Da die Bivalenten sich im Allgemeinen in den Metaphasen mit grosser Regelmaessigkeit anordnen, faellt uns sofort das Vorhandensein der Fragmente auf. Unsere Zeichnung der Abb. 1 zeigt z. B. ein an die Peripherie geschleudertes Fragment. Die Fotos 2 und 5 zeigen aehnliche Faelle.

Nach aufmerksamer Betrachtung der verschiedenen Zellen sieht man tiefgehende Unregelmaessigkeiten, die oft Ausdruck einer komplizierten Neuordnung der Chromosomen sind. Man findet in den Abb. 1, 6 anormal aussehende Bivalente, an denen grosse Veraenderungen vorgegangen sein muessen. Besonders sonderbar ist das sich auf der Seite befindende Chromosom.

Man beobachtet haeufig Unregelmaessigkeiten (Abb. 2, 3 bis 11). Es ist auffaellig, dass man in der Abb. 2 noch 5 Bivalente findet, von denen zwei laenger als die anderen

sind. Wenn das erste, in der Mitte der Platte, das Chromosom *M* ist, so scheint das darunter liegende das Resultat einer *Verschmelzung* zu sein. Das Bivalent auf der linken

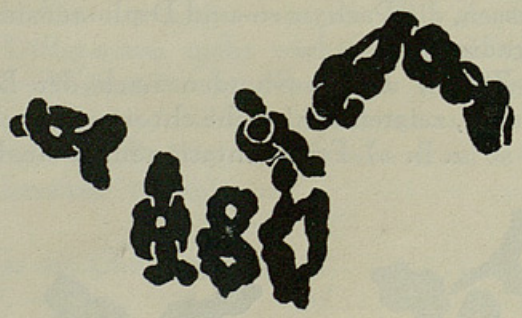

Abb. 3

Seite oben scheint auch einen Austausch mit einem andern zu bestaetigen.

An bestrahltem Material sind jedoch solche Beobachtungen nicht aussergewoehnlich. Abb. 4 stellt das Verschwin-

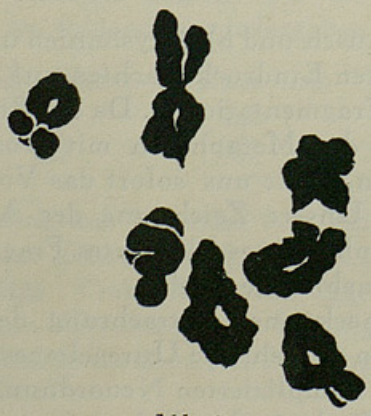

Abb. 4

den des Chromosoms *M* dar, oder besser, seine Fragmentation: Man sieht hier 7 Bivalente. Die durch die Bivalente veranschaulichte Gestalt ist sehr verschieden von den, fuer die Metaphasen der *V. Faba* typisch verschlungenen, Figuren, und zeigt Aenderungen in der Struktur. Das Biva-

lent ohne Zentromera auf der rechten Seite kann leicht dem Stueck des Chromosoms *M* nach dem Bruch zugeschrieben werden.

Die Bivalente auf Abb. 5 haben auch ein eigenartiges

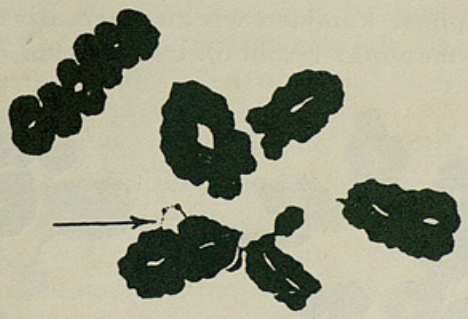

Abb. 5

Aussehen. Eins hat in der Naehe des Chiasmapunktes mit Fortsaetzen versehene Koepfe, die man niemals in den Kontrollversuchen beobachten konnte; ein anderes zeigt einen sehr feinen Faden mit zwei kleinen Schwellungen, von denen eine deutlich zu sehen ist; er verbindet zwei Zonen des Bivalents nach der einen und der andern Seite des Chiasmas.

Wir muessen an dieser Stelle betonen, dass die Verbin-

Abb. 6

dung vielleicht unbemerkt geblieben waere, wenn wir uns nicht gerade vorgenommen haetten, die kleinen Punkte im bestrahlten Material, die manchmal die Chromosomen verbinden, zu studieren, und die wir in einer frueheren

Arbeit dem Gen-Austausch zuschrieben (CAMARA 1936, b). Diese Erscheinungen sind fuer unsere Arbeit so wichtig, dass wir ihnen auf den Grund gingen.

Bei den weiteren Beobachtungen der Veraenderungen in der Metaphase kommen wir zu einem Bivalent mit nur einem Chiasmapunkt (Abb. 6). In der Abb. 7 und 8 sehen

Abb. 7

Abb. 9

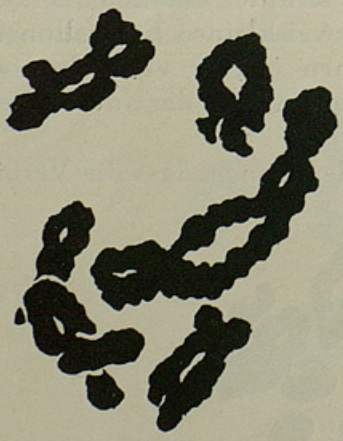

Abb. 8

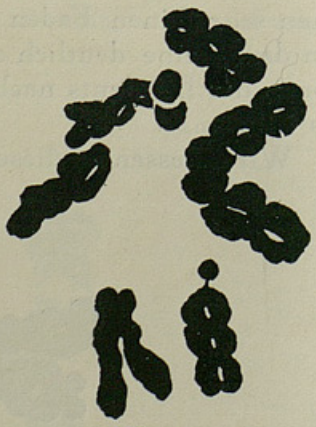

Abb. 10

wir unregelmaessige Verbindungen der totalen Anzahl der Chiasmata, in Abb. 9 ein Bivalent, dass zwei mit Fortsaetzen versehene Koepfe hat, wie wir sie schon weiter oben erwaehnten, und in der Abb. 10 ein sehr seltsames Bivalent, das mit grosser Genauigkeit den Typ des asymetrischen Chromosoms wiedergibt, der nie bei Bivalenten der kleinen Chromosomen *m* beobachtet wurde. (Foto 9).

Mather hat sich in der schon erwaehnten Arbeit bemueht, die Haeufigkeit des Chiasmas in den bestrahlten Chromosomen zu studieren. Man merkt deutlich, dass er von den Arbeiten MAVOR und SVENSON (1923) und MULLER (1925), beeinflusst wurde, die zu dem Schluss kamen, dass die Behandlung mit Roentgenstrahlen die Haeufigkeit des «Crossing-Over»erhoeht. Er sucht dann fuer jene Resultate eine cytologische Grundlage.

Er untersuchte das Verhalten von 50 Zellen und fand, dass die Frequenz des Chiasmas in dem fixierten Material nach drei oder vier Tagen Bestrahlung ungefaehr dieselbe wie in den Kontrollversuchen blieb, dass sie jedoch nach längerer Behandlungszeit zunahm. Wir konnten die Resultate Mathers nicht bestaetigen. Wir haben manchmal, in denselben Zeitraeumen ein ebenso unerklaerliches Zurueckgehen der Chiasmatazahl, wie ein Anwachsen derselben bemerkt (Foto 3). Wir muessen noch berichten, dass wir

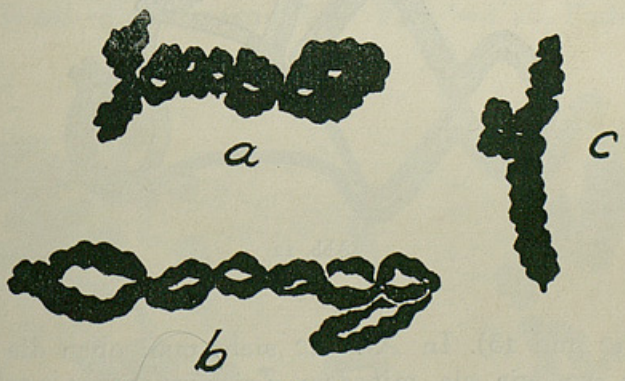

Abb. 11

einige hundert Zellen mit klaren Beispielen prueften, sodass an unsern Beobachtungen nicht gezweifelt werden kann.

Neben den Zellen, mit vollstaendig normalen *M* Chromosomen, (Abb. 11 a) beobachteten wir andere, die von einer unbekannten Kraft in die Laenge gezogen schienen (Abb. 11 b), oder die, in Stuecke gebrochen, ein vollstaendig ungewoehnliches Aussehen, manchmal sogar mit ungleichen Armen, zeigten. (Abb. 11 c).

Es wurden zahlreiche Strukturen, die durch die Verbindung zweier oder mehrerer Bivalente entstanden (Fotos 5 a; b), bemerkt, von denen zwei besonders interessant sind

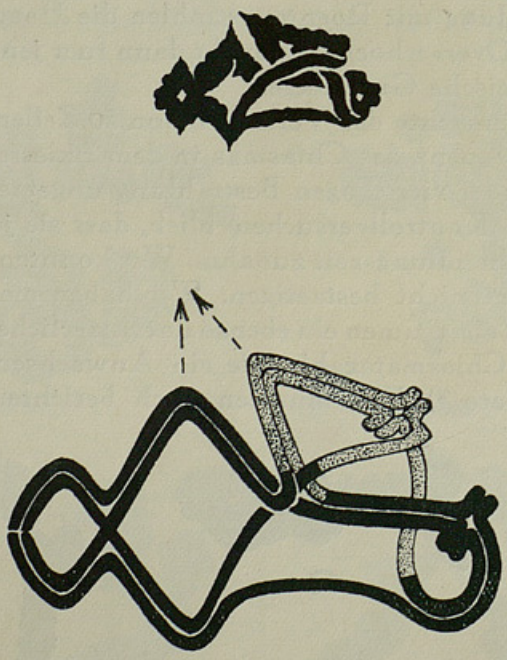

Abb. 12

(Abb. 12 und 13). In Abb. 12 sieht man oben die Tetravalente, so wie sie mit dem Zeichenapparat nachgezeichnet wurde, und unten die wahrscheinliche Erklaerung ihres Zustandekommens. Man konnte einen Segmentenaustausch zwischen den Chromosomen *M* und m feststellen, und dies verursachte ein eigenartiges Aussehen der 4 Chromatiden der beiden Chromosome in der betreffenden Zone.

Wir bemerkten jedoch, dass ausser diesem Segmentenaustausch noch eine neue Zusammensetzung des kleinen Chromosoms stattfand, in der das Zentromera in die Mitte seiner Laenge gebracht wurde.

Wir fanden noch ausser den genannten Anomalien Bivalente, die sehr dicke Koepfe, oder eine deutlich sichtbare

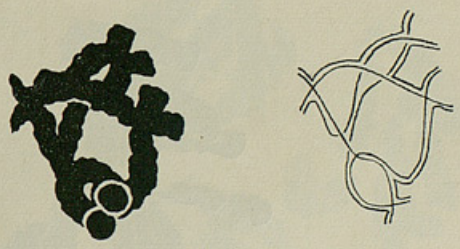

Abb. 13

Punktierung zeigten. Die Fotos 8 a, b zeigen, wenig vergroessert, die sich ueber die Laenge der Windung einer Schraube verteilenden Punkte. Wir nehmen an, dass es sich um eine Ausscheidungsanomalie der Matrixsubstanz handelt.

Wir sahen den eigenartigen Fall, wo ein Faden vom

Abb. 14 Abb. 15

Ende eines unregelmaessig gepaarten Bivalents durchbrach. (Fotos 6 a, b, c,). Wir stellten links den photographischen Apparat besonders auf das Ende des Chromosoms *M* ein. In seiner Naehe ist ein Trabant, und an der rechten Seite ragt der schraubenfoermige sehr zarte Faden,

den wir oben erwaehnten, aus dem Chromosom heraus. Darauf werden wir spaeter noch einmal zurueckkommen.

In den Anaphasen (Fotos 11, 12, 13, 15 und 16)

Abb. 16

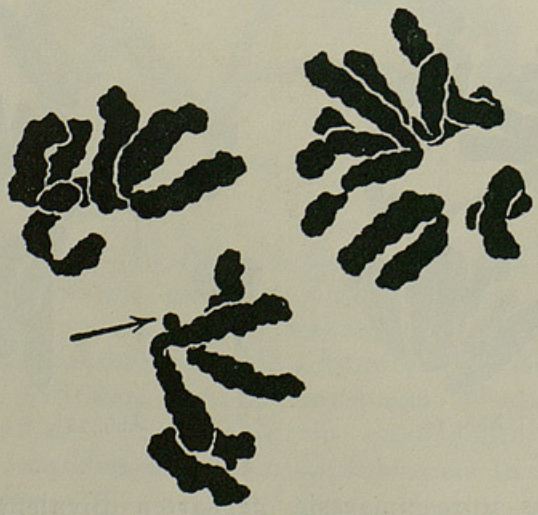

Abb. 17

fanden wir Anomalien, ebenso wie in den anaphasischen Bruecken, die aus den verschiedensten Gruenden in unserm Laboratorium studiert wurden (CAMARA, 1936, c. 38; AZEVEDO

COUTINHO, 1937) (Abb. 14, Fotos 11, 20, 22 und 26), dann auch in Fragmenten (Abb 15, Fotos 24, 26, 27, 28) und

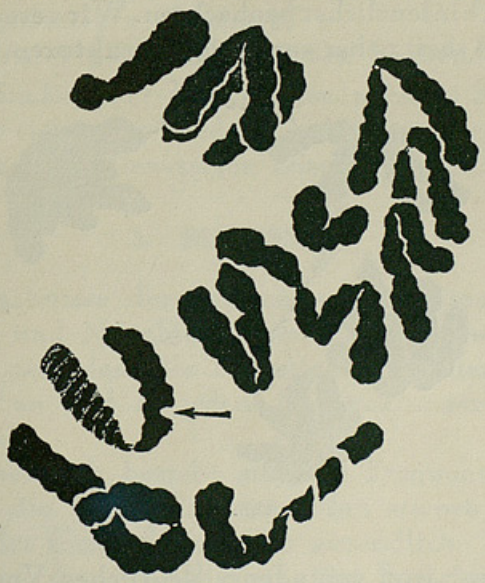

Abb. 18

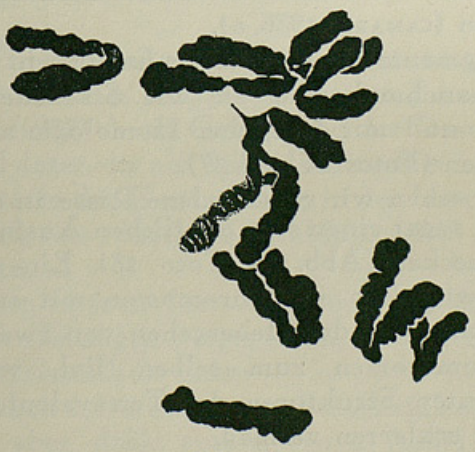

Abb. 19

in nachhinkenden Chromosomen (Foto 23) findet man anormale Erscheinungen.

Wir hatten Gelegenheit verschiedene Faelle von seitlichen Trabanten zu beobachten, wovon die Abb. 16 und 17 (Fotos 25) zwei Beispiele geben. Trotzdem einige

Genetiker KOSSIKOV und MULLER, (1935) an der Existenz dieser Trabanten zweifeln, konnten wir diese waehrend unserer Arbeit verschiedentlichst beobachten. Wir veroeffentlichten schon eine Arbeit ueber verzweigte Strukturen und denken,

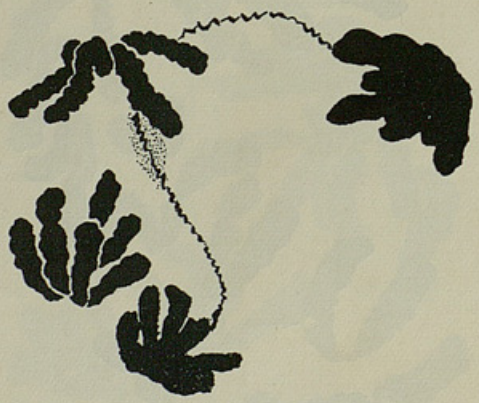

Abb. 20

dass durch ihr jetzt gefundenes deutliches Vorhandensein alle Zweifel ueber die Existenz solcher Strukturen behoben sein duerften (CAMARA, 1936, a).

Die Fragmente der Anaphasen haben sehr verschiedene Formen: manchmal sind sie wie Staebchen (Foto 17) oder gerollt und mit deutlicher Homologie an den aeussersten Enden (Fotos 24 und 27).

Einmal sahen wir verschiedene Risse in einem Chromosom und sogar einen sehr deutlichen Ausfall von Chromosomenstuecken (Abb. 18, Foto 28). Ein anderes Mal bemerkten wir, dass ein Chromosom mit einem andern verbunden war, was das Uebergehen von zwei verschmolzenen Chromosomen zum selben Pol, wie bei den obenerwaehnten Strukturen der Tetravalenten (Abb. 19, Foto 21), zu erklaeren vermag.

Man sah in den zweiten Anaphasen manchmal sehr deutliche Bruecken, die der ersten Teilung widerstanden (Abb. 20). Sie waren wie zarte, gewundene Gebilde und schienen ein Auseinanderziehen der Chromonemata, die eine Verschmelzung durchmachen, erlitten zu haben.

Auch in einigen unregelmaessigen Anaphasen wurde

die Spiralform bemerkt (Foto 13). Am Ende dieser Anaphasen fanden wir umherliegende Fragmente mit sehr unregelmaessigen Umrissen.

Anscheinend gehen die grossen Veraenderungen in den erster Stadien der Fixierungen nach 24 Stunden vor sich. Spaeter sieht man weder Fragmente, noch die sonst so haeufigen unregelmaessigen Dispositionen.

3. DISKUSSION

Die Ergebnisse der zahlreichen Arbeiten, die ueber Bestrahlung und Mutabilitaet veroeffentlicht worden sind, lassen vermuten, dass die Mutationen in allen Zellen, in allen Geweben und in jedem Entwicklungszustand eintreten können.

Hauptsaechlich bezieht sich die Frequenz der Mutationen auf die Genvariationen. Man erwarb durch die Bewertung des Genverhaltens so gruendliche Kenntnisse, dass diese zu den Richtlinien aller Forscher ueber die Wirkungen der Roentgenstrahlen auf die Chromosomen wurden.

Timofeeff-Ressovsky zeigt in seinem ausgezeichneten Buch «Experimentelle Mutationsforschung in der Vererbungslehre» (1937) beim Gruppieren der Resultate seiner Arbeiten und derer, die auf demselben Gebiet forschen, wie man die Prozesse der Genvariation in der Jetztzeit auslegt, und wie man sie durch Bestrahlung mit Kurzwellen erzeugen kann.

Wir halten es jetzt fuer zweckmaessig den Prozentsatz der Veraenderungen festzustellen, die durch die Roentgenstrahlen verursacht wurden.

Diese Arbeit ist mit grossen Schwierigkeiten verbunden, wurde aber doch von MARSHAK (1937) in Angriff genommen. Er veroeffentlichte hochinteressantes Material zur Klaerung dieses Problems.

Wir zoegerten, uns mit dieser Feststellung zu beschaeftigen, da bis jetzt noch keine eindeutige, typische Variation gefunden wurde, die nicht mit andern zu verwechseln waere und so haeufig ist, dass man an ihr das relative Verhalten

der Chromosomen bei Behandlung mit verschieden intensiven Bestrahlungen feststellen koennte.

Man wandte bei den Arbeiten zur Letalerzeugung der *Drosophila melanogaster* die ClB — Methode von Müller an, und benutzte eine Serie, deren Chromosomen eine lange, den Letalzustand hervorrufende Inversion enthalten.

Diese Methode ist einfach und schnell.

Man kann natuerlich auch die ClB Methode kritisch betrachten und z. B. sagen, dass das vaeterliche, der Bestrahlung unterworfene X-Chromosom, verschiedene Ausfaelle von letal wirkenden Chromosomenstuecken erleiden kann; durch obenerwaehnten Prozess kann aber nur *ein* Ausfall entstehen. Da ferner die Bewertung mit Hilfe der letalen Wirkung, die durch sie hervorgerufen wird, gemacht wird, und da diese nicht nur Genen, sondern auch Ausfall von Chromosomenstuecken, Inversionen und Translokationen zugeschrieben werden kann, ist es moeglich, ein gleiches Ergebnis Variationen mit verschiedenen Eigenschaften zuzuschreiben, die vielleicht ein anderes Verhalten in Bezug auf die Bestrahlung zeigen. Es scheint also, dass der Prozess ein wenig ungenau ist. Man muss jedoch zugeben, dass die cytologische Beurteilung noch ungenauer sein muss, denn es gibt keine leicht zu beobachtende Variation, fuer die man typische Zahlen ihrer Frequenz feststellen koennte.

Marshak kommt in seinen Arbeiten ueber *Pisum sativum, Mus musculus. Vicia Faba* und *Lycopersicum esculentum* (1937) zu dem Schluss, dass die Haeufigkeit der durch Roentgenstrahlen verursachten Abaenderungen, von den Beobachtungen der Anaphase der Mitose abgeleitet, unabhaengig von der Wellenlaenge und direkt proportional zur Totallaenge der Chromonemata des somatischen Chromosoms ist. Dieser Forscher hat weiter festgestellt, dass die Groesse des Durchmessers der Chromonemata bei den genau studierten Arten gleich den Ausmassen ist, die man waehrend der Forschung ueber Difraktion der Roentgenstrahlen erlangte, und die als der Durchmesser eines Polypetiden oder eines Protaminmolekuels (10×10^{-8} cm), erkannt wurden.

Beide Schlussfolgerungen sind bestimmt wertvoll und werden andere Forscher veranlassen, in dieser Richtung weiterzuarbeiten. Es scheint uns im Moment nicht leicht, eine genaue Methode zur Feststellung der Frequenz der Variationen zu finden. Wir glaubten anfaenglich, dass wir durch die Anzahl der anaphasischen Bruecken in Meiosis zu den gewuenschten Angaben kommen koennten, da sie ja aus chromosomischen Inversionen entstehen koennen, die sich in einer frueheren Phase (DARLINGTON 1937) bilden. Durch wiederholte Beobachtung hat man jedoch feststellen koennen, dass man viele dieser Bruecken nicht frueher stattgefundenen Inversionen zuschreiben kann, weil sie die Folge von Verzoegerungen der Terminalisierung des Chiasmas oder, was uns *in den meisten Faellen noch wahrscheinlicher ist, der Verschmelzung der Chromonemata von zwei Chromosomen sind, wodurch ein Chromosom mit zwei kinetischen Einschnuerungen entsteht.* Ist die Variation deutlich, so kann man aus dem Aussehen der anaphasischen Bruecken keinen Schluss ziehen, der fuer uns von Interesse waere. Man muss noch hinzufuegen, dass einige dieser Bruecken keine in der Naehe liegenden Fragmente aufweisen (Fotos 11 a, b, 20 und 22), dass dagegen andere sehr verschieden grosse und sehr verschiedenartig gestaltete Fragmente haben (Foto 26 a, b, 27).

Stellt man (nach DARLINGTON 1927) zwischen zwei umgekehrten Chromatiden ein Crossing-Over fest, so formt sich eine Chromatide mit zwei Centromeren (welche in der Fachsprache als dizentrisch bezeichnet wird) oder eine als Schnalle aufgerollte Chromatide ohne Zentromere (welche azentrische Chromatide heisst). Die dizentrische Chromatide formt in der ersten Teilung die schnallenfoermige Chromatide, in der zweiten Teilung eine Bruecke, und die azentrische Chromatide wird zu einem Fragment. Wir koennen die fuer die Faelle der wirklichen Inversionsexistenz gut verstaendliche Auffassung nicht auf alle Faelle der Bildung anaphasischer Bruecken beziehen. Wenn die Vorstellung der Inversion in diesen Bruecken immer bestaetigt werden koennte, dann wuerden die Fragmente nicht eine so unregelmaessige Form haben koen-

nen, wie sie haeufig gefunden wird und in Foto 26 a, b deutlich in Erscheinung tritt. Unserer Ansicht nach ist es auch unverstaendlich, dass man in allen von uns beobachteten anaphasischen Bruecken, und selbst in zurueckgebliebenen Stadien, keine Schnallen der Fragmente sah, die Resultate der Inversion sind. DARLINGTON (1937) vermutet an Hand seiner Hypothese, dass das Chromosom, wenn es von beiden Polen angezogen wuerde, zerbrechen muesste und zum Fragment wuerde. Man muss sich aber fragen, wie es moeglich ist, Anaphasen mit einem aussergewoehnlich langen Chromosom (Fotos 23 a, b) zu beobachten Warum hat die Inversion in der Naehe eines Zentromeren stattgefunden? Waere es nicht natuerlich ein Fragment vorzufinden? Jedoch in diesen, wie in vielen aehnlichen Faellen, in denen man sehr lange Chromosomen in der Nähe der Pole nach Bildung der Bruecken fand, wurde kein Fragment beobachtet.

Ausserdem hat man haeufig bei den anaphasischen Bruecken ein heftige Spannung bemerkt, die so stark ist, dass man die Spirale der Chromonemata sehen kann, ohne dieselben besonders fixieren zu muessen. Wir glauben aus diesen Gruenden, dass es sich nicht um Inversionen, sondern um die Verschmelzung zwischen nicht homologen Chromosomen handelt. Das Vorhandensein von Chromosomen mit 2 kinetischen Einschnuerungen, die ohne Fragmente zu erzeugen sich zu demselben Pol begeben, bestaetigen diese Vorstellung (Fotos 21 a, b).

Wir wollen damit nicht sagen, dass es nicht auch Bruecken gibt, die man mit der Bildung vorhergehender Inversionen erklaeren koennte, doch duerfen wir nicht die diesbezueglichen Eroerterungen vergessen, die wir in einer frueheren Arbeit veroeffentlichten (CAMARA 1938). Wir haben so zwei gleichaussehende Variationstypen anzunehmen und haben festzustellen, dass die Erscheinung der anaphasischen Bruecken nicht geeignet ist, den Intensitaetsgrad der Bestrahlung aus dem Verhalten der Chromonemata dieser Bestrahlung gegenueber, zu ermitteln. Es ist moeglich, dass wirklich die Energie, die die Verschmelzung der Bruchstuecke desselben Chromosoms

bewirkt, eine andere ist, als die, welche die Vereinigung verschiedener Chromosome hervorruft.

Ausserdem kann man aus dem Vorhandensein von Bruecken auf eine Bestrahlung schliessen. Diese koennen brechen oder bestehen bleiben, je nach den vorherrschenden Umstaenden, je nach der relativen Entfernung zwischen den beiden Zentromeren und auch nach der Dehnbarkeit der Chromonemata. Ausserdem muss die von der Inversion ausgeloeste Energie verschieden von derjenigen sein, welche die Verschmelzungen aufrechterhaelt. Man wird jedoch immer Bruecken beobachten koennen und schreibt diesen irrtuemlich oft Gleichwertigkeit zu.

MATHER (1934) ist durch das Studium ueber die Wirkung der Roentgenstrahlen auf die meiotischen Chromosomen der *Vicia Faba* und *Tradescantia bracteata* zu dem Schluss gekommen, dass die Chromosomen vor der Metaphase der *Tradescantia* und in der spaeten Meta- und Anaphase der *Vicia Faba* in Stuecke brachen Seiner Meinung nach ist dieser Unterschied Folge der verschiedenen Kraefte, welche die Terminalisierung der Chiasmata erzeugen. In seinen Schlussfolgerungen behauptet er auch, dass die Frequenz des Chiasmas einige Zeit nach der Behandlung noch erhoeht wuerde.

Die erste seiner Behauptungen koennen wir nicht bestaetigen. Zieht man die Schwierigkeit in Betracht, die sich beim Fixieren der Prophasen der Meiosen von *Vicia Faba* zeigt, und die uebrigens von dem oben erwaehnten Forscher unterstrichen wird, so kann man verstehen, dass es wohl kaum moeglich ist, diese Stadien zu beobachten. Wie kann man also folgern, dass sich in den spaeten Meta-und Anaphasen mehr Variationen bilden? Wir geben zu, dass man sie sieht, aber nicht, dass sie haeufiger als in den Prophasen vorkommen. Waehrend unserer ganzen Arbeit mit bestrahltem Material hat sich erwiesen, dass die geeignete Phase zu Anfang der Prophase ist.

Wir konnten nicht feststellen, dass sich die Zahl der Chiasmata erhoeht. Es ist in einigen Faellen wohl der Fall, aber sie wird in andern ohne einen sichtbaren Anlass

deutlich kleiner. Fuer diese Tatsache gibt es vermutlich keine Regel.

Zuletzt wollen wir noch von dem Auftreten der Trabanten sprechen, die wir zuvor in Kontrollversuchen nie gesehen hatten. Im Foto 19 ist ein Beispiel hierfuer gegeben. Wir erklaeren das Auftreten eines Trabanten

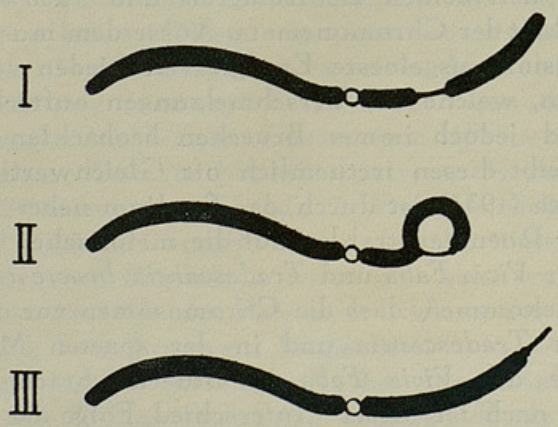

Abb. 21

mit dem Zustandekommen einer Translokation, in der moeglicherweise ein Fragment des *M*-Chromosoms sich nahe bei der zweiten Einschnuerung nach dem aeussersten Ende des andern Chromosoms begibt.

Wir finden diese Erscheinung umso interessanter, als wir einen eigenartigen Fall von einem Trabanten und einem Faden beobachten konnten, so wie es unsere Fotos 6 a, b, c zeigen.

Es scheint, dass in dem Moment, in dem die Matrixsubstanz die Chromonemata umhuellen sollte, sie sich nicht ueber diessen Faden ergiessen konnte. Wir vermuten dass die innere Zone des M-Chromosoms fuer die zweite Einschnuerung (nukleolarbildende Zone nach Fernandes) verantwortlich ist und durch eine einfache Inversion auf das aeusserste Ende desselben Chromosoms uebergeht, wie es in dem Schema unserer Abbildung 21 gezeigt ist.

Man sieht bei I das Chromosom des Typs *M*. Die betreffende Zone ist punktiert gezeichnet. In II ist das

die Inversion erzeugende Einrollen gezeigt. Die Verschmelzung erfolgt in der Naehe der zweiten Einschnuerung. III zeigt das Chromosom nach der Spaltung. Bermerkenswert ist der kleine Koerper, dort, wo sich der Faden mit dem Chromosom verbindet. Wir nehmen an, dass es ein Trabant ist.

Sollten die Dinge sich so verhalten, dann duerfte die extreme Zone des Chromosoms sich nicht mit ihrem Partner paaren. Die Bivalente ist wirklich an diesem aeussersten Ende offen und zeigt in der betreffenden Zone einen Mangel an Homologie.

Wie wir schon sagten, gibt es einen aus einer Bivalente brechenden Faden, der sich mit einem anderen Block zu vereinigen scheint. Unsere Meinung ist, dass moeglicherweise in derselben Chromatide eine Bruecke entsteht, in der Faktoren von einem zum andern Punkt gebracht werden.

Sobald eine Ueberkreuzung chromosomischer Elemente in den Diplotaenstadien, erzeugt wird, ist die Bruecke in der Lage, die Teilung eine Zeitlang, ohne dass sie bricht, zu ueberstehen. Wenn aber am Schluss die Einschnuerung bei dem Uebergang zur Metaphase eintritt, wird die Bruecke zu lang, veraendert ihren Platz und oeffnet sich seitlich zu einer Schnalle.

Es mag sein, dass unsere Beobachtung nicht korrekt ist, wenn auch die Photographien und die Zeichnungen genuegend klar sind. Wir haben bei *Vicia Faba* niemals aehnliche Erscheinungen sehen koennen, und in allem andern Material, das wir seit 1934 nach vorausgehender Bestrahlung untersuchten (z. B. *Aloë arborescens*), konnten wir, obgleich Bruecken im Pachytaenstadium vorkamen, diese niemals in der Metaphase sehen. Deshalb weisen wir darauf mit Vorbehalt hin. Wir wollten jedoch nicht darueber ohne diesen kurzen Hinweis hinweggehen, da wir der Meinung sind, dass es Strukturvariationen gibt, die man nicht mit den altherkoemmlichen Ideen, aehnlich wie den Prozess des «Crossing-Over» zwischen nicht homologen Chromosomen, erklaeren kann.

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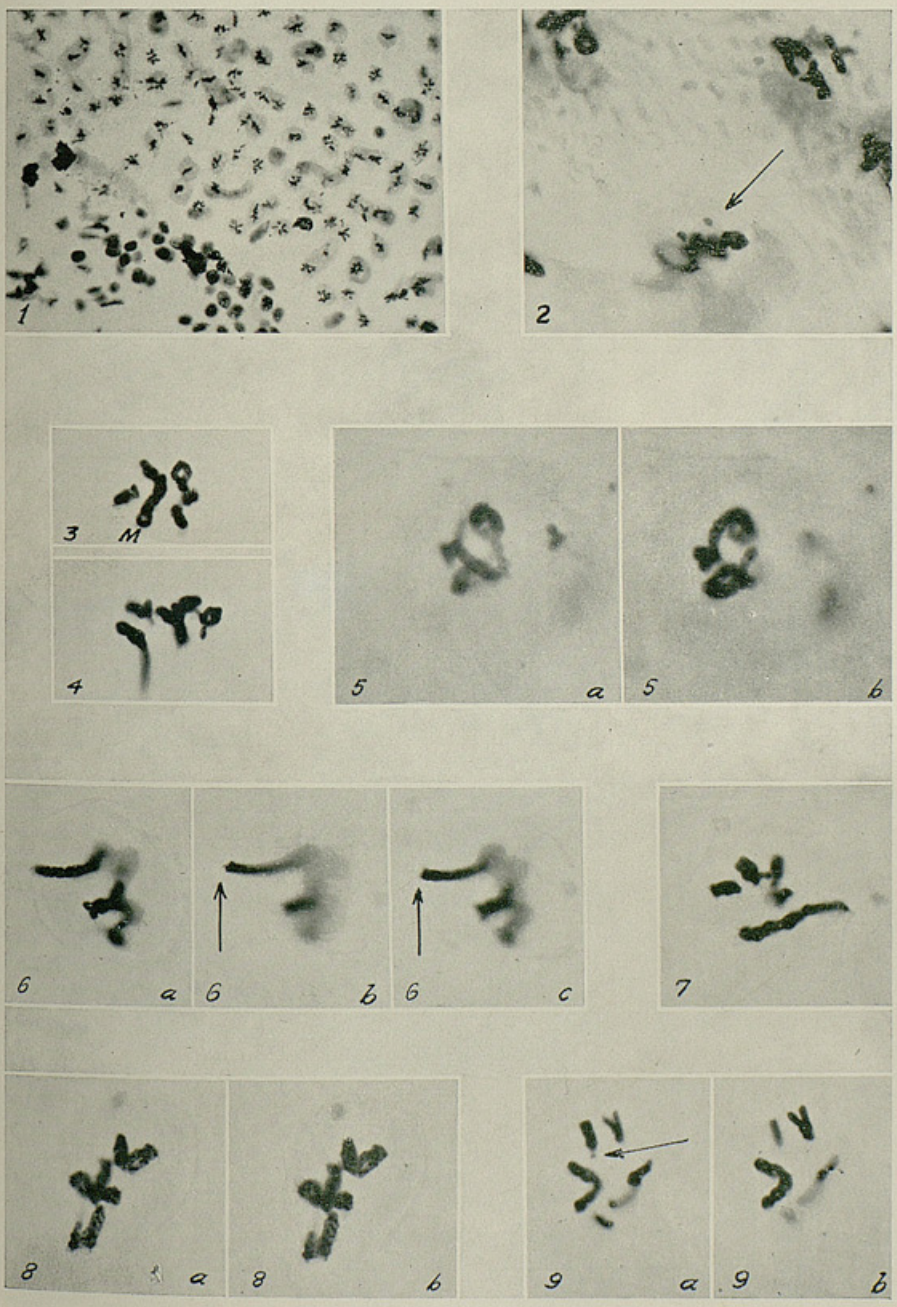
1
2
3 M
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5 a
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6 a
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7
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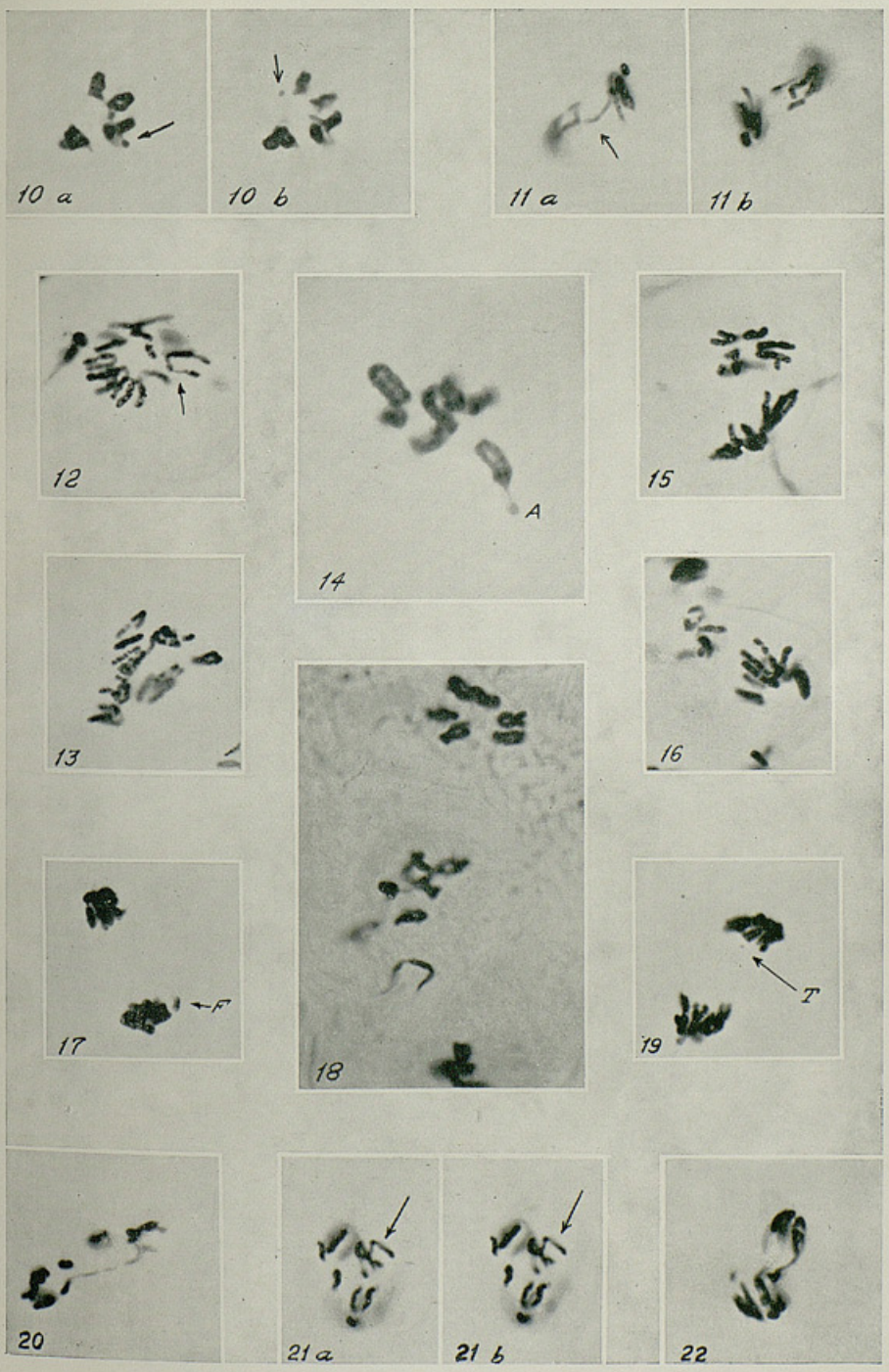
10 a
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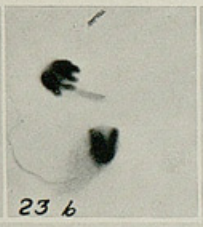
23 a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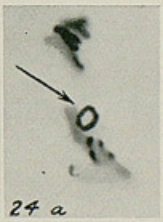
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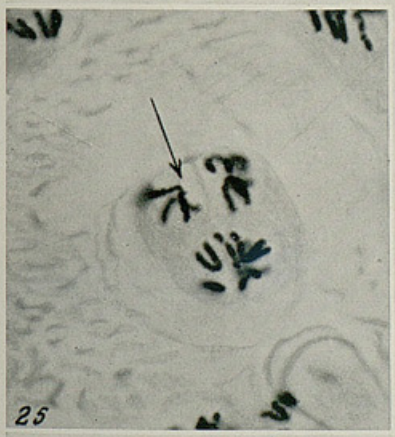
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26 a


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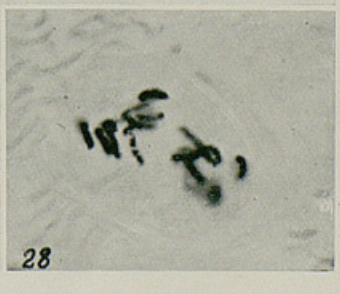
28

SUR LA RÉPARTITION ET L'ÉCOLOGIE DES HÉPATIQUES ÉPIPHYLLES AUX AÇORES

par

VALIA ET PIERRE ALLORGE (PARIS)

LA présence de végétaux épiphylles (1), c'est à dire de végétaux épiphytes non parasites se développant à la surface des feuilles ou des frondes vivantes de plantes vasculaires, est un des traits principaux des forêts tropicales et subtropicales (2).

Ces épiphylles, Lichens (surtout Strigulacées), Algues (Cyanophycées et Trentepohliacées principalement), Mousses (Hookeriacées en particulier), Hépatiques (en majorité Lejeunéacées et Radulacées) constituent, dans ces forêts, des associations bien définies, composées d'espèces strictement confinées, pour la plupart, sur ce support vivant et liées, dans les limites d'un climat régional, à des conditions de climat local et de microclimat dont la caractéristique essentielle est la faible valeur du déficit de saturation.

Mais on a également signalé des épiphylles en dehors des régions tropicales et subtropicales. Des Lichens épiphylles se rencontrent au Portugal (à Sintra, par ex.!),

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(1) L'épithète *foliicole* qui figure dans de nombreuses diagnoses d'Hépatiques et qui s'emploie aussi pour les Lichens est peut-être plus expressive et plus correcte.

(2) Malgré sa signification écologique importante comme réactif climatique, l'épiphyllie est passée sous silence dans la plupart des traités de phytogéographie. Dans la 3me édition du traité classique de A. F. W. SCHIMPER, remanié par F. VON FABER, neuf lignes seulement, insignifiantes d'ailleurs, sont consacrées aux épiphylles. On trouvera dans TH. HERZOG (HERZOG 1926, pp. 70-74 et 206-210) et dans P. W. RICHARDS (RICHARDS 1932, pp. 391-392) les données essentielles sur les Bryophytes épiphylles.

dans les Pyrénées ariégeoises (DUGHI 1934), en Bretagne, dans le Loiret (JOVET 1936), entre autres; le *Catillaria Bouteillei* (Desm.) Zahlbr. remonte sur le Buis, jusqu'au Nord de Paris. Parmi les Algues, le *Phycopeltis epiphyton* Millardet est çà et là dans l'Europe Centrale, sur les aiguilles de Sapin, les feuilles du Buis, du Lierre, des *Rubus*. Les Mousses ne s'accomodent guère de l'épiphyllie en dehors des régions tropicales tandis que les Hépatiques peuvent être nombreuses qui végètent sur les feuilles dans certains territoires à climat hyperocéanique doux.

Dans le domaine atlantique européen, on observe déjà une tendance à la vie épiphylle chez plusieurs Hépatiques. Aux Faeroers, par ex., l'*Aphanolejeunea microscopica* (Tayl.) Evs. végète non seulement sur d'autres Muscinées, mais encore sur les frondes de l'*Hymenophyllum unilaterale* Bory (C. JENSEN 1901, p. 123); c'est également sur *Hymenophyllum* (*H. tunbridgense* Sm. et Sow.) que cette Hépatique a été signalée dans son unique localité continentale, aux Ardennes (VERDOORN 1929, p. 42). Remarquons dès ici que c'est une des épiphylles les plus répandues aux Açores. Aux environs de Cherbourg, le *Colura calyptrifolia* (Hook.) Evs. a été récolté sur frondes de *Pteris* et de *Blechnum Spicant* Roth., le *Microlejeunea ulicina* (Tayl.) Evs. sur frondes d'*Hymenophyllum tunbridgense* Sm. et Sow. (L. CORBIÈRE 1889, pp. 346-347); sur cette même fougère, le Dr. F. CAMUS a noté, au Huelgoat (Finistère), l'*Harpalejeunea ovata* (Hook.) Schiffn. Enfin, le *Cololejeunea Rossettiana* (Mass.) Schiffn., Hépatique atlantico-méditerranéenne vit presque toujours sur les arbuscules du *Thamnium alopecurum* (L.) Bryol. eur. ou sur les rameaux de *Neckera* (*N. crispa* Hedw., *N. complanata* (L.) Hüb.) et d'*Anomodon viticulosus* (L.) Hook. et Tayl. (1). D'ailleurs, presque toutes les Lejeunéacées européennes peuvent vivre sur des Muscinées ou des Lichens corticicoles ou saxicoles, mais on ne saurait parler d'épiphyllie proprement dite, le substra-

(1) A la suite d'observations et d'expériences faites sur le *Lophocolea bidentata* (L.) Dum., AD. DAVY DE VIRVILLE pense que les Hépatiques vivant sur d'autres muscinées s'y comportent en parasites (DAVY DE VIRVILLE 1937). Pour ce

tum vivant étant toujours plus ou moins étroitement appliqué sur le support inerte.

Ce n'est qu'au dessous du 40° N. que les épiphylles vraies commencent à se montrer, au Japon d'une part, aux Açores de l'autre (1).

Au Japon, l'existence d'Hépatiques épiphylles fut successivement notée par A.W.EVANS (EVANS 1906, pp. 146--150-151), FR. STEPHANI (STEPHANI 1913-1916, *passim*), V. SCHIFFNER (SCHIFFNER 1929, p. 87) et Y. HORIKAWA; ce dernier auteur, dans un petit mémoire d'ensemble (HORIKAWA 1932), énumère 27 espèces (24 Lejeunéacées, 2 *Radula* et 1 *Jubula*), plusieurs dépassant le 34° N., sur frondes de fougères, aiguilles ou feuilles de Gymnospermes et d'Angiospermes. Aux Açores, la présence d'Hépatiques épiphylles est connue depuis peu: deux espèces, *Frullania Teneriffae* (Web.) Nees et un *Physocolea*, ont été rencontrées, par T. G. TUTIN et E. F. WARBURG, à l'île du Pico, c'est à dire aux environs du 38° N. (37° 30') (2) (RICHARDS 1932, p. 391 et 1937, p. 137-138).

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qui est des épiphylles, il semble bien qu'elles restent autotrophes et que les substances nutritives leur soient apportées par l'eau de pluie arrivant sur elles en fines gouttelettes après avoir lavé les feuilles, branches et rameaux des couronnes. En attendant une démonstration expérimentale, que nous pensons, d'ailleurs, entreprendre, nous admettrons que les Hépatiques ne sont pas parasites sur les feuilles. D'ailleurs, ces épiphylles s'installent surtout sur des feuilles persistantes à cuticule épaisse, parfois cireuse et leurs rhizoides ne peuvent guère qu'avoir un rôle de fixation (haptères). Mais il reste évident qu'une feuille dont la surface est plus ou moins recouverte par un écran d'épiphylles, parfois entièrement (comme nous avons pu le constater dans les forêts de la Guadeloupe, par ex.) ne peut avoir une activité physiologique normale.

(1) En ce qui concerne l'hémisphère austral, nous n'avons pas trouvé d'indications quant à la limite des épiphylles, mais il ne semble guère douteux qu'il en existe dans les forêts sempervirentes de type antarctique si riches en Muscinées épiphytes (forêt valdivienne, forêts néozélandaise et tasmanienne).

(2) V. SCHIFFNER cite de Madère (32° N.), d'après des récoltes de J. BORNMÜLLER, *Lejeunea lamacerina* (Gottsche) St. « in foliis vivis *Trichomanis radicantis* cum *Cololejeunea madeirensis* Schiffn». (SCHIFFNER 1902, p. 278). Il est à peu près certain que des épiphylles proprement dites se rencontreront à Madère, dans les laurisilves du versant N.; elles ne peuvent manquer non plus dans la laurisilve canarienne où J. PITARD ne cite cependant que des muscicoles, *Lejeunea Pitardii* St., *L. canariensis* St., *Microlejeunea ulicina* (Tayl.) Evs., *Cololejeunea calcarea* (Lib.) Spr., *C. Rossettiana* Mass., sur *Echinodium spinosum* Mit t.surtout (PITARD 1907, pp. 42-43).

En réalité, le mode de vie épiphylle est trés répandu chez les Hépatiques dans l'archipel açoréen (1); au cours d'un récent voyage (2) nous avons observé, en effet, des Hépatiques épiphylles dans cinq des sept îles par nous visitées: S. Miguel, S. Jorge, Pico, Faial et Flores, c'est à dire dans chacun des trois groupes insulaires, oriental (S. Miguel, Santa Maria), central (Terceira, Graciosa, S. Jorge, Pico et Faial) et occidental (Flores, Corvo). L'île de Flores, par 39°30' N., représente le point le plus septentrional atteint par les épiphylles proprement dites. Il est fort probable que les épiphylles ne manquent pas à Santa Maria (dans les ravins boisés de la partie centrale) et à Terceira (sur les pentes culminales boisées de la Caldeira de Santa Bárbara, par ex.), îles que nous n'avons pu visiter que très rapidement au cours de ce premier voyage. Quant à Graciosa et à Corvo, où nous n'avons pas abordé, elles paraissent trop peu boisées pour convenir aux épiphylles.

I. — RÉPARTITION DES HÉPATIQUES ÉPIPHYLLES AUX AÇORES

HARPANTHACEAE

Lophocolea fragrans De Not. et Mor. — Flores: chemin de Lages à Fajãsinha, hauts talus encaissés, sur *Trichomanes speciosum* Willd. (3), vers 510 m. — Ce *Lophocolea* est généralement corticicole aux Açores (S. Miguel, S. Jorge, Faial).

Distrib.: Iles Britan., Norvège., France N. W., Corse, Italie, Madère, Canaries.

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(1) L'épiphyllie n'est pas limitée aux Hépatiques; nous avons également observé sur feuilles ou frondes des Mousses, très rares d'ailleurs (*Hypnum canariense* (Mitt.) Jaeg., *H. resupinatum* Wils.) des Lichens (*Parmeliella*, *Leptogium*, des Crustacés), des Algues (*Trentepohlia*, *Scytonema*, *Nostoc*).

(2) Du 27 Mai au 24 Août 1937, notre excellent collègue et ami le Dr. H. PERSSON qui a visité les Açores quelque temps avant nous a récolté plusieurs Hépatiques épiphylles sur *Acrostichum squamosum* Sw., dans le massif de Vara (île S. Miguel).

(3) La nomenclature adoptée pour les plantes vasculaires est celle de TRELEASE (TRELEASE 1897).

PLAGIOCHILACEAE

Plagiochila tridenticulata Tayl. — S. Miguel: forêts des pentes du Pico da Vara, sur frondes d'*Acrostichum squamosum* Sw., vers 900 m. — S. Jorge: ravins de la route de Calheta à Topo, même substratum, ca. 600-700 m. — Existe aussi sur branchettes de *Juniperus brevifolia* Ant., de *Persea azorica* Seub. et d'*Erica azorica* Hochst. à Flores, dans un ravin descendant à la Lagoa Comprida, vers 600 m. et à Pico, au dessus de Serra Gorda, vers 700 m.

Distrib.: Iles Britan., Norvège mérid., Normandie, Pyrénées occid., Canaries, Madère, Etats-Unis (Tennessee).

RADULACEAE

Radula Aquilegia Tayl. — S. Miguel: forêts des pentes du Pico da Vara, vers 900 m. et du Salto do Cavalo, vers 750 m., sur *Persea* et *Acrostichum* Sw. épiphyte. — Assez répandu aux Açores, sur écorce et sur rochers, souvent avec périanthes.

Distrib.: Faeroers, Iles Britan., Norvège.

Radula Carringtonii Jack. — S. Miguel: parc José do Canto, rive sud de la Lagoa das Furnas, vers 280-300 m., sur *Camelia* et *Phoenix*. — Flores: sur *Trichomanes speciosum* Willd., chemin creux sous le Pico da Casinha, vers 350 m. et talus du chemin de Lages à Fajãsinha, vers 540 m. — Répandu dans presque toutes les îles de l'archipel, surtout dans l'étage inférieur, sur écorce et rochers.

Distrib.: Iles Britan., Espagne N. W.

LEJEUNEACEAE

Aphanolejeunea microscopica (Tayl.) Evs. — S. Miguel: parc José do Canto, rive sud de la Lagoa das Furnas, 280-300 m., sur *Camelia, Phoenix, Sabal, Podocarpus, Prunus Lauro-cerasus* L.; forêts des pentes du Pico da Vara, du Pico Verde, de la Serra Trunqueira, du Salto do Cavalo, 700-900 m., sur *Persea, Viburnum Tinus* L. var. *subcordatum* Trel., *Hedera canariensis* Willd., *Acrostichum;* pentes

intérieures de la caldeira de la Lagoa do Congro vers ca. 450 m., sur *Trichomanes* épiphyte. — Faial: pentes intérieures de la Caldeira Grande, 800 m., sur *Persea* — S. Jorge: ravins de la route de Calheta à Topo, 600-700 m., sur *Persea, Ilex Perado* Ait., *Myrsine africana* L. var. *retusa* DC., *Trichomanes, Acrostichum* épiphyte. — Pico: au dessus de Serra Gorda, env. 700 m., sur *Acrostichum* épiphyte (sur *Erica azorica* Hochst.). — Flores: pentes intérieures des Caldeira Sêca et Caldeira Comprida, env. 550 m., sur *Persea azorica* Seub.; chaos basaltique boisé au-dessus de Fajãsinha, env. 250 m., sur *Trichomanes;* chemin creux sous le Pico da Casinha, env. 350 m., sur *Hymenophyllum tunbridgense* Sm. — Semble rare sur d'autres substratums (écorces, souches pourrissantes, rochers), mais souvent épiphyte sur Muscinées corticicoles ou saxicoles (*Neckera intermedia* Brid., *Thamnium alopecurum* Bryol. eur. var., *Echinodium Renauldii* (Card.) Broth., *Porella canariensis* Nees, *Radula Carringtonii* Jack., etc.).

Distrib.: Faeroers, Irlande, Ecosse, Luxembourg, Madère.

Cololejeunea minutissima (Sm.) Schffn. — S. Miguel: parc de l'hôtel «Terra Nostra», à Furnas, env. 210 m., sur *Camelia, c. per.;* parc José do Canto, rive sud de la Lagoa das Furnas, 280-300 m., sur *Camelia* et *Podocarpus, c. per.* — Egalement sur écorces et rochers, dans l'étage inférieur de la plupart des îles.

Distrib.: Iles Britan., Belgique, France W., Espagne N. W., Portugal, rég. méditerr. occid., Amérique N. atlantique (1).

Colura calyptrifolia (Hook.) Evs. — S. Miguel: forêts des pentes du Pico da Vara, du Pico Verde, de la Serra Trunqueira, du Salto do Cavalo, 700-900 m., sur *Persea, Viburnum, Ilex, Hedera, Acrostichum* épiphyte et *Hymenophyllum unilaterale* Bory épiphyte, *c. sp.* — Pico: au-dessus de Serra Gorda, vers 750 m., sur *Acrostichum* épiphyte. — S. Jorge: ravins de la route de Calheta à Topo, sur *Persea,*

(1) Existerait aussi au Japon (HORIKAWA).

Ilex, Hedera, Acrostichum, 600-700 m. — Semble exceptionnel sur d'autres substratums; observé une fois (Pico da Vara), sur branchettes et pétioles de *Persea*. — Les sporogones, fréquents, sont mûrs en Juin.

Distrib.: Iles Britan., Normandie, Bretagne.

Drepanolejeunea hamatifolia (Hook.) Schffn. — S. Miguel: parc José do Canto, rive sud de la Lagoa das Furnas, 280-300 m., sur *Phoenix* et *Sabal;* forêts des pentes du Pico da Vara, du Pico Verde, de la Serra Trunqueira, du Salto do Cavalo, 700-900 m., sur *Persea, Ilex, Viburnum, Notelaea excelsa* Webb., *Hedera, Acrostichum* épiphyte. — Faial: pentes intérieures de la Caldeira Grande, 750-800 m., sur *Persea.* — Pico: au-dessus de Serra Gorda, 750 m., sur *Acrostichum* épiphyte. — S. Jorge: ravins de la route de Calheta à Topo, 600-700 m., sur *Persea, Ilex, Myrsine, Acrostichum* épiphyte. — Flores: pentes des caldeiras de la Lagoa Sêca et de la Lagoa Comprida, 550-600 m., sur *Persea* et *Sticta sinuosa Pers.* — Avec *Aphanolejeunea microscopica* (Tayl.) Evs., c'est l'Hépatique la plus répandue en épiphylle aux Açores, mais elle se rencontre souvent aussi sur d'autres substratums: écorces, rochers, autres Muscinées. Les périanthes sont fréquents, mais, comme aux Iles Britanniques, les sporogones ne semblent pas se développer.

Distrib.: Iles Britan., Normandie, Bretagne, Pyrénées occid., Mad re.

Harpalejeunea ovata (Hook.) Schffn. — S. Miguel: forêts des pentes du Pico da Vara, vers 800 m., sur *Persea,* très rare; parc José do Canto, rive sud de la Lagoa das Furnas, 280-300 m., sur *Phoenix,* très rare également. — Cette Lejeunéacée semble exceptionnellement épiphylle, tandis qu'elle est répandue comme corticicole, saxicole ou muscicole dans l'étage inférieur de toutes les îles.

Distrib.: Iles Britan., Norvège mérid., Normandie, Bretagne, Pyrénées occid., Pénins. ibér. occid., région méditerr. occid., Canaries, Madère, Amér. N. atlantique.

Lejeunea flava (Sw.) Nees. — Faial: ravin de la Ribeira

da Praia, vers 150 m., sur frondes d'*Adiantum hispidulum* Sw. — Dans les autres localités où nous avons observé cette Hépatique, elle végète soit sur rochers (Flores: ravins autour de Santa-Cruz, Fajãsinha; S. Jorge: ravins au dessus de Calheta), soit sur écorces (Pico: Serra Gorda, sur *Erica azorica* Hochst.).

Distrib.: Irlande, Madère, Canaries, rég. trop. et subtrop. (Antilles, Japon, Indonésie, etc.).

Lejeunea Holtii Spr. — Flores: chemin de Lages à Fajãsinha, hauts talus encaissés, 540 m., sur *Trichomanes*. Surtout muscicole-saxicole (S. Miguel: Pico da Vara; S. Jorge: S. António).

Distrib.: Irlande, Madère.

Lejeunea patens Lindb. — S. Miguel: forêts des pentes du Pico da Vara, de la Serra Trunqueira et du Salto do Cavalo, 700-900 m., sur *Persea, Viburnum, Hedera, Acrostichum* épiphyte. — S. Jorge: ravins de la route de Calheta à Topo, 600-700 m., sur *Persea, Ilex, Acrostichum* épiphyte. — Pico: au dessus de Serra Gorda, 750 m., sur *Acrostichum* épiphyte. — N'est pas rare aux Açores, soit sur écorce ou bois pourrissant, soit sur rochers, soit sur d'autres Muscinées (*Fissidens serrulatus* Brid., *Echinodium Renauldii* (Card.) Broth., *Thamnium alopecurum* Bryol. eur. var. etc.).

Distrib.: Iles Britan., Norvège, France N. W., Pyrénées occid., Espagne N. W., Madère, Amérique N. atlantique.

Lejeunea planiuscula (Lindb.) Buch. (1) — S. Miguel: parc José do Canto, rive sud de la Lagoa das Furnas, 280-300 m., sur *Camelia* et *Phoenix*.

Distrib.: Europe atlantique, encore mal connue.

Marchesinia Mackayi Gray. — S. Miguel: parc José do Canto, rive sud de la Lagoa das Furnas, 280-300 m., sur *Camelia* et *Phoenix*, *c. sp.* — C'est l'Hépatique la plus répandue dans l'étage inférieur de toutes les îles; presque

(1) Détermination de notre excellent collègue le Prof. Th. HERZOG (Iéna).

toujours fertile, elle forme des plaques étendues, étroitement appliquées au substratum, sur les écorces et les rochers.

Distrib.: Iles Britan., Bretagne, Pyrénées occid., Espagne N. W., Portugal, Madère, Canaries, rég. méditerr. occid.

Physocolea sp. — «Epiphyllous on leaf of *Persea azorica*, Pico» (TUTIN et WARBURG ap. RICHARDS 1937, p. 137).

FRULLANIACEAE

Frullania microphylla (G.) Pears. — S. Miguel: parc de l'hôtel «Terra Nostra», à Furnas, env. 210 m., sur *Camelia;* parc José do Canto, rive sud de la Lagoa das Furnas, 280-300 m., sur *Camelia, Phoenix, Podocarpus* et *Prunus Lauro-Cerasus*, c. per.; forêts des pentes du Pico da Vara et du Salto do Cavalo, 700-900 m., sur *Persea* et *Hedera.* — S. Jorge: ravins de la route de Calheta à Topo, 600-700 m., sur *Ilex, Trichomanes, Acrostichum* épiphyte. — Flores: chemin creux sous le Pico da Casinha, vers 350 m., sur *Trichomanes* et *Hymenophyllum tunbridgense* Bory. — Répandu dans toutes les îles, sur écorce ou rochers, souvent fertile.

Distrib.: Faeroers, Iles Britan., Bretagne, Pyrénées basques, Maroc, Madère, Canaries.

Frullania Teneriffae (Web.) Nees. — Pico: «on living leaves of *Ilex Perado*, crater, 4.000 ft» (TUTIN et WARBURG ap. RICHARDS 1937, p. 138).

Distrib.: Madère, Canaries.

Frullania aff. **Tamarisci** (L.) Dum. (1) — S. Miguel: forêts des pentes du Pico da Vara et du Salto do Cavalo, 700-900 m., sur *Persea, Viburnum* et *Hedera.*

Frullania sp. — S. Miguel: mêmes localités, sur *Persea* et *Ilex.*

(1) Cette espèce et la suivante ont été soumises à l'examen de notre excellent collègue, le Dr. FR. VERDOORN qui a bien voulu étudier les *Frullania* que nous avons récoltés aux Açores.

Jubula Hutschinsiae (Hook.) Dum. subsp. **Hutschinsiae** Verd. — Flores: chemin de Lages à Fajãsinha, hauts talus encaissés, env. 540 m., sur *Trichomanes*. — Cette Frullaniacée n'est pas rare aux Açores, sur les talus et rochers humides, dans les ravins très couverts.

Distrib.: Iles Britan., Bretagne, Pyrénées basques, Madère, Canaries.

METZGERIACEAE

Metzgeria furcata (L.) Dum. — S. Miguel: forêts des pentes du Pico da Vara et du Salto do Cavalo, 700-900 m., sur *Persea, Ilex* et *Acrostichum* épiphyte.

Distrib.: circumboréal.

Quelques remarques intéressantes découlent de l'analyse de ce petit catalogue.

Tout d'abord, il faut souligner le nombre élevé de Lejeunéacées observées: sur 21 Hépatiques que comporte, d'après ces premières recherches, la florule épiphylle açoréenne, 11 appartiennent à cette famille dont la prédominance est donc un caractère général du peuplement épiphylle, qu'il s'agisse de régions tropicales ou de régions tempérées. Au Japon, par ex., sur 27 Hépatiques citées, 24 ressortissent aux Lejeunéacées (HORIKAWA 1932). Rappelons aussi que toutes les Hépatiques qui manifestent une tendance à l'épiphyllie dans le domaine atlantique européen sont également des représentants de cette famille.

Tandis qu'au Japon la florule hépaticale épiphylle comprend, en majorité, des espèces spéciales au substratum feuille (ou fronde), ici, aucune des 18 Hépatiques nommées n'est exclusivement épiphylle. Le *Colura calyptrifolia* (Hook). Evs. mis à part, qui vient presque toujours sur feuilles ou frondes (constaté rarement sur pétioles et ramilles), toutes les autres prospèrent sur d'autres substratums, vivants (Muscinées, Lichens) ou inertes (écorces, rochers, terre), plusieurs même y ayant leur habitat normal, telles *Marchesinia Mackayi* Gray, *Harpalejeunea ovata* (Hook.) Schffn., *Lejeunea Holtii* Spr. Il s'agit, en somme, d'une

épiphyllie facultative et régionale, puisque dans d'autres parties de leur aire, ces Hépatiques ne s'installent pas sur les feuilles, sauf dans un très petit nombre de cas (1).

Enfin, un autre caractère notable de la florule épiphylle açoréenne est la dominance très marquée des éléments atlantiques. En effet, les 18 espèces nommées appartiennent aux types de répartition suivants:

10 espèces eu-atlantiques: *Aphanolejeunea microscopica* (Tayl.) Evs., *Colura calyptrifolia* (Hook.) Evs., *Drepanolejeunea hamatifolia* (Hook.) Schffn., *Frullania microphylla* (G.) Pears., *Jubula Hutschinsiae* (Hook.) Dum., *Lejeunea Holtii* Spr., *L. patens* Lindb., *L. planiuscula* (Lindb.) Buch, *Radula Aquilegia* Tayl., *R. Carringtonii* Jack.;

3 espèces euryatlantiques: *Cololejeunea minutissima* (Sm.) Schffn., *Harpalejeunea ovata* (Hook.) Schffn., *Plagiochila tridenticulata* Tayl.;

2 espèces atlantico-méditerranéennes: *Lophocolea fragrans* De Not. et Mor., *Marchesinia Mackayi* Gray.;

1 espèce atlantico-tropicale: *Lejeunea flava* (Sw.) Nees.;

1 espèce macaronésienne: *Frullania Teneriffae* (Web.) Nees.;

1 espèce circumboréale: *Metzgeria furcata* (L.) Dum.

Si l'on pouvait s'attendre à ce haut pourcentage d'éléments atlantiques (plus de 80 %) puisque, par définition, ces espèces caractérisent les climats océaniques, il faut remarquer que, dans l'ensemble de la flore hépaticale açoréenne, les espèces atlantiques ne représentent que 30 % environ. L'épiphyllie exprime donc des conditions d'environnement très particulières.

II. — ENVIRONNEMENT ET SUBSTRATUM

A l'Ile S. Miguel, où nos récoltes et nos observations ont principalement été faites, les conditions favorables à la présence d'épiphylles — atmosphère calme et très humide, abri contre la pluie et l'insolation directe — sont

(1) *Lejeunea flava* (Sw.) Nees est épiphylle au Japon (HORIKAWA 1932).

réalisées soit dans certains parcs très couverts de l'étage inférieur, équivalents écologiques des forêts laurifoliées de basse altitude (= étage du *Myrica Faya* de GUPPY, du littoral à 600-700 m. env.) aujourd'hui presque partout détruites (1), soit dans les forêts, toujours plus ou moins dégradées, de l'étage moyen (= étage du *Juniperus brevifolia* de GUPPY, au-dessus de 600-700 m.) qui ont persisté sur les pentes intérieures des caldeiras, sur les versants très raides et peu accessibles, dans les ravins à bords abrupts, et qui évoquent la grande laurisilve primitive, groupement climatique qui couvrait les parties hautes des îles avant l'installation de l'homme (2).

Sauf pour le littoral, où précisément les épiphylles manquent, on ne dispose d'aucune donnée météorologique; nous devrons donc nous borner à décrire la végétation de deux localités à florule épiphylle bien développée, essayant d'en déduire quelques remarques écologiques explicatives: le parc José do Canto près Furnas (S. Miguel) pour l'étage inférieur, et les pentes du Pico da Vara (S. Miguel) pour l'étage moyen.

1. — Le parc José do Canto qui s'étend sur la rive Sud et Sud-est de la Lagoa das Furnas (280-290 m.) est sans doute la localité la plus riche en épiphylles de l'étage inférieur: le voisinage d'une grande masse d'eau permanente, la présence d'une haute pente abrupte surplombant le parc au Sud, la densité de la végétation ligneuse sempervirente créent dans le sous-bois, toujours humide par les pluies

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(1) Nous en avons aperçu quelques vestiges dans les ravins très encaissés de la haute vallée de la Ribeira da Cruz, Ile Flores, malheureusement inaccessibles — d'où leur conservation, d'ailleurs. Les *Persea* et les *Notelaea* y dépassaient 13 mètres au moins.

(2) D'après GUPPY (GUPPY 1917, pp. 359-371), à l'île du Pico, la seule de tout l'archipel dont l'altitude dépasse 1.200 m., cet étage du Genévrier atteint 1.350 m.; au-dessus, après une bande de transition où les arbres se rabougrissent, l'étage des landes (et pelouses-landes), s'élève jusqu'au sommet du Pico (2.352 m.). Dans les autres îles élevées la forêt peut donc atteindre les cimes (Pico da Vara, 1.105 m., à S. Miguel; Caldeira de Santa Bárbara, 1.067 m., à Terceira; Pico da Esperança, 1.066 m., à S. Jorge; Caldeira Grande, 1.021 m., à Faial): la violence des vents sur certaines crêtes et surtout l'action destructrice tenace de l'homme expliquent l'absence ou la rareté des forêts sur la plupart de ces sommets,

fréquentes et les brouillards, les conditions de climat local favorables.

La strate arborescente, de haute venue, est constituée surtout par des essences exotiques (*Magnolia, Eugenia, Podocarpus, Ficus, Cryptomeria, Pittosporum, Grevillea*, etc.) mêlées à des arbres de la laurisilve primitive, Fayas et Lauriers. La strate arbustive comprend des Camélias, des Lauriers-Cerise, des Palmiers, des Fougères arborescentes, entre autres. Dans la strate herbacée, fort réduite par suite de l'illumination toujours très faible, on note surtout des Fougères (*Aspidium dilatatum* Hook., *Pteris arguta* Ait., *Asplenium Filix-foemina* Bernh.) et des Carex (*C. macrostyla* Lapeyr. var. *peregrina* L. H. Bailey, *C. Hochstetteriana* Gay).

La strate muscinale terricole n'est bien développée que sur les talus: avec *Fissidens asplenioides* Hedw., *F. serrulatus* Brid., *Oxyrhynchium Stokesii* (Turn.), *Thamnium alopecurum* (Hedw.) Bryol. eur. var., *Conocephalus conicus* (L.) Dum., *Anthoceros Husnoti* St., il faut signaler surtout, sur des talus argileux frais, mais non mouillés, le *Dumortiera hirsuta* (Sw.) Bl. N. et R., hépatique au thalle délicat, très sensible à la dessiccation, généralement cantonnée au voisinage immédiat des cascades ou des filets d'eau ombragés. Son abondance locale ici suggère un état hygrométrique voisin de la saturation; même indication est donnée par certaines espèces du groupement muscinal qui peuple les souches et troncs pourrissants (*Riccardia palmata* (Hedw.) Carr., *Telaranea nematodes* (Gottsche) Howe, *Nowellia curvifolia* (Dicks.) Mitt., *Lepidopilum virens* Card.).

Les épiphylles se localisent sur les feuilles des branches inférieures, c'est à dire dans la strate à degré hygrométrique maximum et peu variable en même temps qu'à l'abri des averses et de l'insolation directe. Au-dessus de 2 mètres, dans les stations les plus abritées, ces épiphylles disparaissent; les feuilles les plus basses sont les plus investies. Trois espèces sont surtout fréquentes: *Frullania microphylla* (G.) Pears., *Aphanolejeunea microscopica* (Tayl.) Evs. et *Cololejeunea minutissima* (Sm.) Schffn.: sur 50

feuilles de Camélia prises au hasard, sur plusieurs arbustes, le *Frullania* se rencontrait sur 49 d'entre elles, l'*Aphanolejeunea* sur 34, le *Cololejeunea* sur 24. Des huit espèces observées en épiphylles dans ce parc, trois sont répandues dans l'étage inférieur, sur d'autres substratums (rochers, écorces) également, et manquent dans l'étage moyen: *Cololejeunea minutissima* (Sm.) Schffn., *Marchesinia Mackayi* Gray et *Radula Carringtonii* Jaek. Deux autres, moins exclusives, restent nettement plus abondantes ici que dans l'étage moyen: *Frullania microphylla* (G.) Pears. et *Aphanolejeunea microscopica* (Tayl.) Evs. Ces cinq espèces caractérisent donc une petite association d'hépatiques épiphylles propre à l'étage inférieur (association épiphylle à *Cololejeunea minutissima).*

2. — Les forêts qui couvrent les pentes de la haute vallée du rio Guilherme (massif de Vara), entre 700 et 900 m., représentent les témoins les mieux conservés de la végétation primaire des montagnes de l'île S. Miguel; parcourues par le bétail dans certains parties, mises à feu sur leurs marges, exploitées pour le bois, elles ont conservé néanmoins, sinon leur structure phytosociale originale intacte, du moins la flore primitive de la laurisilve macaronésienne, très appauvriée aux Açores.

Ces forêts, soumises à un climat extrêmement humide, baignent dans les nuages ou le brouillard pendant la plus grande partie du temps et les sommets ne sont que rarement découverts au-dessus de 700 m. Les averses sont fréquentes en toute saison; sur les crêtes, la violence des vents plaque les arbres vers le sol (1).

Nous prendrons comme exemple une petite bande de forêt d'une trentaine de mètres de longueur sur une dizaine de large, parallèle au sentier qui mène de la route (Povoação-Nordeste) au sommet du Pico da Vara, sur les pentes raides du Pico da Cruz, vers 850-875 m. d'altitude, à exposition Est.

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(1) Le beau peuplement de Genévriers (*Juniperus brevifolia* Ant.), malheureusement très entamé par l'écobuage, qui couvre le flanc oriental du sommet du Pico da Vara (1.105 m.), montre de belles morphoses tabulaires chez les arbres modelés par le vent.

Très difficilement pénétrable par suite de la densité des arbres, de leurs ramures intriquées, de leur faible hauteur — 2 m. 50 au plus, dans cette localité — cette forêt basse est dominée par deux essences, le *Juniperus brevifolia* Ant. et le *Persea azorica* Seub. auxquels s'associent, assez abondant le *Viburnum Tinus* L. var. *obcordatum* Trel., plus dispersés l'*Ilex Perado* Ait., l'*Erica azorica* Hochst. et le *Vaccinium cylindraceum* Sm.) très rares le *Prunus lusitanica* L. et le *Notelaea excelsa* Webb. Le *Myrsine africana* et la Callune représentent une strate subarbustive très claire, une liane, le *Smilax excelsa* L. va fleurir dans les couronnes, des ronces (*Rubus rusticanus* Merc. et *R. Hochstetterorum* Seub.) encombrent les pistes des ruminants. C'est la profusion des Fougères qui frappe le plus dans le sous-bois; aux espèces de grande taille *Dicksonia Culcita* L'Hér., *Woodwardia radicans* Sm., *Pteris arguta* L., *Osmunda regalis* L., *Aspidium Borreri* Newm., *A. dilatatum* Hook. se mêlent, plus humbles, *Lomaria Spicant* Desv., *Gymnogramme Totta* Schl., *Aspidium aemulum* Sw., *Asplenium monanthemum* L., *A. Filix-foemina* Bernh. Sur le sol détrempé et acide s'étend une strate muscinale presque continue: gros bombements de Sphaignes (*Sphagnum cymbifolium* Ehrh., *S. plumulosum* Röll) chaussant la base des troncs et les souches des Fougères, hautes touffes de *Polytrichum commune* L., tapis spongieux de *Thuidium tamariscinum* (Hedw.) Bryol. eur. mêlés d'*Hylocomium proliferum* (L.) Lindb., *Breutelia azorica* Mitt., *Leucobryum glaucum* (L.) Schimp., *Trichocolea tomentella* (L.) Dum., *Lepidozia reptans* (L.) Dum., *Saccogyna viticulosa* (Mich.) Dum., *Pellia epiphylla* (L.) Corda, etc. Une Sélaginelle (*Selaginella Kraussiana* A. Br.) rampe parmi les Muscinées; des Luzules (*Luzula purpureo-splendens* Seub., *L. multiflora* Desv.), *Lysimachia azorica* Hornem., *Sibthorpia europaea* L., *Habenaria micrantha* Hochst. complètent la strate basse.

Mais le trait le plus remarquable de la végétation est l'extrême abondance des épiphytes, expression directe du climat hyperhygrique qui règne dans cette forêt basse, très close: les troncs et les grosses branches auxquels l'*Acrostichum squamosum* Sw. suspend ses frondes vert foncé, argen-

tées-mordorées en-dessous, sont enserrées dans d'épais manchons de Muscinées, toujours imbibés d'eau, tissés d'Hymenophylles (*Hymenophyllum unilaterale* Bory), les branchettes et ramilles disparaissent sous un lacis d'Hépatiques frangé de Lichens et de Mousses pendantes.

L'ensemble muscinal rencontré ici — et que nous avons retrouvé dans d'autres îles (Pico, Faial, S. Jorge) — s'individualise surtout par le nombre important d'espèces hyperatlantiques et macaronésiennes qu'il comprend:

Herberta azorica (St.) P. W. Richards
Bazzania trilobata (L.) Gray
Lepidozia pinnata Spr.
Lepidozia sp.
Acrobolbus Wilsonii (Tayl.) Nees
Leioscyphus sp.
Plagiochila spinulosa (Dicks.) Dum.
P. tridenticulata Tayl
Tylimanthus anisodontus (Tayl.) St.
Adelanthus decipiens (Hook.) Mitt.
Scapania gracilis (Lindb.) Kaal.
Nowellia curvifolia (Dicks.) Mitt.
Radula Aquilegia Tayl.
Odontoschisma denudatum (Mart.) Dum.
Drepanolejeunea hamatifolia (Hook.) Schffn.
Lejeunea patens Lindb.
Frullania Teneriffae (Web.) Nees
F. aff. *Tamarisci* (L.) Dum.
Metzgeria hamata Lindb.
M. furcata (L.) Dum.
Riccardia aff. *sinuata* (Dicks.) Trev.
Campylopus flexuosus (L.) Brid.
Dicranum anglicum Reim.
Ulota calvescens Mitt.
Daltonia splachnoides (Sw.) H. et T.
Myurium Hebridarum Schimp.
Echinodium prolixum (Mitt.) Broth.
Hypnum canariense (Mitt.) Jaeg.
Gollania Berthelotiana (Mont.) Broth.

Quant aux épiphylles, ici aussi très abondantes, elles restent localisées à une faible hauteur au-dessus du sol (de 1 m. à 1 m. 75), sur les feuilles des branches les plus basses, les plus abritées par conséquent des mouvements de l'air, de l'insolation et des averses. Sur certains rameaux, toutes les feuilles, sauf celles qui viennent de se dérouler, possèdent leur petit jardin d'épiphylles qui s'installent aussi sur les frondes d'*Acrostichum*. Il s'agit d'une association différente de celle de l'étage inférieur et comprenant les espèces suivantes:

Plagiochila tridenticulata Tayl.
Radula Aquilegia Tayl.
Aphanolejeunea microscopica (Tayl.) Evs.
Colura calyptrifolia (Hook.) Evs.
Drepanolejeunea hamatifolia (Hook.) Schffn.
Harpalejeunea ovata (Hook.) Schffn.
Lejeunea patens Lindb.
Frullania microphylla (G.) Pears.
F. aff. *Tamarisci* (L.) Dum.
Frullania sp.
Metzgeria furcata (L.) Dum.

L'espèce la plus caractéristique est le *Colura*, absent de l'étage inférieur et épiphylle presque exclusif; avec *Radula Aquilegia* Tayl. et *Metzgeria* qui manquent aussi, du moins en épiphylles, aux basses altitudes, *Drepanolejeunea* qui est constant ici (1), cette Hépatique individualise le groupement de l'étage moyen (association épiphylle à *Colura calyptrifolia)* (2).

* * *

En ce qui concerne les rapports des épiphylles avec leur support vivant, l'examen de la liste des espèces (cf. supra) permet de tirer quelques conclusions.

(1) Sur 80 feuilles de *Persea* examinées, il était présent sur toutes, le *Colura* sur 68 d'entre elles.

(2) Nous n'avons pu établir la limite supérieure des épiphylles; elles doivent disparaître avec la forêt.

D'après les caractères de l'épiderme supérieur des feuilles et des frondes persistantes, on peut distinguer les types suivants:

feuilles très glabres, lisses: *Camellia, Podocarpus, Hedera, Ilex, Notelaea;*

feuilles glabres ou subhirsutes, légèrement rugueuses: *Persea, Viburnum;*

feuilles glabres cannelées: *Phoenix, Sabal;*

frondes pellucides, glabres, gaufrées: *Trichomanes,* Hymenophylles;

frondes densément écailleuses, puis glabrescentes: *Acrostichum.*

Il ne paraît pas que ces différents types possèdent des épiphylles en propre; chaque type de feuille ou de fronde peut héberger presque toutes les espèces. Si l'on s'en tient aux épiphylles largement répandues, les seules qui doivent entrer en ligne de compte, on constate, en effet, qu'elles se trouvent indifféremment sur la plupart des types foliaires distingués plus haut. L'*Aphanolejeunea microscopica* (Tayl.) Evs. et le *Frullania microphylla* (G.) Pears. se rencontrent sur presque tous ces types foliaires, le *Drepanolejeunea hamatifolia* (Hook.) Schffn. ne manque guère que sur les feuilles de Camélia, le *Colura calyptrifolia* (Hook.) Evs. s'installe sur beaucoup de feuilles et frondes dans l'étage moyen (1).

La position, ou plutôt la direction, des feuilles ne semble guère avoir d'importance pour la répartition des épiphylles: les feuilles subverticales des *Persea* sont tout aussi riches en épiphylles que les frondes pendantes de l'*Acrostichum* ou les feuilles étalées des Camélias (2).

On admettra donc que les caractères du support vivant n'exercent en général qu'une influence très secondaire, sur le peuplement épiphylle. Ce sont avant tout les conditions

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(1) Certaines feuilles ou frondes, dans les «bonnes» localités à épiphylles, portent jusqu'à 9 espèces (*Acrostichum* en particulier).

(2) D'ailleurs, dans une atmosphère presque toujours très humide comme celle dans laquelle baignent les feuilles à épiphylles, l'adhérence des spores et des propagules doit toujours se faire facilement.

bioclimatiques locales qui déterminent l'installation et le maintien des épiphylles et dès que ces conditions sont favorables, les feuilles et les frondes persistantes peuvent être colonisées, quels que soient leurs caractères.

RÉSUMÉ ET CONCLUSIONS

1. Les Hépatiques épiphylles sont répandues aux Açores dans la plupart des îles (S. Miguel, S. Jorge, Pico, Faial et Flores, sans doute aussi Terceira et Santa Maria).

2. Comme dans les régions tropicales, les Lejeunéacées sont surtout représentées dans cette florule épiphylle (11 espèces sur un total de 21).

3. Les espèces atlantiques constituent l'élément dominant (plus de 80 %).

4. L'épiphyllie de ces Hépatiques est facultative; sauf *Colura calyptrifolia* (Hook.) Evs., presque exclusif, les autres espèces existent aussi, quelques unes de préférence, sur d'autres substratums que les feuilles (rochers, écorces, sol).

5. Ces épiphylles sont abondantes soit dans les parcs et forêts très humides de l'étage inférieur (au-dessous de 600 m.; parc José do Canto, à Furnas, par ex.), soit dans la laurisilve nébuleuse, plus ou moins dégradée, de l'étage moyen (entre 600 et 1.000 m. au moins; pentes du Pico da Vara, S. Miguel, par ex.).

6. Deux associations peuvent être distinguées: l'une, de l'étage inférieur (assoc. à *Cololejeunea minutissima*, avec *Marchesinia Mackayi* Gray et *Radula Carringtonii* Jack. caractéristiques, *Aphanclejeunea microscopica* (Tayl.) Evs. et *Frullania microphylla* (G.) Pears. constants), l'autre, de l'étage moyen (assoc. à *Colura calyptrifolia*, avec *Radula Aquilegia* Tayl. et *Metzgeria furcata* (L.) Dum. caractéristique, *Drepanolejeunea hamatifolia* (Hook.) Schffn. constant).

7. La distribution de ces épiphylles dépend étroitement, et presque uniquement, du climat local et du microclimat; les qualités du substratum, toujours feuilles ou frondes persistantes (lisses, rugueuses, écailleuses, poilues etc.), n'ont qu'une importance réduite. Pour la plupart, les Hépatiques épiphylles s'installent sur toutes sortes de feuilles ou de frondes lorsque les conditions bioclimatiques favorables sont réunies.

8. La présence constante d'épiphylles dans la laurisilve açoréenne — et sans aucun doute dans les laurisilves madérienne et canarienne — accentue, avec l'abondance des autres épiphytes et des Fougères, les affinités de la forêt laurifoliée macaronésienne avec certaines forêts sempervirentes des montagnes tropicales.

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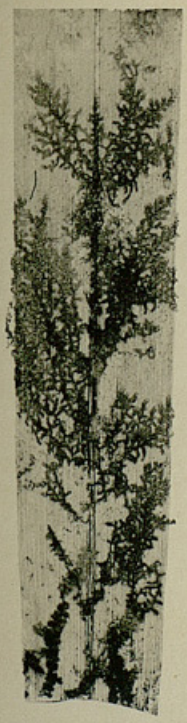
EXPLICATION DES PLANCHES

PLANCHE I

Fig. 1. *Frullania microphylla* (G.) Pears. sur fragment de palme de *Phoenix* (Parc José do Canto, 290 m.); fig. 2, *Drepanolejeunea hamatifolia* (Hook.) Schffn. sur feuilles de *Persea azorica* Seub., (Salto do Cavalo, S. Miguel, 800 m.); fig. 3, *Cololejeunea minutissima* (Sw.) Spr. et *Frullania microphylla* (G.) Pears. sur feuille de *Camelia* (Parc José do Canto, Lagoa das Furnas, 290 m.); fig. 4, *Frullania* sp. et *Lejeunea patens* sur feuille d'*Hedera canariensis* Willd. (ravin au Rete do Canário entre Calheta et Topo, S. Jorge, alt. ca. 700 m.); fig. 5, *Frullania* sp. sur feuille de *Persea azorica* Seub. (pentes de la Caldeira Sêca, Flores, vers 570 m.). Grand. nat.



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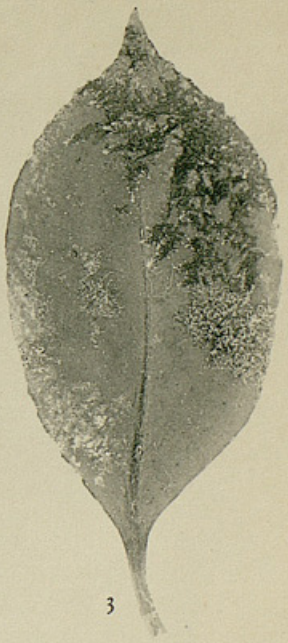

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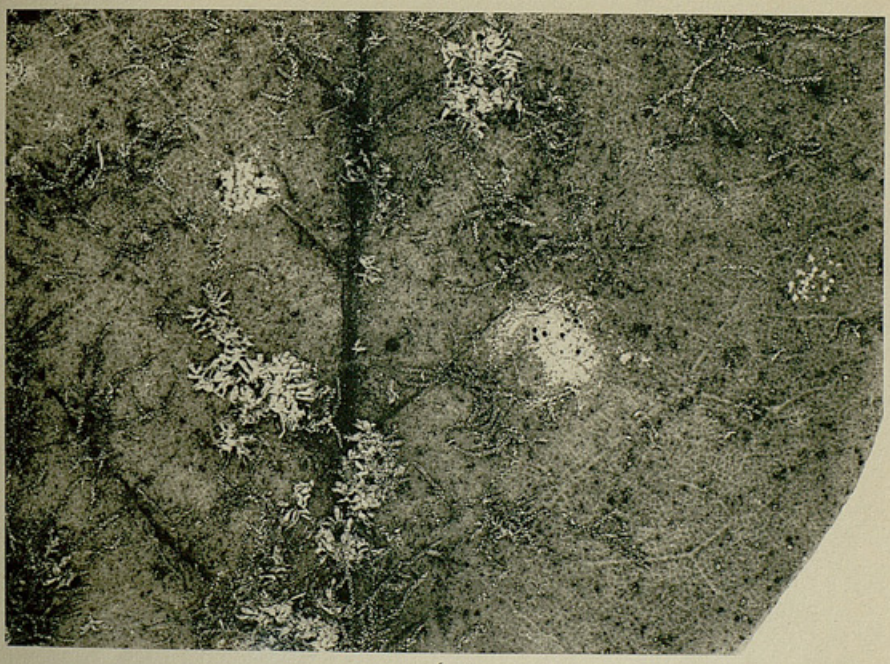
Hépatiques épiphylles I

PLANCHE II

Fig. 1. *Colura calyptrifolia* (Hook.) Tayl. et *Drepanolejeunea hamatifolia* (Hook.) Schffn. sur feuille de *Persea azorica* Seub. (pentes N. E. du Pico da Vara, S. Miguel, 875 m.) gross. 5 env.; fig. 2, *Cololejeunea minutissima* (Sw.) Schffn. c. *per.*, sur feuille de *Camelia* (Parc José do Canto, Lagoa das Furnas, alt. 290 m.) gross. 3; fig. 3, *Lejeunea patens* Lindb., *Colura calyptrifolia* (Hook.) Tayl. et *Aphanolejeunea microscopica* (Tayl.) Evs., sur feuille d'*Hedera canariensis* Willd. (pentes N. de la Serra Trunqueira, S. Miguel, alt. ca. 750 m.) gross. 3.



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Hépatiques épiphylles II

MICROPLANCTON DA REGIÃO DA FOZ DO DOURO

por

ALBERTO CANDEIAS
(Professor do Liceu de Gil Vicente, Lisboa)

A presente lista de formas planctónicas, começada a organizar há já alguns anos mas interrompida por mais de uma vez, só agora se apronta para satisfazer o pedido de colaboração no número do Boletim da Sociedade Broteriana, a publicar em memória do falecido Professor Doutor Luiz Carrisso.

Uma dupla e forte razão nos levou a considerar a aceitação dêsse pedido como o cumprimento indeclinável de um dever,— mesmo depois de considerar as inevitáveis limitações a que tal colaboração estava sujeita.

A-pesar-de, talvez, não mais do que numa ocasião termos tido a honra de conversar com o Dr. Luis Carrisso, dêle recebemos freqüentes provas de deferência, já traduzidas na generosa cedência de publicações que nos eram necessárias, já expressando-se por incitamentos cheios de entusiasmo e compreensão, a prosseguirmos nos trabalhos de sistemática a que ocasionalmente nos dedicáramos e cuja natureza tinha para o ilustre Professor a sedução que advem do seu intrínseco interêsse biológico, e, mais pessoalmente. o valor sentimental de uma recordação dos seus primeiros passos como Naturalista.

Por outro lado, o acrescentamento de alguns elementos para o conhecimento da microflora planctónica das águas costeiras portuguesas, conhecimento que, deve dizer-se, está muito longe de ser sequer satisfatório, não ficaria mal numa colectânea de trabalhos de biologia, destinada a prestar homenagem à memória infinitamente digna de

aprêço de um botânico cuja tese de doutoramento exactamente versou o assunto, com averiguada meticulosidade. E, quanta persistência e paciência o falecido professor pôs na execução dêsse seu notável trabalho, valiosíssimo como primeira resenha sistemática da população planctónica das costas portuguesas, só quem, alguma vez, ocupou horas sôbre horas em luta com as dificuldades de tais estudos e a escassez de elementos de trabalho indispensáveis, com que, declaradamente, também êle se viu a braços, — só alguem nessas condições poderá exactamente e justamente avaliar.

Aqui deixamos, pois, como expressão da nossa devida e sincera gratidão pela memória do naturalista ilustre, estas achegas modestas para a organização do levantamento planctónico das nossas águas costeiras, levantamento que o malogrado Professor iniciou como simples particular mas com clara compreensão da sua importância e entusiasmo môço, mas que, infelizmente, poucos têm prosseguido com continuidade e à sombra do auxílio indispensável à realização de tão útil tarefa.

Lisboa, Junho de 1938.

ALBERTO CANDEIAS

LISTA DE ESPÉCIES

O matérial que nos serviu para a elaboração desta lista é o mesmo sôbre que organizámos um outro trabalho publicado em 1932 (1), e foi colhido na Foz do Douro em Agôsto de 1931. Pora aqui transcrevemos, resumindo-o, o quadro das estações, que então apresentámos. Quando no texto da presente nota nos referimos às amostras em que encontrámos os organismos estudadas ou apenas registados, o algarismo romano a seguir à letra A, corresponde ao número da colheita respectiva.

A. I. — Dentro e à saída do Pôrto de Leixões. 5 de Agôsto, das 9 1/2 às 10 1/2 horas.
A. II. — 1 milha em frente do Molhe de Carreiros. 8 de Agôsto, das 9 1/2 às 10 1/2 horas.
A. III. — 200 metros em frente do aqüário da Foz. 13 de Agôsto, das 9 1/2 às 10 1/2 horas.
A. IV. — Junto ao Molhe de Carreiros. 21 de Agôsto, das 10 às 10 1/2 horas.
A. V. — Entre Leixões e o Molhe de Carreiros, 1 milha ao mar. 26 de Agôsto, das 9 às 10 horas.

As figuras que acompaham o texto foram primitivamente desenhadas com a ampliação 500, e reproduzidas depois com a redução de 2/3.

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(1) «Nota sôbre algumas espécies de *Tintinnoinea*», nos «Anais da Faculdade de Ciências do Porto», Tomo XVII.

PERIDINIALES

DINOPHYSIACEAE

Phalacroma rotundatum (Claparède e Lachmann)

Paulsen, 1908, p. 17, fig. 18. Candeias, 1930, p. 14, est. I, figs. 15, 16. Paulsen, 1930, p. 32, fig. 17.

Encontrado um único exemplar em A. I, que corresponde à variedade *laevis* de Jorgensen, caracterisada por ter a espinha inferior da barbatana longitudinal, forte e terminada em forma de massa.

Dinophysis sacculus Stein

Fig. 1

Pavillard, 1905, p. 59. est, III, fig. 10 (*D. acuminata* Cl. e Lach, e var. *reniformis*). ? Carrisso, 1911, p. 93, est. II, fi. 2 *(D. ovum)* Pavillard, 1916, p. 59, est. II, fig. 9. Paulsen, 1930, p. 34, fig. 18.

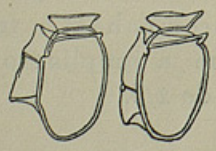


Fig. 1

Atribuimos a esta espécie, que não será talvez mais do que uma forma de águas temperadas, da espécie boreal *D. acuminata*, Cl. e Lach, alguns exemplares que em geral concordam com a descripção de qualquer daquelas espécies e, principalmente, com a figura de Paulsen (1930), exceptuada a ausência neles, de protuberâncias posteriores: o contôrno é perfeitamente liso. Dimensões: comprimento

total 52 μ; largura máxima, na altura da 2.ª espinha que suporta a barbatana, 32 μ.

A espécie que Carrisso designa por *D. ovum* Schüt, é, provàvelmente, esta espécie de Stein. *D. ovum*, é muito muito mais regularmente oval.

Raríssimo em A. V.

Dinophysis tripos Gourret

Paulsen, 1908, p. 19, fig. 20 *(Dinophysis homunculus*, var *tripos)*. Lebour, 1925, p. 82, fig. 22. Candeias, 1930, p. 17, est. I, fig. 24.

Encontrados apenas uma vez em A. V, dois indivíduos gêmeos ainda unidos.

Fig. 2

Dinophysis caudata Kent

Fig. 2

Pavillard, 1916, p. 56, fig. 15, A, B (*Dinophysis homunculus* Stein). Candeias, 1930, p. 16, est. I, figs. 22, 23. Paulsen, 1930, p. 34, fig. 19.

Ainda que não tenhamos podido consultar o trabalho de Jörgensen (1923) em que êste autor trata de pôr alguma ordem na arrumação das formas desta espécie, atendendo ao que dissemos anteriormente (1930) e à figura de Paulsen (1930), podemos considerar os raros exemplares da forma que encontrámos nas presentes colheitas como da variedade *abbreviata* de Jörgensen.

PERIDINIACEAE

Goniaulax spinifera (Claparède e Lachmann)

Carrisso, 1911, p. 93, est. II, figs. 3-5. Lebour, 1925, p. 92, est. III, figs. 1a-1b. Candeias, 1930, p. 18, est. I, fig. 26.

Raríssimo em A. I.

? Goniaulax apiculata (Penard)

Fig. 3

Paulsen, 1908, p. 31, fig. 39. Lebour, 1925, p. 95, fig. 29.

Só a título provisório referimos a forma que representamos, a esta espécie, uma vez que não pudemos ver a tabulação característica do género. Em todo o caso, afora o contôrno da epiteca que é mais regular no nosso exemplar do que nas representações da espécie, dadas por aqueles autores, a forma geral é a mesma. Comprimento total, 37 μ; diâmetro transverso, 27 μ. O habitat atribuido à espécie, por aqueles autores cujos trabalhos se referem ao Mar do Norte e adjacentes: «água dôce, raro em água de baixa salinidade e no mar de Aral», (a salinidade no local da colheita não deveria ser muito baixa), não vem emprestar grandes probabilidades de que a determinação seja exacta.

Raríssimo em A. III.

Fig. 3

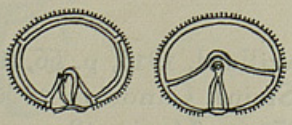


Fig 4

Diplopeltopsis minor Lebour

Fig. 4

Paulsen, 1908, p. 36, fig. 45. *(Diplopsalis lenticula* forma *minor)*. Lebour, 1922, p. 801, figs. 11-15.

Os exemplares que atribuimos a esta espécie, são figurados por Paulsen (1908) exàctamente como se nos apre-

sentavam, excepção feita da pequena placa intercalar do lado esquerdo, que não era tão evidente. Algumas tinham uma coloração rosada. Dimensões variáveis, a supor que tôdas as formas com o aspecto geral que figuramos, pertenciam a esta espécie e não a algumas espécies dos géneros próximos *Peridiniopsis* e *Diplopsalis* com que é fácil confundi-las. O exemplar desenhado tinha de diâmetro transverso 47 μ e de diâmetro antero-posterior, 36 μ.

Raros em A.I e A.III. Comuns em A.IV, livres ou contidos em larvas de Polychetos.

? Peridinium intermedium n. sp.

Fig. 5

Entre as formas do género *Peridinium* que estudámos nas nossas colheitas e procurámos identificar com as espécies descritas nos trabalhos consultados, encontrámos alguns

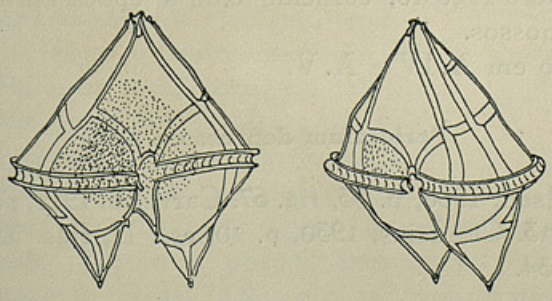


Fig. 5

exemplares que nos não foi possível referir a nenhuma dessas espécies. Consideramo-los provisòriamente uma forma à parte; e a designação específica que lhe atribuimos, refere-se ao facto de participar dos caracteres das espécies afins, principalmente *P. pentagonum* Gran, *P. conicum* (Gran) e *P. Leonis* Pavillard, que, demais, terão algumas vezes sido confundidas.

Os nossos exemplares pertencem claramente ao grupo Ortoperidinium. A célula tem um aspecto túrgido, de contôrno um pouco irregular, muito similhante ao desenho de Fauret-Fremiet (1908), fig. 8. A cintura eqüatorial é pràticamente circular, escavada, com listas bem visíveis. O

sulco longitudinal é profundamente aberto, com pequenos espinhos nas margens ventrais. As estrias intercalares são medianamente largas. As suturas dorsais das placas 2', 2" e 4', 6", e a ventral da placa 3' seguem-se em linha recta, como em *P. conicum;* as pontas à esquerda e à direita da abertura apical, são bem visíveis como em *P. Leonis*. Espinhos antapicais pequenos e sólidos.

Altura: 90-104 μ. Diâmetro transverso 88-99 μ.

Teriam sido provàvelmente exemplares como os que descrevemos, que Carrisso (1911), a título provisório, determinou como *P. pentagonum*, distinguindo claramente certos caracteres dos exemplares que examinou, diferentes dos daquela espécie. As dúvidas de Carrisso e as discrepâncias referidas, vêm aumentar a probabilidade de realmente estarmos em presença de uma forma nova que a perspicácia dêste autor suspeitou. A própria época da aparição dos seus exemplares: Julho e Agosto, coincide com a época em que colhemos os nossos.

Raro em A. IV e A. V.

Peridinium depressum Bailey

Paulsen, 1908, p. 53, fig. 67. Carrisso, 1911, p. 96, est. II, figs. 12, 13. Candeias, 1930, p. 20, est. II, figs. 32, 33. Candeias, 1934.

Provém dêste material os exemplares que estudámos (1934) sob o ponto de vista da sua variabilidade de forma e dimensões.

É muito diferente a sua abundância nas nossas cinco amostras: raro em A. I e A. III; comum em A. II; abundante em A. IV e A. V.

Peridinium oceanicum V. Höffen

Paulsen, 1908, p. 54, fig. 69. Candeias, 1930, p. 21, est. II, fig, 34. Paulsen, 1930, p. 66, fig. 37.

Os poucos exemplares que observámos, têm dimensões mais reduzidas do que as dadas pelos autores.

A-pesar-de ter sido colhido muito freqüentemente pelo «*Sylvana*» ao longo da costa portuguesa, nem Carrisso (1911) o cita nem aparece nas nossas colheitas de 1930 nem nas actuais em abundância: raríssimo em A. I e A. V.

Peridinium claudicans Paulsen

Fig. 6

Paulsen, 1908, p. 55, fig. 71. Carrisso, 1911, p. 98, est. II, figs. 14, 15. Lebour, 1925, p. 123, est. XXV, figs. 1a-1d. Peters, 1930, p. 76, figs. D, E.

Ainda que pelo comprimento que apresentam, os nossos exemplares pudessem melhor incluir-se na espécie próxima *P. oblongum*, pelas proporções e aspecto geral devemos considerá-los pertencentes à espécie de Paulsen, tendo, porém, que alargar o limite máximo do seu comprimento total para, até 119 μ.

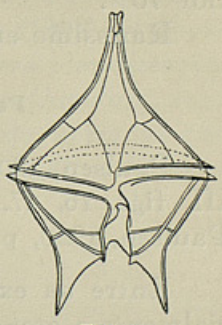


Fig. 6

Também êles não mostram um aspecto de contornos tão rotundos como os figurados pelos autores, particularmente quando vistos tão de frente como o indivíduo que desenhámos; esta posição é, porém, excepcional; o seu diâmetro transverso mede 72,8 μ, e o seu comprimento total, 119 μ, como acima dissemos; observámos exemplares menores, de 93 μ de comprimento total.

Raro em A. III, A. IV e A. V.

Peridinium ovatum (Pouchet)

Fig. 7

Fauret-Fremiet, 1908, p. 17, fig. 4. (*P. lenticulatum*). Paulsen, 1908, p. 44, fig. 54. Carrisso, 1911, p. 95, est. II, figs. 6, 7. Lebour, 1925, p. 126, est. XXVI, figs. 1a-1d. Dangeard, 1927, p. 3, fig. 3.

Examinámos apenas raríssimos exemplares de Peridinium, que referimos a esta espécie apoiando-nos nas dimen-

sões da célula, na sua forma geral e na existência de dois espinhos antapicais alados.

Quanto às estrias intercalares que Lebour diz não existirem ou serem estreitas, são, pelo contrário, largas nos nossos exemplares. Exactamente êste desenvolvimento das estrias intercalares tornou-nos difícil distinguir a disposição das placas. Assim, por exemplo, a placa 1 parece losângica; e a representação, na figura, das linhas de contacto das placas precingulares na região dorsal é apenas aproximada.

Diâmetro transverso 83 μ; diâmetro antero-posterior 70 μ.

Raríssimo em A.I e A.V.

Peridinium divergens Ehremberg

Paulsen, 1908, p. 56, fig. 72. Carrisso, 1911, p. 98, est. III, figs. 16, 17. Candeias, 1930, p. 22, est. II, figs. 38-40. Paulsen, 1930, p. 63.

Entre os exemplares que observámos, feriu-nos especialmente a atenção um de pequenas dimensões (comprimento total: 78 μ; diâmetro transverso: 68 μ), com a superfície das placas singularmente eriçada de pontas.

Raríssimo em A.I, A.IV e A.V.

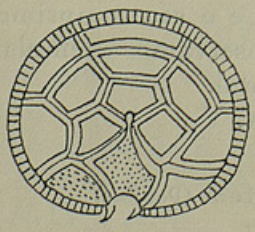


Fig. 7

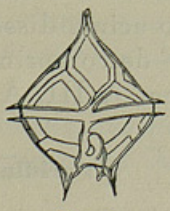


Fig. 8

Peridinium pellucidum (Bergh) Schütt.

Fig. 8

Fauret-Fremiet, 1908, p. 221, fig. 7, est. XVI, fig. 10. Paulsen, 1908, p. 49, fig. 61. Lebour, 1925, p. 134, est. XXVIII, figs. 2a-2d. (*non* Carrisso, 1911, p. 96, est. II, figs. 10, 11).

Não foi sem algumas dúvidas que inicialmente referimos exemplares como o representado na fig. 8 à espécie *P. pellucidum*, já porque as suas dimensões (diâmetro transverso 72 μ; comprimento total 73 μ) excedem um pouco o limite máximo atribuido a essa espécie, já porque o contôrno geral da célula, quando vista de frente, é antes rômbico, pelo que se aproxima de *P. pallidum* Ostenfeld. O côrno apical é, também, mais longo do que o de qualquer daquelas duas espécies. O que, consideradas as descrições das duas espécies, fica como único caracter distintivo, é o facto de na primeira não existir compressão dorso-ventral. Ora os nossos exemplares não apresentam essa compressão. A consulta do trabalho de Fauret-Fremiet (1908) veio posteriormente decidir-nos a manter a primitiva identificação. Trata-se, com efeito, de exemplares de *P. pellucidum*, var. *acuta*, como se pode concluir comparando a figura que damos, com a dêste autor, as quais, salvas ligeiras diferenças, coincidem satisfatòriamente.

Raríssimo em A. IV e A. V.

Peridinium diabolus (Cleve)

Fig. 9

Pavillard, 1909, p. 279, fig. 2B. Carrisso, 1911, est. II, figs. 10, 11 (*P. pellucidum*). Pavillard, 1916, p. 38, fig. 10. Lebour, 1925, p. 135, est. XXIX, figs. 2a-2c. Candeias, 1930, p. 27, est. II, figs. 49 (e p. 50, *P. formosum*). O. Paulsen, 1930, p. 57, fig. 29.

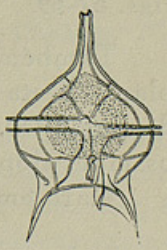


Fig. 9

Já em um trabalho anterior apresentámos as nossas dúvidas sôbre a necessidade da separação feita por Pavillard em 1909, das duas espécies. *P. diabolus* e *P. formosum*. Com efeito, comparando as descrições que êste autor dá do *P. formosum* (1909, 1916) parece dever concluir-se que a única diferença expressamente valível entre estaforma e o *P. diabolus* é o achatamento antero posterior da célula, pois que as dimensões dadas pelo autor no seu trabalho de 1916, e as calculadas sôbre a sua figura de 1909, tomando co-

mo base a ampliação com que esta é desenhada, não excedem em muito as de *P. diabolus*. Mas, como já dissemos (1930), tão pouco verificámos nos exemplares que, pelas dimensões, caíriam dentro da definição de *P. formosum*, pronunciada compressão dorso-ventral. Quanto à forma geral do corpo que é, realmente, nas duas figuras de Pavillard citadas, um pouco diferente, não está também relacionada com as dimensões, pois que o exemplar que figuramos e cujo contorno geral se aproxima mais do da representação feita pelo autor citado, de *P. formosum*, do que da de *P. diabolus*, tem apenas 68 μ de comprimento total (sem espinhos antapicais) e 55 μ de diâmetro transverso. A tabulação nos exemplares que examinámos é, mais ou menos nìtidamente, de *Paraperidinium*. Em todo o caso a dificuldade, que notara, em distinguir a forma da placa 1, é bem exemplificada pelo desenho de Pavillard (1909) que a figura com a forma losângica.

Relativamente à descrição de Carrisso (1911) relativa a *Peridinium pellucidum* (Bergh) Schüt, refere-se provàvelmente a esta espécie; e as figuras do mesmo autor, certamente, como já Paulsen (1930) fez notar.

Raríssimo em A. I, A. III, A. IV e A. V.

Ceratium furca Ehrenberg)

Carrisso, 1911, p. 106, est. V, figs. 33-35. Jörgensen, 1920, p. 17, figs. 7-12. Candeias, 1930, p. 29, est. III, figs. 57-59.

Também nas presentes colheitas encontrámos exemplares desta espécie com os diferentes aspectos já registados em 1930. Os que aparecem menos freqüentemente são os mais alongados, como o representado na fig. 58 (l. c.).

Raro em A. I e A. III; comum em A. V.

Ceratium fusus (Ehrenberg)

Carrisso, 1911, p. 106, est. V, fig. 36. Jörgensen, 1920, p. 41, fig. 30. Candeias, 1930, p. 31, est. III, figs. 64, 64 a.

Raríssimo em A. I e A. III; comum em A. V.

Ceratium platycorne von Daday

Fig. 10

Paulsen, 1908, p. 74, fig. 97. Carrisso, 1911. p. 101, est. III, fig. 23. Jörgensen, 1920, p. 79, figs. 74, 75. Lebour, 1925, p. 153, figs. 50 a, 50 b. Paulsen, 1930, p. 86.

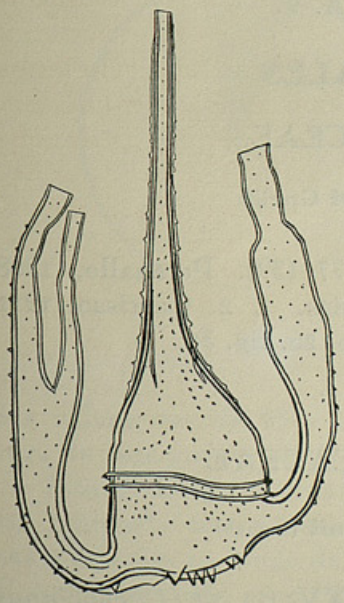


Fig. 10

Na colheita A. I encontrámos alguns exemplares da variedade ou forma *dilatatum* Karsten, e um único indivíduo caracterizado por ter o corno posterior direito dilatado irregularmente até três quartos da origem e bruscamente contraído no último quarto; e o esquerdo profundamente fendido. Incluiremos esta forma, seguindo Jörgensen, na forma *incisum* do tipo α.

Dimensões do exemplar que figuramos: comprimento total, 229 μ; diâmetro transverso, 62 μ.

Raríssimo em A. I.

Ceratium tripos (Müller)

Jörgensen, 1920, p. 47, fig. 34. Paulsen, 1930, p. 78, fig. 47.

Esta espécie que, como Jörgensen (1920) observou, fórma, através uma série de formas intermediárias, uma só unidade sistemática com o *C. pulchellum* Schröder, é representada nas nossas colheitas por muito poucos exemplares da variedade *atlanticum* Ostf. que constitui a transição, de limites muito mal definidos, para a forma *C. pulchellum*, f. *tripodioides*. Paulsen considera, mesmo, esta forma uma variedade de *C. tripos* (1930). Um dos exemplares observados tinha os cornos posteriores abertos e mais

estreitos na extremidade, dando a impressão de regeneração subseqüente a uma fractura ocasional.

A fig. 26 de Carrisso representa uma forma intermediária entre as duas variedades limites das espécies *tripos* e *pulchellum*. Quanto à fig. 27 parece-nos, antes, representar o *C. gracile* (Gourret).

Raríssimo em A. I, A. II, e A. V.

DIATOMALES

MELOSIRACEAE

Melosira Borreri Graville

Fig. 11

Forti, 1899, p. 477 (39). Peragallo, 1908, p. 446, est. CXX, figs. 1, 2. Carrisso, 1911, p. 13. Lebour, 1930, p. 26, fig. 30.

Raríssima em A. I.

Fig. 11

COSCINODISCACEAE

Coscinodicus Granii (Gough)

Fig. 12

Peragallo, 1908, p. 424, est. CXV, fig. 12 (*C. concinnus*, p. p.). Gran, 1905, p. 34-35, fig. 35. Lebour, 1930, p. 44-45, figs. 20, 21. Pavillard, 1931, p. 11, (*C. concinnus*, inclus: *G. Granii*,.

A legitimidade desta espécie, aliás controvertida por Péragallo (1908) e, ùltimamente, ainda por Pavillard (1931), parece-me suficientemente justificada. Se a escultura das valvas é como a de *C. concinnus*, as proporções e dimensões das células, a forma convexa e assimétrica radialmente, das faces valvares e a ausência de bandas intercalares, são caracteres suficientes para justificarem a distinção morfológica entre *C. Granii* e *C. concinnus*. Resta, é certo, o facto registado por Miquel (segundo Péragallo) de, por cultura, ter obtido ao lado de *C. concinnus* típico, «a forma de valvas inclinadas». Mas esta forma é admitida também

por Lebour que a ela se refere como podendo ser «às vezes levemente mais alta dum lado do que do outro».

Os exemplares que observámos correspondem às descrições de Gran e Lebour. Apenas a variação no diâmetro

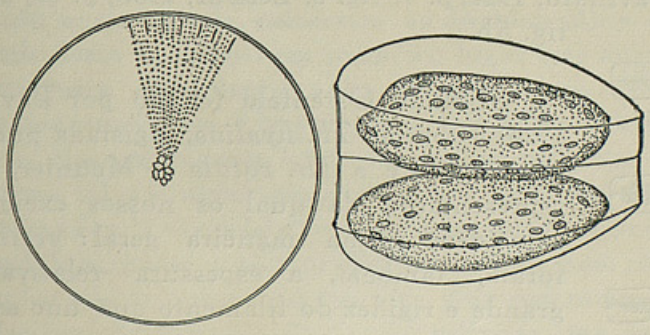


Fig. 12

das valvas vai de 93 a 165 μ, e a máxima e mínima largura da face sutural estão entre si como 5 para 2.

Não podemos afirmar que a espécie seja pela primeira vez registada nas nossas águas, porque Pavillard (1931), nas 2 estações ao longo das nossas costas, em que encontrou *C. concinnus*, não especifica se nelas aparece a forma típica se a «cuneiforme», segundo a designação de Peragallo. Carrisso (1911) que regista *C. concinnus* como uma das formas mais freqüentes e abundantes nas nossas colheitas, também não se refere à forma de «valvas inclinadas» ou por não a ter encontrado ou por, com Peragallo, não a distinguir de *C. concinnus*.

Em qualquer caso, restaria averiguar se esta forma «cuneiforme» ou de «valvas inclinadas» é realmente aquela a que *Gough* deu o nome de *C. Granii*.

Em A. I. é *Coscinodicus Granii* Gough (Gran, Lebour) a única espécie do género que aparece, e mesmo com relativa freqüência. Abundante em A. III, associada com outros que não pudemos determinar.

THALASSIOSIRACEAE

Thalassiosira rotula Meunier

Fig. 13

Pavillard, 1925, p. 7, fig. 6. Lebour, 1930, p. 60, est. II, fig. 5b.

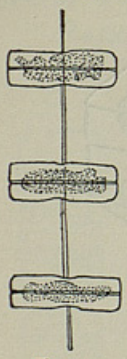


Fig. 13

Segundo Ostenfeld (citado por Pavillard, 1925) a espécie *Th. hyalina*, registada por Carrisso (1911) é a *Th. rotula* de Meunier, com a representação da qual os nossos exemplares coincidem duma maneira geral: verificadas foram, também, a espessura relativamente grande e rigidez do filamento que une as diferentes valvas.

Raríssimo em A. III.

Schröderella Schröderi (Bergon)

Fig. 14

Pavillard, 1925, p. 23, fig. 33. Lebour, 1930, p. 68, 69, fig. 41. Paulsen, 1930, pp. 10, 11, fig. 2. Candeias, 1930, p. 40, est. V, fig. 84 (*Landeria borealis* Gran).

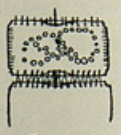


Fig. 14

Pavillard (1925) cita esta espécie como tendo sido colhida uma só vez durante o cruzeiro do «*Thor*» no verão, em frente do Cabo Finisterra.

Raríssimo em A. I, A. II, A. III.

SKELETONEMACEAE

Stephanopyxis turris (Grev.)

Fig. 15

?Carrisso, 1911, p. 14. Lebour, 1930, p. 73, fig. 45.

Não nos parece dar lugar a dúvidas a determinação dos exemplares que incluimos nesta denominação, já pelo seu aspecto geral, menos robusto do que o da espécie afim,

S. Palmeriana, (diâmetro das valvas: 22-44 μ; comprimento das células: 76-104 μ), já pela estrutura da sua rede alveolar que verificámos em mais de um exemplar ser constituida por malhas iguais.

Quanto aos exemplares que Carrisso (1911) examinou e incluiu nesta espécie, subsistem as dúvidas sôbre a legitimidade dessa inclusão: em primeiro lugar êste autor não figurou êsses exemplares; além disto a figura de Gran (1905) que consultou é imprecisa, e Peragallo (1908), que também cita, representa uma das valvas pela face valvar por forma tal que antes parece tratar-se de *S. Palmeriana*. As figuras das duas espécies apresentadas por Lebour (1930), uma original, outra segundo Pavillard (1925), bem como as descrições que as acompanham são, pelo contrário, muito elucidativas. Julgamos, pois, poder afirmar que as duas espécies, *Stephanopyxis turris* e *S. Palmeriana* se encontram no Atlântico e, em especial, nas costas de Portugal.

Raríssimo em A. I e A. II. Comum em A. IV.

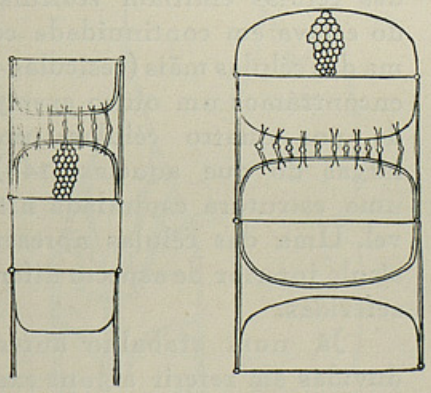


Fig. 15 Fig. 16

Stephanopyxis Palmeriana (Grev.) Grunow.

Fig. 16

Peragallo, 1908, p. 439 *(S. turgida?)*, est. CXXI, fig. 1. ? Carrisso, 1911, p. 14 *(S. turgida)*. Pavillard, 1925, p. 5, fig. 3. Lebour, 1930, p. 74, fig. 47.

Esta espécie distingue-se fàcilmente de *S. Turris*, pela sua forma mais robusta e, principalmente, pela rede hexa-

gonal que ornamenta as valvas, cujas malhas vão diminuindo gradualmente para o bôrdo valvar, quando vistas lateralmente. O diâmetro das valvas dos exemplares que examinámos varia de 73 a 78 μ, e o comprimento das células de 60 a 96 μ. A cadeia mais longa era formada por 6 células ainda agrupadas 2 a 2.

Comum em A. I e A. II.

LEPTOCYLINDRACEAE

Leptocylindrus danicus (Cleve)

Fig. 17

Pavillard, 1925, p. 24, fig. 35. Candeias, 1930, p. 4, est. V, fig. 85 (e p. 4, est. V, fig. 86; *Guinardia flacida* (Castr.)?).

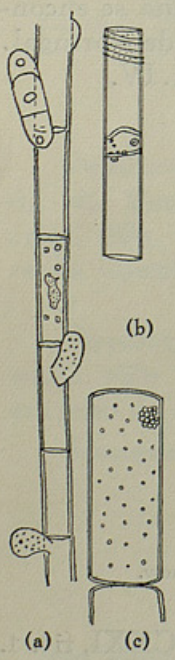


Fig. 17

A par de uma cadeia de 6 indivíduos da espécie, bem caracterizados, mas sem extriação aparente da frústula, em que 4 das células emitiam vesículas cujo conteúdo estava em continuidade com o citoplasma das células mãis (vesículas auxosporais?), encontrámos um outro exemplar, constituído por quatro células; um pouco mais largas do que aquelas (14μ), providas de uma estrutura espiralada nítidamente visível. Uma das células apresentava uma vesícula interior de aspecto diferente das acima referidas.

Já num trabalho anterior tiveramos dúvidas em referir alguns exemplares como os representados na fig. 17 (c), à espécie do Género próximo, *Guinardia flacida*, apesar da sua grande similhança com a figura de Meunier (1915) referente a esta espécie.

Aparecem-nos, de novo, exemplares como aqueles, sem o mínimo vestígio do dente na margem valvar que serve para imbricar as células umas nas outras. Por outro lado Pavillard (1925) refere-se a exemplares provenientes do

mar de Alboran com dimensões excepcionais, 30 μ (de largura?); a largura das valvas dos nossos exemplares varia de 31 a 42 μ. Estrutura de face sutural invisível. Só muito dubitativamente propomos a inclusão de exemplares como êstes na espécie *Leptocylindrus danicus* e, mesmo, no género *Leptocylindrus*.

As duas primeiras formas são raríssimas em A. I. A última, rara em A. I. e A. II.

RHIZOSOLENIACEAE

Rhizosolenia semispina Hensen

Fig. 18

Pavillard, 1925, p. 32, fig. 49. Candeias, 1930, p. 42, est. V, figs. 91, 91 a.

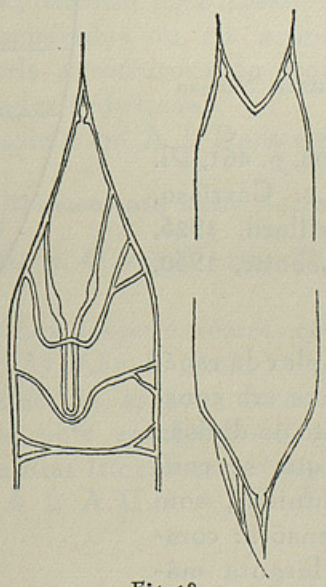


Fig. 18

A acrescentar ao que já dissemos (1930) sôbre as espinhas terminais, ocorre-nos sugerir que aquelas, nas extremidades livres, se apresentarão em geral partidas, pois que

nas cadeias de células, as extremidades sobrepostas apresentam as espinhas um pouco mais longas mas sem nunca excederem o diâmetro das células. Excepcionalmente encontrámos exemplares mais estreitos (24μ) com a caliptra e a sêda terminal mais alongadas: (68 + 48 μ).

Alguns exemplos de deformação da caliptra são dignos de menção geral. E especialmente num caso, uma célula, de diâmetro normal terminava por calíptras geminadas e deformadas.

Raríssima em A.V. Comum em A. I. e A. III. Abundante em AII.

Rhizosolenia robusta *Norman*

Fig. 19

Peragallo, 1908, p. 461, Pl. CXXIIII, figs. 1,2. Carrisso, 1911, p. 20. Pavillard, 1925, p. 29, fig. 43. Lebour, 1930, p. 94, fig. 68.

O único exemplar da espécie que observámos era constituído pelo produto da divisão de duas células que se conservavam ainda unidas, com as seguintes dimensões: comprimento, 675μ; largura máxima 140μ. A sêda terminal, ausente da extremidade jóvem, quando separada esta da célula mãi, é bem visível na extremidade da última, saindo do tôpo de um processo ôco. Raríssimo em A. I.

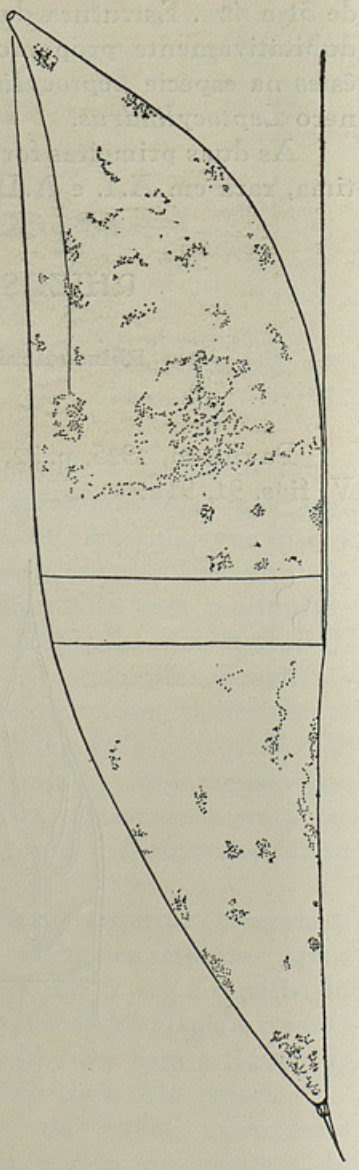


Fig. 19

Rhizosolenia Shrubsolei Cleve.

Fig. 20

Cleve, 1881, p. 26. Pavillard, 1925, p. 31, fig. 46. Lebour, 1930, p. 96, fig. 69.

Não pudemos ver claramente a disposição escamiforme das bandas intercalares; apoiamos, por conseqüência, esta determinação na estrutura do processo apical o qual, segundo Lebour (1930), que se apoia em Mangin (1913), é ôco, com duas asas muito pequenas na base, as quais se estendem até 1/3 da espinha terminal e não se prolongam pela própria valva, enquanto em *R. styliformis*, a cavidade do processo apical se prolonga pela valva e as asas nascem na própria valva e terminam próximo da base do processo.

Largura de um dos exemplares examinados: 22 μ; comprimento do processo com a sêda, 12 μ. Células separadas ou em grupos de 2; nestes é mais nítida a estrutura do processo terminal das extremidades imbricadas.

Raríssima em A.I. Rara em A.II.

Fig. 20

Rhizosolenia alata Brightu

Candeias, 1930, p. 41, est. V, figs. 87,88.

Encontramos nas nossas amostras células de diâmetros muito diferentes, (5μ, 7,5μ, 9μ, 10μ, 12,5μ 13,7μ) correspondentes, por conseqüência, às duas formas, *gracillima* e *genuina*. Esta pode pois encontrar-se associado à forma *gracillima* no habitat litoral característico desta última.

Comum em A.I, A.II e A.III. Abundantíssima em A.IV e A.V.

Rhizosolenia Stolterfothii H. Pérag.

Candeias, 1930, p. 42, est. V. fig. 90.

Raríssima em A.I e A.II.

CHAETOCERACEAE

Chaetoceros densum Cleve

Fig. 21

Gran, 1905, p. 67, fig. 79. Carrisso, 1911, p. 21. Lebour, 1930, p. 115, fig. 81. ? Candeias, 1930, p. 43, est. V, fig. 93 (*Chaetoceros Eibenii*).

Examinada uma única cadeia de células de 30 μ de diâmetro e 25 μ de comprimento com as aberturas intercelulares pequenas mas visíveis, e as sedas laterais inseridas por dentro das margens das valvas. A espécie que noutro lugar (1930) registámos como *C. Eibenii* Meunier, é, muito provavelmente, esta mesma.

Raríssima em A. I.

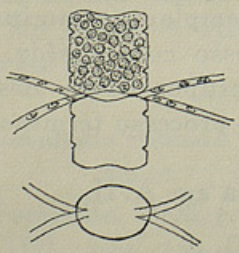


Fig. 21

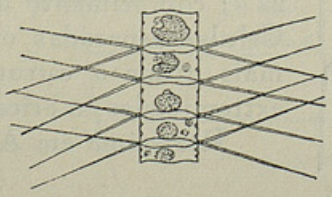


Fig. 22

Chaetoceros constrictum Gran

Fig. 22

Gran, 1905, p. 80, fig. 96. Lebour, 1930, p. 134, fig. 98.

O exemplar que referimos a esta espécie, único encontrado nas nossas amostras era constituido por uma cadeia de 19 células. Largura das células 22,5 μ, sempre menos longas que largas. Não observadas sedas terminais.

Raríssimo em A. III.

Chaetoceros pelagicum Cleve

Fig. 23

Gran, 1908, p. 83, fig. 101. Pavillard, 1925, p. 48 (V. *C. laciniosum*). Lebour, 1930, p. 137, (*C. laciniosus*).

Uma cadeia de cinco células de 10 μ de diâmetro e espaços intercaláres de 10 μ a 12 μ, é todo o material que incluimos nesta espécie.

A forma é, segundo Pavillard, caracterizadamente pelágica e, segundo Gran, uma forma da espécie nerítica, *C. laciniosus* com que habitualmente se parece. Mas as dimensões e proporções do nosso exemplar, bem como o seu aspecto geral, coincidem flagrantemente com a figura de Gran.

Raríssima em A. I.

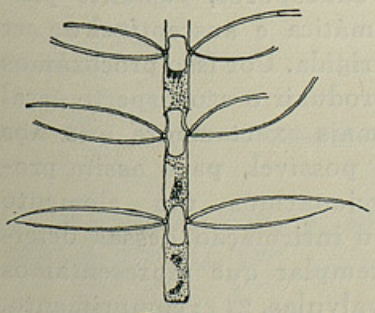


Fig. 23

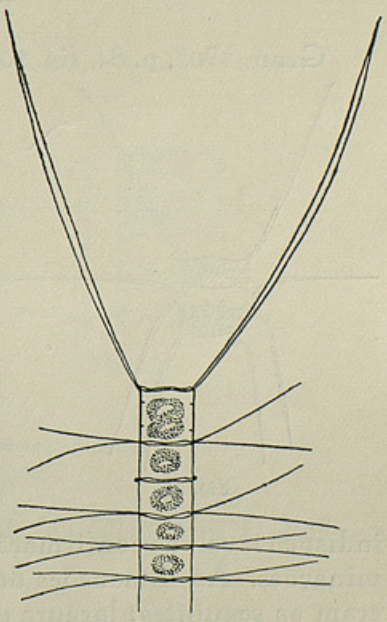


Fig. 24

Chaetoceros affines Lauder

Fig. 24

Pavillard, 1925, p. 47, fig. 74, Lebour, 1930, p. 135, fig. 99.

Não pudemos observar nos exemplares que referimos a esta espécie, nem os auxosporos, de forma constante, nem a pequena verruga no centro das valvas terminais, que, segundo Gran e Yendo (1914) citados por Pavillard (1925),

caracterizam a espécie e tôdas as formas que nela são actualmente incluídas. Mas não conhecemos outra espécie em que possamos incluir aqueles, nem a larga distribuïção geográfica de *C. affinis* invalida radicalmente a nossa determinação que, no entanto, consideramos sujeita a ser rectificada.

Raríssimo em A. I.

Chaetoceros diadema (Ehrb)

Fig. 25

Gran, 1905, p. 84, fig. 102. Pavillard, 1925, p. 49, fig. 77.

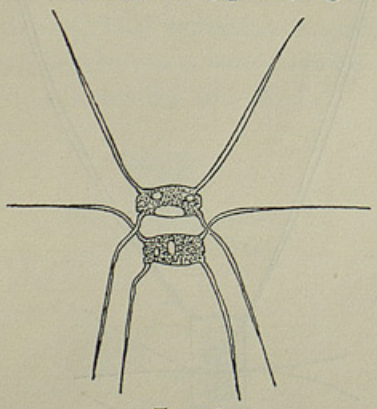


Fig. 25

A determinação dos indivíduos que referimos a esta espécie, como as dos que incluímos nas outras espécies do mesmo género é, na ausência de endosporos, bastante problemática e susceptível de ser corrigida. Por isso procurámos reproduzir o seu aspecto geral o mais exactamente que nos foi possível, para assim proporcionarmos um elemento indispensável à confirmação ou infirmação dessas determinações. As dimensões do exemplar que representamos eram as seguintes: largura das valvulas, 21 μ; comprimento, 12,5 μ; espaço intervalvar, 10, μ, medido ao meio, onde é mais estreito.

Raríssimo em A. I.

Chaetoceros pseudocurvisetum Mangin

Candeias, 1930, p. 44, est. V, fig. 26.

Muito comum em A. I. Abundante em A. II. Raro em A. III.

BIDDULPHIACEAE

Biddulphia mobiliensis (Bail) Grun.

Fig. 26

Pavillard, 1925, pág. 55, fig. 96. Lebour, 1930, p. 174, fig. 134.

Encontrados raríssimos exemplares desta espécie em A. I, A. III, A. V.

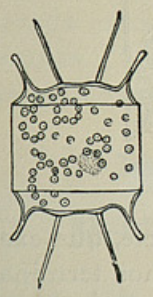


Fig. 26

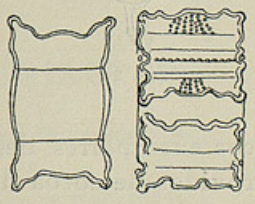


Fig. 27

Biddulphia obtusa Kützing

Fig. 27

Péragallo, 1908, p. 381, pl. XCVIII, fig. 2. Lebour, 1930, p. 179, fig. 139.

O aparecimento desta espécie nas águas portuguesas não foi ainda registado, tanto quanto podemos concluir da bibliografia de que dispomos que, aliás, é parca. Apenas observei um exemplar com 65 μ de comprimento e 37,5 μ de largura, e outro em divisão, em A. I.

Hermiaulus Hauckii Grun

Fig. 28

Candeias, 1930, p. 45, est. V, figs. 101, 101 a.

Raríssimo em A. II.

Ditylium Brightwelli (West.)

Fig. 29

Peragallo, 1908, p. 395. est. XCVI, fig. 6-11. Carrisso, 1911, p. 23. Pavillard, 1925, p. 53, fig. 91. Lebour, 1930, p. 186, fig. 146 (a).

Fig. 28

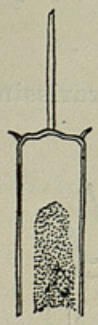


Fig. 29

Os poucos exemplares desta espécie, que examinámos, não eram providos de corôa de espinhos terminal. Diâmetro transverso 25 μ.

Raríssimo em A. I.

EUCAMPIACEAE

Eucampia Zodiacus Ehr.

Fig. 30

Peragallo, 1908, p. 376, est. XCV, fig. 2. Carrisso, 1911, p. 23. Pavillard, 1925, p. 53, fig. 89. Lebour, 1930, p. 187, fig. 147.

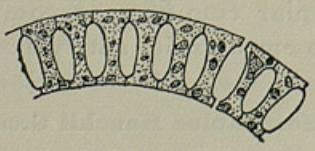


Fig. 30

Abundante em A. I e A. III.

Abundantíssima em A. II.

FRAGILARIACEAE

Thalassiothrix Frauenfeldii (Grunow)

Fig. 31

Péragallo, 1908, p. 321, est. 81, fig. 15. Pavillard, 1925, p. 59, fig. 106.

Fig. 31

Observada uma só célula de 250 μ de comprimento e 7,5 μ de largura.

Raríssima em A. I.

TABELLARIACEAE

Rhabdonema Adriaticum Kützing

Fig. 32

W. Smith, 1856, p. 35, est. XXXVIII, figs. 305 b, 305 a, b. Forti, 1899, p. 476 (38). Carrisso, 1911, p. 26. Pavillard, 1925, p. 57, fig. 102. Lebour, 1930, 202, fig. 264.

Comprimento das valvas variável entre 62 e 145 μ.

Raríssimo em A. I.

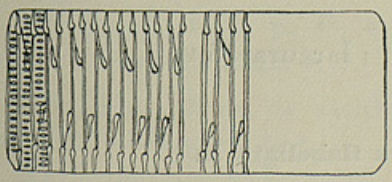


Fig. 32

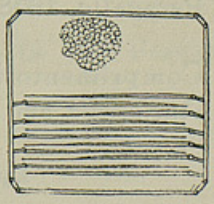


Fig. 33

Striatella unipunctata Ag.

Fig. 33

Péragallo, 1908, p. 360, est. LXXXIX, fig. 1. Pavillard, 1925, p. 58, fig. 104. Lebour, 1930, p. 200, fig. 162.

Raríssimo em Á. I

Grammatophora oceanica Ehr.

Fig. 34

Peragallo, 1908, p. 354, est. LXXVII, fig. 9-11. Candeias, 1930, p. 46, est. V, fig. 102.

O referirmos os exemplares que representamos, à espécie *oceanica*, resulta de, como já sucedera num trabalho anterior (1930), não termos podido observar a estriação, muito fina na espécie, o que a distingue de *G. marina*. É, ainda, na forma *communis* que incluimos os presentes exemplares. O que representamos com mais pormenores tinha de comprimento total 38 μ e de largura 12 μ.

Raríssima em A. I.

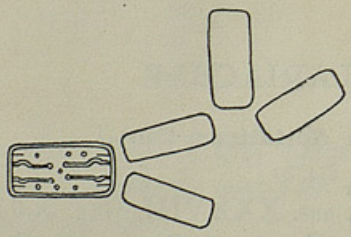


Fig. 34

Fig. 35

Grammatophora serpentina Ehr.

Fig. 35

Peragallo, 1908, p. 356, est. LXXXVII, fig. 3.

Comprimento total, 60 μ; largura 36 μ.

Raríssima em A. I.

Lycmophora flabellata Ag.

Fig. 36

W. Smith, 1853, est. XXVI, fig. 234, est. XXXII, fig. 234. Peragallo, 1908, p. 344, est. LXXXIV, fig. 1.

Examinadas, sôbre o mesmo suporte duas colónias de 6 e 9 indivíduos, respectivamente, e indivíduos destacados. Comprimento das frustulas 171 μ.

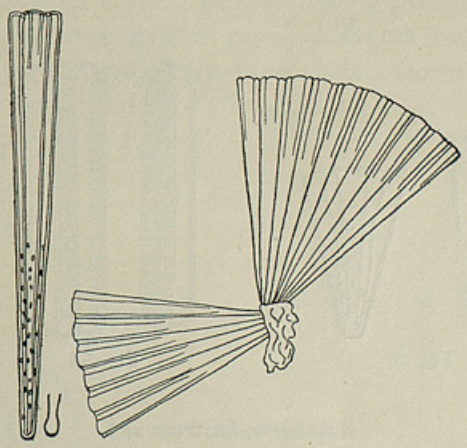
Comum em A. II.

Lycmophora Lyngbyei K.

Fig. 37

Peragallo, 1908, p. 349, est. LXXAV, figs. 9-12. Carrisso, 1911, p. 26. Lebour, 1930, p. 203, fig. 165. Candeias, 1930, p. 46, est. V, fig. 103.

Raríssimo em A. I.



(a) (b)

Fig. 36, (a) × 330 ; (b), × 165

NAVICULACEAE

Navicula liber Sm.

Fig. 38

W. Smith, 1853, p. 48, est. XVI, fig. 133. Peragallo, 1908, p. 71, est. IX, figs. 5, 6.

Bela diatomácea, de escultura muito visível. Comprimento 107 μ; largura 20 μ.

Raríssimo em A. I.

Navicula Crucicula (W. Smith)

Fig. 39

Smíth, 1853. p. 60, est. XIX, fig. 192 (*Stauroneis crucicula*). Peragallo, 1908, p. 60, est. VII, fig. 47.

Comprimento da valva 47 μ, largura 14 μ.

Raríssimo em A. I.

?Navicula Beyrichiana A. S.

Fig. 40

A. Schmidt, 1873-904, est. 69, fig. 16, 17. Peragallo, 1908, p. 122, est. XVI, fig. 8-10.

Comprimento da valva 97 μ; largura na região contraída 25 μ.

Raríssimo em A. I.

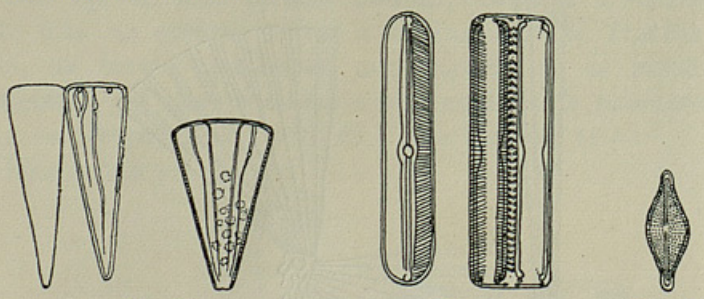


Fig. 37 Fig. 38 Fig. 39

Schizostauron sp ?

Fig. 41

Cleve, 1880, p. 16, est. III, fig. 44. Cleve, 1893, p. 151. Engler, 1928, p. 278.

Cleve (1893) reproduz de Grünov a diagnose do género *Schizostauron*, nos seguintes termos: «Frustulia naviculaceae, valvis ovatis vel lanceolatis nodulus centrali transversim dilatato. lineari, utroque fine bifido.»

Antes de conhecer esta descrição e a figura que o mesmo autor dá de *S. crucicula* em 1880, observámos e desenhámos um exemplar de *Navicula* com a divisão do *stauros* característica do sub-género.

Das espécies europeias do género, cita Cleve (1893): *S. sagitta* Cl., que diz ser muito similhante na forma a *S. linearis* W. S. (W. Smith, 1853, p. 60, est. XIX, fig. 193) e *S. Reichardtianum* Grun, que não conhece.

O nosso exemplar distingue-se de *S. sagitta* por não ter as margens trionduladas; e de *S. Reichardtianum* por não ter os ramos dos *stauros* arqueados, bem como pelas

dimensões. Não se trata, pois, de nenhuma destas espécies. A-pesar-de uma pronunciada similhança de forma e de dimensões entre o exemplar de que tratamos e *S. Crucicula* Grun., tão pouco deve tratar-se desta espécie, de habitat americano.

Será, porventura, uma espécie nova, de água dôce ou de baixa salinidade. Como, porém, não pudemos examinar a estriação, limitamo-nos a representar o exemplar visto pela face valvar, sutural e um pouco de escorço.

Comprimento total 35 μ; largura 11 μ.

Raríssimo em A. I.

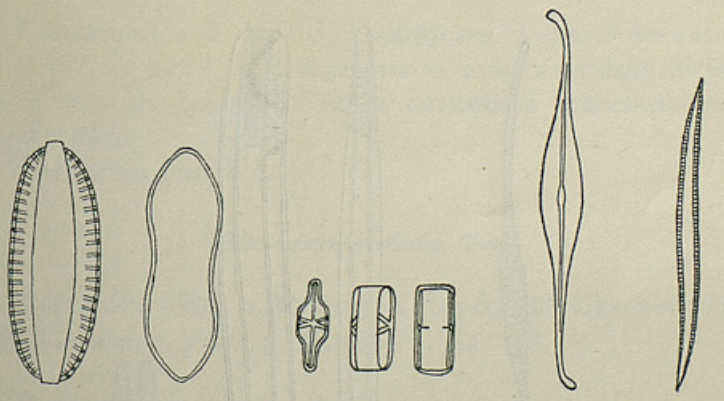


Fig. 40 Fig. 41 Fig. 42 Fig. 43

Pleurosigma fasciola Sm.

Fig. 42

Smith, 1853, p. 67, est. XXI, fig. 211. Peragallo, 1908, p. 173, est. XXXIV, fig. 30-32.

Não conseguimos observar a estriação dos exemplares que estudámos. A sua determinação funda-se, pois, sòmente na forma geral da valva e nas suas dimensões: 150 μ de comprimento, 12,5 μ de largura.

Raríssimos exemplares em A. I.

NITZSCHIACEAE

Nitzschia rigida K.

Fig. 43

W. Smith, 1853, p. 45, est. XV, fig. 128 *(Amphipleura Sigmoidea)*. Peragallo, 1908, p. 291, est. LXXIV, fig. 8, 9.

Além do exemplar que desenhámos, observámos um outro com as extremidades menos atenuadas.

Dimensões do exemplar representado: comprimento 130 μ; largura 5 μ. 12 pontos carenais em 10 μ.

Raríssima em A. I.

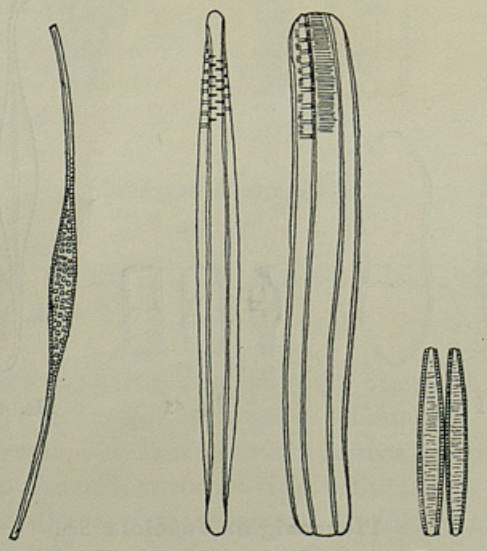


Fig. 44. × 220 Fig. 45. × 260 Fig. 46

Nitzschia longissima Ralfs

Fig. 44

Peragallo, 1908, p. 293, est. LXXIV, fig. 20. Pavillard, 1925, p. 62, fig. 114.

Examinados 3 exemplares de comprimento 306 μ, 307 μ e 362 μ, compreendendo os dois prolongamentos terminais. A parte central tinha de comprimento um

pouco mais de 1/4 do comprimento total. A forma destes exemplares leva-me a inclui-los na forma *typica*.

Um outro exemplar de 244 μ de comprimento total e com a parte central mais dilatada pertencerá à var. *closterium*.

Rara em A. I.

Nitzschia insignis Greg.

Fig. 45

W. Smith, 1853, p. 39, est. XIV, fig. 116 *(N. spectabilis)*. Peragallo, 1908, p. 295, 296, est. LXXV, fig. 3, est. LXXVI, fig. 1.

Examinados 3 únicos exemplares respectivamente de 268 μ, 237 μ e 252 μ de comprimento total e os dois últimos 28 μ e 25 μ de largura, com a curvatura característica de var. *Smithii*.

Raríssima em A. I.

Nitzschia seriata Cleve

Peragallo, 1908, p. 300, est. LXX, fig. 28. Carrisso, 1911, p. 28. Candeias, 1930, p. 46, est. V, fig. 104.

Raríssima em A. I e A. II.

FRAGILARIACEAE

Thalassiotrix nitzschioides Grun.

Fig. 46

Peragallo, 1908, p. 320, est. LXXXI, figs. 17, 18. *(Thalassionema nitzschioides)*. Carrisso, 1911, f. II, p. 27. Lebour, 1930, p. 198, fig. 160.

O único exemplar que examinámos media 68 μ de comprimento, e o par de células unidas, conjuntamente 16 μ de largura.

Raríssimo em A. I.

SURIRELLACEAE

Surirella gemma Ehr.

Fig. 47

Peragallo, 1908, p. 254, est. LXVIII, fig. 4. Pavillard, 1925, p. 63, fig. 115. Lebour, 1930, p. 214, fig. 180 (b).

Raríssima em A. I.

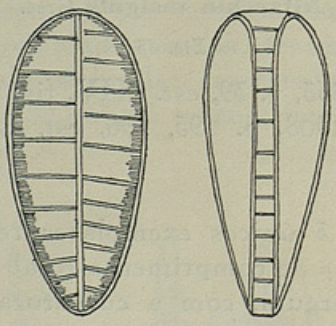


Fig. 47

Surirella splendida Ehr.

Fig. 48

V. Heurk, 1899, p. 371, est. 12, figs. 577, 577. Peragallo, 1908, p. 255, est. LXVII, fig. 6. Engler, 1928, p. 298, fig. 409 A-B.

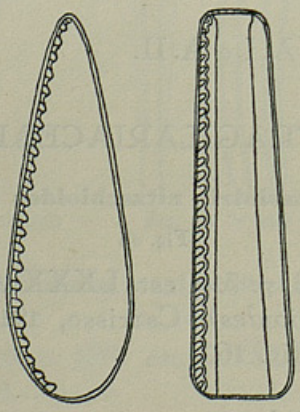


Fig. 48

Os raros exemplares que examinámos e referimos a esta espécie correspondem tanto pelo aspecto valvar como

pelas dimensões a *S. splendida*. O aspecto sutural, porém é, antes, o de *S. robusta*, segundo V. Heurk, de que *S. splendida* não é, segundo Peragallo, senão uma forma pequena.

Tanto a espécie *robusta* como as suas diferentes formas, são de água dôce, mas, de acôrdo com êste último autor, encontram-se por vezes em águas de fraca salinidade, o que é o caso do local onde a colhemos.

Rara em A. I.

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SPECIES NOVAE VEL CRITICAE FLORAE LUSITANICAE

por

WERNER ROTHMALER

CUANDO estuve la primera vez en Portugal en el año 1936 para estudiar su vegetación fué particularmente L. Wittnich CARRISSO quien me ayudó en mi labor invitándome a trabajar en el Instituto Botánico de Coimbra. Todo el tiempo que permanecí allí, él fué quien siempre me facilitó mis trabajos. Al publicar ahora algunos de los resultados de mis viajes en los años 1936 y 1938 quiero contribuir con mis modestas notas en esta publicación a un homenaje al que fué un eminente botánico y excelente compañero.

Tengo que agradecer también a los directores y personal de los Institutos Botánicos de Coimbra y Lisboa y así mismo al director y los colegas de la Estação Agronómica Nacional de Lisboa por todas las facilidades y ayuda que me prestaron.

Asplenium Virgilii Bory — *Asplenium Adiantum-nigrum* L. ssp. *Onopteris* Heufl.

Frecuente en casi todo el pais excepto las altas montañas.

Asplenium Adiantum-nigrum L. s. str. — *Asplenium Adiantum-nigrum* L. ssp. *nigrum* Heufl.

En las montañas mas altas; la encontré en la Serra do Gerez, cerca de Ponte da Maceira.

Estas dos especies se distinguen fácilmente por tener, aquella el peciolo mucho mas largo que el limbo, y los segmentos inferiores curvados hacia arriba e igualando la mitad del resto del limbo, y ésta el peciolo mas corto o

igual de largo que e limbo, y los segmentos inferiores horizontales y cada uno del mismo tamaño que el resto del limbo.

Polypodium serratum (Willd.) Christ

Frecuente en casi todo el país, excepto las altas montañas.

Polypodium vulgare L.

En las montañas altas, como en la Serra do Gerez y en la Serra da Estrela, bastante frecuente encima de los 1000 metros de altura.

P. vulgare es caracterizada por sus limbos lanceolados de un verde obscuro con los segmentos cortos y generalmente obtusos, *P. serratum* se aparta por sus hojas largas, ovado-lanceoladas de un verde amarillento con los segmentos bastante alongados y muy agudos.

Elodea canadensis Rich.

Esta especie falta en la Flora Portuguesa de P. COUTINHO a pesar de no ser rara; la encontré bastante frecuente, sobre todo en los alrededores de Alfarelos.

Triglochin striata R. et P.

abunda en los prados húmedos y salados del litoral desde Lanhelas (Miño) hasta Aveiro, formando asociaciones con *Paspalum vaginatum* de tal forma que las dos parecen plantas indígenas del pais.

Festuca elegans Boiss.

es abundante en todas partes de la Serra da Estrela (por ejemplo: Cántaros, Poço do Inferno, Manteigas, Penhas Douradas, Gouveia, S. Romão, Lagôas etc.). La encontré tambien en el alto de la Serra de Gardunha.

Nardurus patens (Brot.) Hack.

Algarve, Serra de Monchique, frecuente en el lugar llamado Barranco dos Pisões.

Especie nueva para el Algarve.

Silene cintrana Rothmaler spec. nov. — *Silene gibraltarica* Winkl. ex Wk. et Lge., Prodr. III (189) 667 nec Boiss.

Suffruticosa e sect. BOTRYOSILENE caudice crasso lignoso ramoso; folia rosulatim congesta crassa utrinque pubescentia, orbiculato-spathulata, obovata vel lanceolata, ad 8 cm longa, ad 3 cm lata in petiolum longe ciliatum attenuata apice mucronulata, superiora lanceolata, summa bracteiformia margine longe ciliata; caules erecti vel adscendentes, 10-40 cm alti crassi fistulosi, basi violascentes pubescentes, superne glabri viscidi; panicula dense corymbosa floribunda, bracteis bracteolisque late lanceolatis margine ciliatis; flores erecti pedicellis brevibus ad 5 mm longis pubescentibus suffulti; calyx umbilicatus, floriferus 14-15 mm longus, 4-5 mm latus, clavatus, fructiferus 7-10 mm latus, sat ampliatus, sub capsula constrictus, breviter pubescens striis viridibus vel fuscescentibus apice anastomosantibus munitus, dentibus triangularibus vel ovato-triangularibus, acutiusculis, ad 3 mm longis et latis late albo-marginatis circumcirca breviter ciliatis, petalis purpureis vel violascentibus obscurius venosis, 16-17 mm longis unguibus vix exsertis limbo ad 8 mm longo, fere ad basin usque bifido lobis obovato-spathulatis, corona brevissima bifida; carpophorum 7 mm longum pubescens, capsula 12-13 mm longa, 8-9 mm lata ovalis exserta, dentibus erectis, seminibus cinereis vel nigricantibus, ca. 1 mm diametro, reniformibus faciebus concavis, dorso canaliculatis obtuse tuberculatis.

Hab.: Lusitania, in montibus Cintra: in rupibus graniticis prope S. Pedro (ROTHM. 1867), Penasco dos Corvos (WELWITSCH, Herb. Inst. Bot. Lisboa), Castello dos Mouros (JOAQ. DOS SANTOS, Herb. Inst. Bot. Lisboa) Peninha (SOBRINHO, Herb Inst. Bot. Lisboa). Cabo da Roca (ROTHM. 13141, Typus, 13 maji 1938 leg.).

Esta especie, mucho mas bonita que la *S. longecilia* (Brot.) Otth., de la cual es muy afín, la tomaron WILLKOMM y WINKLER respectivamente por *S. gibraltarica* Boiss. En el porte se parece bastante mas a ésta que a *S. longecilia*, pero difiere mucho por su taxonomía. De *S. longecilia* se dis-

tingue por sus pedicelos mas cortos, por su inflorescencia corymbiforme, por sus flores, frutos y semillas mayores etc. Otra diferencia muy notable es su hábitat: *S. longecilia* se encuentra en casi todas las partes calcáreas del pais, *S. cintrana* sin embargo habita tan sólo las partes graníticas de esta isla que forma la Serra de Cintra con sus granitos terciarios dentro de los terrenos calcáreos de Estremadura portuguesa. Es más un endemismo de esta sierra que desgraciadamente va perdiendo todos sus encantos con la plantación de pinos no indígenos de ésta.

Brassica Pseudo-Erucastrum Brot.

Algarve, Serra de Monchique. Esta especie nueva para la flora del Algarve, se encuentra bastante abundante en el valle llamado Barranco dos Pisões.

Anthyllis maura Beck

En Portugal no existe ni *A. Vulneraria* L. ni *A. Webbiana* Boiss. En las partes calcáreas del centro y sul desde Coimbra hasta Monchique se encuentra esta especie caracterizada por sus hojas basilares muy grandes, por sus flores purpureas y por su cáliz oblicuo y grande. Además de esta existe una especie muy afín en el Cabo de Roca que describo abajo. En el norte del pais existen otras especies del grupo *Vulneraria;* de estas trataré especialmente en otra parte.

Anthyllis pachyphylla Rothmaler nov. spec.

E sect. *Vulneraria* herbacea e rhizomate crasso perenne pluricaulis caulibus decumbentibus vel adscendentibus crassis ramosis basi patentim superne adpresse pilosis; folia imparipinnata crassa glaucescentia supra glabra subtus adpresse vel fere subsericantim pilosa, infima rosulata longe petiolata, plerumque simplicia, foliolo unico terminale magno ovato basi cordato obtuso, ad 9 cm longo, ad 6 cm lato, foliola lateralia nulla vel 2-3-para parva ovata, caulina 2-4-juga, summa 3-5-juga, foliolo terminale bis triplove maiore ovato, lateralia ovalia, omnia obtusa; capitula magna multiflora subsessilia geminata, ternata vel

solitaria, bracteis 2 palmato-digitatis floribus plerumque brevioribus lobis oblongis vel oblongo-ovatis obtusis suffulta; flores ad 18 mm longi, calyce 13-14 mm longo inflato pallido apice purpureo dense sub-adpressim piloso, oblique truncato, breviter 5-dentado, alis vexilloque roseo-purpurascentibus, carina obscure purpurea praediti.

A. pachyphylla es bastante afín de *A. Maura*, pero en ésta los tallos son erguidos y delgados, las hojas membranaceas, los foliolos un tanto agudos, los foliolos apicales lanceolados o lanceolado-ovados (hasta 9 cm de largo y 4 cm de ancho) con la base no cordiforme; las brácteas tienen divisiones lanceoladas y agudas.

Hab.: Lusitania, Serra de Cintra, in rupestribus graniticis promontorii Cabo da Roca dicti, ad 100 m alt. (ROTHM. 13140, Typus, 13 maji 1938 leg.).

El Cabo da Roca es famoso por una serie de plantas — variedades y especies — endémicas, sobre todo caracterizadas por sus hojas gruesas. Este punto mas occidental de Europa tiene un clima especialmente húmedo y por otra parte muy ventoso, su suelo granítico — como lo tiene toda la Serra de Cintra — le hace ser una isla como las Berlengas que son las partes graniticas mas cercanas.

Adenocarpus grandiflorus Boiss.

Observé en bastante cantidad en unas colinas detrás de la Quinta de Vasco da Gama cerca de Vidigueira en la parte de Beja. En la Serra do Mendro a la cual pertenecen estas colinas no debe ser planta rara.

Vicia bithynica L.

Se cita como planta rara en Portugal pero no debe ser así. En los alrededores de Coimbra como de Cintra ví bastante esta Vicia.

Viola juressi (Link ap. Becker) Rothm. nov. comb. — *V. palustris* ssp. *juressi* Lk. ap. Becker es realmente la planta designada *Viola palustris* o *Viola epipsila* por los autores portugueses. Link dice que la planta abunda

en los peñascos de la Serra do Gerez; realmente es así, pero claro está que sólo en los peñascos húmedos. *Viola juressi* difiere tanto de *V. palustris* como de *V. epipsila*. *V. juressi* Lk. es un nomen nudum, *V. Herminii* Wein publicado como ssp. de *V. palustris* (1906) se refiere a una forma especial y pequeña de la Serra da Estrela. La verdadera *V. juressi* difiere de las formas centroeuropeas por sus peciolos y pedunculos peludos aparte de otros detalles.

Lavatera arborea L. var. **berlengensis** P. Cout.

La encontré al pie del Cabo da Roca, parte granítica mas vecina de las islas Berlengas, donde sólo se conocía hasta ahora.

Convolvulus siculus L.

Esta especie considerada como rara hasta en la parte de Arrábida, es realmente abundante en las peñascos calcáreos de la Serra da Arrábida en la vertiente S. desde Setubal hasta Sezimbra.

Antirrhinum calycinum Lam.

Es una especie bien diferente del A. Orontium L. mismo en sus caracteres morfológicos como geográficos. *A. Orontium* L. es calcífugo y se encuentra en toda Europa. *A. calycinum* Lam. en cambio es calcífilo y solo existe en la parte austral de la pennísula ibérica a pesar de encontrarse bastantes terrenos calcáreos en otras partes. Esto demuestra que es de facto una especie vicariante del *A. Orontium* que se junta sólo pocas veces con aquella en la parte de Lisboa, donde están las tierras ácidas del basalto al lado del calcáreo. *A. calycinum* es uno de los mejores indicadores de tierras calcáreas en Portugal, como lo es el *A. Orontium* de terrenos silíceos.

Antirrhinum cirrhigerum Welw. ap. Ficalho (1877) — *A. majus* var. ramosissima Willk.

Esta especie es bien diferente de las demás del grupo por sus hojas estrechas etc. La particularidad de tener zarzillos no tiene importancia sistemática, ya que se encuentran

éstos en casi todas las especies, como *A. Linkianum*, *A. graniticum*, etc. *A. cirrhigerum* Welw. es una especie típica de las arenas del litoral, especialmente del Alemtejo, donde se encuentra casi siempre con Corema album.

Antirrhinum Linkianum Boiss. et Reut.

Distribuido por grandes partes del pais; el verdadero *A. majus* L. no lo ví nunca en Portugal y dudo de que exista aquí.

Antirrhinum meonanthum Hoffgg. et Lk.

Caracterizada por sus flores pallidas amarillentas pequeñas y estrechas, por sus tallos y hojas lampiñas, sus pedicelos cortos y sus sépalos lanceolados es una especie calcífila que se encuentra sobre todo en las calizas antiguas cerca de Coimbra (p. e. Penacova); formas parecidas y afines (*A. Huetii* Reut. etc.) se encuentran en Galicia y Asturias sobre las calizas cámbricas.

Antirrhinum ambiguum Lge.

Pertenece al grupo de la especie anterior, se distingue de ella por su corola mas ancha y por sus hojas y tallos pubescentes. De Portugal se conoce esta especie únicamente de la Serra da Estrela (p. e. Poço do Inferno), donde crece como en España sobre pizarra.

Antirrhinum graniticum Rothmaler nov. spec. — *A. meonanthum* Samp. nec al.— *A. hispanicum* P. Cout. nec al.

Planta perennis caulibus erectis vel adscendentibus ramosissimis intricatis tortuosis glanduloso-viscidis; folia lanceolata acutiuscula mollia utrinque et margine ± densim glanduloso-viscida; inflorescentia laxa, densissime glandulosa, bracteis late ovato-lanceolatis pedicellis dimidio aequantibus; flores 27 mm longi, 7,5 mm lati labio superiore producto gibba basilari fere nulla, albi vel pallide rosacei, palato luteo vel aurantiaco praediti, sepalis ellipticis obtusiusculis, 7 mm longis, 2,5 mm latis instructi, pedicellis

4-6 mm longis; capsula matura oblique ovata, 11 mm longa, 9 mm lata, pedicellis 12-15 mm longis suffulta.

Hab.: Lusitania, in rupestribus graniticis Beirae altae et meridionali. Castello Branco, prope Soalheira (ROTHM., 13643, Typus, 15 junii 1938 leg.). Serra de Gardunha, praecipue prope Alpedrinha copiosissime. Ad margine fluvii Durii, praecipue prope Regua, et supra flumen usque ad Lamego (ROTHM. 14044, 2 aug. 1928 leg.).

Ya por el porte, esta especie es muy diferente de las anteriores, la corola es mucho mayor, mas blanca o, a veces, ligeramente rosada, tallos y hojas son densamente cubiertas por un indumento glanduloso muy viscoso, los pedicelos son largos y los sepalos anchos, elipticos y obtusos. La encontré solamente en las terrenos antiguos graníticos del interior del pais. Es esta especie que SAMPAIO considera como el verdadero *A. meonanthum*, pero la lámina y la descripción de HOFFMANNSEGG y LINK no permiten la menor duda que ellos llamaban así la especie arriba indicada. El *A. hispanicum* es una especie diferente.

Omphalodes Kuzinskyanae Willk.

La observé en gran abundancia en el lugar llamado Praia da Adraga cerca de Collares y no lejos del Cabo da Roca. La planta cubre allí todas las peñas calcáreas de la misma costa en las inmediaciones del mar, también aquí tiene las flores casi blancas o solo levemente azuladas hacia el apice. Esta especie debe encontrar-se distribuida por toda la costa calcárea desde Estoril hasta Praia das Maçãs, siendo hallada hasta ahora solo en tres lugares por la poca accesibilidad de esta costa brava.

Echium pomponium Boiss.

Esta planta hasta ahora poco observada en Portugal, se halla en las pequeñas manchas calcáreas de los alrededores de Beja, donde se encuentran plantas como *Salvia argentea, Linaria Ricardoi, Antirrhinum calycinum* etc., p. e. en un lugar llamado Quinta do Soeiro.

Valeriana montana L.

Encontré con cierta abundancia en los peñascos de la parte superior del Valle da Maceira en la Serra do Gerez.

Matricaria anthemoides (Dav.) Mariz

Esta especie rara se encuentra en la parte de Lisboa no sólo en la cumbre basáltica del Monte Abraão de Bellas, sino también en las colinas basálticas de los alrededores de Algés. Parece planta calcífuga y debe de hallarse también en otras partes basálticas de la región de Lisboa.

Centaurea Carrissoi Rothmaler nov. spec.

Planta e sect. *Centaurium* Cass. ex aff. *C. vicentina* Welw. ap. Mariz, herbacea perenne caule longo decumbente striato simplici monocephalo, rarius ramoso 2-3-cephalo, apice nudo, pilis longis disperse lanato-pilosa; folia longe petiolata lanceolata acuta, supra glabrescentia, margine et subtus precipue secus nervos disperse longeque lanato-pilosa, basilaria longius petiolata integerrima, caulina versus apicem decrescentia brevius petiolata integra, haud raro basi utrinque dentibus 1-3 brevissimis acutis obsita; anthodium 3 cm longum, 2 cm latum globoso-oblongum squamis pallide viridibus fuscostriatis, inferioribus anguste scarioso-marginatis, intimis latissime scarioso-marginatis et appendice scarioso longo instructis, corollis magnis purpureis praeditum, achaenia 5-6 mm longa, 2 mm lata obconica, basi obliqua circumcirca incrassata, costis 6-8 longitudinalibus albicantibus paulo notatis apicem versus obsoletis instructa, intervallibus vix rugosis, pappo setis valde inaequalibus ad 3 mm longis barbata.

Hab.: Lusitania, in substepposis ad margines viarum inter S. Tiago de Cacém et Cercal, ad bifurcationem viarum Sines-Cercal et S. Tiago-Cercal frequenter occurrit cum Thymo villoso (ROTHM. 13376, Typus, 25 maji 1938 leg.).

Esta especie ya fué observada por WELWITSCH que la tomó como una forma juvenil de *C. vicentina*, ya que sólo poseía un ejemplar incompleto. *C. vicentina* difiere de ella por sus hojas 1-(-2-) pinpatipartidas, por sus aquenios mas anchos (hasta 3 mm) rugoso-denticulados provistos de 4

costillas blanquecinas y denticuladas. *C. vicentina* extiende su area desde el Cabo de S. Vicente hasta Odemira, desde Odemira para el Norte (hasta S. Thiago de Cacém) se encuentra esta nueva especie.

Inula prostrata Rothmaler nov. spec.

Planta suffruticosa glabrescens ex aff. *I. viscosae* et *I. revolutae*, caulibus lignosis decumbentibus prostratis flexuosis irregulariter ramosis, ramis lignosis pilis pluricellularibus et glandulis stipitatis sparse obsitis; folia oblonga vel oblongo-lanceolata integra margine revoluta obtusa vel obtusiuscula utrinque glandulis sessilibus viscosissima; panicula sat ramosa expansa pedunculis ad 2 cm longis praedita; anthodia ± 1 cm lata squamis inaequalibus erectis regulariter imbricatis covexis cucullatis, infimis obtusis rotundato-ovatis interioribus obovato-lanceolatis vel lanceolatis obtusis vel obtusiusculis obsita; reliquo ut in affinibus.

Hab.: Lusitania. in locis sterilibus ad oram maris in promontorio Cabo de Sines dicto, solo arenaceo-argilloso, ad 50 m alt (ROTHM. 14196, Typus, 8 sept. 1938 leg.).

Inula viscosa L. abundante en casi toda la región mediterranea y también en el norte de Portugal, tiene su limite austro-occidental un tanto al sur del Tejo y es representada allí por una especie afín, *I. revoluta* Hoffgg. et Lk. De estas dos especies se distingue la nueva — de todas maneras mas afín a la *I. revoluta* que a la *I. viscosa* — por su porte especial siempre achaparrado, por sus hojas y sus escamas de las cabezuelas obtusas y por su indumento menos denso. En el Cabo de Sines no ví ninguna de las especies afines, ésta seguramente representa un endemismo local de este cabo.

Lisboa, Estação Agronómica Nacional, Octubre 1938.

ELEMENTOS PARA A HISTÓRIA DA EXPLORAÇÃO BOTÂNICA DE ANGOLA

ITINERÁRIO E RELAÇÃO DOS VIAJANTES E EXPLORADORES QUE FIZERAM COLECÇÕES BOTÂNICAS EM ANGOLA

por

JOHN GOSSWEILER

A exploração da flora angolana começou, no princípio do século passado, com a colheita de plantas em Luanda. O nome do primeiro colector é desconhecido, mas os especímenes encontram-se em Paris e um dêles serviu de base para a descrição de *Maerua angolensis*, a «Muriangombe» dos barrancos de Luanda, publicada em 1824.

A segunda colecção, depositada no Herbário do Jardim Botânico de Kew, foi efectuada pelo Dr. CURROR, médico do navio de guerra «Water-Witch» e que em 1840 desembarcou no Cabo de Santa Marta (Baía dos Elefantes).

Desde então até à presente data têm sido numerosas as explorações botânicas em Angola. A de WELWITSCH, feita durante os anos de 1853 a 1860, é, entre tôdas, a mais importante debaixo de todos os pontos de vista. Efectivamente, o material colhido durante êsses anos foi considerável e tem sido objecto de muitas publicações entre as quais figura o livro do Conde de FICALHO, «Plantas Úteis da África Portuguesa», publicado em Lisboa, em 1884, e que se baseia nas colecções depositadas no Herbário da Universidade de Lisboa. Entre os colectores figuram também duas senhoras que, no século passado, acompanharam os seus maridos em viagem pelos sertões. A Senhora J. J. MONTEIRO, de nacionalidade inglesa, era uma pessoa das relações do director do Jardim Botânico de Kew e foi sem dúvida êste o motivo que a levou a fazer colecções, em 1871, durante a sua permanência na região do Bembe, uma das terras ainda hoje das mais desoladas do Congo Portu-

guês. A Senhora D. MARIA GARCIA CHAVES é a única portuguesa de que há notícia de se ter dedicado à colheita de plantas em Angola; é-nos porém desconhecida a entidade com quem se correspondeu em Portugal. Os especímenes, depositados em Coimbra, estão datados de 1886 e 1889 e as localidades mencionadas nos respectivos rótulos, escritos por essa Senhora, são situadas na zona do litoral, entre o estuário do Zaire e a fronteira do Território de Cabinda, isto é, numa região que hoje faz parte do Congo Belga.

As regiões relativamente melhor exploradas são as das florestas do Cafeeiro, sobretudo as do Cazengo e Golungo Alto, onde WELWITSCH fez, durante dois anos, a sua estação de trabalho. A floresta pluviosa do Cuango — entre Ienga e a foz do rio Zaza — é apenas conhecida superficialmente pela descrição das viagens de BÜTTNER, MECHOW e BACELAR BEBIANO, não existindo contudo em Portugal material botânico colhido nesta região. O mesmo conhecimento superficial se tem dos massiços de árvores de porte elevado da Lunda e da fronteira leste do Moxico.

Muitas das explorações científicas têm tido como objectivo o estudo da região desértica de Mossâmedes, da Serra da Chela e do planalto da Humpata. Estas regiões, de acôrdo com as condições orográficas, abrangem, numa distância de 150 quilómetros, importantes áreas de comunidades climax. Por êsse motivo, essas regiões têm sido visitadas por numerosos naturalistas de diversas nacionalidades e a sua vegetação despertou a curiosidade de alguns colonos e missionários que principiaram a coleccionar plantas. Desta maneira, chegou a reunir-se um material precioso dessas regiões, contendo dezenas de espécies inéditas. Apesar disso, a maior percentagem de plantas desconhecidas ainda hoje encontra-se na planície de Namib e no deserto de Mossâmedes. A sua colheita é bastante difícil, dada a luta que o homem é forçado a sustentar no deserto contra os elementos em qualquer época do ano.

O sector do Baixo Cunene, embora não seja completamente desconhecido, nunca despertou muito a atenção dos exploradores botânicos pelo facto de ser apenas uma

planície de depósito superficial de areia do Kalaari e ter uma vegetação bastante homogénea.

Os distritos de Cubango, Moxico, Lunda e a parte leste do Bié, que podem reunir-se numa só unidade corológica caracterizada pelos aluviões continentais de areia, estão muito longe de se encontrarem convenientemente estudados, apesar de terem sido atravessados por numerosos naturalistas que dali trouxeram avultadas colecções para a Europa.

O planalto de Benguela, especialmente o sub-sector montanhoso com altitudes superiores a 2000 metros, é-nos ainda desconhecido e o mesmo acontece no que diz respeito ao território de Andulo.

Sôbre a floresta do tipo *Hiemilignosa* e as savanas do planalto de Malange estão publicados alguns elementos, mas a maior parte está ainda por explorar e estudar.

No planalto do Congo — Maquela do Zombo — são freqüentes os facies com aspectos fisionómicos muito parecidos com os de Vila da Ponte, embora sejam constituídos por outras espécies. Dêste sector corológico existem apenas as colecções efectuadas pelo Dr. BÜTTNER, em 1884, e pela Senhora J. J. MONTEIRO, em 1872.

No distrito do Zaire conhecem-se, graças também à colecção da Senhora J. J. MONTEIRO, alguns componentes das savanas situadas entre Ambrizete e Bembe. A floresta de aluvião dêsse distrito foi em parte explorada, por conta da Companhia do Fomento Geral de Angola, por GOSSWEILER, durante o ano de 1924. Para êsse efeito, GOSSWEILER herborizou em diversos pontos, situados entre Santo António do Zaire e Emílio de Carvalho.

A flora do Território de Cabinda é apenas conhecida pelas colecções de D. MARIA V. GARCIA CHAVES, efectuadas na zona marítima ao sul da fronteira, e pelas de H. SOYAUX, feitas no litoral de Chinxocho, localidade situada um pouco ao sul de Massabi. Alguns facies da floresta do Maiombe foram explorados por GOSSWEILER durante as viagens feitas a expensas do Fomento Geral de Angola. A flora desta região é do tipo *Pluviisilva* e é a mais luxuriante de tôdas as vegetações das possessões portuguesas do continente

africano; a sua exploração não é recomendada para naturalistas medrosos ou aprendizes!

O conhecimento actual da vegetação angolana permite-nos fazer já uma ideia geral da distribuïção das diversas classes das suas formações, mas muito mais material será necessário reunir, sobretudo dos sectores ainda não explorados, para se poder fazer o estudo da flora.

Para melhor se avaliar da origem dos conhecimentos que actualmente possuímos, da maneira como êsses conhecimentos se encontram documentados e da forma como foi arquivado o material de referência permanente, apresentamos em seguida uma breve notícia de cada um dos principais colectores, cujo nome ficou vinculado à obra da exploração botânica daquela província.

ABREU (GUILHERME DE):

Regente agrícola ao serviço da Repartição Técnica dos Serviços de Agricultura, Comércio, Colonização e Florestal de Angola e Chefe da Repartição das Dunas em Mossâmedes. Dêste colector, foi recebida em Coimbra a primeira remessa de plantas em Junho de 1938. Esta colecção contém material de um género novo e de algumas espécies inéditas, encontradas na região desértica de Mossâmedes.

ALMEIDA (JOSÉ DE):

Professor do Instituto Superior de Agronomia, primeiro director do Jardim Colonial de Lisboa e sócio correspondente da Academia das Ciências de Lisboa. Nas suas diversas viagens por Angola (1902-1919), em serviço oficial e particular, fez colecções botânicas de algumas centenas de especímenes que se encontram actualmente no Herbário do Jardim Colonial de Lisboa.

AMADO (PAULO DE MELO RAMALHO):

Assinava-se, a maior parte das vezes, abreviadamente, Paulo Amado. Era oficial da guarnição militar de Angola, natural de Coimbra e genro de Adolpho Frederico Moller, Jardineiro Chefe do Jardim Botânico de Coimbra. Em 1890, fez uma viagem ao Cuanhama, região ainda não submetida nessa data, e em 1891 fez parte da coluna que investiu contra os Cuamatos. Em 1894, era tenente do Batalhão de Caçadores 4 da Guarnição Irregular da Humpata. Em Abril dêsse mesmo ano, andando em exercícios, caiu com o cavalo em que montava, do que lhe resultou deslocação do braço direito pelo cotovelo, ficando assim inutilizado para o serviço activo e tendo de se reformar no posto de tenente (1).

Como oficial reformado, desempenhou diversos lugares na Administração Civil de Angola até 1923. A colecção botânica que organizou consiste em pouco mais de 100 exemplares, colhidos no planalto da Huíla, sobretudo na Humpata. A referida colecção, que se encontra depositada no Herbário de Coimbra, tem a data de 1895.

ANCHIETA (JOSÉ DE):

Nasceu em Setúbal em 1832. Em 1866 encontrava-se em Angola fazendo explorações zoológicas por conta do Govêrno Português. Durante os anos que residiu em Caconda — 1885-1896 — colheu algumas centenas de plantas que se encontram distribuídas pelos Herbários de Coimbra, Lisboa, Kew e Museu Britânico de História Natural de Londres. Morreu em Caconda em 14 de Setembro de 1897. O seu nome, vinculado a muitas descobertas zoológicas, também aparece na classificação de algumas plantas endémicas de Caconda, como por exemplo em *Dolichos Anchietae*.

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(1) Informação fornecida ao Exmo Sr. Dr. Luís CARRISSO, em 1932, pelo General EDUARDO MARQUES.

A biografia de JOSÉ DE ANCHIETA, da autoria de J. B. BARBOSA DO BOCAGE, encontra-se publicada no *Jornal de Sciências Mathemáticas, Physicas e Naturais*, 2.ª Série, N.º XVIII, Lisboa, 1897.

ANTUNES (PADRE JOSÉ MARIA):

Padre das Missões Portuguesas do Espírito Santo da Huíla. Nasceu em Santarém em 22 de Maio de 1856. Foi para a Huíla em 1881. Voltou para Lisboa em 1904 para se ocupar das obras de formação missionária em Portugal e da Procuradoria das Missões. Faleceu em Paris em 10 de Dezembro de 1928.

Fez importantes colecções no distrito da Huíla, durante os anos de 1889-1903, especialmente na Serra da Chela, Gambos, Vale do Cacolovar e Humpata. Destas colecções, existem aproximadamente 100 especímenes, acompanhados de várias indicações e dos nomes indígenas, no Herbário de Coimbra. A restante parte das colecções está depositada em Montpellier e Berlim, onde foi estudada por diversos botânicos. Êste material forneceu diversos tipos clássicos aos quais foi dado o nome específico em homenagem a êste explorador. Entre muitos poderemos mencionar: *Pterocarpus Antunesii*, *Acacia Antunesii* e *Albizzia Antunesiana*.

BAUM (H.):

Botânico de nacionalidade alemã. Em 1899-1900, fez parte da expedição organizada pela Companhia de Mossâmedes e chefiada por PIETER van der KELLEN e que se destinava a explorar o leste do distrito da Huíla. A expedição saíu de Mossâmedes no mês de Agosto de 1899 e seguiu para Pôrto Alexandre, subiu até Ediva, no vale do Cacolovar, depois para Humbe, vale do rio Chitanda até Cas-

singa, vale do rio Cubango até à Terra dos Cuangares. Desta região, seguiu depois para o Norte até ao vale do rio Longo e Cuiriri, onde os exploradores acamparam durante algumas semanas.

Acompanhado por alguns membros da expedição, BAUM atingiu as margens do rio Cuando, atravessando o Cuito, Conjumbo e Cueio. No regresso, a expedição seguiu para oeste, passando por Vila Serpa Pinto, Vila da Ponte, vale do Chitando (Colui), Cacolovar, Chibia, Capangombe e Mossâmedes.

BAUM foi o primeiro explorador que fez colheitas botânicas na bacia hidrográfica do Cunene e do Cubango. A sua colecção, depositada no Museu de Berlim, contém para cima de 1000 números entre os quais dezenas de tipos clássicos incluindo os géneros novos *Baumia* e *Calanda*, descritos no livro *Kunene Sambesi Expedition*, Berlim, 1903, publicado a expensas do «Kolonial Wirtschaftliches Komitee». Na descrição da viagem de BAUM, publicada no mesmo volume, aparece pela primeira vez um relatório concreto sôbre a exploração da borracha nas «chanas» do sul de Angola.

BEATRIZ (MANUEL GUERREIRO):

Técnico algodeiro que desde 1913 até 1919 esteve ao Serviço da Direcção de Agricultura e Comércio de Angola. A sua colecção botânica consiste em algumas centenas de plantas, colhidas em Cacoba, Cuanza Sul, Terra de Quissàma, Catete, Icola e Bengo, durante os anos de 1929-1930, e encontra-se depositada no Herbário de Coimbra.

BERTHELOT (MISSIONÁRIO?):

Nos trabalhos de taxonomia aparecem citadas plantas colhidas em 1908, no Território de Cabinda, por um explorador com êste nome. Todo o material se encontra, segundo parece, nos Herbários de França.

BONNEFOUX (M.) & VILLAIN (F.):

Padres das Missões Portuguesas do Espírito Santo da Huíla. Colheram algumas centenas de plantas, no distrito da Huíla, que se encontram no Museu Nacional de História Natural de Paris.

O Padre MARIUS BONNEFOUX nasceu em 8 de Setembro de 1861, em Viveroles, Auvergne, França. Foi para a Huíla em Novembro de 1885 e faleceu na Missão desta localidade em 20 de Julho de 1937.

O Padre FELIX VILLAIN nasceu em Contances, Normandia, França, em 1879. Foi para a Huíla em 1904, onde faleceu em 18 de Junho de 1937.

BOSS (DR. G.):

Professor de botânica no Liceu de Swakopmund, Damaralândia, Sudoeste Africano. Nas suas diversas viagens de estudo por Angola, durante os anos de 1932 a 1937, fez colecções de plantas nos distritos de Mossâmedes, Huíla, Benguela, Cuanza Sul e Cuanza Norte. Estas colecções estão depositadas nos Institutos Botânicos de Swakopmund, Pretória e Berlim.

BRÜHL (PROF. DR.):

Na qualidade de Director dos Museus de Pescarias e Indústrias Marítimas da Prússia, foi em 1922 a Angola, a expensas da Companhia do Fomento Geral daquela colónia, estudar a possibilidade do aproveitamento das riquezas marítimas de Mossâmedes. Durante a sua permanência nos portos do Sul de Angola, fez uma pequena colecção de plantas nos desertos do litoral, colecção esta que se encontra depositada no Museu Botânico de Berlim.

BUCHNER (DR. MAX):

Explorador de nacionalidade alemã. Seguindo, em 1878, o itinerário de POGGE até às terras de Muato Ianvo, fez

notáveis explorações na Lunda e, em seguida, no vale do Cuango. No seu regresso para Malange, em 1880, atravessou o Cuango nas proximidades de Cassange.

As suas plantas encontram-se depositadas no Museu Botânico de Berlim e entre elas existem diversos tipos clássicos de espécies endémicas em Angola, como: *Buchnerodendron speciosum*, *Anthocleista Buchneri*, *Aeolanthus Buchnerianus* e outras.

A descrição da viagem, com cartas e itinerários, foi publicada pela «Mitteil. Afrik. Ges. Berlin», com o título *Die Buchnerische Expedition* (1878-1883).

BÜTTNER (DR. RICHARD):

Geógrafo e botânico alemão. Viajou em Angola e no Congo durante os anos de 1884 a 1886. Depois de estudar o litoral do Gabão, seguiu de Luango para S. Salvador, Quibocôlo, Maquela do Zombo, Sacandica, vale do Cuango até Cassongo (Lunda) então chamada Muene Putu Cassongo, situada a uns 15 quilómetros da actual séde da Administração Civil do Cuango. No regresso, seguiu pelo Norte, descendo o rio Cuango até às margens do Zaire e finalmente até ao litoral, via Kinchassa.

A sua colecção, constituída por 500 números, encontra-se no Museu Botânico de Berlim. Metade da colecção foi colhida no território português e contém espécies típicas.

Existem diversas publicações relativas à viagem do Dr. BÜTTNER; a parte que trata da região do Congo Português encontra-se na Parte III, do volume 5.º da obra editada pela «Mitteilungen der Afrikanischen Gesellschaft, Berlim».

CAPELO & IVENS:

Existem algumas centenas de especímenes colhidos por êstes exploradores portugueses no litoral de Mossâmedes e noutras localidades incertas, durante os anos de 1881-1884. Êstes especímenes não têm sido citados nas publi-

cações da especialidade, porque só no princípio dêste ano foi notada a sua existência no Herbário do Jardim Botânico da Universidade de Lisboa.

CARDOSO (JOAQUIM ANTÓNIO):

Colono que viveu 42 anos em Angola. Durante os anos de 1929 e 1930, época em que fez parte da Direcção da Estação de Policultura Planáltica do Bié, fez colecções de algumas centenas de plantas que se encontram hoje no Jardim Colonial de Lisboa e nos Herbários das Universidades de Lisboa e Coimbra. Êste material está sendo aproveitado e a êle se fará referência nos sucessivos fascículos da obra em publicação *Conspectus Florae Angolensis.*

Os últimos anos da sua vida empregou-os a estudar o aproveitamento da fibra da *Sansevieria cylindrica*, cuja exploração lhe foi concedida na área de Dande e à qual associou, ultimamente, a Companhia do Açúcar de Angola. JOAQUIM ANTÓNIO CARDOSO faleceu, em 21 de Junho de 1938, no Hospital da Fazenda Tentativa do Dande, Luanda.

CARRISSO (L. W.) & MENDONÇA (F. A.):

Director e naturalista do Instituto Botânico da Universidade de Coimbra. Durante a sua Missão à Colónia de Angola, em 1927, colheram 657 especímenes botânicos, nos distritos de Luanda, Cuanza Norte, Malange, Lunda (incluindo Dundo e Nordeste), Moxico, planalto de Benguela, Huíla e Mossâmedes.

Uma descrição desta viagem está publicada no volume VI (2.ª série) do *Boletim da Sociedade Broteriana* de 1932. Do material colhido, que se encontra no Herbário do Instituto Botânico de Coimbra, muitos números foram já citados no primeiro fascículo do *Conspectus Florae Angolensis.*

CARRISSO (L. W.) & SOUSA (F.):

Director e auxiliar de naturalista do Instituto Botânico da Universidade de Coimbra. Colheram 354 números du-

rante a Missão Botânica a Angola, organizada pelo Professor L. W. CARRISSO em 1937. Esta colecção contém plantas raras da região desértica de Mossâmedes, assim como do planalto de Benguela.

CASTRO (MÁRIO DE):

Natural do Pôrto. Auxiliar nos serviços de campo da Missão Geológica em Angola durante os anos de 1929 a 1933. Colheu algumas centenas de plantas no planalto de Benguela, assim como nas proximidades de Chapeu Armado e outras localidades do distrito de Mossâmedes. O material está depositado no Herbário de Coimbra e os números já estudados estão citados no primeiro fascículo do *Conspectus Florae Angolensis.*

CHAVES (MARIA V. GARCIA):

Segundo consta do arquivo da Administração Civil de Boma (Congo), esta Senhora e seu marido, funcionário superior de uma casa comercial holandesa em Banana e Boma, eram naturais do Pôrto. O material botânico colhido pela Senhora CHAVES no estuário do Zaire, Vista e Praia do Oceano, entre a fronteira do Território de Cabinda e Banana, durante os anos de 1886-1889, consiste em algumas centenas de plantas que se encontram depositadas no Herbário de Coimbra. Só nas publicações posteriores a 1906 se encontram citações das plantas colhidas por esta Senhora, porque até àquela data êsse material não foi submetido a estudo. No prefácio do volume IV, Sect. 2, da *Flora da África Tropical*, os botânicos dos Jardins Reais de Kew referem certos especímenes, originários do Congo, a um Major F. CHAVES; presumo que se trata de um êrro e que o colector seja a Senhora citada, cujo marido faleceu no Pôrto.

CURROR (DR. R. N.):

Médico do navio de guerra inglês «Water-Witch». Desembarcou em 1840 no Cabo de Santa Marta, Baía dos

Elefantes (aproximadamente no paralelo 14°), para coleccionar plantas e insectos. As plantas herborizadas encontram-se no Herbário dos Jardins Reais de Kew, Surrey. Não temos menção da existência de colectores botânicos em Angola anteriores a êste.

CURTISS (ANITA G.):

No Gray Herbário da Universidade de Harvard, Estados Unidos da América do Norte, existem algumas centenas de plantas, colhidas por esta Senhora, que era provàvelmente relacionada com as missões americanas. As colheitas foram realizadas, nos anos de 1920-1923, na África Oriental e no planalto de Benguela. Alguns números estão estudados e publicados nas revistas da especialidade.

DEKINDT (P.e EUGÈNE):

Padre das Missões Portuguesas do Espírito Santo da Huíla. Nasceu em Caeskerke, Bélgica,em 21 de Julho de 1865. Foi para a Missão da Huíla em Julho de 1893. Voltou para a Europa, gravemente doente, em Março de 1904. Faleceu em Lisboa a 18 de Dezembro de 1905.

Fez uma avultada colecção, excedendo 1000 números, durante os anos de 1899-1902. As plantas foram colhidas nas margens dos rios Mounyno (Moninho), Cacolovar, Nene e Luala e nos morros de Queputu e Tyiwingiro. A colecção, depositada nos Museus Botânicos de Berlim, Montpellier e Coimbra, contém numerosas espécies raras, como por exemplo: *Pterocarpus Dekindtii*, *Dalbergia Dekindtiana*, *Rhynchosia Dekindtii* e o género *Dekindtia* Gilg, arbusto endémico na área da Humpata.

DAWE (M. T.):

Técnico especializado em agricultura tropical, de nacionalidade inglesa. Durante a sua viagem de estudo por

Angola (1920-1922) fez colecções de algumas centenas de plantas no Maiombe Português, Congo, Cuanza Norte, planalto de Malange e Libolo. Estas plantas encontram-se depositadas no Herbário dos Jardins Reais de Kew.

EXELL (A. W.) & MENDONÇA (F. A.):

O material do Iter Angolanum 1937, que consiste em 3211 especímenes depositados no Instituto Botânico de Coimbra, foi colhido durante a viagem feita pela Missão Botânica do Dr. L. W. CARRISSO. Um relatório sôbre esta viagem, da autoria do Dr. A. W. EXELL, encontra-se publicado em *The Journal of Botany*, Maio, 1938. A colecção consta de plantas colhidas em todos os distritos de Angola, menos no Congo e os seus números vão naturalmente aparecer citados em quási tôdas as páginas da obra em publicação *Conspectus Florae Angolensis*.

FENAROLI (PROF. DOTT. LUIGI):

Naturalista da Missão Italiana que, em 1928, foi a Angola estudar a possibilidade da colonização do planalto de Benguela. A sua colecção, que consiste em algumas centenas de números colhidos no Bailundo e na área de Nova Lisboa, assim como no litoral de Luanda e Benguela, deve estar hoje depositada no Herbário de Florença.

FRITZSHE (BERTHA):

Durante a sua permanência no planalto da Humpata, esta Senhora coleccionou, nos anos de 1902-1903, algumas centenas de plantas no distrito da Huíla.

Esta colecção, depositada no Museu de Berlim, está em grande parte estudada pelos botânicos berlinenses e é citada em diversas publicações.

GOMES E SOUSA (ANTÓNIO DE FIGUEIREDO):

Engenheiro agrónomo, antigo chefe da Missão Botânica da Guiné e chefe da Repartição de Florestas em Angola. Herborizou, durante o ano de 1930, nos distritos de Mossâmedes e Huíla, assim como no planalto de Benguela. A colecção consiste em algumas centenas de números depositados no Herbário do Jardim Colonial de Lisboa e no do Instituto Botânico de Coimbra, assim como nos Museus Botânicos de Berlim.

GOSSWEILER (J.):

Técnico especializado, contratado pelo Govêrno Geral de Angola, de nacionalidade suíssa. No desempenho das missões e trabalhos de que era encarregado pela Direcção dos Serviços de Agricultura, fez importantes colheitas em todos os distritos da colónia, mas sobretudo no Maiombe Português. Em 1937, fez parte, como adido, da Missão Botânica do Dr. L. W. CARRISSO. As suas colecções encontram-se no Jardim Colonial de Lisboa, assim como nos Herbários das Universidades de Lisboa e Coimbra. A colecção princeps encontra-se no Museu Britânico de Londres e alguns duplicados foram distribuídos, gratuitamente, pelos Herbários de Kew, Berlim e Washington.

GÜSSFELDT (PAUL):

Fez parte da expedição Pechuel Laesch, realizada nos anos de 1874-1882, e coleccionou algumas poucas plantas no Território de Cabinda, principalmente nas áreas de Mossabi e Luango. A colecção encontra-se no Herbário do Museu Botânico de Berlim.

GREGORY (J. W.):

Viajante de nacionalidade inglesa e chefe da Missão judaica incumbida de estudar as possibilidades agrícolas e

de colonização de Angola. Colheu, em 1912, umas centenas de plantas, no planalto de Benguela, que se encontram no Herbário do Museu Britânico em Londres.

HOEPFNER (DR.):

Explorador de nacionalidade alemã. Fez, no fim do século passado, a viagem de Mossâmedes à Damaralândia, colhendo plantas no vale do Coroca e outros locais do sul de Angola. A colecção foi enviada para Berlim. Alguns exemplares encontram-se também depositados no Herbário Hausknecht em Weimar, Alemanha.

HUNDT (OTTO):

Agricultor e colono alemão, estabelecido no planalto de Benguela. Coleccionou plantas em Xongorola, Ganda e Caconda durante os anos de 1930-1934. As colecções encontram-se no Museu Botânico de Berlim.

JOHNSTON (HARRY, H.):

Explorador inglês. Em 1883, durante a sua viagem pelo sul de Angola, herborizou algumas plantas nos distritos de Mossâmedes e Huíla. Esta colecção está depositada no Herbário de Kew.

JESSEN (PROF. D. O.):

Professor de Geografia da Universidade de Rostock e autor do livro *Reisen und Forschungen in Angola*. Durante as suas viagens por Angola, em 1931-1932, fez colecções botânicas de algumas centenas de plantas que se encontram hoje no Herbário do Museu Botânico de Berlim.

LYNES (H.):

Contra-almirante inglês. Fez colecções de algumas centenas de plantas no planalto de Benguela (1919?). Estas plantas encontram-se no Herbário do Museu Britânico de Londres.

MARQUES (SISENANDO AGOSTINHO):

Sub-chefe da expedição ao Muato-Ianvo. Fez, em 1884-1888, uma colecção de algumas centenas de plantas no planalto de Malange e na Lunda. Êste material encontra-se hoje nos Herbários de Coimbra e Berlim. O nome dêste explorador, vinculado pelos botânicos de Berlim a muitas das suas descobertas, encontra-se por exemplo na árvore do género *Marquesia* e no arbusto *Strychnos Marquesii*, ambos endémicos em Angola.

MARTINS (DR. EMÍLIO VICTOR):

Delegado de Sanidade Pecuária da região do Baixo Cunene e Director da Estação Zootécnica de Vila Pereira d'Eça (Anchiba). Durante a sua permanência nesta região do extremo sul de Angola, colheu algumas centenas de plantas que foram determinadas, em 1933, no Herbário do Govêrno do Transvaal, em Pretória. Algumas dúzias de especímenes estão também depositados no Herbário do Instituto Botânico de Coimbra.

MORENO (CAPITÃO MATEUS):

Comandante de Bateria de Artilharia de Montanha em Sá da Bandeira. Coleccionou, desde 1936, algumas centenas de plantas, no distrito da Huíla, que remeteu para o Instituto Botânico de Coimbra.

MONTEIRO (TENENTE PICADOR, ANTÓNIO DA SILVA):

Agricultor e proprietário da Quinta do Ribatejo. Em 1938, remeteu, por intermédio do Capitão Mateus Moreno, para o Herbário do Instituto Botânico de Coimbra, algumas centenas de plantas colhidas na área da Humpata.

MONTEIRO (J. J. ROSE, MRS.):

Senhora de nacionalidade inglesa e muito bem relacionada com a direcção dos Jardins Reais de Kew. Durante o período em que acompanhou seu marido, autor do livro em 2 volumes *Angola and the river Congo*, London 1875, nas suas viagens de pesquizas mineiras por Angola e Moçambique, fez importantes colecções de plantas, que os taxonomistas do Herbário de Kew principiaram imediatamente a estudar. Na Flora da África Tropical, desde o volume II de 1877 até à presente data, encontram-se citadas as plantas que esta Senhora coleccionou nas colónias portuguesas, sobretudo entre Ambrizete e Bembe, Cambambe, Luanda e região desértica de Mossâmedes. A colecção principal, contendo dúzias de espécies típicas de Angola, está no Jardim de Kew. Foi esta Senhora que em 1872 mandou para a Europa o material sôbre o qual está fundada a *Angolaea fluitans*, planta que existe nos rápidos do Cuanza, em Cambambe e que, desde essa data, nenhum coleccionador voltou a encontrar. Depois da morte de seu marido, Mrs. MONTEIRO viveu em Lourenço Marques e escreveu o livro *Delagoa Bay: its natives and natural history*, London, 1891.

NEWTON (FRANCISCO XAVIER OAKLEY DE AGUIAR):

Nasceu no Pôrto em 1864. Era filho de ISAAC NEWTON. Numa carta, escrita em Lisboa em 8-III-1885, dizia FRANCISCO NEWTON que já tinha andado viajando pela Província

de Angola, tendo percorrido todo o distrito de Mossâmedes e a costa entre o Zaire e o Cabo Frio, e que, durante essas viagens, tinha feito alguns estudos e colecções botânicas e zoológicas. Num requerimento feito em Lisboa e datado de 27-VII-1885, em que NEWTON pedia para ir estudar a fauna da Província de S. Tomé e Príncipe, por conta do Govêrno, com o fim de enriquecer as colecções dos museus nacionais, diz o mesmo NEWTON que tinha estado em África durante três anos fazendo estudos zoológicos, acompanhando os exploradores Lord MAYO, ERIKSSON e ELSEN. Êste requerimento foi deferido pelo Ministro Pinheiro Chagas e, em Portaria de 7-VIII-1885, foi NEWTON encarregado de ir a S. Tomé e Príncipe estudar a fauna desta Província. Em 1886, visitou a colónia francesa Dahomey, fazendo também ali colecções botânicas.

José Vicente Barbosa do Bocage, num ofício de 4-VI--1895, diz que os resultados dos trabalhos de NEWTON, no que respeita à exploração das Ilhas de S. Tomé, Princípe e Ano Bom, já estavam aproveitados pela ciência, em sucessivas publicações vindas a lume no *Jornal das Sciências Matemáticas, Físicas e Naturais* da Academia Real das Ciências de Lisboa. Em 15-X-1895 foi nomeado para fazer a exploração zoológica de Timor, de onde regressou em 1897. Em 19-VIII-1898 foi encarregado da exploração botânica e zoológica de Cabo Verde e Guiné. Em 29-X-1892 de Angola; em 10-IV-1907 da Guiné; em 12-II-1908 foi publicada uma portaria exonerando-o dessa comissão.

O material botânico, remetido para Coimbra por NEWTON e estudado mais tarde em Berlim e Londres pelo pessoal especializado na taxonomia de plantas africanas, contém numerosas espécies típicas da flora africana, e o seu nome encontra-se vinculado a muitas das suas descobertas, como por exemplo no fungo *Dedalea Newtoni* Bres., colhido na Ilha do Príncipe em 1888; na gramínea *Ctenium Newtoni*, Hackel de Dahomey, freqüente também em Angola; e em *Hyparrhenia Newtoni* Stapf da Humpata e sul de Angola (1).

(1) Os dados aqui contidos sôbre êste explorador foram-nos fornecidos pelo Ex.mo Sr. DR. LUÍS CARRISSO que por sua vez os obteve (carta de 28 de Janeiro de 1932) graças à gentileza do Ex.mo Sr. General EDUARDO MARQUES.

NOLDE (BARONESA ISLE VON):

Mulher culta, esposa do agricultor e colono alemão Baron von NOLDE, proprietário da fazenda «Camacol», Quela, distrito de Malange. Coleccionou plantas, desde 1930, que remeteu para o Museu Botânico de Berlim. Duplicados dessa colecção encontram-se também no Museu Britânico em Londres e no Instituto Botânico de Coimbra.

O'DONNELL (HENRIQUE):

Director da Missão Geológica do Huambo (Nova Lisboa). Durante os anos de 1929-1933 fez colecções de algumas centenas de plantas no planalto de Benguela.

Estas plantas foram enviadas para o Instituto Botânico de Coimbra.

PACOCK (MISS M. A.)

Professora de Botânica na União Sul Africana. Em 1934 herborizou nos distritos de Cubango, Bié e Benguela.

A colecção principal perdeu-se na cidade do Cabo e os restantes especímes estão actualmente em Pretória. Outros exemplares, embora pouco numerosos, encontram-se em Berlim e no Museu Britânico de Londres.

PEARSON (H. H. W.):

Fundador do Jardim Botânico de Kirstenbosch, cidade do Cabo da Boa Esperança, onde se encontra sepultado desde 1916. Visitou Angola em 1908, coleccionando plantas no distrito da Huíla e Cuanza Norte. O itinerário dessa viagem está publicado na revista *Annals of the South African Museum*, volume IX, London, 1908-1909, e as suas colecções de plantas estão depositadas no Herbário dos Jardins Reais de Kew, Londres, assim como no Herbário «Harry Bolus» da Universidade da Cidade do Cabo da Boa Esperança.

PITTARD (MISS P.):

Esta Senhora coleccionou, nos anos de 1937-1938, algumas centenas de plantas nos arredores de Lobito e Ganda, assim como nas estações intermediárias da linha férrea de Benguela. Êste material está depositado no Museu Britânico de Londres.

POCOCH (M. A.):

Nas publicações recentes aparecem citações de plantas coleccionadas por êste naturalista no distrito de Cubango. Todo o material se encontra no herbário do Museu Botânico de Berlim.

POGGE (DR. PAUL):

Explorador e geógrafo de nacionalidade alemã. Viajou em Angola no século passado. Partiu de Malange em 1875 seguindo até Mona Quimbundo, próximo da Vila Henrique de Carvalho (Lunda). Aí permaneceu durante seis meses, regressando pelo mesmo caminho e atravessando o rio Cuango na altura onde hoje existe a ponte de alvenaria da estrada entre Nova Guia e Xa-Sengue, isto é, aproximadamente a 10° 30' lat. S.. Numa segunda viagem (1880-1884), foi acompanhado por H. WISSMANN. Seguiram pelo mesmo caminho até Mona Quimbundo e de lá dirigiram-se, pelas margens do rio Chicapa, na direcção norte, para o Congo Belga, onde se separaram. Na viagem de regresso por Angola, POGGE atravessou outra vez a terra do Muato Ianvo e veio a morrer em Luanda, em 17-III-1884, seis meses depois da sua chegada ao litoral.

O material botânico dêste viajante está depositado no Herbário do Museu Botânico de Berlim. O seu nome encontra-se ligado a muitas das suas descobertas incluindo duas plantas endémicas da Lunda, conhecidas como *Poggea* e *Poggeophyton*. Além do seu livro *No Reino do Muato*

Yanvo, Berlin, 1880, estão publicados diversos relatórios na revista *Mitt. Afrik. Ges.*, Berlim, dos anos 1880 até 1885.

POWELL COTTON (MISS A.):

Filha do Major Powell Cotton, caçador de feras e proprietário de um Museu de História Natural em Inglaterra, que fez uma viagem de estudos etnográficos pelo Baixo Cunene na companhia de sua irmã mais velha, Miss D. Powell Cotton. Coleccionou plantas nas terras dos Dongoenas, Cuamatos e Cuanhamas durante os anos de 1936 e 1937. Os filmes «Cine Kodack», sôbre os povos do Baixo Cunene, feitos por estas jovens Senhoras, foram muito apreciados em Londres.

SCHINZ (DR. HANS):

Director durante muitos anos do Jardim Botânico de Zurich. Desembarcou em 1883 em Mossâmedes e seguiu para Ovambolândia, atravessando nesta jornada a planície de Namib e as terras do Baixo Cunene. As avultadas colecções dêste intrépido explorador, que ainda vive, encontram-se nos Museus Botânicos de Berlim, Zurich e Kew.

SERPA PINTO (MAJOR):

Explorador português e autor do livro *Como eu atravessei a África*. Fez em 1880, no planalto de Benguela, pequenas colecções que se encontram arquivadas nos Herbários das Universidades de Lisboa e Coimbra.

SOYAUX (H.):

Da publicação *Die Vegetation Afrikas*, Berlim, 1908-1910, consta que SOYAUX era de nacionalidade alemã e que

residiu em Chinxocho (5.º 1' L. S.) Massabi, Território de Cabinda e mais tarde no Gabão. As suas colecções foram feitas no território português e no Maiombe Francês durante os anos de 1874-1876. Encontram-se nos Museus Botânicos de Berlim e Kew e contêm espécies típicas de Angola, como por exemplo *Celtis Soyauxii*, muito comum nas florestas do Cazengo e Amboim.

THEUSCH (TEUCZ):

Naturalista da expedição à bacia hidrográfica do Zaire e Cuango chefiada pelo Major Alexandre von Mechow. Desembarcaram em 1878 em Luanda, seguindo depois para o planalto de Malange, via Dondo e Pungo Andongo. A sua colecção de plantas de Angola, que contém algumas espécies típicas, encontra-se nos Museus Botânicos de Berlim e Kew, muitas vezes sob o título de Mechow e Teucz.

O relatório dessa expedição encontra-se publicado na *Verh. der Gesellsch. f. Erdkunde 1882*, S. 475. ff., Berlim, como título de *Aufklärung des Kuango-Stromes, 1878-81.*

WAWRA VON FERNSEE (DR. HENRI):

Naturalista austríaco muito viajado. Desembarcou em Benguela em 1857 e ali coleccionou algumas centenas de plantas que foram publicadas em *Sertum Benguelense*, Viena de Áustria, Academia das Ciências, XXVIII (1859).

WELLMAN (DR. F. CREIGHTON):

Médico canadiano ao serviço das Missões Americanas do planalto de Benguela. Foi para Angola em 1902. Em 1906 mandou, desprovidos de números, 80 especímenes de plantas colhidos no Bailundo, para o Herbário dos Jardins Reais de Kew. Uma segunda remessa, também coleccionada no planalto de Benguela, contendo os números

1765 a 1820 e as anotações de 15°, 5' L. S., 12° 44' L. S. e alt. 1360, foi recebida pelo mesmo Herbário de Kew. Os restantes números estão, segundo parece, no Herbário do Museu Botânico de Berlim.

WELWITSCH (DR. FREDERICH):

Médico e naturalista austríaco, ao serviço do Govêrno Português na Colónia de Angola durante os anos de 1853 a 1861. Foi o principal investigador da flora de Angola. As suas colecções botânicas contêm plantas dos distritos de Luanda, Cuanza Norte, Malange, Benguela, Mossâmedes e Huíla e encontram-se depositadas nos Herbários de Lisboa e Museu Britânico. Por disposição testamentária do DR. WELWITSCH, executada pela Academia de Ciências de Lisboa, foram entregues duplicados de plantas dêste explorador aos Herbários de Berlim, Coimbra, Kew, Paris, S. Petersburgo (Leningrado) e Viena. Êste material botânico encontra-se estudado e foi publicado desde 1896 pelo Museu Britânico de Londres numa obra em 2 volumes. Uma biografia com o título *O Dr. Frederich Welwitsch e a sua obra*, escrita pelo Prof. José de Almeida, apareceu, em partes, no *Boletim da Agência Geral das Colónias*, desde o número do mês de Julho de 1926.

YOUNG (R. G. N.):

Naturalista inglês formado em artes e ciências pela Universidade de Johannesburg, Transvaal. Depois de ter feito explorações botânicas nas áreas de Dilolo e Catanga, no Congo Belga, entrou em Angola, em 1932, acompanhado de sua mulher, pela Vila Teixeira de Sousa. No distrito da Lunda fez estações no Dundo, Henrique de Carvalho, Dala e Xa-Sengue; no distrito de Moxico em Vila Luso. Mais tarde seguiu para Malange e Luanda. Todo o material coleccionado durante esta longa viagem, desde a Rodésia do Norte até Luanda, está na posse do Museu Britânico de Londres.


LEGENDA
BAUM, 1901
BUCHNER, 1878-1880
BÜTTNER, 1884-1886
CAPELO e IVENS, 1881-1886
CARRISSO e MENDONÇA, 1927
CARRISSO (MISSÃO BOT.), 1937
CARRISSO e SOUSA, 1937
GOSSWEILER, 1905-1937
MARQUES, 1884-1888
MECHOW e TEUCZ, 1878
MONTEIRO, 1872
PEARSON, 1908
POGGE, 1875
SCHINZ, 1885
SERPA PINTO, 1880
WELWITSCH, 1853-1861
YOUNG, 1932-1933
RIO ZAIRE
S.to ANT.o do ZAIRE
S. SALVADOR DO CONGO
MAQUELA DO ZOMBO
SACANDICA
CUANGO
DAMBA
AMBRIZETE
BEMBE
AMBRIZ
UIGE
NEGAGE
CAMABATELA
LUANDA
QUIBAXE
CATETE
GOLUNGO ALTO
VILA SALASAR
DUQUE BRAGANÇA
MALANGE
PUNGO ADUNGO
DONDO
CALULO
MUSSENDE
QUIRIMA
Pto AMBOIM
GABELA
QUIBALA
NOVO REDONDO
Va. Nova DE SELES
BIMBE
AURORA
TEIXEIRA DE SILVA
QUIPEIO
BIÉ
LOBITO
BENGUELA
NOVA LISBOA
CACONDA
HANHA
Sta. MARTA
CHAPEU ARMADO
SÁ DA BANDEIRA
HUMPATA
HUÍLA
MOSSAMEDES
Pto ALEXANDRE
Bª dos TIGRES
GAINDE
Chibemba (GAMBOS)
HUMBE
CUANHAMA
Vª PEREIRA de EÇA
DONGOENA
CUNENE
Va. DA PONTE
SERPA PINTO
CUITO CUANAVALE
CUANGAR
CUBANGO
DIRICO
LIALUI
MUATA YANVUO
NORDESTE
(SAURIMO)
HENRIQUE DE CARVALHO
MONA QUIMBUDO
Vª TEIXEIRA DE SOUZA
DALA
CASSAI
VILA LUZO
CACHIPOQUE
MUNHANGO
CUEMBA
Rio LUENA
Rio ZAMBEZE
Rio LUNGUE BUNGO
Rio LUANGINGA
CUANDO
CABINDA
LANDANA
MAIOMBE
BELIZE
BUCO ZAU
BOMA
VISTA
CAPELLO e IVENS 1884
SERPA PINTO 1880
POGGE e WISSMANN 1880-1884
MECHOW e TEUCZ 1878
SCHINZ 1885
BAUM 1901
GOSSWEILER 1907
YOUNG 1932
MARQUES BISENHANGO 1882
BUCHNER 1880
M.B.L.W. CARRISSO 1937
CARRISSO e SOUZA 1937
PEARSON 1908

CONTRIBUÏÇÕES PARA O CONHECIMENTO DA FLORA DE ÁFRICA

I

NOVAS ESPÉCIES DA FLORA DE ANGOLA

por

A. W. EXELL E F. A. MENDONÇA

Por motivos de ordem técnica do estudo da Flora de Angola, que temos entre mãos, não pudemos preparar mais extensa contribuïção para o *In Memorium* do malogrado Prof. Dr. L. W. CARRISSO, a-pesar-de termos averiguadas numerosas espécies novas das famílias *Tiliaceae-Ampelidaceae*, dos materiais da Missão Botânica a Angola, de 1937. Membros desta frutuosa Missão, prestamos à memória do intrépido Chefe e querido amigo a rendida homenagem da nossa admiração pelo Homem Bom e pelo sábio que tombou no seu pôsto de trabalho por amor à ciência e à sua Pátria.

Polygala Carrissoana EXELL & MENDONÇA, sp. nov. (Polygalaceae)

Herba perennis prostrato-arcuato-adscendens, caulibus juventute fulvo-pilosis tandem pilosulis. *Folia* petiolata, petiolo 3-10 mm. longo fulvo-piloso, lamina suborbiculare ovata elliptica ovato-elliptica vel ovato-lanceolata apice rotundata obtusa vel acuta basi paullo inaequilaterale in petiolum unilateraliter decurrente, 10-55 × 8-30 mm., supra subtusque sparse appresse setuloso-pilosa. *Flores* in racemos pseudo-terminales bracteatos, bractea lanceolato-apiculata 2.5-3 mm. longa margine ciliolata, dispositi. *Sepala* caduca carinata, 2.5-3 mm. longa, posteriora acuta anteriora fere ad apicem connata. *Alae* caducae obovato-oblongae, 5 × 2 mm., margine rubrae. *Petala* superiora oblonga 2 mm. longa, carina 3.5 mm. longa cristata, crista

lobata. *Capsula* nuda quadrangula apice emarginata basi leviter rotundata vel subcordata, 3×3 mm., juventute minute pubescens, seminibus subpyriformibus, 2.5-3×1.3 mm., albo-sericeis, arillo parvo appendicibus duobus parvis instructo.

LUNDA: próx. de Vila Henrique de Carvalho, alt. c. 1100 m., fl. e fr., 22. IV. 1937, *Exell & Mendonça* 983 (BM, tipo; Coi; Lis. JC) (1).

Esta espécie pertence à Sect. *Chamaebuxus* e é próxima de *P. Cabrae* Chod., da qual difere pelas inflorescências mais longas, pedicelos mais curtos, fôlhas menores e mais espessas e pelo indumento rígido e fulvo. A espécie encontra-se também no Congo Belga (*Vanderyst* 5446, no herbário de Bruxelas).

Sedopsis Carrissoana EXELL & MENDONÇA, sp. nov. (Portulacaceae).

Herba annua prostrata radicans, ramulis ad nodos lanuginosis ceteroque glabris. *Folia* caulina carnosa elliptica supra plana subtus convexa, 2.5-3.5×1-2 mm., glabra, involucralia subtrigona. *Flores* rosei terminales in cymas plurifloras dispositi. *Sepala* scariosa erecta ovata basi truncata, 2.5×2 mm., glabra. *Petala* 3 mm. longa apice rotundata glabra in tubum 1.5 mm. altum connata. *Stamina* 4, filamentis 0.9 mm. longis ad corollae tubum basin versus insertis, antheris 0.7 mm. longis basi divaricatis. *Ovarium* ovato-oblongum glabrum, stylo quadrifido, stigmatibus breviter plumosis, ovulis numerosis. *Capsula* basin versus circumcisa, operculo conico. *Semina* numerosa subreniformia brunnea, tuberculis parvis cinereis in lineas concentricas ornata.

HUILA: rio Cunene, Ruacaná, alt. c. 1000 m., nas fendas das rochas, fl. e fr., 8.VI.1937, *Exell & Mendonça* 2716 (BM, tipo; Coi; K; Lis. JC; Lis. U).

(1) As abreviaturas são as empregadas no *Conspectus Florae Angolensis*.

Esta espécie difere das anteriormente descritas de Pungo Andongo (*S. sedoides* (Welw.) Exell & Mendonça e *S. saxifragoides* (Welw.) Exell & Mendonça) pelo estilete quadrifido, em cujo caracter precisa ser modificada a diagnose do género, mas concorda pela coalescência das pétalas até metade do comprimento e a presença de apenas quatro estames. A afinidade com *S. saxifragoides* é muito estreita. *Portulaca hereroensis* Schinz pertence também a esta afinidade e deve ser transferida para o género *Sedopsis* (1). Esta última espécie difere de *S. Carrissoana* pelas fôlhas maiores tôdas trigonais, pela corola branca de pétalas coalescentes até cêrca de dois terços, filetes 1.5 mm. longos e anteras maiores não divaricadas na base. (Êstes pormenores provêm do espécime *Dinter* 7076 (BM) classificado como *Portulaca hereroensis* Schinz pelo próprio Dinter).

Ceraria Carrissoana EXELL & MENDONÇA, sp. nov. (Portulacaceae).

Suffrutex, frutex vel *arbor* parva ad 2-3 m. alta, ramis in sicco carnosulis rugosis cinereis glabris, ramulis ultimis c. 1.5 mm. crassis nodibus subdecussatis. *Folia* e ramis abbreviatis orta geminata petiolata, petiolo 4-5 mm. longo, lamina in vivo crassa obovata vel suborbiculare vel elliptica basi cuneata, 1-3.5 × 1-1.8 cm., omnino glabra. *Flores* bisexuales (vel nonnunquam dioici?) ad nodos 2-6-fasciculati pedicellati, pedicellis gracilibus 1.5-3 mm. longis glabris, bracteis ovato-acuminatis minutis. *Sepala* 2 obverse semi-elliptica medio costata, 2-3 × 1 mm., persistentia glabra. *Stamina* 5, filamentis 2 mm. longis glabris, antheris 1 mm. longis glabris versatilibus, thecis basin versus paullo divergentibus. *Ovarium* ellipsoideum applanatum, 1.8 × 0.6-0.8 mm., glabrum, stylo nullo, stigmatibus 2. *Fructus* juvenilis ellipticus applanatus corolla accrescente vestitus.

MOSSÂMEDES: Montemor, Km. 74 do Caminho de Ferro de Mossâmedes, alt. c. 500 m., fr. jov., 20.V.1937, *Exell*

(1) ***Sedopsis hereroensis*** (SCHINZ) EXELL & MENDONÇA, comb. nov. *Portulaca hereroensis* Schinz in Mém. Herb. Boiss. 20:18 (1900).

& Mendonça 2107 (BM; Coi; Lis. JC); Km. 70 do Caminho de Ferro de Mossâmedes, alt. 350-450 m. fl. e fr. jov., 19.V.1937, *Exell & Mendonça* 2171 (BM, tipo; Coi; Lis. JC); Chipeia, alt. 350 m., *Gossweiler* 10840 (Coi); Serra da Lua, alt. 500 m., *Gossweiler* 10864 (BM; Coi).

A descoberta desta espécie no Distrito de Mossâmedes alarga muito a área conhecida da distribuïção do género *Ceraria* que é registado pela primeira vez para a Africa tropical. As espécies já descritas provêm tôdas da parte extra-tropical de Africa austro-ocidental.

C. Carrissoana é muito semelhante a *C. fruticulosa* Pearson & Stephens, da qual difere pela estatura, dimensões das fôlhas, forma das brácteas, dos nós floríferos, e flores em regra bisexuais. Êste último caracter não está em conformidade com a diagnose de Pearson e Stephens. Êstes autores separam o seu género *Ceraria* de *Portulacaria* pelas características seguintes — «*Ceraria* differs from *Portulacaria* in being dioecious and in having a slightly flattened ovary and a fruit which is at first 1-winged and later (nearly ripe fruit seen only in *C. fruticulosa)* fleshy and wingless; the fruit of *Portulacaria* is 3-winged and dry» (H. H. W. Pearson and E. L. Stephens in Ann. S. Afr. Mus. IX: 32, 1912).

O exame das flores da nossa espécie mostra maioria de flores que parecem verdadeiramente bisexuais (algumas parecem ter estames abortivos). Ainda que o caracter *flores dioicas* se revele agora não ser uma diferença constante entre *Ceraria* e *Portulacaria* não hesitamos em manter o primeiro género que parece bem distinto pelos outros caracteres inumerados por Pearson e Stephens. Infelizmente, o nosso material não tem frutos maduros mas o hábito da planta mostra estreita afinidade com *Ceraria fruticulosa* e não temos dúvida que a espécie angolana pertence a êste género.

Melhania Carrissoi EXELL & MENDONÇA, sp. nov. (Sterculiaceae).

Arbuscula 1 m. alta, ramulis primo stellato-tomentosis demum glabrescentibus. *Folia* petiolata, petiolo stellato-

-tomentoso ad 0.5-2.5 cm. longo, lamina ovata apice rotundata margine serrata basi cordata 5-nervia, 2-7 × 1.5-5 cm., omnino stellato-tomentosa vel dense stellato-pubescenti, stipulis filiformibus 3-6 mm. longis stellato-pubescentibus. *Flores* in cymas axillares 1-4-floras dispositi, pedunculo stellato-tomentoso ad 3 cm. longo, pedicellis stellato-tomentosis ad 1.5 cm. longis, bracteolis ovatis apice acuminatis acutis basi cordatis accrescentibus, 10-15 × 4-9 mm., stellato-tomentosis vel dense stellato-pubescentibus. *Sepala* anguste lanceolata acuta dorso unicostata, 13-16 × 2.5-3.5 mm., dense stellato-pubescentia. *Petala* obovata, 15-20 × × 12-15 mm., glabra. *Stamina* 5, antheris oblongis 3.5 mm. longis, filamentis 1 mm. longis basi cum staminodiis spathulatis 6 mm. longis glabris in tubum 1.5 mm. altum connatis. *Ovarium* ovoideo-subglobosum, 3 × 2.7 mm., dense stellato-pubescens, loculis 5-ovulatis, stylo 3.5 mm. longo glabro, stigmatibus 1.5 mm. longis. *Capsula* subglobosa, c. 7 mm. in diam., dense stellato-pubescens, seminibus convexo-trigonis 2 mm. longis.

MOSSÂMEDES: Pedras Salvadoras, fl. e fr., 13.VI.1937, *Carrisso & Sousa* 348, (BM, tipo; Coi; Lis. JC); Morros das «Paralelas», 14.VI.1937, *Carrisso & Sousa* 354 (BM; Coi; Lis. JC); Montemor, Km. 74 do Caminho de Ferro de Mossâmedes, alt. c. 500 m., fl. e fr., 19.V.1937, *Exell & Mendonça* 2192 (BM; Coi).

«Subarbusto até 1 m. com flores brancas ou amarelas do mato xerófilo espinhoso e do deserto».

Esta espécie pertence ao Subgen. *Eumelhania* K. Schum.

Dombeya Antunesii EXELL & MENDONÇA sp. nov.

Arbor vel *arbuscula* 3-8 m. alta, ramulis primo stellato-hirsutis demum glabrescentibus. *Folia* longe petiolata, petiolo usque 10 cm. longo, primo dense stellato-hirsuto demum glabrescenti, basi stipulato, stipulis lanceolatis 14 × 4 mm., lamina ovata apicem versus leviter trilobata apice acuta basi profunde cordata 7-9 nervia, 11-23 × 10-16

cm., supra primo densissime demum sparsiore stellato--pilosa. *Flores* pedicellati, pedicello 1.5-2 cm. longo stellato--piloso, in pseudo-umbellas multifloras longe pedunculatas, pedunculo 7 cm. longo stellato-piloso, dispositi. *Sepala* anguste lanceolata acuta, 10×3-3.5 mm., extus stellato--pilosa. *Petala* late obovata, 12×10 mm., glabra. *Ovarium* 5-loculare, loculis 4-5-ovulatis intus glabris, stylo 4.5 mm. longo glabro, stigmatibus 5 recurvis.

HUILA: Huila, fl. V, *Antunes* A 58 (BD, tipo); Serra da Chela e próx. de Mumpula, fl. VI, *Welwitsch* 4731 (BM; Lis. U).

O espécime de Welwitsch foi citado por Hiern (Cat. Afr. Pl. Welw. I:87, 1896) sob *Assonia Burgessiae* var. *crenulata* (Szyszyl.) Hiern. *Dombeya Antunesii* difere da *D. Burgessiae* pelas flores menores, inflorescências mais distintamente pseudo-umbeladas, pedúnculos mais curtos, pedicelos gráceis e lobos laterais das fôlhas infletidos para o ápice. As flores no espécime típico são adiantadas demais para descrever o androceu.

A espécie pertence à Sect. *Eudombeya* K. Schum. e é da afinidade de *D. Burgessiae* Gerr.

Hermannia Johnstonii EXELL & MENDONÇA, sp. nov.

Herba perennis, caulibus verisimiliter prostratis stellato-pubescentibus vel stellato-tomentellis et glanduloso-pilosulis. *Folia* petiolata, petiolo stellato-tomentello 3-6 mm. longo, stipulis ovatis margine denticulatis 3-5 mm. longis, lamina ovata vel ovato-lanceolata apice acuta margine dentata basi cordata, 15-35×8-22 mm., supra subtusque stellato-pilosula, nervis supra leviter insculptis subtus prominulis. *Flores* geminati, pedunculo 10-15 mm. longo, glanduloso-pubescenti, bracteolis ovato-lanceolatis 3-4 mm. longis basi connatis, pedicellis 6-15 mm. longis glanduloso-pubescentibus. *Sepala* lanceolata acuta, 7×2 mm., fere ad medium connata, glanduloso-pubescentia. *Petala* sepala superantia obovato-spathulata, 8×3 mm., basin

versus margine stellato-puberula. *Stamina* sepalis aequantibus, antheris 4 mm. longis glabris, filamentis 4 mm. longis apicem versus linearibus, basin versus oblongis, 0.3 mm. latis, ad medium callosis et dense stellato-pilosulis. *Ovarium* obovoideum pentagonum 3×2.5 mm., stellato-tomentellum, ovulis c. 14 pro loculo, stylis 5 cohaerentibus 4 mm. longis basin versus pilosulis.

HUILA: Humpata, *Johnston* s. n. (K, tipo).

Esta espécie pertence ao Subgen. *Mahernia* (L.) K. Schum., Ser. *Dentatae* Harv. Parece próxima de *H. depressa* N. E. Br. da qual difere pelas fôlhas mais ou menos densamente estrelado-pilosulas, e de *H. adenotricha* K. Schum. da qual difere pelas fôlhas cordiformes na base.

Hermannia Pearsonii EXELL & MENDONÇA, sp. nov.

Herba verisimiliter perennis, ramulis prostratis sparse pilosis et dense glanduloso-pubescentibus vel glanduloso-pilosulis. *Folia* petiolata, petiolo glanduloso-pubescenti, 3-8 mm, longo, stipulis 2-3 mm. longis sparse pilosis et dense glanduloso-pubescentibus, lamina lineari-oblonga vel lineari-elliptica apice acuta margine serrulata basi cuneata, 10-35×2-6 mm., supra subtusque stellato-pubescenti, costa media nerviisque supra insculptis subtus prominulis. *Flores* solitarii axillares, pedunculo ad 15 mm. longo glanduloso-pubescenti apice bibracteolato, bracteolis filiformibus 2.5 mm. longis, pedicello 3-4 mm. longo. *Sepala* lanceolata acuta 7.5-8.5 mm. longa dense pilosula basi in calycem 1.5 mm. altum connata. *Petala* quam sepala multo breviora, 3.5-4×2 mm., glabra. *Stamina* quam sepala paullo breviora, antheris 5.5 mm. longis ciliolatis, filamentis late cuneatis, 2×2 mm., margine ciliolatis. *Ovarium* obovoideum pentagonum, 2.5×1.8 mm., loculis c. 9-ovulatis, stylis 5 cohaerentibus 4 mm. longis, ciliolatis. *Capsula* apice breviter quinquecornuta.

HUILA: entre Chibemba e Cahama, *Pearson* 2404 (K,

tipo); prox. de Camacunde, Vila Pereira de Eça, *A. Powell--Cotton* 1186 (BM).

«Branches prostrate; among grasses in open places» (Pearson).

Esta espécie pertence ao Subgen. *Acicarpus* Harv. e difere de *H. viscosa* Hiern pelas pétalas menores e pecíolos mais curtos. *H. boraginiflora* Hook. é também muito próxima, mas tem pétalas muito maiores quási igualando o comprimento das sépalas.

Leptonychia Youngii EXELL & MENDONÇA, sp. nov.

Arbor vel *arbuscula*, ramulis gracilibus juventute sparse stellato-puberulis mox glabrescentibus nitidulis. *Folia* petiolata, petiolo 4-6 mm. longo sparse stellato-puberulo, glabrescenti, lamina oblanceolata longe acuminata basin versus cuneata basi subrotundata trinervia, 6-15×1.5-4.5 cm., supra glabra subtus sparsissime stellato-puberula et vix distincte minute lepidota, costis lateralibus 5-7-paris. *Flores* in cymas breves axillares 1-4-floras plerumque 2-5-fasciculatas, pedunculo 1-4 mm. longo minute stellato--puberulo, bracteolis ovatis 0.6 mm. longis, pedicellis 1-4.5 mm. longis minute stellato-puberulis. *Sepala* oblonga, 6-6.5×1.7-1.9 mm., extus dense minute stellato-puberula. *Petala* suborbicularia margine cohaerentia, 1.3×1.2 mm., dense pubescentia. *Stamina* fertilia 10, antheris 1 mm. longis, filamentis 3-3.5 mm. longis basi cum staminodiis in tubum 1 mm. altum connatis, staminodiis brevibus cum petalis alternantibus 1 mm. longis, longioribus cum staminibus fertilibus in phalanges connatis et filamentis staminium fertilium aequilongis. *Ovarium* subglobosum, 1.5× ×1.5 mm., dense stellato-pubescens, stylo 4.5 mm. longo basin versus ciliato. *Fructus* ignotus.

LUNDA: Dundo, rio Luachimo, *Young* 546 (BM, tipo).

Esta espécie é muito semelhante a *L. Mildbraedii* Engl. mas difere pelas sépalas mais curtas (8 mm. de comprimento em *L. Mildbraedii)*, filetes e estilete mais longos.

Cola Noldeae EXELL, sp. nov.

Arbor, ramulis stellato-pubescentibus. *Folia* spiraliter ordinata petiolata, petiolo 1-3.5 cm. longo stellato-puberulo apice incrassato, lamina integra subcoriacea elliptica apice acuminata basi cuneata omnino fere glabra, 10-14×3.5-5 cm., costa media supra prominula subtus prominente, costis lateralibus 6-8-paris, stipulis 5 mm. longis valde caducis. *Flores* ♂ breviter pedunculati, pedunculo 2-3 mm. longo, in axillis foliorum (et foliorum delapsorum) dense fasciculati. *Calyx* breviter campanulatus 5 mm. longus extus dense fusco-velutinus intus ad loborum apices stellato-puberulus, lobis lanceolatis 2.5-3 mm. longis. *Anthera* 10, uniserialia, c. 5 mm. longa, androphoro 2.5-3 mm. longo glabro. *Flores* ♀ et *fructi* ignoti.

MALANGE: Quela, floresta higrófila, fl. X-XI, *I. Nolde* 332 (BD, tipo).

Esta espécie pertence ao Subgen. *Haplocola* K. Schum. e parece ser próxima de *C. yambuyaensis* De Wild. (ex descr.), mas difere dela pelas flores menores e anteras muito mais curtas.

Grewia myriantha EXELL & MENDONÇA, sp. nov. (Tiliceae)

Frutex scandens 4 m. altus, ramulis primo stellato-tomentellis glabrescentibus, folia petiolata, petiolo 4-7 mm. longo stellato-tomentello, stipulis linearibus 2-2.5 mm. longis, lamina obovato-elliptica vel obovato-oblonga vel elliptica vel elliptico-oblonga apice abrupte acuminata acumine obtuso margine integra basi subrotundata vel obtusa, 3-11×1.5-5 cm., supra juventute ad nervos stellato-puberula mox glabrescenti ceteroque glabra subtus stellato-puberula. *Flores* parvi aurantiaco-rubri in paniculas multifloras terminales et axillares dispositi, pedicellis 3-6 mm. longis stellato-tomentellis. *Sepala* obovato-oblonga cymbiformia 4-5×2.5 mm. omnino minute velutina. *Petala* ovato-acuminata 2×1 mm. basi glandulosa, glandula margine pube-

rula. *Androgynophorium* 1 mm. longum minute puberulum. *Stamina* 2.5-3.5 mm. longa. *Ovarium* dense stellato--tomentosum, stylo 2 mm. longo glabro stigmatibus erectis.

CABINDA: Maiombe, Pango Munga, fl. I, *Gossweiler* 6186 (BM); Maiombe Belize, fl. III, *Gossweiler* 7014 (BM, tipo).

Esta espécie pertence à Sect. *Microcos* (L.) Wight & Arn., Subsect. *Integristipulae* Burret. Aproxima-se de *Grewia Seretii* De Wild., da qual difere pelas fôlhas mais abruptamente acuminadas, não pilosas, apenas tomentelas sôbre as nervuras da página inferior, e pelo ovário densamente tomentoso (glabro em *G. Seretii*).

Grewia benguellensis EXELL & MENDONÇA, sp. nov.

Frutex 1.5 m. altus, ramulis primo stellato-tomentosis mox glabrescentibus. *Folia* petiolata, petiolo 2-4 mm. longo stellato-pubescente, stipulis anguste lanceolatis 3.5-4 mm. longis, lamina elliptica apice rotundata margine minute serrata basi plerumque paullo cordata, 0.7-2.3×0.4-1.9 cm., supra praecipue ad nervos stellato-puberula glabrescenti subtus stellato puberula et ad nervos stellato-pilosula demum glabrescenti. *Flores* oppositifolii plerumque solitarii, pedunculo gracile 2-7 mm. longo stellato-pubescenti, pedicelo simili. *Sepala* 7×1.3 mm. *Petala* linearia, 3×0.4 mm., basi glandulifera, glandula margine ciliata. *Androgynophorium* 0.5-1.3 mm. longus glabrum. *Stamina* 3-3.5 mm. longa. *Fructus* normaliter inciso-4-lobatus, pyrenis 4.5-5 mm. diam. sparse pilosulis.

BENGUELA: Lengue, alt. 50 m., fl. e fr., 16. XII. 1932, *Gossweiler* 9708 (BD; BM, tipo; Coi; Lis. JC).

Esta espécie pertence à Sect. *Oppositiflorae* Burret, Subsect. *Ellipticipetalae* Burret e aproxima-se de *G. tenax* (Forsk.) Fiori. Êste último epíteto, no senso lato em que

usualmente é empregado, constitui uma espécie muito polimorfa. *G. benguellensis* difere nìtidamente de *G. tenax* típica pelas fôlhas elípticas pequenas miudamente serradas. As flores são quási sempre solitárias, mas há indícios de existirem alguns pedúnculos plurifloros.

Grewia mossamedensis EXELL & MENDONÇA, sp. nov.

Frutex 1-2 m. altus, ramulis primo stellato-pubescentibus vel stellato-tomentosis demum glabrescentibus. *Folia* petiolata, petiolo 2-10 mm. longo primo stellato-tomentoso demum glabrescente stipulata, stipulis linearibus 3-5 mm. longis, lamina ovata vel ovato-elliptica vel late elliptica vel suborbicularia pice acuta vel obtusa vel leviter acuminata vel nonnunquam subrotundata margine serrato-dentata, basi plerumque rotundata nonnunquam cuneata, 1-3.7 × × 0.6-2.4 cm., supra subtusque stellato-pubescenti demum glabrescenti. *Flores* albidi solitarii oppositifolii, pedunculo 4-6 mm. longo primo dense stellato-pubescenti demum glabrescenti, pedicello 5-6 mm. longo simili. *Sepala* 12 × 2 mm. *Petala* anguste elliptica, 8-9 × 2.5-3 mm., basi glandulifera glandula margine ciliata. *Androgynophorium* 1 mm. longum glabrum. *Fructus* normaliter inciso-4-lobatus, 4-pyrenus, pyrenis usque 7 mm. diam. sparse pilosulis aurantiacus.

MOSSÂMEDES: rio Mucungo, arbusto de 1 m., frutos maduros aurancíacos, fr., 27. V. 1937, *Exell & Mendonça* 2269 (BM, tipo; Coi; Lis. JC).

HUILA: Vila Pereira de Eça, arbusto muito ramificado, fr., 12. VI. 1937, *Exell & Mendonça* 2829 (BM; Coi; Lis. JC).

Esta espécie pertence à Sect. *Oppositiflorae* Burret, Subsect. *Ellipticipetalae* Burret, e, de harmonia com a sua classificação dêste género, aproxima-se de *G. tenax* (Forsk.) Fiori, da qual difere pelas fôlhas mais espessas, serrado-dentadas (não crenadas), sempre mais compridas que

largas, nunca cordiformes na base, e pelos pedúnculos mais espessos.

O espécime *Welwitsch* 1378, do Bumbo, distrito de Mossâmedes, pertence aqui.

Grewia Carrissoi EXELL & MENDONÇA, sp. nov.

Frutex, ramulis primo dense stellato-pubescentibus demum glabrescentibus. *Folia* petiolata, petiolo 4-5 mm. longo stellato-pubescenti, stipulis lineari-lanceolatis 4-4.5 mm. longis, lamina ovata vel ovato-elliptica apice acutiuscula vel obtusa nonnunquam leviter acuminata, margine minute serrata base paullo cordata, 1.3-3.6×0.8-2.1 cm., supra stellato-puberula glabrescenti subtus stellato-pubescenti et ad nervos stellato-pilosula. *Flores* oppositifolii plerumque in triades nonnunquam solitarii, pedunculo gracile 5-13 mm. longo stellato-puberulo glabrescenti, pedicellis similibus apice incrassato 4-7 mm. longis. *Sepala* stellato-tomentella 6 mm. longa. *Petala* linearia, 6-7×1 mm., fere glabra basi glandulifera, glandula margine ciliata. *Androgynophorium* 0.5-1 mm. longum glabrum. *Fructus* normaliter inciso-4-lobatus, 4-pyrenus, pyrenis usque 5.5 mm. diam. sparse pilosulis.

MOSSAMEDES: Morro Preto, *Carrisso & Sousa* 211 (BM, tipo; Coi; Lis. JC).

Esta espécie é muito próxima da anterior da qual difere pelas flores em tríades, frutos menores, pedúnculos menos espessos e margens das fôlhas miudamente serradas. É também muito próxima de *G. rupestris* Dinter & Schinz da qual difere pelos pedúnculos mais gráceis e flores distintamente menores.

Grewia argentea EXELL & MENDONÇA, sp. nov.

Suffrutex 0.5 m. altus, ramulis primo dense stellato-pubescentibus demum glabrescentibus. *Folia* petiolata, pe-

tiolo 3-7 mm. longo stellato-tomentello, stipulis deciduis, lamina lanceolata vel elliptico-lanceolata vel auguste elliptica apice acuta margine serrata basi rotundata, 4-13×1-5.2 cm., supra scabriuscula sub-bullata sparse stellato-puberula subtus densissime albo-velutina et ad nervos sparse brunneo-stellato-puberula. *Flores* (delapsi) 1-4-umbellati oppositifolii vel extra-axillares, pedunculo usque 3 mm. demum incrassato glabrescenti, pedicellis similibus 6-10 mm. longis. *Fructus* normaliter subinciso-4-lobatus, 4-pyrenus, pyrenis 6-8 mm. diam. verruculosis sparse stellato-puberulis.

MOSSAMEDES: colinas da base da Serra da Chela, próx. de Humbia, sub-arbusto de 0.5 m., fr. V, *Exell & Mendonça* 2066 (BM, tipo; Coi; Lis. JC).

Esta espécie parece distintíssima pelas fôlhas grandes lanceoladas com indumento velutino pulcro argenteo na página inferior. Pelo aspecto geral da planta e forma do fruto, parece aproximar-se de *Grewia suffruticosa* K. Schum. (Sect. *Glomeratae* Burret) mas difere nìtidamente pelo indumento mais fino, fôlhas lanceoladas e pecíolos mais curtos.

Grewia cerocarpa EXELL & MENDONÇA, sp. nov.

Frutex ad 3 m. altus, nonnunquam subscandens, ramulis tomentellis et stellato-puberulis demum glabrescentibus. *Folia* petiolata, petiolo 7-11 mm. longo tomentello et stellato-puberulo, stipulis deciduis, lamina suborbiculare vel ovata apice breviter acuminata acuta vel obtusa, margine duplicato-serrata, basi plerumque cordata nonnunquam rotundata, 3.5-9.5×2.5-7.3 cm., omnino stellato-pubescenti. *Flores* (delapsi) plerumque oppositifolii 2-4-umbellati, pedunculo 2-6 mm. longo, demum incrassato pubescenti, pedicellis similibus 5-8 mm. longis. *Fructus* normaliter inciso-4-lobatus, 4-pyrenus, pyrenis 5-8 mm. diam. sparsissime stellato-pilosulis vel glabris epicarpio verisimiliter cerífero.

MOSSAMEDES: Vila Arriaga, alt. c. 900 m., arbusto subscandente de 3 m., fr. VI, *Exell & Mendonça* 2922 (BM tipo; Coi; Lis. JC).

Na ausência de flores, é difícil definir a afinidade desta espécie. As folhas fazem lembrar as de *G. villosa* Willd., mas as inflorescências parecem opostas às folhas e não aglomeradas.

Grewia Hierniana EXELL & MENDONÇA, sp. nov.

[*Grewia megalocarpa* (non Beauv.). — Mast. in Oliv., Fl. Trop. Afr. I: 245 (1868) pro parte quoad spec. angol.— Hiern, Cat. Afr. Pl. Welw. I: 94 (1896) pro parte quoad spec. Welw. 1374].

Grewia Newtonii Burret in Engl., Bot. Jahrb. XLV: 189 (1910) pro parte quad spec. Welw.— Exell in Journ. of Bot. LXV, Suppl. Polypet.: 45 (1927).

Frutex 1-2.5 m. altus, ramulis primo tomentosis mox stellato-pubescentibus demum glabrescentibus. *Folia* petiolata, petiolo 2-3 mm. longo primo tomentoso, lamina elliptica vel obovato-elliptica vel ovato-elliptica apice acuta nonnunquam paullo acuminata margine serrulata basi oblique rotundata trinervia, 1.5-5.5 × 0.7-3 cm., supra sparse stellato-puberula vel glabra subtus nonnunquam primo densiuscule stellato-pubescenti demum ad nervos sparse stellato-puberula, nervis secondariis 3-5 paris. *Flores* albidi oppositifolii 2-3-umbellati, pedunculo 2-5 mm. longo primo tomentoso demum glabrescenti. *Sepala* 14-15 × 2-2.5 mm. stellato-tomentella. *Petala* anguste elliptica, 5 × 1.5 mm. apicem versus glabra basin versus intus glandulifera dense pubescentia. *Androgynophorium* supra nodum breviter elongatum c. 1 mm. longum glabrum. *Staminium filamenta* 7 mm. longa. *Ovarium* tomentosum, stylo 6 mm. longo glabro.

BIÉ: rio Cubango, Vila da Ponte, *Gossweiler* 2240 (BM); 2940 (Coi); 3894 (BM; Coi; K; Lis. JC).

HUILA: Huila, *Antunes* 228 (BM; Coi); rio Caculovar, prox. de Humbe, alt. c. 1100 m., *Exell & Mendonça* 2691 (BM; Coi; Lis. JC; Lis. U); Quihita, *Gossweiler* 10902 (BM; Coi); Morro de Lopolo, *Welwitsch* 1374 (BM, tipo; Coi; K; Lis. U).

Esta espécie pertence à Sect. *Oppositiflorae* Burret e é próxima de *G. Newtonii* Burret da qual difere pelas folhas quási glabras no tempo da frutificação.

II

TWO NEW SPECIES OF COPAIFERA FROM ANGOLA

by

MILDRED A. EXELL

THE first of these two species I have named in memory of the late DR. CARRISSO to whom I shall always feel indebted for his unfailing courtesy and kindness and particularly for inviting me to accompany his Mission to Angola with my husband. Not only was the invitation so warmly given, but he did much to make it possible for me to go. The journey through Angola was a thrilling and highly interesting one and I remember with gratitude the man who spared himself no effort in organising the Mission in every detail and who died so tragically while the expedition was still in Angola.

These two species of *Copaifera* are especially interesting because it is very probable that they produce at least some of the Copal gum which is still found in the sandy soil of the littoral region of Luanda and Benguela and which has been exported in considerable quantities during the past.

Dr. Welwitsch (Journ. Linn. Soc. Bot. IX, 287, 1867) gives a full account of his search for the source of this Copal gum. He was never able to observe it actually being produced in the coastal districts. It was always dug up from the ground by natives, sometimes from a considerable depth.

Several species of *Copaifera* from the higher inland regions and from the south of Angola may also produce Copal but none has ever been recorded from the coastal districts of Luanda or Benguela. Welwitsch considered that the species producing it must have become extinct.

Mr. Gossweiler, Dr. Mendonça and my husband (A. W. Exell) saw large numbers of the species here described as *C. Carrissoana* at Bemba, near Luanda, where it often forms pure consociations. Formerly it may well have covered a much greater area and together with the second species *(C. Gossweileri)* is probably the origin of this Copal. The nearest ally of these two species, *C. Demeusei* Harms, is an important producer of Copal in the Belgian Congo.

Copaifera Carrissoana M. A. EXELL sp. nov.

Frutex vel arbuscula ad 6 m. alta, caulibus leviter pubescentibus. *Folia* bifoliolata, petiolo puberulo 12-18 mm, longo, foliolis chartaceis, oblique ovatis vel oblongo-ovatis. breviter acuminatis, basi obliquis, glabris et supra nitidis, adultis plerumque 8-10 cm. longis nonnunquam longioribus, 3.5-5 cm. latis. *Inflorescentia* paniculata 12-15 cm, longa, ramulis alternatis, gracilibus, sparse pubescentia, multiflora, in foliorum axillis disposita. *Flores* pedicellati, pedicellis 1.5-2 mm. longis pubescentibus, bracteolis 2 mox caducis extus pubescentibus, concavis, suborbicularibus 2-3 mm. in diam., breviter apiculatis. *Sepala* 4 imbricata, glanduloso-punctata, omnino pubescentia, 2 majora ± ovata. 6-7 mm. longa, 4-5 mm. lata subacuta, 2 minora lineari--oblonga, ± 6 mm. longa, 2-3 mm. lata. *Petala* 0. *Stamina* 10, antheris dorsifixis 3.5 mm. longis. *Ovarium* subglabrum rotundato-ovatum, stylo ± applanato valde contorto 6-7 mm. longo, stigmate terminali; ovulis 2 lineari-oblongis, oblique affixis. *Legumen* ovale, basi aequilaterale, oblique apiculatum, marginatum, glabrum, reticulato-nervosum, planum, vix coriaceum, ± 30 mm. longum, 23-25 mm. latum, semine immaturo.

LUANDA: Bemba, *Exell & Mendonça* 29 (Typus in Herb. Mus. Brit.; Herb. Conimbr.).

This species is allied to *C. Demeusei* Harms, of which there is a good figure in Veg. der Erde IX, Pflanzenw. Afr. III, 1: 438, f. 242 (1915) and in Notizbl. Bot. Gart. Berlin-

-Dahlem V: 175 (1910) where Dr. Harms writes about *C. Demeusei* and other species as Copal-producing trees. The new species differs chiefly in its larger flowers, with distinct pedicels, and its thinner, more membranous pod, which is fairly centrally attached. The leaflets also are generally smaller. It is a shrub or small tree of the dry littoral region, whereas *C. Demeusei* is a large tree of the wet forests of the Congo, Cameroons and Upper Ubangi region.

Copaifera Gossweileri M. A. EXELL, sp. nov.

Frutex vel arbusculus 3-5 m. altus, cau'ibus glabrescentibus. *Folia* bifoliolata, petiolo pubescenti vel subglabro 10-12 mm. longo, foliolis chartaceis, obliquis, oblique ovatis vel oblongo-ovatis, breviter acuminatis, glabris, supra nitidulis, 4-6 cm. longis, 2-2.5 cm. latis. *Inflorescentia* paniculata multiflora, plerumque ± 10 cm. longa, ramulis alternatis, gracilibus, puberulis, in foliorum axillis disposita. *Flores* subsessiles, bracteolis mox caducis, suborbicularibus, ± 1.5 mm. in diam., pubescentibus. *Sepala* 4, valde imbricata, pubescentia, glanduloso-punctata, 4-5 mm. longa, 2 majora ovata 4-5 mm. lata, 2 minora angustiora, 2.5-3.5 mm. lata. *Petala* 0. *Stamina* 10, antheris 3 mm. longis. *Ovarium* ± glabrum, oblique rotundatum, stylo ± 3 mm. longo; ovulis 2. *Legumen* ovale, oblique affixum, oblique apiculatum, anguste marginatum, planum, glabrum, reticulato-nervosum, coriaceum, 2,5-3 cm. longum, ± 2 cm. latum, semine 1 plano majusculo repletum.

LUANDA: Musseque, Km. 32 on railway line from Colombo, near R. Cuanza, alt. 120-130 m., *Gossweiler* 10611 (typus in Herb. Mus. Brit.; Herb. Conimbr.) native name «Mutange»; *Gossweiler* 10611 b. (Herb. Conimbr.)

CUANZA NORTE: Cambambe, Dondo, waterfall on R. Cuanza, alt. 80 m. *Gossweiler* 9252 a (Herb. Mus. Brit.); Catete, near R. Bengo and Cuanza, alt. 60 m., *Gossweiler* 9238 (Herb. Mus. Brit.) «Mutonsche».

BENGUELA: Anha, N'tenda, R. Cuvaco, *Gossweiler*

1705 (Herb. Mus. Brit.); «Mutei-anjamba» — «small tree ± 3 m., trunk very slender.»

This species is an ally of *C. Demeusei* Harms and of the foregoing. It differs from both in being generally smaller in most parts. It is easily distinguished from *C. Carrissoana* by its smaller, sessile flowers, shorter style and thicker pod which is quite obliquely attached. The inflorescence seems to be more slender than that of *C. Demeusei* and while that species is a large tree of wet forest regions in the Congo and further north this is a shrub or small tree of the dry coastal lowlands.

III

AFRICAN DIPTEROCARPS: AN HISTORICAL AND TAXONOMIC SURVEY OF THE GENUS *MONOTES* A. DC.

by

HELEN BANCROFT

ABOUT the middle of last century, the Portuguese Government became especially interested in the natural resources of its African Colony, Angola; and DR. FRIEDRICH WELWITSCH was accordingly subsidised to carry out investigations in that area. Between 1853 and 1861, in the course of his travels, he collected a large number of plant specimens; certain of these have since proved to be of very great interest from the phytogeographical point of view, for they provided the first evidences of the occurrence in Africa of a group hitherto known only from Asiatic representatives: namely, the *Dipterocarpaceae*.

WELWITSCH's African Dipterocarps were found growing on dry sandy or stony ground in the neighbourhood of Huila (15° 3' S. by 13° 34' E.); on the basis of flower-structure, they were referred by him to the genus *Vatica* L., with the specific epithet *africana*, and two varieties were recognised: α *denudans*, a shrubby and comparatively small-leaved form, with a small amount of indumentum over the veins, only, of the lower leaf-surface, and a glabrescent upper leaf-surface; and β *hypoleuca* — apparently the less common form — a small tree, having larger leaves with a close whitish covering of hairs over the whole of their lower surface, and a somewhat more sparsely tomentose upper surface. These were described and figured by WELWITSCH in his «Sertum Angolense», which appeared in 1869 (35), and duplicate sets of the specimens

themselves [1] ultimately became the property of the Portuguese Government, and of the British Museum.

Before WELWITSCH's own account of his plant collections appeared, however, Professor DANIEL OLIVER published the first volume of his «Flora of Tropical Africa» (29); in this work many of the descriptions were based upon WELWITSCH's specimens, including «*Vatica africana*». While accepting this particular reference, OLIVER pointed out that the new African *Vatica* differs from the Asiatic species of the genus in having an indefinite number of stamens, instead of fifteen; it is, however, similar to certain of them — those now often included in the «*Isauxis* Arn.» section of *Vatica* [2] — in having all five of the persistent sepals equally or sub-equally elongated in the fruit.

Important points indicated in the «Flora of Tropical Africa» are that the African Dipterocarps extend beyond Angola, and that they present a wider range of variation than was evident to their original discoverer. From the Highlands of the Batoka Country, an area north of the Zambesi River, in the southern part of what is now Northern Rhodesia, OLIVER described two further «varieties» of *Vatica africana*, namely: *glabra*, with glabrous leaves, both upper and lower surfaces being without indumentum; and *glomerata*, with closely fascicled inflorescences. These «varieties» were based upon specimens collected by Dr. John Kirk, in 1860, while with Livingstone's Zambesi Expedition; the specimens are now at Kew, and an examination of them has shown «var. *glabra*» to represent a distinct type, being referrable to the species *glaber*, as subsequently proposed by SPRAGUE (32), for a Southern

1. *Welwitsch* 1035 & 1036, respectively. *Welwitsch* 1077, also from Huila, is noted by Hiern (23) as being «intermediate between α and β». Several specimens bearing this number have been examined by the writer, at Kew and at the Berlin Herbarium, and found to be small-leaved examples of «α *denudans*», with rather more lower indumentum than is usual, but situated over the veins only, as in 1035, the type specimen; «*Welwitsch* 1077» in the Botanical Department at the University of Lisbon, however, is *M. angolensis* De Wild.

(For an historical account of the proceedings leading to a decision as to the ownership of WELWITSCH's specimens, see HIERN, 23, preface).

2. *Cf.* the works of BRANDIS and GILG (8), and of TORRE and HARMS (33).

Rhodesian specimen [1]; but it may also be noted in this connection that the original «*V. africana*» type occasionally possesses leaves which are almost or entirely glabrous on the lower as well as on the upper surface [2].

OLIVER's «var. *glomerata*», also, represents a very distinct form, which differs from «*V. africana*» in certain outstanding characters, notably in the compacted, sub--spicate and terminal, compound inflorescence. Reference will be made to this form later, as being of common occurrence in Northern Rhodesia and in the Katanga area of the Belgian Congo. Other than OLIVER's note in the «Flora of Tropical Africa», the only mention of this form as «variety *glomerata*» of which the writer is aware, is in Sir H. H. JOHNSTON's account of an African tour, for which MR. I. H. BURKILL compiled a list of plants occurring in British Central Africa, Nyasaland, and the British Territory north of the Zambesi; « *Vatica africana* Welw. var. *glomerata* Oliv.» was noted as being amongst the plants found in the Batoka Country during that tour (27). It should perhaps be pointed out here that there are one or two other forms of the general «*Vatica africana*» type occurring in the Northern Rhodesian area, in which the small axillary inflorescences tend to be somewhat glomerulate, owing to a shortening of the pedicels [3]; this is,

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1. *Allen* 734 (K).

The abbreviations used in reference to the various herbaria consulted in the course of this work, are those given in «Conspectus Florae Angolensis» (10), namely:

BD = Botanisches Museum,, Berlin- Dahlem.

BM = British Museum, London.

Br = Jardin Botanique de l'État, Bruxelles.

Coi = Instituto Botanico, Coimbra.

K = Royal Botanic Gardens, Kew.

Lis. JC = Jardim Colonial, Lisbon.

Lis. U. = Jardim Botânico da Universidade, Lisbon

In addition, IFI = Imperial Forestry Institute, University of Oxford; P = Muséum d'Histoire Naturelle, Paris; and U = Botaniska Museet, Uppsala.

2. This is the case in *Milne-Redhead* 576 and 938 (K), specimens respectively from the Solwezi and Mwinilunga Districts of Northern Rhodesia.

3. *Cf.* the form of the inflorescence in, for example, *Monotes dasyanthus* Gilg.

however, in some forms at least, a variable characteristic, and, with the evidence of Dr. Kirk's specimen at hand, although the material is not in good condition, there is no doubt that OLIVER's «variety *glomerata*» refers exclusively to the form with sub-spicate terminal inflorescences, and not to one or other of the forms with small axillary inflorescences like those of the original *Vatica africana*, but short-pedicelled and therefore more compacted.

«Variety *hypoleuca*» was apparently accepted by OLIVER in the same sense as it was originally applied by WELWITSCH, the outstanding characteristic of the plant having been considered to lie in the possession of a whitish indumentum completely covering the lower leaf-surface, occurring in the meshes of the reticulum, as well as on the veins; as further discoveries of related types have been made, however, this character has proved to be of frequent occurrence, and the descriptive epithet has become, in consequence, misleading. The variety has subsequently been definitely raised by GILG to the status of an independent species *(20)*; it may be remarked that WELWITSCH himself was inclined to believe that it might be specifically different from «*α denudans*», and that he actually referred to it, in one instance, as «*Vatica hypoleuca*» *(35*, p. 17*)*.

The remaining variety, *laxa*, quoted by OLIVER, seems to be synonymous with WELWITSCH's «*α denudans*». WELWITSCH's term, however, apparently had reference to the sparse indumentum of the lower leaf-surface, and was thus applied in contrast to the varietal epithet «*hypoleuca*»; and, in this connection, it should be noted that WELWITSCH evidently considered «*denudans*» to be the type of his new species, for he did not invariably use the varietal designation: in the explanation of his figures, for example, he referred to «*Vatica africana α denudans*» simply as «*Vatica africana*» *(35*, tab. 5; *cf.* GILG, 20*)*. OLIVER's term *laxa*, on the other hand, was presumably applied in contrast to «var. *glomerata*», and had reference to the loose few-flowered type of inflorescence characteristic of the original *Vatica africana*, that is to say, of «*Welwitsch* 1035». *V. africana* Welw., *V. africana α denudans* Welw. and *V. africana*

Welw. var. *laxa* Oliv. appear, therefore to be interchangeable terms, and to refer to the first African Dipterocarp discovered by WELWITSCH, in Angola; this plant, and examples of the same form, are now described without a varietal epithet.

In the same year — 1868 — as OLIVER's «Flora of Tropical Africa» appeared, DE CANDOLLE published an account of the *Dipterocarpaceae* in the «Prodromus» *(9)*. This author separated the species *africana* from others of the genus Vatica, primarily on account of the type and number of the stamens. These have small, ovate, equally-lobed anthers with short connectives, and fairly long, slender filaments, and are thus of a type not elsewhere represented in the *Dipterocarpaceae*; and, as previously noted by OLIVER, they are indefinite in number, the flowers being similar in this respect to those of *Shorea*, rather than to those of the Asiatic Vaticas. DE CANDOLLE further pointed out that a considerable and equal or sub-equal accrescence of the sepals in the fruit is not a condition typical of the genus *Vatica* as a whole *(cf.* p. 327), and it is of infrequent occurrence amongst other members of the *Dipterocarpaceae*; it is to be found, indeed, only in *Parashorea* Kurz, in which the stamens are fifteen in number, and in *Dryobalanops* Gaertn. f., where they are definitely in three series, the short filaments being joined in a fleshy ring *(cf.* BRANDIS and GILG, 8*)*. The combination of characters thus presented by «*Vatica africana*», led DE CANDOLLE to regard it as a new generic type, for which he suggested the name *Monotes*, thereby signifying that this form was the sole known representative of the *Dipterocarpaceae* occurring beyond the limits of Asia *(*9: see also GILG, 20*)*.

«*Monotes* A. DC» was adopted by HIERN in his catalogue of Welwitsch's plants published in 1896 *(23)*. It had also been accepted by certain other writers previous to HIERN — namely, by PIERRE *(30*: 1880-83*)*, by HEIM, in 1892 *(22)*, by BRANDIS and GILG, in 1894 *(8)*, and by BRANDIS *(7*: 1895) and GILG (18: 1895; see also 19) in independent works.

Originally, in 1869, WELWITSCH had described «*Vatica*

africana denudans» as «Frutex..... resinosus»; there being gum-sacs in the external tissues, and «diffuse» resin in the woody tissues of the stem, it is possible that WELWITSCH's note may have had reference to exudations from damaged or old parts of the plant, the excreted substance being confused with the oleo-resin characteristic of the true Dipterocarps. Until 1892, any further recognition of the discovery and status of *Monotes* A. DC., was made without detailed description of anatomical features; in this year, however, HEIM published his monograph of the *Dipterocarpaceae*, including an anatomical consideration of the limited amount of *Monotes* material available at the time. Leaf, flower, fruit and seed characters were investigated, and the gum-sacs of *Monotes* contrasted with the resin--canals of the Asiatic Dipterocarps. It was, however, largely the structure of the ovular integuments which led HEIM to question the inclusion of *Monotes* in the *Dipterocarpaceae*; although fully recognising its close relationship to the rest of the family, he concluded that on the whole it should be allied with the *Tiliaceae*, its characters being, according to his view, especially reminiscent of those of *Grewia*, a large tropical genus, occurring in Asia and Australia, as well as in Africa. It is interesting to note that PIERRE, in his «Flore Forestière de la Cochinchine», published between 1880 and 1885, had already suggested the inclusion of *Monotes* in the *Tiliaceae*, rather than in the *Dipterocarpaceae*.

In 1894, in the «Natürlichen Pflanzenfamilien», BRANDIS and GILG described *Monotes* as a genus doubtfully referrable to the *Dipterocarpaceae*; but while, following HEIM, they noted it as being distinguished from the true Dipterocarps in the possession of versatile anthers and a short androgynophore (a structure previously figured by PIERRE), and in the absence of resin-canals, they apparently did not think it advisable to ally it with the *Tiliaceae*, since at the time sufficient material for investigation was not available (8). It is noteworthy, however, that in his «Enumeration of the *Dipterocarpaceae*», published the next

year, BRANDIS omitted *Monotes* in his estimation of the number of species belonging to the family *(7)*.

*Monotes africanus (*Welw.*)* A. DC. remained the only recognised species of the genus until 1895, in which year GILG published a description of a new form, *M. adenophyllus* [1] (18); this was found on the dry «steppes» of the Central African Lake region, and in 1889 had been included by HOFFMAN, in his Flora of Central East Africa, as *Vatica africana* (24). GILG separated it from the type species on account of the indumentum of simple hairs on the upper surface of the leaf *(*as well as over the veins of the lower surface*)*, a feature especially conspicuous in the young condition; the specific epithet was evidently suggested by the large gland, or extrafloral nectary, at the base of the leaf-lamina, for while a similar structure is present in WELWITSCH's original specimen, and was noted by him, it is there much less conspicuous than in this new form, and was not mentioned in other early accounts of the type. It may be observed here that a gland at the base of the lamina has proved to be characteristic of the genus *Monotes* as a whole.

From 1895 to the present time, as Tropical Africa has been opened up, expeditions, both private and those sponsored by governments or institutions, particularly from Britain, Germany, Belgium, Portugal, Sweden and France, have provided the various European Herbaria with large numbers of specimens, obviously closely allied to the original *Monotes africanus* (Welw.) A. DC., but clearly, in many cases, specifically distinct from it. These specimens have been drawn chiefly from South Tropical Africa, the «*Monotes* belt» stretching across the continent, from west to east; the genus is represented fairly widely, but more sparsely, to the north of the Equator, in which latitudes it apparently does not extend in an easterly direction beyond the Central Sudan region.

In order to make clear the following survey of the

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1. Bohm 31 A (BD).

further development of our knowledge of *Monotes* which has resulted from these expeditions, it should be stated here that the characters which seem to be of diagnostic importance in the genus are very largely leaf-characters, mature, but not old, leaves from normally grown shoots providing the standard of reference in each case. The *distribution of indumentum* over the leaf-surfaces seems to be a most significant feature in the genus: this point is, indeed, indicated by WELWITSCH's original distinction between his varieties *denudans* and *hypoleuca*, and by GILG's separation of *M. adenophyllus* from the type-species. An examination of young, as well as of more mature, material is of course essential, particularly so far as the upper leaf-surface is concerned, for the amount of indumentum is very dependent upon the age of the leaf, and in old examples its distribution may be obscured by reduction in amount; it should also be noted that amount of indumentum may be further dependent upon the position of individual leaves on the tree, and upon climatic and edaphic conditions, so that *of itself*, it is of no great value in considering the relationships of the various species. The *type of indumentum*, particularly of the upper leaf-surface, is of some importance, as are also the *length of petiole*, the *number of pairs of lateral veins*, and the *relation of the veins to the leaf-margin*. Leaf-size is so very variable within the species, and even in the same individual plant, that it is of only subsidiary importance in estimating relationships; the *general shape and proportions (length: breadth) of the lamina*, and especially, the *average shape of apex and base*, are, however, of value when the sample of material is sufficiently large. In the case of herbarium material, colour of the leaf-surface and of the indumentum is a character which should be used only with caution, and after the examination of material from different sources; for not infrequently, the original colour of the leaf is much altered by the conditions under which the specimen is dried and by the solution which is used for poisoning.

With regard to other than leaf-characters, the inflo-

rescences are almost uniform in type and arrangement throughout the genus, being, in general, small panicles borne in the axils of ordinary foliage leaves; in two forms, however, they are large and compound, many very small panicles, each in the axil of a much reduced leaf, being arranged in terminal and sub-spicate groups. The flowers vary somewhat in size, but are constant in general structure, and also in detail, except in one small group of species, where the stamens are without the small triangular connective described and figured by WELWITSCH for the type species of the genus; and, while the fruits of the different species are more variable in size than the flowers, individuals of the same species often showing a considerable range in this respect, and also in the shape of the accrescent sepals, their general structure is constant throughout, and it is only rarely that a fruit-character is of especial value in diagnosis.

In 1897, PIERRE described as «*M. glandulosa*» a large-leaved Angolan form [1], very similar to GILG's *M. adenophyllus* in the possession of simple hairs on the upper leaf-surface and over the veins only of the lower surface (31); as also in *M. adenophyllus*, resin-containing glandular hairs occur amongst the simple hairs, particularly on the veins of the lower surface, while, besides these points of similarity, PIERRE's specimen sufficiently resembles *M. adenophyllus* to indicate that the two species belong at least to the same form-group or type, an indication which is supported by the occurrence, subsequently realised, of «connecting links» between them, both morphologically and geographically. The early discovery of these two similar forms from widely-separated areas is a point of interest from the taxonomic point of view, for had there existed a better means of co-ordination and interchange of scientific material and results, the possibility of their very close connection might earlier have been realised, and a check imposed, at the outset, on the multiplication of «species» which has taken place to an unne-

1. *Pierre* 4/97 (P).

cessary extent in the genus *Monotes*, as in many other cases.

In 1899, as a result of the acquisition by the Berlin Botanical Museum of new material from various parts of tropical Africa, GILG published an account of *Monotes*, by that time known, he claimed, from the characters of seven species. It should, however, be noted that this computation excluded PIERRE's *M. glandulosus*, but included «*Monotes acuminatus*», an Angolan form [1] which GILG had described in 1896, as being especially distinguished by its acuminate leaves, but which R. E. FRIES has subsequently (in 1914) shown to be of another generic type [2]. It was in this paper that «*Vatica africana* β *hypoleuca* Welw.» was definitely raised to species-status as *Monotes hypoleucus* (Welw.) Gilg; while the remaining five species enumerated were *M. africanus* (Welw.) A. DC. and *M. adenophyllus* Gilg (the type specimens and origins of which have already been noted), together with the new forms *M. caloneurus* Gilg, from Angola [3], and *M. magnificus* Gilg [4] and *M. rufotomentosus* Gilg [5], both from the Uhehe Plateau, in what is now the southern part of Tanganyika Territory, to the N. E. of Lake Nyasa. *M. caloneurus* and *M. magnificus* are similar to one another (and to *M. hypoleucus)* in the possession of a «general» [6] indumentum on the lower leaf-surface; this is

1. *Buchner* 525 (BD).

2. *Marquesia* Gilg (GILG, 19; R. E. FRIES, 16).

3. *Buchner* 159 & 524 (BD). In his original diagnosis of *M. caloneurus*, GILG also mentioned *Schweinfurth* 2678 & 4262 (BD), from Central Africa; these are undoubtedly *caloneurus*-like in aspect, but they agree more closely with *M. Kerstingii*, a West African form later described by GILG. The Berlin specimens of these numbers have been transferred to *M. Kerstingii* by MILDBRAED, who found the same species in the Kameroons (28), and the Kew material has been renamed by HUTCHINSON and DALZIEL *(cf.* 26).

[N. B. In the references to specimens illustrative of species, all those mentioned in the original diagnoses are given, the actual *type specimen* (or *specimens*, as in the case of certain of GILG's diagnoses) being noted *first*].

4. *Goetze* 680 (BD).

5. *Goetze* 501 & 683 (BD).

6. i. e., covering the whole surface, occurring in the meshes of the vein-reticulum, as well as on the veins themselves.

quite persistent in *M. magnificus*, but generally disappears more or less completely from the midrib and stronger parts of the lateral veins in mature leaves of *M. caloneurus*. They also possess an upper indumentum, which, in *M. caloneurus*, tends to disapper, leaving the leaf-surface glabrous at maturity. *M. caloneurus* is further characterised by the regular nature of its lateral venation, and *M. magnificus* by its especially large leaves. Two specimens are associated in the diagnosis of *M. rufotomentosus*, which was considered to be nearly related to *M. africanus;* these two specimens are certainly similar, but not identical, in character, as GILG's account seems to imply, and reference will be made to their status in the more detailed taxonomic section of this paper.

Perhaps the main interest of GILG's 1899 account of *Monotes* lies in his discussion of the relationships of the genus; this discussion was summarised by the present writer in 1933-35 to the following effect (2, p. 509):—

In accordance with his arguments as set out in a previous paper on the dangers of holding too rigidly to the anatomical method in systematic speculations (17), GILG criticised HEIM's separation of *Monotes* from the *Dipterocarpaceae* as being based too much upon purely anatomical evidence which, when divorced from a consideration of the type and structure of the reproductive organs, is likely to be misleading; he therefore proceeded, from an examination of his new material, to enquire whether there were any additional data to be gained from it, particularly so far as the structure of the flower, fruit and seed was concerned, which would indicate the desirability, either of separating *Monotes* from the *Dipterocarpaceae*, or of including it in the *Tiliaceae*. He concluded that the genus is certainly distinct from the other Dipterocarps in its stamen-type. It also differs in the absence of resin--ducts; but since there are various families — such as the *Pinaceae* and *Leguminosae* [1] — wich include members

1. The *Leguminosae* are, of course, typically non-resin-producing; but certain types, notably *Copaifera* and *Daniellia*, possess resin-ducts in the older parts of the plants; and, following WETWITSCH's description — «Frutex... resino-

both with and without resin-ducts in the wood, GILG did not consider this point to constitute a cogent argument against the inclusion of *Monotes* in the *Dipterocarpaceae*; from a concensus of various reproductive characters, indeed, he concluded that its original reference to that family by WELWITSCH and OLIVER was fully justified. GILG suggested that *Monotes* represents a branch, or sub-family, of *Dipterocarpaceae* — the *Monotoideae* — which diverged from the main stock — the *Dipterocarpoideae* — at an early age; while in the latter, a typically Indo-Malayan group, the development of schizogenous resin-canals has become a marked, though variable, feature, this line of structural evolution has not been followed in the former, a purely African group, although, it is true, secretory *cavities* are present, and these may, under certain circumstances, become elongated in a canal-like manner. A difference between the two groups lies in the nature of the secretion product occurring in the cavities — a gum in the *Monotoideae* and an oleo-resin in the *Dipterocarpoideae (cf.* CLOVER 11); but since resin also occurs in the *Monotoideae*, although in diffuse form, this difference can hardly be regarded as of fundamental nature.

In 1933, the present writer, after examination of a considerable amount of Monotoid material, including wood--samples, was in agreement with GILG concerning the systematic position of the group; but the tentative suggestion was also made that in view of what appeared at the time to be its very definite and circumscribed nature, it might ultimately be desirable to raise it to the status of a separate family, when the evidence of all characters had been completely reviewed and discussed (3). Between 1933 and the present time, however, further study of the *Monotoideae* has made such a separation appear to be entirely unnecessary, and indeed undesirable, for it would obscure

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sous» — GILG concluded that the same might hold for *Monotes* also. The present writer has examined available specimens of *Monotes* timbers, and has, as yet, found no canals, even in old wood. There is, however, much diffuse resin, and this is often abundant locally, and may show as dark flecks or streaks on the cut surface of the wood.

the fact that the group is not only closely related to the *Dipterocarpoideae*, but that it is more closely related to that group than to any other. Moreover, cl se examination of an Angolan specimen originally referred to «*Monotes africana*» and variously re-named at intervals [1], has indicated that the *Monotoideae* may be much less circumscribed and definite a group than originally appeared to be the case, and that the existence of connecting links between it and the *Dipterocarpoideae* may indeed occur (*cf.* 10, p. 143). At the present time, therefore, GILG's suggestion may be maintained, namely, that *Monotes* is the type of a sub--family, the *Monotoideae*, in certain respects distinct from, but closely related to, the *Dipterocarpoideae*, the more typical group of the *Dipterocarpaceae*.

Further additions to the Berlin Museum between 1899 and 1907 provided five new species of *Monotes*, according to GILG's determinations, and further extended the known distribution-area of the genus (21). The new species are as follow:

M. dasyanthus Gilg [2], from the Kunene-Zambesi area, in Angola (*cf.* BAUM in 34). This form was considered by GILG to be related to *M. hypoleucus*, but to be distinct in its broadly ovate, weakly cordate leaves, with more indumentum on the lower surface than in that species, and in its thick, spherical inflorescence. Actually, *M. dasyanthus* is very distinct from *M. hypoleucus*, but not especially in those points which GILG selected for contrast; in its distribution and type, rather than amount, of indumentum, its tendency to acuminate leaf-form, its dense (though small and axillary) inflorescences, and in the possession of stamens without a connective, *M. dasyanthus* is a member of a species-group to which OLIVER's «*Vatica africana* var. *glomerata*» also belongs (*cf.* pp. 328 & 329, of this paper).

M. Kerstingii Gilg [3], from Upper Guinea, West Africa.

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1. *Gossweiler* 2247 (BM).
2. *Baum* 888 (BD; also BM, Coi, & K).
3. *Kersting* 11, 121 & 209 (BD).

The specimens upon which this species is based are similar to certain specimens from Central Africa, which GILG had previously included under *M. caloneurus*, and which have now, by later investigators, been transferred to *M. Kerstingii* [1]. GILG himself apparently did not realise the similarity between his new species and *M. caloneurus*, for he claimed that *M. Kerstingii* is nearest related to *M. hypoleucus*, an opinion which seems to have been based largely upon the presence of a dense whitish indumentum on the lower surface of its leaves. Actually, *M. Kerstingii* is extremely similar to *M. caloneurus*, so far as both leaves and inflorescences are concerned, but its elliptical leaf-laminae are shorter in proportion to their breadth than in typical examples of *M. caloneurus*, and — a very characteristic feature — they are curved to a greater or less extent, the upper surface being convex; in both species, the upper surface of young leaves bears simple, tufted and glandular hairs, but tends to be glabrous in the mature condition; there is, however, in both, a varying amount of residual indumentum, particularly of the glandular resinous type in *M. Kerstingii*. It is a point of interest that GILG's original reference of SCHWEINFURTH's Central African specimens to *M. caloneurus* should confirm the present writer's view that *M. caloneurus* and *M. Kerstingii* belong to same form-group, and represent geographical varieties of a single fundamental type, rather than distinct «Linnæan» species; there are, indeed «border-line» specimens which it is difficult to refer definitely to one or other of GILG's species [2].

M. Engleri Gilg [3], from Umtali, Mashonaland (Southern Rhodesia). This species was placed by its author near to *M. caloneurus*, and, so far as the type and main distribution of indumentum on the leaf-surfaces, and the tendency to glabrescence of the upper surface of old leaves are concerned, *M. Engleri* certainly seems to be a small-

1. *Schweinfurth* 2678 & 4272 (BD, K).
2. e. g., *Chevalier* 6706 (K), from Central Africa («Chari oriental»).
3. *Engler* 3159 (BD).

-leaved form of the *M. caloneurus* circle of affinity; it is, however, quite distinct from *M. caloneurus* and *M. Kerstingii* in petiole-length and in number of lateral veins.

M. elegans Gilg [1], from Tabora, in the Central African Lake region (now Tanganyika Territory). GILG placed this species, also, near to *M. caloneurus*, but rightly regarded it as distinct. *M. elegans* is indeed similar to the members of the «*caloneurus* alliance» in the character of its venation (the lateral veins running very close to the leaf-margin), and in the tendency to glabrescence of the upper surface of old leaves; it is also similar to these forms, and especially to *M. Engleri*, in the type and distribution of the indumentum of the lower leaf-surface; but, in the possession of a typically velvety indumentum of (principally) short-branched stellate hairs covering the upper surface of the younger leaves, *M. elegans* is nearer to *M. hypoleucus* than to the members of the *caloneurus* alliance, and may easily be confused with that species, since lateral vein-number and petiole-length are similar in the two forms [2]; there are, however, cases in which the upper indumentum approaches the more shaggy type to be found on young leaves of members of the *caloneurus* alliance, and which it is difficult to refer readily to any

1. *Holtz* 1474 (BD).

2. It should be noted that in the survey of the Angolan species of *Monotes* for the «Conspectus Florae Angolensis» (10, pp. 135 & 140), the present writer associated *Gossweiler* 1804 (Coi, K, Lis. JC), *Gossweiler* 2934 (BM, Coi, K), *Gossweiler* 3943 (BM, K, Lis. JC), and *Lynes* s. n. (BM) with *M. hypoleucus*, on account of the general similarity of upper indumentum, lateral vein-number and petiole-length. None of these forms, however, exactly agrees with *M. hypoleucus* in the relation of the lateral veins to the leaf-margin; they are more similar to *M. caloneurus* in the fact that the veins run very close to the margin before tapering and anastomosing; *Gossweiler* 2934 had previously, indeed, been definitely referred to that species. After a detailed examination of a large number of specimens, it appears to the writer that the *Gossweiler* numbers are more similar to the type of *M. elegans*, while *Lynes* s. n., with its rather more shaggy upper indumentum and sparse covering of the main veins on the lower leaf-surface, approaches *M. caloneurus*. (It should be noted that one of the various sheets bearing the number *Welwitsch* 1036 (Lis. U) shows two small branches of the *M. elegans* type).

one of the species *caloneurus*, *Engleri* or *elegans* [1]. From an examination of a considerable number of specimens drawn from the whole of the known distribution-area of *Monotes*, there can be little doubt that *M. caloneurus* and *M. Engleri*, together with *M. Kerstingii*, form a closely related group, which is also allied to *M. hypoleucus* through *M. elegans*.

M. Wangenheimianus Gilg [2], from Nyasaland. This species was considered by GILG to be near *M. magnificus*, and the two forms certainly are similar in the size and shape of the leaves, and in the possession of small extra--floral nectaries in the axils of the lateral veins in addition to the much larger gland at the base of the leaf-lamina. Actually, however, *M. Wangenheimianus* has more in common with GILG's *M. adenophyllus* and PIERRE's *M. glandulosus* so far as distribution of indumentum on the lower leaf-surface is concerned, for while in *M. magnificus* the indumentum covers the entire surface, in *M. adenophyllus*, *M. glandulosus* and *M. Wangenheimianus*, the indumentum occurs outstandingly on the veins, the meshes of the reticulum being glabrous, or practically so.

In 1909, SPRAGUE described *M. glaber* [3], from the valley of the Hanyani River, in Southern Rhodesia (32); the author suggested that this type is allied to *M. africanus*, from which it differs in the facts that its leaves are glabrous on both surfaces, that the lateral veins are not strongly marked on the upper surface, and that the reticulum of veinlets is not conspicuous. The possibility of identity between OLIVER's «*Vatica africana* var. *glabra*» and *M. glaber* was noted by SPRAGUE, although Kirk's specimen upon which OLIVER's variety was based, was taken from a much smaller, shrubbier plant than *Allen* 734, with longer leaves, having a more distinct reticulum of veinlets. As

1. e. g., *Adamson*, s. n. (IFI), from the Tabora District, Tanganyika; *Nutt* s. n. (K), from Kambole, S. W. of Lake Tanganyika; *Stevenson* 235 & 236 (IFI), from N. Rhodesia; cf. also the case of *Lynes* s. n. refered to in footnote 2 of p. 340.

2. *von Wangenheim* 41 (BD).

3. *Allen* 734 (K).

noted above (p. 327), there is no doubt that Kirk's specimen is of the same type as *M. glaber;* several similar examples have now been listed from Northern Rhodesia and Tropical Bechuanaland [1], and while from these areas the leaves tend to be somewhat longer and to have a more distinct venation, as in Kirk's specimen, in essential characters they are in agreement with those of the Southern Rhodesian forms.

In 1914, R. E. FRIES described *Monotes discolor* [2], a species from North-eastern Rhodesia (15); this form is distinct in aspect from any other hitherto described, the upper leaf-surface having a yellowish-green colour and a somewhat resinous and very finely roughened appearance, due to the presence of a large number of minute rounded resin-glands; short simple hairs and a few branched examples also occur, but these tend to disappear in old leaves. *M. discolor* was considered by its author to be nearest *M. hypoleucus*, to which species it is undoubtedly related; but it also recalls *M. caloneurus* in the possession of large leaves with a high number of regularly and rather closely placed lateral veins, which, however, join the midrib at a somewhat characteristically wide angle in *M. discolor*, while a further distinguishing feature of the new species lies in the often markedly cordate nature of the leaf-base. It may be noted that *M. discolor* is similar to the members of the «*caloneurus* alliance», to *M. elegans*, and also to *M. hypoleucus* in the possession of a close indumentum entirely covering the lower leaf-surface.

Between 1900 and 1927, discoveries in the Katanga district of the Belgian Congo have shown that individuals of *Monotes* spp. are abundant in that region; they are, indeed, amongst the most common trees occurring on the wooded upland plains, or savannahs (see 12 & 13). DE WILDEMAN has added several new specific designations to the literature on the *Monotoideae* (36-41), although, in

1. e. g., *Burtt Davy* 17865, *Martin* 787 (IFI), from N. Rhodesia; and *O. B. Miller* 143 (IFI), from Tropical Bechuanaland.

2. *R. E. Fries* 1175 (U, BD).

some cases, the evidence was inadequate, as indeed DE WILDEMAN himself realised.

The Katanga forms of *Monotes* are as follow: —

M. katangensis de Wild. This species was originally listed as *Vatica katangensis* by DE WILDEMAN in 1903, from specimens collected by VERDICK in 1900; it was described as *Monotes katangensis* in 1913, and a full account of it was given in 1927 from the evidence of material contributed by various collectors from 1912 onwards [1]. It is evidently a very common and variable form, occurring particularly in the neighbourhood of Elisabethville, and all states of development of flowers, fruits and foliage are represented in the herbarium at Bruxelles [2].

DE WILDEMAN did not suggest for it any especial affinity with other forms of *Monotes;* the specimens included under this species are, however, of great interest, for they agree in leaf-form and structure, in inflorescence-type, and in the absence of a triangular stamen-connective, with Dr. Kirk's specimen from the neighbouring Rhodesian area, OLIVER's «*Vatica africana* var. *glomerata*», which must undoubtedly be included under *M. katangensis.* The relationship between Kirk's specimen and *M. dasyanthus* has already been noted; it thus appears that *M. dasyanthus*

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1. *Homblé* 326 and *Verdick* 486, 548; also *Bequaert* 360, *Thomas* 1214, 1230, 1275, *Delevoy* 101, 906, 929, etc. (Br). See DE WILDEMAN, 36, p. 92; 38, p. 111; 40, p. 134; and, for the full account of *M. katangensis*, 41, pp. 176-179.

2. HOMBLÉ, in the case of his specimen 326, has noted that the calyces of the young fruits are red, giving a very ornamental aspect to the tree; later the fruit-wings lose their red tinge, becoming brown at maturity. The majority of specimens of *M. katangensis* seen by the writer have been in the young fruiting condition, with small, rather velvety, apiculate ovaries and short wings (up to 2.5 cm. in length) of very varyng breadth.

According to DE WILDEMAN, adult fruits have an ovary of about 1.1 or 1.2 cm. in diameter, while the calyx-lobes are from 4.0 to 4.5 cm. in length and 1.5 to 2.3 cm. in breadth; mature fruits of this size have been examined by the writer in the case of Homblé's specimens.

The size of the whole fruit and, particularly the breadth of the wings, are very variable in *Monotes* as a whole, both within the species, and from an individual plant; and in *M. katangensis*, the occurrence of rather surprisingly large fruits in some cases may possibly be due to the complete development of only a limited number of those originally «set» from the large and dense inflorescense.

and *M. katangensis* form a small group somewhat apart from, but nevertheless closely related to, the other species of *Monotes* so far described. A point of interest in *M. katangensis* to which attention may be drawn here, is the tendency to the formation of extrafloral nectaries on the upper surface of the leaves, in the axils of the lateral veins.

M. Homblei De Wild. [1]. This species was described in 1915 (39, p. 55), the considerable range in size of the «orbicular-ovate to obovato-orbicular» leaves, and the variable length of the petioles being especially noted. DE WILDEMAN believed his new species to be near to *M. hypoleucus* and *M. magnificus;* the suggestion of affinity to the latter species is especially cogent, because the larger leaves of *M. Homblei* are certainly very similar to those of *M. magnificus* in shape, size and distribution of indumentum; *M. Homblei* seems, however, to be distinct from *M. magnificus* in the type of indumentum of the upper leaf-surface, for while that of the latter species bears stiff, simple hairs, that of the new species is more «velvety», having less bristly simple hairs, with a proportion of tufted hairs amongst them; in this respect, *M. Homblei* shows a condition intermediate between that of *.M magnificus* and that of *M. hypoleucus. M. Homblei* also differs from *M. magnificus* in apparently lacking any tendency to the formation of subsidiary glands in the vein-axils on the upper leaf-surface, such glands having been noted in *M. magnificus.*

M. Delevoyi De Wild. [2]. The leaf-characters of this type closely ally it with *M. adenophyllus* Gilg, and, more particularly, with *M. glandulosus* Pierre and *M. Wangenheimianus* Gilg; it differs from these forms, essentially, only in the *amount* of indumentum of the leaf-surfaces, this being typically very sparse in *M. Delevoyi.* DE WILDEMAN noted the similarity between*M. Delevoyi* and *M. Wangenheimianus,* and also compared his new species with M. *Homblei,* from which, however, it differs not only in amount, but also, and more significantly, in type and dis-

1. *Homblé,* 1177 (Br).
2. *Delevoy* 524 (Br.); see DE WILDEMAN, 41, pp. 171, 172.

tribution of indumentum; on the other hand, the leaves of the two species are very similar in shape and general aspect.

M. kapiriensis De Wild [1]. DE WILDEMAN only provisionally suggested this specific designation for the specimens collected by Homblé and Delevoy, having no knowledge of the flowers: he believed the specimens to be at least very near to *M. discolor* R. E. Fries, if not of the same specific type; while he also allied them with *M. magnificus* and *M. Homblei.* In the recently-published «Conspectus Florae Angolensis», the present writer treated *M. kapiriensis* as a species distinct from *M. discolor;* but a comparison of the two diagnoses given in the synoptical account of the Angolan species of *Monotes* (10, p. 136), reveals what now appear to be only non-essential differences, and in the light of evidence from a considerable amount of new material, and of material not available to DE WILDEMAN, there seems to be little doubt that «*M. kapiriensis*» and *M. discolor* are conspecific; their leaf-characters coincide, and the fruits of Homblé's specimen, although somewhat variable, are large and similar to those of the type-specimen of *M. discolor*, while there are also indications that the inflorescence of «*M. kapiriensis*» was of the same rather dense, short-pedicelled type as in *M. discolor.*

M. Thomasi. De Wild. [2], a species based upon one specimen consisting of leaves and a single fruit, and named provisionally, but recognised as being near to *M. magnificus.* The specimen certainly suggests that species at sight, and on close examination, it is found to agree with it in detail of leaf-characters, while the large fruit, also, is similar to those of *M. magnificus.* DE WILDMAN also compared «*M. Thomasi*» with *M. Wangenheimianus*, so far as leaf-size is concerned, using the *colour* of the indumentum of the lower leaf-surface as a differentiating character; «*M. Thomasi*», however, differs from *M. Wangenheimianus* in having its lower leaf-surface entirely covered with

1. *Homblé* 1228, *Delevoy* 111 (Br); see 41, pp. 175-177.
2. *Thomas* 1250 (Br); see 41, pp. 182-3.

indumentum, as in *M. magnificus*, in which species it should undoubtedly be included.

M. Verdicki De Wild.[1], a species based upon one flowering specimen, the fruits being unknown. It was compared by its author especially with *M. Homblei*, in the type--specimen of which, however, the inflorescence is shorter. But there is considerable variation in inflorescence-length within the species of *Monotes*, and it does not seem necessary to separate Verdick's specimen from *M. Homblei* on this character alone; the open flowers of the two forms are similar in size, and the leaf-characters are essentially identical; «*M. Verdicki*» may, in fact, be considered simply as a small-leaved specimen of *M. Homblei* which, it has already been noted, shows a considerable range of variation with regard to leaf-size.

In his collected account of the genus *Monotes*, given in 1927 (41), DE WILDMAN dercribed two further new species, *M. angolensis* and *M. Gossweileri*.

M. angolensis De Wild. was based primarily upon Angolan material, with which its author associated two rather doubtful specimens from the Belgian Congo [2]. DE WILDMAN was inclined to ally this species with «*M. Verdicki*», and further to compare it with *M. katangensis*; his views with regard to the possible relationships of *M. angolensis* must, however, have been the outcome of an incomplete examination of his material, and a more cogent suggestion was made in a note to *M. hypoleucus* (41, p. 175), indicating that he recognised the similarity of type which exists between *M. hypoleucus* and *M. angolensis*: *M. angolensis* has, in fact, the essential characters of a small-leaved *M. hypoleucus*. It may be conveniently noted here that in «Conspectus Florae Angolensis», the two forms were treated separately, although closely associated (10, p. 135); the actual reason for separate treatment in

1. *Verdick* 374 (Br); noted as «*Vatica africana* var. *hypoleuca*» and as «*M. hypoleucus*», originally (40); described as a new species in 1927 (41, pp. 183-185).

2. *Gossweiler* 2910 & 2893, from Angola; *Delevoy* 502 & 523, from the Belgian Congo (Br); see 41, pp, 168-170.

this work was based upon what now appears to be a misconception concerning the content of *M. hypoleucus*, certain forms having been associated with the original WELWITSCH specimen, which are now, on account of the type and extent of lateral venation, considered to be of the *M. elegans* type, in which the lateral veins practically reach the margin of the lamina, whereas in the original *M. hypoleucus* and *M. angolensis*, they anastomose some little distance from the margin (see footnote 2, p. 340). Actually, the writer has not seen any specimen exactly «matching» the original *M. hypoleucus*; the only differences between it and *M. angolensis*, however, lie in the size of the leaves — a relatively unimportant point in *Monotes*, within certain limits — and in the *average* colour of the indumentum of the lower leaf-surface. The dusky colour of the lower leaf-surface in *M. angolensis* at first appeared to be somewhat characteristic, as compared with the greyish-white of *Welwitsch* 1036; but detailed examination of a number of specimens of *M. angolensis* has revealed the fact that the colour is very variable, being apparently dependent upon the number of resin-containing glandular hairs mixed with the ordinary type of simple hair. The question therefore arises whether *M. angolensis* represents the same species as *M. hypoleucus*; the writer is now inclined to believe that it does, and moreover, that *M. angolensis* represents the more normal state for the species, so far as leaf-size is concerned, the size and texture of the leaves in *Welwitsch* 1036 indicating a vegetatively-vigorous and quickly-grown condition; or at least it may be suggested that *M. angolensis* is a small-leaved, possibly ecological, variety of the same fundamental type as *M. hypoleucus*. It is an interesting point that if the specimens of Gossweiler and Lynes are, as they undoubtedly should be, excluded from *M. hypoleucus* as originally defined from *Welwitsch* 1036 (see footnote 2, p. 340), and the doubtful Delevoy specimens excluded from *M. angolensis*, the two forms are found to be confined to a restricted Angolan area, occupying the higher land of the adjacent provinces of Huila, Bié and Benguela. Until more material, with com-

prehensive field-notes, is available, it is, of course desirable to maintain the two specific designations; so that, at the moment, *M. hypoleucus*, as originally described by WELWITSCH, appears to be represented only by several specimens of the same number, *Welwitsch* 1036. It may be noted that the inflorescences of the two forms, *M. hypoleucus* and *M. angolensis*, are of the same few-flowered paniculate type.

M. Gossweileri De Wild. [1], apparently an exclusively Angolan form, very distinct in habit, being, according to notes attached to the original specimens, a low shrub, with stems spreading in a caespitose manner. DE WILDEMAN allied this form to GILG's «*Monotes acuminatus*», with little justification, for, as pointed out above, this latter species is of another generic type, while *M. Gossweileri*, although so distinct in habit, is certainly a *Monotes*, having the typical axillary inflorescence and stamens with the small triangular connective, characteristic of by far the larger section of the genus. *M. Gossweileri* is very close to *M. Homblei* in type and distribution (although not necessarily in amount) of indumentum on upper and lower surfaces on the leaves, but it is quite distinct from that species in its very short petioles, and smaller number of lateral veins, associated with much smaller leaves, which are of variable shape, particularly so far as the apex is concerned; the not infrequent tendency to acuminate form of the latter is certainly somewhat reminiscent of «*Monotes acuminatus*», and may account for DE WILDEMAN's suggestion of affinity between the two types [2].

In 1931, as a result of GENERAL SMUTS' (1930) botanical expedition to Rhodesia, DR. J. HUTCHINSON gave a list of species of *Monotes* from that area, principally from the Northern Province (25). Six new species were proposed,

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1. *Gossweiler* 3904 (Br; also BM, Coi, K, Lisb. JC); see 41, pp. 173-4.

2. DE WILDEMAN further added to his list of «new *Monotes* spp.» two forms which need not be considered here, namely: — «*M. Gilleti*», which is undoubtedly the same species as GILG's original «*M. acuminatus*», transferred, as noted above, to another generic type, *Marquesia* (see p. 335; *cf.* also 4); and «*M. Sapini*», also a *Marquesia* (3, pp. 723 *et seq.*).

four of them being considered as entirely new discoveries; these are as follow: —

M. cordatus Hutch. [1]. The material upon which this species is based suggests, at sight, a mature condition of *M. discolor;* and a detailed comparison of the original and subsequently-named specimens of «*M. cordatus*» with material included under M. *discolor* (and also originally under «*M. kapiriensis*») has indicated that HUTCHINSON's new species is old, fruiting material of the same specific type, the leaves having become glabrous and lost their «resiny roughness» as the glandular hairs have dried out. The fruits of «*M. cordatus*» also agree in general type with those of *M. discolor.*

M. lukuluensis Hutch. [2]. In this case, again, the essential characters of the leaves and fruits suggest that the material under consideration is an old specimen of the general *M. discolor* type, the leaf-bases being somewhat less cordate than is typically, although by no means invariably, the case in that species; the upper leaf-surface still has a rather granular, resiny appearance in «*M. lukuluensis*». It thus appears that R. E. FRIES' original *M. discolor* represents a variable and widely-ranging type, which includes not only *M. kapiriensis* De Wild., but also *M. cordatus* and *M. lukuluensis*, as defined by HUTCHINSON.

M. oblongifolius Hutch. [3]. The type specimen in this case also consists of mature leaves and fruits: the characters suggest an alliance with *M. angolensis*, from which, however, the specimen differs in the facts that its lateral veins run somewhat nearer to the leaf-margin than in that species, and that its upper leaf-surface is almost glabrous, with remains, only, of simple and stellate hairs and resinous glandular hairs; in this point it is reminiscent of the *discolor* group. The aspect of the lower leaf-surface is especially similar to that of *M. angolensis.* It is impossible, at the moment, to determine whether this form does indeed

1. *Hutchinson and Gillett* 3703 (K); *Milne-Redhead* 598 (K); and *Stevenson* 64 & 142 (K, IFI).

2. *Hutchinson and Gillett* 3741 (K, Br).

3. *Hutchinson and Gillett* 3765 (K, Br).

represent a distinct species, or whether it is a hybrid segregate, one of the parental forms being *M. angolensis.*

M. obliquinervis Hutch. [1]. This species does not appear, at first sight, to be sufficiently different from the numerous and varying forms included under *M. katangensis* to warrant the suggestion of a new specific epithet. The outstanding characteristic of the leaves is the straight and oblique course of the closely-placed and strongly-marked lateral veins; not infrequently, however, the venation has a similar aspect in what appear to be otherwise very typical specimens of *M. katangensis.* The leaves are poorly-preserved, but they are of the same general shape as those of *M. katangensis,* particularly so far as the apex is concerned; there is the same tendency, as in that species, to the formation of subsidiary glands in the axils of the lateral veins; while the indumentum of the upper surface is of the same type, and disappears in the same manner, leaving the surface dotted with the rather enlarged bases of the hairs; moreover, the rounded, softly-pubescent twigs, the form of the inflorescence, and the apparently immature fruits, with their somewhat cone-shaped, apiculate ovaries and reddish wings, are all of the general *M. katangensis* type. The lower leaf-surface of the Rhodesian specimen is entirely covered by an indumentum similar to that of *M. katangensis,* but much more sparse; this condition may, however, occur in otherwise quite typical specimens of *M. katangensis,* also from Rhodesia [2]. A significant feature of *M. obliquinervis* is the occurrence of a certain number of stamens with a very small triangular connective amongst those of the ordinary *katangensis* form, which are without such a connective; a similar occurrence has been noted in another Rhodesian specimen, which, moreover, possesses lateral venation reminiscent of that of *M. obliquinervis,* but in association with a dense lower indumen-

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1. *Hutchinson and Gillett* 3963 (K, Br).

2. *Cf. Pole Evans* 3045 (2) (K); see also *Gamwell* 160 (BM), in which the *meshes* of the vein-reticulum of the lower leaf-surface are almost free from indumentum.

tum [1]. The combination of characters in these specimens of *general katangensis type* suggests their hybrid origin — a suggestion which seems to be confirmed by examination of a very significant specimen from the Katanga [2]. This specimen is near to *M. africanus* in the characters of its twigs and leaf-surfaces, and in petiole-length, while the leaf-shape (particularly as regards the apex), and the type of venation indicate some relationship to *M. katangensis.* The fruits accompanying the leaves and twigs of this specimen are detached, there being no indication of inflorescence-type; the fruits themselves give no especial clue with regard to affinities, except that the wings are of the same reddish tinge as in young fruits of *M. katangensis,* and this feature of itself is of little value, for a red tinge occurs in the fruit-wings of various forms. Since the fruits are too mature to yield remains of the staminal whorls, it is impossible to say whether the stamens of this specimen were with or without connectives, or whether both forms occurred, as in *M. obliquinervis.* The leaf-characters of Quarré's Katanga specimen, however, undoubtedly suggest a combination of those of *M. africanus* and *M. katangensis;* and it may be that HUTCHINSON's «*M. obliquinervis*» and the various aberrant forms which have been considered as «near to *M. katangensis*», but showing a lack of exact conformity to that species in such a way as to suggest modification by another species, rather than simple variation, represent a plexus of hybrid segregates, only slightly modified, in these particular instances, by the characters of the second form, which may be, according to the indications provided by Quarré's specimen, *M. africanus;* if further evidence proves this to be the case, it will, of course, be necessary to prefix the hybrid sign to the specific name *M. obliquinervis.* In support of this suggestion of hybridity between the two species, it should be observed that *M. africanus,* in its regional forms, and

1. *Pole Evans* 4868 (28) (*K*).
2. *Quarré* 1773 (Br).

M. katangensis each occur, both in the Katanga and in Northern Rhodesia [1].

The two remaining new species of *Monotes* in HUTCHISON's Rhodesian list are as follow:

M. glandulosissimus Hutch., based primarily upon a specimen collected during the 1930 expedition, reference being also made to certain specimens collected by Dr. Burtt Davy in Northern Rhodesia, during a Central African tour in 1929 [2]. It does not seem possible to distinguish specifically between these specimens and Kirk's original Rhodesian discovery, « *Vatica africana* Welw. var. *glomerata* Oliv.», which should, as noted above (p. 343), be included in DE WILDMAN's species *M. katangensis*. HUTCHINSON's suggested designation for the later-collected Rhodesian material thus seems to be unnecessary; for in the form of the inflorescence, in the structure of the stamens, and in essential leaf-characters, the specimens from the Katanga and from Rhodesia undoubtedly represent the same specific type.

M. tomentellus Hutch. et Milne-Redhead. The type of this species is a specimen from Southern Rhodesia, collected by Teague in 1915, and in the first instance, referred tentatively to *M. Engleri* Gilg. So far as the present writer is able to determine from a comparison with the origin al . *Engleri*, and an examination of a considerable amount of material of the same type, at varying stages of maturity, *M. Engleri* is the correct reference for Teague's specimen, and the species *M. tomentellus* is superfluous. As previously noted (p. 340), *M. Engleri* seems to be a small-leaved, but quite distinct,

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1. *M. africanus:* from the Katanga, cf. *Ritschard* 1561 (Br); from N. Rhodesia, cf. *Duff* 71/33 (IFI). *M. katangensis:* from the Katanga, cf. *Quarré* 369 (Br); from N. Rhodesia, cf. *Duff* 402/32 (IFI).

(N. B. No specific epithet is as yet suggested for *Quarré* 1773; and since the stamen-type is not known, it is not possible to refer to it in the key which summarises this account of the genus *Monotes*).

2. *Hutchinson and Gillett* 3595 (K); and *Burtt Davy* 20950 and 20857 (K). It may be noted that Burtt Davy also collected similar material in the Belgian Congo, in 1919 [17857 (K)].

member of the *M. caloneurus* circle of affinity, which, as a whole, is closely connected with *M. hypoleucus*; it is, therefore, of interest to find that certain specimens collected by Swynnerton, and listed by BAKER as «*M. hypoleucus*», are actually of the *M. Engleri* type, and are, indeed, included under «*M. tomentellus*» by HUTCHINSON and MILNE-REDHEAD in the original diagnosis of their proposed species. A further point of interest in connection with Swynnerton's specimens is that they were collected between 1905 and 1908, from a locality in Southern Rhodesia not very far distant from the locality which in 1905 yielded the original *M. Engleri* [1].

In a survey of John Gossweiler's plants from Angola, made in 1932 as a preliminary study for a work on the flora of that area, EXELL (14) described two further forms of *Monotes*, namely:

M. loandensis EXELL [2]. This species is clearly of the *caloneurus* alliance, but is quite distinct in aspect, with its smaller, narrower leaves, frequently somewhat spathulate in shape, its shorter petioles and smaller number of lateral veins; moreover, the midrib and bases of the lateral veins on the lower leaf-surface are much more markedly glabrous than in *M. caloneurus*.

li. Hutchinsonianus Exell [3]. This species is closely allied to the group of forms which includes *M. adenophylus*, *M. glandulosus*, *M. Wangenheimianus* and *M. Delevoyi*; it differs from them, and approaches *M. Homblei* and *M. Gossweileri*, in the presence of occasional stellate hairs in the meshes of the vein-reticulum of the lower surface of the leaf; more material is however required to elucidate the significance of this approach to two species otherwise

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1. The specimens associated under «*M. tomentellus*» by HUTCHINSON and MILNE-REDHEAD are: *Teague* 431 (K), from the Umtali area; *Eyles* 4555 and 4646 (K), from the neighbourhood of Salisbury, S. Rhodesia; and *Swynnerton* 157 and 1314 (K, B M), from the Buzi district (cf. BAKER, 1). The original *M. Engleri* (*Engler* 3159), like *Teague* 431, came from the Umtali area, a little to the north of the Buzi highlands.

2. *Gossweiler* 9492 (Coi, BM, Lis. JC).

3. *Gossweiler* 9581 (Coi. BM, Lis. JC); see also *Gossweiler* 1440 (BM).

distinct, and on this account it seems advisable to maintain, at least for the time being, EXELL's specific designation for these Angolan specimens, although their similarity is aspect and structure to *M. glandulosus* and *M. Delevoyi* is very marked.

In the course of a study of the genus *Monotes* as represented in Angola, the present writer has recently added four new types to the list; these may be outlined as follows: —

M. Dawei Bancroft [1]. This is clearly a member of the *caloneurus* alliance, although at first sight it appeared to be quite distinct from *M. caloneurus* itself in the narrow form of the leaves, and in the possession of a distinct indumentum on the mature upper leaf-surface. Actually, however, after examination of a considerable amount of material, *M. Dawei* proves to be the least distinct member of the *caloneurus* group of forms; and it now seems likely that it represents a somewhat extreme, narrow-leaved form of *M. caloneurus* itself, with more remains of upper indumentum on the mature leaves than is usual; certainly there are «border-line» specimens which it is difficult to refer definitely to *M. caloneurus* or *M. Dawei*. It would be, perhaps, advisable to distinguish this form as «*M. caloneurus* forma *Dawei*» rather than to give it the status of a distinct species; or, at any rate, if «*Dawei*» is retained as a specific designation, it should be fully recognised that the «specific differences» between *M. caloneurus* and *M. Dawei* are not of the same magnitude as those between *M. caloneurus* and *M. Engleri*, also of this same group of allied forms.

M. Pearsonii Bancroft [2]. This species is plainly allied to *M. discolor* as indicated by the type and distribution of the indumentum of the upper and lower leaf-surfaces. It is, however, distinct in leaf-size and proportions, and its fruits are especially characteristic, with their long, narrow and pointed, accrescent, sepals, which are rather markedly

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1. *Dawe* 324 (fl.) (K); *Baum* 925 (fr.) (K, BM, BD, Coi). See 54 and 10.
2. *Pearson* 2649 (K). See 5 and 10.

unguiculate at the base, and said to be of a bright scarlet colour in the fresh condition.

M. Noldeae Bancroft[1]. This again appears to be a distinct form, although combining to some extent the characters of *M. africanus* and *M. angolensis*, in such a way as to suggest its origin by hybridity of those two species. The general aspect of *M. Noldeae* is also similar, at first sight, to that of *M. Engleri* of the *caloneurus* alliance, but it is distinct from *M. Engleri*, and nearer to *M. loandensis* of the same alliance, in that the midrib and lateral veins are practically glabrous on the lower leaf-surface. Much more material is necessary to prove the correctness or otherwise of the suggestion with regard to the hybrid origin of *M. Noldeae*.

M. rubriglans Bancroft[2]. This form is known only from a single specimen, and appears to be a somewhat small-leaved type of the *M. glandulosus* form-group, distinct in the red colour of its extrafloral nectary.

Amongst a number of *Monotes* specimens collected in Northern Rhodesia, Nyasaland and Tanganyika Territory and recently sent to Kew by the late Mr. B. D. Burtt, no actual new types have been descovered, but distribution--areas of previously known species have been extended, and the collection is of considerable value in that it provides certain «connecting links» for distributions otherwise somewhat difficult to explain; this is especially illustrated in the case of *Monotes Engleri* and the nearly-related «*M. rufotomentosus*».

The most recent collection of *Monotes* examined by the present writer is that made by the late Dr. L. W. CARRISSO and his colleagues in Angola during the 1937 expedition (14 a). Besides adding new area records and contributing some interesting variations of known species, this collection contains two distinct new forms, namely: —

1. *I. Nolde* 202 (BD); also *Gossweiler* 9520 (Coi, Lisb. JC, BD, BM). See 6 and 10.

2. *Bonnefoux et Villain* 57 (P). See 10, pp. 133 & 138.

M. Carrissoanus Bancroft [1]. This species falls within the «*Monotes discolor* group» of forms, agreeing with them in type and distribution of indumentum; in general leaf--shape it is similar to *M. oblongifolius* of this group. In the relation of the lateral veins to the leaf-margin, it is more similar to *M. angolensis* than to *Moblongifolius;* it is, however, outstanding and different from either of these two species in the considerable irregularity of the tertiary venation, in the possession of markedly long petioles, slender infructescences, and slender-winged, crimson to red-brown fruits.

M. xasenguensis Bancroft [2]. This is clearly allied to *M. glaber* Sprague, from which it differs in the possession of longer petioles and more numerous lateral veins, and in the more or less heart-shaped outline of the leaf-gland.

From the foregoing chronological survey of the genus *Monotes,* it will be seen that, to date, thirty-six species have been proposed. Of the thirty-six specific epithets, seven are here considered as synonyms, namely:

M. kapiriensis De Wild. *M. cordatus* Hutch. *M. lukuluensis* Hutch.	= *M. discolor* R. E. Fr.
M. glandulosissimus Hutch.	= *M. katangensis* De Wild.
M. tomentellus Hutch. et Milne-Redhead	= *M. Engleri* Gilg.
M. Thomasi De Wild.	= *M. magnificus* Gilg.
M. Verdicki De Wild.	= *M. Homblei* De Wild.

1. *Exell and Mendonça* 1788 (BM, Coi); also *Gossweiler* 11,311 (BM, Coi).

Monotes Carrissoanus Bancroft, sp. nov., cum speciebus sectionis *M. discoloris* proprietate et distributione indumenti foliorum congruens, sed nervis tertii ordinis irregularibus, nervis lateralibus utrinque 10-13 (plerumque 11-12) cum nervis subsidiariis brevis crebris, et petiolis longis (saepissime 2.2—2.6 cm. longis) differt.

(Full diagnoses of this and the following species hawe now appeared in the Journal of Botany, 1939).

2. *Gossweiler* 11,755 (BM, Coi).

Monotes xasenguensis Bancroft, sp. nov., affinis *M. glabro* Sprague, sed petiolis longioribus, nervis lateralibus pluribus, et glandula foliorum plus minusve cordata differt.

With regard to the remaining twenty-nine species, a consideration of the taxonomic notes appended to the chronological list will indicate that there are, within the genus *Monotes*, eight types, or main lines of development, which may be defined as follows: —

1. The KATANGENSIS type, distinct from all other groups of *Monotes* species in the possession of stamens *without* a triangular prolongation of the connective. The leaves possess an upper indumentum outstandingly, at least, of rather coarse simple hairs, which, in *M. katangensis* De Wild. itself, disappear more or less completely at maturity; a «general» lower indumentum; and a varyingly acuminate, acute, or apiculate form of the apex. Associated with *M. katangensis* is *M. dasyanthus* Gilg, which may be distinguished by its broader leaves, more persistent upper indumentum, and small, though dense, axillary inflorescences; the new Angolan material however, presents specimens which appear to be intermediate between typical specimens of these two species. Reference must be made under this heading to *M. obliquinervis* Hutch., of which the majority of the leaf, inflorescence and fruit characters ally it with *M. katangensis*; the occurrence of stamens of mixed type, both without and with a prolonged connective, and the sparse, though general, nature of the indumentum of the lower leaf--surface, however, suggest the origin of *M. obliquinervis* by hybridity between *M. katangensis* and a member of the more typical form-groups of the genus, possibly *M. africanus*.

The other seven lines of development are characterised by the prolongation of the stamen-connective as a triangular appendage; as a whole, they are represented by closely-allied species, the distinctions between which are often very ill-defined.

2. The GLABER type, in which both leaf-surfaces are glabrous, and the lateral veins taper and anastomose conspicuously short of the leaf-margin. This type is represented by two species, *M. glaber* Sprague and *M. xasenguensis* Bancroft. Much material of the former species is available,

and this shows considerable variation in leaf-size and shape; the variations in leaf-size are, however, independent of the more restricted variations in petiole-length and lateral vein-number.

3. The AFRICANUS type, in which the upper leaf--surface is glabrous, while indumentum occurs only on the veins of the lower surface; the lateral veins run close to the leaf-margin. *M. africanus* (Welw.) A. DC. appears to be the only species representing this type, but it has various regional forms, differing in leaf-size and in proportions of length to breadth of the lamina; the *amount* of lower indumentum may also be variable — a glabrous form, recalling *M. glaber,* has indeed been recorded; but all forms agree in petiole-length and in lateral vein-number, both of which show only a small range of variation, which, again, is independent of variations in the size of the lamina.

4. The GLANDULOSUS type, represented by six very closely-allied forms, *M. glandulosus* Pierre, *M. Delevoyi* De Wild., *M. Hutchinsonianus* Exell, *M. Wangenheimianus* Gilg, *M. adenophyllus* Gilg and *M. rubriglans* Bancroft. These forms are similar in the possession of leaves characterised by the following points: — The upper leaf--surface bears an indumentum of, at least predominantly, simple hairs, amongst which occur a varying number of glandular, resiniferous hairs; the indumentum as a whole is variable in amount and tends to disappear as the leaf matures. The lower indumentum is of the same type and composition as that of the upper leaf-surface, and also is variable in amount in different specimens, and in different states of development, of the same species; it occurs typically over the veins only, so that the meshes of the reticulum are generally glabrous *(cf.* the AFRICANUS type), although occasional *isolated* stellate hairs may occur, as in the type specimen of *M. Hutchinsonianus;* the epidermis of the meshes is, however, always plainly visible. The lateral veins of all these species run close to the leaf-margins before anastomosing. The leaves within the group vary greatly in size, although they are, on the whole, large; *M. rubriglans* has the smallest leaves, while those of

M. Wangenheimianus are very large, but it should, of course, be remembered that these two forms are known from the type specimens only. The shape of the leaves also varies, from somewhat oblong and «straight-sided» in *M. glandulosus* (also a single-specimen form [1]) to broadly-elliptical, obovate, or sub-orbicular in *M. Wangenheimianus;* the leaf-base is typically rounded to sub-cordate; and there ts a tendency — manifested particularly in *M. Delevoyi* and *M. Wangenheimianus* — to the formation of subsidiary leaf-glands in the axils of the lateral veins. So far as can be determined, inflorescence, flower and fruit structures are uniform in the group; the inflorescences are apparently exclusively axillary, as in all known species of *Monotes*, except *M. katangensis* and *M. obliquinervis*, and are of the more lax, few-flowered type.

It is very debatable how far these six forms should be considered as separate species; it may be that they are only geographical or ecological forms or varieties of a single species. For the moment, however, since there is comparatively little material, and since, moreover, it has been collected in more or less isolated localities, it is convenient to keep them separate for purposes of reference, but it should be remembered that the «specific difference» between, for example, *M. glandulosus* and *M. Delevoyi*, is very far from being of the same order as that between *M. africanus* and *M. hypoleucus*, and even these, it may be recalled, were originally considered by WELWITSCH and by OLIVER to be varieties of a single form. For the moment then, and for convenience of reference, these six closely--related forms, constituting a group characterised by the features outlined above, may be distinguished as follws:— *M. glandulosus*, an Angolan form, with leaves somewhat oblong in shape; *M. adenophyllus* (Tanganyika), a form having a conspicuous upper indumentum, even in fairly mature leaves, and being further characterised by a fringed and somewhat undulating leaf-margin; *M. Wangenhei-*

1. An Angolan specimen collected by Admiral Lynes in 1927 (BM) approaches *M. glandulosus* in leaf-characters, the outstanding difference consisting in the shape of the lamina-base, this being somewhat cuneate, as in *M. loandensis*.

mianus (Tanganyika), with very large, broadly-ovate to sub-orbicular leaves, and a distinct tendency to the formation of subsidiary leaf-glands; *M. Delevoyi* (characteristically from the Katanga, but similar specimens have also been recorded from Tanganyika and Northern Rhodesia [1]), with leaves of very variable size, but generally smaller than those of *M. Wangenheimianus*, broadly-elliptical to sub-cordate in outline, having occasional subsidiary leaf--glands, typically rather thin-textured, with a very sparse upper and lower indumentum, the latter almost invariably quite absent from the meshes of the vein-reticulum; *M. Hutchinsonianus* (Angola and Katanga), with broadly--elliptical leaves, very similar in appearance to those of *M. Delevoyi*, but characterised especially by the occurrence of isolated, but not infrequent, stellate hairs in the meshes of the vein-reticulum on the lower leaf-surface; and *M. rubriglans* (also from Angola), with comparatively small leaves, practically glabrous mature leaf-surfaces, except for the presence of glandular resiniferous hairs, and distinct in the possession of a small, flat, red-coloured leaf-gland.

The differences between *M. glandulosus*, *M. Wangenheimianus* and *M. Delevoyi*, especially, seem to be more in degree than in kind, and since, of the three specific epithets, *glandulosus* has priority, this whole group of six closely-related forms may be conveniently referred to as the «*glandulosus* group», or as representing the «GLANDULOSUS type» of development.

5. The CALONEURUS type. This line of development is represented by an alliance of similar forms, in which the lateral veins run close to the leaf-margin, and which agree in the possession of a typically somewhat shaggy indumentum on the upper surface of the young leaves, and in the occurrence of a fine, close indumentum in the meshes of the vein-reticulum of the lower leaf-surface. The upper indumentum disappears at maturity, to a greater or less extent, tending to leave the surface glabrous, especially in *M. caloneurus* Gilg, *M. loandensis* Exell and *M. Engleri*

1. e. g., *Wigg* 395 (IFI) and *B. D. Burtt* 5924 (K and IFI), respectively.

Gilg; in *M. Kerstingii* Gilg there are more often remains of indumentum, while in *M. Dawei* Bancroft, a readily--detectable residuum of shaggy hairs appears to constitute the normal condition in mature leaves.

The lower indumentum completely covers the leaf-surface, even at maturity, in *M. Kerstingii* and *M. Engleri;* in *M. caloneurus, M. loandensis* and *M. Dawei,* however, the midrib and at least the thicker, basal portions of the lateral veins are more or less glabrous at maturity, although the finer veins and the meshes of the reticulum are completely covered by the indumentum.

As having very distinct affinities with the members of the «*caloneurus alliance*», *M. elegans* Gilg must be considered here. This is a widely-ranging species, or rather group of forms, to be found in the typical *Monotes* habitats. i. e., in open forest or savannah woodland, on acid soils, from Angola through Northern Rhodesia to Tanganyika. The Angolan forms of *M. elegans* are very similar to *M. hypoleucus,* and so, indeed, is the type specimen from Tanganyika; these typical examples apparently differ essentially from *M. hypoleucus* only in the character of the lateral venation, which has a closer relation to the leaf-margin than in that species (see footnote 2, p. 340). In this respect, *M. elegans* is more similar to *M. caloneurus*; actually, some of the more easterly forms of *M. elegans* are extremely difficult to separate from *M. caloneurus,* since they approach the latter in the possession of a somewhat more shaggy upper indumentum than is typical for *M. elegans* [1]. This species thus seems to include a number of variable forms, intermediate between *M. caloneurus* and *M. hypoleucus;* whether its apparently intermediate nature, and its variability, are due to an original hybridisation between those species, or whether external conditions emphasize its close relationship, sometimes to one, sometimes to the other, species, it is at the moment impossible to say definitely; on the grounds of

1. *Cf.,* for example, *Nutt* s. n. (K), from Kambole, S. W. of L. Tanganyika.

the known distribution of *M. caloneurus* and *M. hypoleucus*, the suggestion with regard to hybridity certainly seems unlikely. In connection witht he origin and relationship of this, and other, forms, however, a very significant fact with regard to the occurrence and habitat of many of the specimens submitted for identification must be taken into consideration: namely, that considerable areas of open forest and savannah woodland, in the more colonised districts, for example in Tanganyika and Northern Rhodesia, have been at some time under cultivation. The method of preparing the land for agricultural purposes appears to have been by cutting down the woody material, burning it over as it lay upon the ground, and digging in the ash; the stumps of shrubs and trees remained in the ground, and when the land passed out of cultivation, the woody plants asserted themselves once more by sending up coppice-shoots. It must be remembered that the leaf-characters of such shoots are often much modified [1], and that without a thorough knowledge of the country and its agricultural history, it is impossible to pronounce upon the affinites of this coppice material; the herbarium systematist is entirely dependent upon workers in the field for *full* information concerning both habit and habitat of the specimens sent for identification. The type specimen of *M. elegans*, which is similar to the Angolan specimens in its approach to *M. hypoleucus*, came from the Tabora District of Tanganyika, having been collected by Holtz in 1904; much of this area, according to the account of Forest Officers, has now been burnt over and cultivated in the manner indicated above, and it is an interesting and significant fact that it is the later-collected Tabora material, like that sent by Adamson (s. n.), which is a-typical, or variable, in aspect.

Also connected with the «*caloneurus* alliance», in this case through *M. Engleri*, is *M. rufotomentosus* Gilg. It will be remembered that the diagnosis of this species was

1. *Cf.* the practical impossibitity of identifying the European Elms from coppice material.

based upon two specimens from the Uhehe Highlands in Tanganyika, *Goetze* 501 and 683. These are superficially similar, but they differ in certain respects: namely, the inflorescences of 683 are somewhat shorter than those of 501; the upper leaf-surfaces of 683 are practically glabrous and similar to those of *M. africanus*, while those of 501 have scattered remains of hairs and a good many short, round-headed resiniferous hairs; the lower leaf-surfaces of 683 have a very fine reticulum, and generally much more tomentum than in 501, including a number of very fine stellate hairs in the meshes of the vein--reticulum. It should be noted that, with the exception of the latter point, the presence of stellate hairs in 683 and their absence in 501, the differences between the two specimens are more in degree than in kind, and might conceivably have been due to somewhat different growth-conditions. There being a good deal of material of these two specimens in the different herbaria, it was possible to compare the petiole-length and the number of lateral veins, and to show that in these points, also, there are slight differences which contribute to a certain difference in aspect of the specimens as a whole; the petioles are distinctly shorter in 501 than in 683, and the number of lateral veins is smaller; in these respects, 501 approaches *M. africanus*, while 683 is more similar to *M. Engleri*.

Other specimens from Tanganyika, Nyasaland and Northern Rhodesia subsequently referred to *M. rufotomentosus* by Gilg and other investigators show a wide range of variation in detail, some of them very nearly approaching *M. africanus* in leaf and inflorescence characters, and others showing a marked similarity to *M. Engleri*. It is possible, of course, that *M. rufotomentosus* may be a plexus of variable forms produced as a result of former cultivation operations, as described under consideration of the case of *M. elegans*, and the approach to the characters of *M. africanus* or *M. Engleri* may be apparent only, and incidental, rather than an indication of origin; but it has been possible to examine so comprehensive a series of forms ranging between *M. africanus* and *M. Engleri*in

aspect and in details of structure, that the suggestion of hybridity is, in the case of *M. rufotomentosus*, at least not unreasonable. The approach to the characters of *M. africanus* and *M. Engleri* is easily accounted for if the idea of hybridity is valid, since *M. africanus*, although typically Angolan, extends, in its various forms, through Northern Rhodesia as far eastwards as Nyasaland and Tanganyika; while *M. Engleri*, although most frequent in Southern Rhodeisa, also appears to extend into Tanganyika (Uhehe Plateau) and Nyasaland, as well as into Northern Rhodesia (Abercorn District) [1]. It may be noted that in the specimens from Tanganyika and Nyasaland, the *amount* of indumentum on the lower leaf-surface is somewhat less than in the type of *M. Engleri*, although it is distinctly more than in *Goetze* 683, one of GILG's original forms of *M. rufotomentosus*, and the general aspect of the specimens is thus immediately reminiscent of *M. Engleri*. It is at least evident that *M. rufotomentosus* is not a «species» with definite limits, even when normal variation is allowed for; it must be regarded rather as a range of forms, the extent and type of the range indicating its not improbable origin by hybridity.

In connection with the «*M. rufotomentosus* plexus», it may be noted that certain specimens from Southern Rhodesia seem, at first sight, to be of this general type; a closer examination, however, reveals an apparent combination of the characters of *M. Engleri* with those of *M. glaber*; hybridisation in this case might readily be accounted for by the occurrence of the two species in close proximity [2].

A form of which the general aspect has a certain similarity to that of members of the *caloneurus* alliance, especially to *M. Engleri* and *M. loandensis*, is *M. Noldeae*

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1. *St. Clair Thompson* 461 (K) (Tanganyika); *B. D. Burtt* 5925 (K, IFI) (Nyasaland); *B. D. Burtt* 5921 (K, IFI) (Northern Rhodesia).

2. Such apparent hybrids are *Kelly-Edwards* s. n. (IFI), a specimen from near Salisbury, in which area both *M. Engleri* and *M. glaber* occur, and *Munro* 1684 & 1750 (BM), from Victoria, from which locality *M. Engleri* has been recorded, while *M. glaber* occurs in the neighbouring Selukwe area.

Bancroft (see p. 355); a consideration of the type and distribution of indumentum in the leaves of this species for the purpose of construction of an identification-key, would, at any rate, place it under the CALONEURUS type. From a detailed analysis of its leaf-characters, however, it seems not unlikely that the similarity to *M. Engleri*, for instance, may be a matter of superficial aspect only, for *M. Noldeae* certainly combines the characters of *M. africanus* and *M. angolensis* in such a way as to suggest its probable origin by hybridity of these two species. The distribution of *M. Noldeae*, however, as at present known, does not support this suggestion.

6. The HYPOLEUCUS type. This type includes *M. hypoleucus* (Welw.) Gilg and *M. angolensis* De Wild., the very close relationship between which has been discussed on p. 347; the main leaf-characters of the type are the close, general indumentum of the lower surface, the persistent «velvety» indumentum of stellate or branched hairs on the upper surface, and the anastomosis of the lateral veins at some distance from the leaf-margin. This type, as indicated above, is closely connected with the CALONEURUS type by *M. elegans*.

7. DISCOLOR type. This is represented by *M. discolor* R. E. Fr., *M. Pearsonii* Bancroft and *M. Carrissoanus* Bancroft. These possess a general indumentum similar to that of *M. hypoleucus* on the lower leaf-surface, and an upper indumentum characterised by the presence of many glandular hairs, the other hairs — simple, stellate or tufted — being sparse; the upper leaf-surface, indeed, tends to become more or less glabrous, and, in *M. discolor* itself, even somewhat shining, at maturity. In *M. discolor*, the lateral veins run close to the leaf-margin before anastomosing, as in the CALONEURUS type, while in *M. Carrissoanus* they anastomose some distance from the leaf-margin, as in the HYPOLEUCUS type; in *M. Pearsonii*, the «lateral vein: leaf-margin relationship» is intermediate between that in .*M Carrissoanus* and in *M. discolor*. *M. oblongifolius* may be included under this type, its leaf-surfaces being very similar to those of *M. discolor*,

and the relation of lateral veins to leaf-margin being as in *M. Pearsonii.* The origin and status of *M. oblongifolius* is, however, somewhat difficult to assess; in leaf-size, petiole-length and lateral vein-number it is very reminiscent of *M. angolensis,* from which it differs in the almost glabrous upper surface of mature leaves and in the somewhat nearer appoach of the lateral veins to the leaf--margin; its characters certainly provide connecting links between the HYPOLEUCUS type, as represented by *M. angolensis,* and the DISCOLOR type, as represented by *M. discolor* itself.

8. The HOMBLEI type, represented by three quite distinct species, *M. magnificus* Gilg, *M. Homblei* De Wild. and *M. Gossweileri* De Wild. These all agree in the possession of a general indumentum on the lower leaf-surface, and an upper indumentum which is more or less persistent, even at maturity. In *M. magnificus,* the upper indumentum is of stiff simple hairs; in the other two species, while simple hairs seem to predominate, these are less harsh, and there is a proportion of tufted hairs amongst them; in *M. Homblei* especially, the upper leaf--surface has a somewhat velvety texture approaching that of the leaves of *M. hypoleucus.* In all three species, the length of the leaf-lamina is typically less than twice its breadth, being broadly elliptical to sub-orbicular in shape; in *M. Gossweileri,* the leaves are small, and in *M. magnificus,* very large, while those of *M. Homblei* are variable in size, sometimes reaching the dimensions of those of *M. magnificus*; the smallest leaves in *M. Homblei* are however, considerably larger than those of *M. Gossweileri.* The three species form a somewhat loose alliance or series, which is conveniently referred to as representing the «HOMBLEI type» within the genus since *M. Homblei* seems structurally to constitute the middle term of the series; it is especially the characters of *M. Homblei,* moreover, which indicate, on the one hand, an affinity with *M. hypoleucus,* thus forming a link between the HOMBLEI and HYPOLEUCUS types; and on the other hand, so far as leaf-form, size and venation are concerned, with

M. Delevoyi, thus connecting the HOMBLEI and GLANDULOSUS types.

In the course of listing the sheets of *Monotes* specimens from the various herbaria, certain suggested, but unpublished, specific epithets have been noted, attached to specimens not at first sight readily referrable to authenticated species. The specimens bearing these suggested names have been carefully examined and compared with a range of similar specimens in each case, and it has not been found necessary to regard any of them as representing new species; they are, however, of considerable interest, and since they illustrate the difficulties presented by the taxonomy of the genus, they may be briefly listed and discussed as follows: —

Kassner 2406 & 2605: «*M. Gilgii* Engler» [1].
Stevenson 247/31: «*M. Stevensonii* Burtt Davy» [2].
Robyns 1954: «*M. pwetoensis* Robyns» [3].
Gomes Sousa 1324: «*M. nyasensis* Hutchinson» [4].

The specimens of Kassner, Stevenson and Robyns are all of the GLANDULOSUS type (see pp. 358-360). The small distinctions between the representatives of this type being recognised, *Kassner* 2406 (*«M. Gilgii»*) is referrable to *M. Delevoyi; Kassner* 2605 (also *«M. Gilgii»*) is comparable with *M. Hutchinsonianus*, having an occasional stellate hair in the meshes of the vein-reticulum: otherwise it is quite similar to *Kassner* 2406; *Stevenson* 247/31 (*«M. Stevensonii»*) is referrable to *M. Delevoyi* on all points, except that there is more indumentum than is typical in that form, both on the upper, and on the veins of the lower, leaf-surfaces, and the upper indumentum is somewhat more «shaggy» than is usual in the whole GLANDULOSUS group — it approaches, in fact, in this respect, the

1. From the Belgian Congo; (BD, BM).
2. From Northern Rhodesia; (IFI, K).
3. From the Belgian Congo; (Br, IFI).
4. From Nyasaland; (K).

condition found in *M. Kerstingii* of the CALONEURUS type, or in *M. Homblei; Robyns* 1954 *(«M. pwetoensis»)* has the general aspect of *M. Delevoyi*, but there is a very occasional hair in the meshes of the vein-reticulum, so that, in this feature, Robyns' specimen is more comparable with *M. Hutchinsonianus.*

The extension of the *Hutchinsonianus* form of the GLANDULOSUS type beyond the limits of Angola [1] into the Belgian Congo, the type-area for *M. Delevoyi*, and the occurrence of such specimens as *Robyns* 1954, in which the examination of a large amount of material reveals only a very small number of stellate hairs, render it increasingly difficult to regard *M. Hutchinsonianus* as specifically distinct from *M. Delevoyi* — or *M. glandulosus*, should *Delevoyi* ultimately be included in *glandulosus;* in the «Conspectus Florae Angolensis», it was pointed out that *Hutchinsonianus* and *Delevoyi* might prove to be conspecific, but in accordance with the views expressed on p. 359 of the present contribution, the separate names are here retained for convenience of reference. The occurrence of occasional stellate hairs on the lower leaf-surface in the *Hutchinsonianus* form, and the rather abundant and shaggy upper indumentum of *Stevenson* 247/31, considered in conjunction, suggest a linkage between the GLANDULOSUS and HOMBLEI types of Monotoid structure — a suggestion which is supported by the great similarity in general aspect between such specimens as *B. D. Burtt* 5919 (referred to *M. Delevoyi)* and *B. D. Burtt* 5927 (referred to *M. Homblei)* [2]. On the other hand, the occasional development of stellate hairs in the meshes of the vein-reticulum on the lower leaf-surface may simply be the expression of a fundamental tendency within the group; and the greater *amount*, at any rate, of both upper and lower indumentum in Stevenson's specimen may result merely from the action of certain ecological conditions.

Gmoes Sousa 1324, the original *«M. nyasensis»* of

1. *Cf.* Conspectus Florae Angolensis (10), p. 138.

2. Specimens from Northern Rhodesia and Tanganyika Territory, respectively (K, IFI).

HUTCHINSON, is a member of the «*M. rufotomentosus* plexus», of a type very near to *M. africanus*; the extreme difficulty in dealing with the taxonomy of these East African forms of *Monotes*, is illustrated by the fact that the same name has been suggested for three specimens which it is impossible, after an examination and comparison of all available material, to regard as other than forms of *M. africanus* itself [1], and for a specimen from Southern Rhodesia, which at first sight, has the aspect of a member of the *M. rufotomentosus* plexus, but which on analysis appears to be a hybrid form between *M. Engleri* and *M. glaber* [2].

The existence of such specimens as those reviewed in the preceding paragraphs, certainly complicates the taxonomic problem of avoiding the dangers, on the one hand, of a too minutely analytical «species-splitting», and on the other hand, of a comprehensive «species-lumping» which does not take into account the occurrence either of well--marked geographical and ecological forms, or of possible series of hybrid segregates.

It will be useful to append here a summary of the *Monotes* types and «species» as listed above, and such a summary may well take the form of an identification-key, in which the main divisions differentiate between the eight types of development, and the sub-divisions distinguish between the species and forms associated under those types.

It has already been remarked that leaf-characters are of considerable diagnostic importance in the genus *Monotes*, particularly with regard to *the distribution and type of indumentum on the surfaces of mature leaves*, and, after the separation of the two stamen-types within the genus — which, in fact, broadly correspond to differences in *the form of the leaf-apex* — it is on these features that the key-summary is very largely based. The leaf-lamina is extremely variable in size within a species, both length

1. *Clements* s. n. and 188 (IFI); *Townsend* 8 (IFI): all specimens from Nyasaland.

2. *Kelly- Edwards* s. n. (IFI).

and breadth showing a considerable range of dimensions. With regard to *length of lamina*, this may vary, in *M. Homblei* for example, from 7.5 to 16 cm.; for this reason, the length of lamina is expressed neither as an average, nor as a range of measurements, but in general terms only; these terms, based upon the most frequently-occurring dimension, or short range of dimensions, which the available specimens have provided, are as follow: —

Lamina	generally	below	6	cm. in length		..... short.
»	»	from	6-8	cm. »	»	short-intermediate.
»	»	»	8-10	cm. »	»	.....intermediate.
»	»	»	10-12	cm. »	»	.long-intermediate.
»	»	above	12	cm. »	»	.....long.

The *breadth of the lamina* is expressed in terms of its general relation to the length, and is correlated with the typical *shape* in each case,where such details are necessary in the key, for distinction between species or forms.

It is interesting that in *Monotes* spp., the *length of the petiole* bears a general relation to the length of the lamina: types with the longer laminae tend to have also the longer petioles, and *vice-versa*. This point is illustrated, on the one hand by . *caloneurus*, with long laminae and petioles about 1.7 cm. in length, and on the other hand by *M. Gossweileri*, with short laminae and petioles 1.0 cm., or generally less, in length. The range of variation in petiole-length per species, however, is naturally much less than that in lamina-length; and in the short notes on species in the key, therefore, this feature is expressed in definite terms, where it is necessary to include it for identification purposes.

A broad correlation also exists between the length of lamina and petiole and the number of pairs of lateral veins: in general, the longer the petiole, the larger the number of pairs of lateral veins, and *vice-versa*. This is illustrated by *M. discolor*, in which the average petiole--length is about 2.5 cm., and the most frequent number of pairs of lateral veins is from 15-17; and by *M. africanus*, with a petiole-length of 0.8-1.0 cm., and from 10-12 pairs of lateral veins in typical examples of leaves. It may be

noted that an exception to the general relation between petiole-length and number of lateral veins occurs in *M. magnificus*, which possesses the largest leaves in the genus: the lamina may reach as much as 24.0 cm. and the petiole 3.0 cm., or even more, in length, while the number of pairs of lateral veins ranges only from 9 to 13.

Since the genus *Monotes* comprises a group of very closely-related species and forms, which are, moreover, very variable amongst themselves in their several characters, it is naturally extremely difficult to «key out». In some cases, a large amount of material, and from a fairly wide area, has been available for examination; so that the concept of average specific characters in such cases is presumably more correct than in those cases where the supply of material is limited: the chances are small that limited material would happen to provide the mean of the range of specific variation. It is not, therefore, claimed that the descriptions and key are by any means final: they are liable to modification in greater or less amount as more material comes to hand, so that the following «synoptical key» is necessarily only provisional.

SYNOPTICAL KEY TO THE TYPES AND SPECIES OF THE GENUS *MONOTES* A. DC.

(N. B. The main divisions of the key (under capital--letter-indicators) differentiate between the eight types of development in the genus; under each type, the various species, or sub-groups of species, are distinguished (in contrasting type, with small-letter-indicators); any individual distinguishing feature of a species, or group of species, is added, in brackets, to facilitate identification).

A. All, or a proportion, of the stamens without a triangular connective; leaf-apex typically acute or apiculate: . . . . . KATANGENSIS type

a. Stamens entirely without a connective; lower leaf-surface with an general, dense and felt-like indumentum:

b. Inflorescences dense, large, terminal and sub-spicate; leaves

with an upper indumentum in the young condition, tending to become glabrous at maturity; extra leaf-glands in the vein-axils frequent: . . . . . *M. katangensis*

bb. Inflorescences dense, but small, axillary and paniculate; leaves with an upper indumentum of stiff hairs even at maturity; extra leaf-glands not observed: . . . . . *M. dasyanthus*

aa. Stamens of mixed type, without and with a small connective; inflorescences large, terminal and sub-spicate; lower indumentum general, but sparse; upper indumentum tending to disappear at maturity; presence of extra leaf-glands indicated:
(lateral veins rather markedly oblique): . . (?×) *M. obliquinervis*

AA. Stamens with a distinct triangular connective; inflorescences axillary and paniculate; leaves of varying form, apex *generally* obtuse, rounded or emarginate:

B. Leaves, even in young condition, with glabrous upper surface, except occasionally along the line of the main veins:

C. Leaves, even in young condition, with glabrous lower surface also: lateral veins anastomosing some distance from the leaf-margin; young shoots glabrous: . . . . GLABER type

a. Laminae typically short, elliptical or obovate, length about × 2 breadth; petiole-length typically from 0.6-0.9 cm.; lateral veins typically 8-11 pairs: . . . *M. glaber*

aa. Laminae short-intermediate to intermediate, elliptical to obovate-elliptical, length more than × 2 breadth; petiole-length typically from 2.2-2.6 cm.; lateral veins typically 14-15 pairs:
(leaf-gland more or less heart-shaped in outline): . . . . . *M. xasenguensis*

CC. Leaves with indumentum on lower surface, but on veins only; lateral veins anastomosing very near the leaf-margin; young shoots with indumentum: . . . . . AFRICANUS type

a. Laminae generally elliptical, size variable, but in the typical form of the species, length generally short to short-intermediate, about, or somewhat more than, × 2 breadth; petiole-length 0.7-1.0, mostly 0.8 or 0.9 cm.; 10-12 pairs of lateral veins, rather markedly decurrent with the midrib; inflorescences few-flowered and somewhat lax: . . . . . *M. africanus*

aa. Laminae elliptical, length short to intermediate, generally about × 2 breadth; petiole-length generally over 1 cm., and reaching as much as 1.6 cm.; lateral veins frequently 12 or more pairs, not markedly decurrent with the mid-

rib; inflorescences few-flowered, comparatively dense: . . . . . (? ×) *M. rufotomentosus* (in part) [1]

BB. Leaves in young condition with a varying amount of indumentum on both surfaces (upper surfaces tend to become glabrous at maturity, to a greater or less extent, throughout this series of forms):

D. Indumentum typically absent from meshes of vein-reticulum on lower leaf-surface (an occasional hair, usually stellate, may occur, but the epidermis of the mesh is always visible):
(lateral veins anastomose at or very near the leaf-margin): . . . . . GLANDULOSUS type

a. Upper indumentum dense in young, and distinct even in mature, leaves:
(laminae ovate to elliptical or orbicular-ovate, length short-intermediate to long-intermediate, less than × 2 breadth; margins fringed and slightly undulating; petiole--length typically 1.5-1.7 cm.; lateral veins typically 10-12 pairs) . . . . . *M. adenophyllus*

aa. Upper indumentum tending to disapper more or less completely in mature leaves:

---

1. N. B. In material of *M. africanus* from Nyasaland and Tanganyika Territory, much of which is apparently coppice-growth, the lamina frequently reaches intermediate length, and the length is *less than* × 2 the breadth; the petiole-length averages 1.0 cm., and the lateral veins 11-13 pairs; this material, referred to as «*M. africanus* forma», is with difficulty distinguished from certain members of the «*M. rufotomentosus* plexus» when individual features and leaves are considered. It is the *aspect of the specimen as a whole*, which finally serves to distinguish between *M. africanus* forma and those members of the *M. rufotomentosus* plexus which very closely approach *M. africanus;* these latter have, *on the whole*, longer petioles and a higher number of lateral veins, while the upper leaf-surface is more plane than in *M. africanus*, and the flowers shorter-pedicelled. If, as appears to be very probable, «*M. rufotomentosus*» is indeed a plexus of hybrid segregates, the parental forms being *M. africanus* and *M. Engleri*, it will naturally be difficult to distinguish the segregates at one end of the range from *M. africanus*, and those at the other, from *M. Engleri*. «*M. rufotomentosus*» is again referred to in this key, under the CALONEURUS type, in association with *M. Engleri*.

In the preceding text, and in the distribution tables which follow this key, «*M. rufotomentosus*» is included under the CALONEURUS type and not referred to under the AFRICANUS type; this arrangement is of course, simply a matter of convenience, and has arisen from the fact that the distribution-area of «*M. rufotomentosus*» coincides with that of *M. Engleri*, the geographical range of both being more restricted than in the case of *M. africanus*.

b. Leaf-gland distinctly red:
(laminae elliptical to obovate, length short-intermediate to intermediate, less than × 2 breadth; upper leaf-surface somewhat shining and areolate; petiole-length generally 1.2 cm.; lateral veins typically 12 pairs): . . . . . *M. rubriglans*

bb. Leaf-gland dark brown or black:

c. Laminae oblong to elliptical:
(laminae long, length somewhat less than × 2 breadth; petiole-length 1.9-2.1 cm.; lateral veins 14-15 pairs): . . . . . *M. glandulosus*

cc. Laminae broadly-elliptical to sub-orbicular:
(extra leaf-glands may occur in the axils of lateral veins):

d. Isolated stellate hairs in meshes of vein-reticulum on lower leaf-surface occasional to not infrequent:
(laminae long, length considerably less than × 2 breadth; petiole-length 1.5-2.2 cm.; lateral veins 10-14 pairs): . . . . . *M. Hutchinsonianus*

dd. Meshes of vein-reticulum generally quite glabrous:

e. Indumentum over the veins of the lower leaf-surface generally sparse:
(laminae long-intermediate to long, length considerably less than × 2 breadth; petiole-length ranging from 1.0-2.8, but generally 1.9-2.1 cm.; lateral veins 8-14, typically 9-12, pairs): . . . . . *M. Delevoyi*

ee. Indumentum over veins abundant:
(laminae long, length considerably less than × 2 breadth; petiole-length about 1.5 cm.; lateral veins 12 pairs): . . . . . *M. Wangenheimianus*

DD. Indumentum always and distinctly present in meshes of vein-reticulum on lower leaf-surface:

E. Upper indumentum of distinct, rather long, simple and tufted hairs:
(lateral veins *generally* anastomosing at or very near the leaf-margin):

F. Upper indumentum typically somewhat shaggy, consisting of rather thin-walled hairs, tending to disappear at maturity: . . . . . CALONEURUS type

a. Lower indumentum tending to be partial at maturity, being absent or very sparse over midrib and bases of lateral veins:

b. Laminae elliptical or obovate-elliptical, length occasionally intermediate to long; lamina-base typically rounded to sub-cordate; number of lateral veins mostly from 13-18 pairs:

c. Lamina-length reaching 16.0 cm., less than × 2 breadth; upper surface almost entirely glabrous at maturity; petiole-length mostly 1.4-1.8, but reaching 2.0 cm.: . . . . . *M. caloneurus*

cc. Lamina-length reaching 13.0-13.5 cm., about, or more than, × 2 breadth; upper surface with considerable remains of indumentum at maturity; petiole-length mostly 1.2-1.7 cm.: . . . *M. Dawei*

bb. Laminae narrowly elliptical to obovate-elliptical or obovate, generally short-intermediate:

d. Laminae short-intermediate, length more than × 2, occasionally almost × 3 breadth, base narrowed, cuneate to sub-rotund; upper surface matte and glabrous; petiole-length 1.2-1.6 cm.; lateral veins 11-12 pairs, anastomosing a short distance from leaf-magin; midrib and bases of lateral veins markedly glabrous and reddish--brown in colour: . . . . . *M. loandensis*

dd. Laminae short to intermediate, length about × 2 breadth, base typically rounded, sometimes slightly cuneate or slightly cordate, upper surface shining and almost glabrous; petiole-length 1.4-1.7 cm.; lateral veins 10-13 pairs, *almost* reaching leaf-margin; midrib and bases of lateral veins pratically glabrous: . . . . . *M. Noldeae*

aa. Lower indumentum complete at maturity, being typically present on all veins:

e. Laminae sometimes short-intermediate, but generally intermediate to long-intermediate:

f. Laminae broadly elliptical to elliptical-orbicular, length less than × 2 breadth, base rounded

to sub-cordate; upper surface convex, glabrous or with remains of indumentum at maturity; lower surface densely felted with rather coarse hairs petiole-length generally 2.0-2.5 cm.; lateral veins generally 13-15 pairs: . . . . . *M. Kerstingii*

ff. Laminae elliptical to obovate-elliptical, length less than, about, or more than, × 2 breadth, base rounded to sub-cordate, butf requently narrowed; upper surface plane, glabrous, or with remains of shaggy and shorter-branched hairs in varying proportion; lower surface with fine, close indumentum; petiole-length mostly 1.0-1.5 cm.; lateral veins 11-15 pairs, with tendency to formation of short subsidiaries: . . . . . *M. elegans* (in part)

ee. Laminae short to short-intermediate, occasionally intermediate:

g. Lower indumentum greyish-white, markedly dense and fine, over veins and meshes alike: (laminae elliptical to obovate-elliptical, length generally short, about or less than × 2 breadth; upper surface at maturity typically glabrous and somewhat shining, areolate; petiole-length generally 1.0-1.5 cm.; lateral veins generally 9 or 10-12 pairs, with tendency to formation of short subsidiaries): . . . . . *M. Engleri*

gg. Lower indumentum fine, but more or less sparse over veins, or meshes, or both:

h. Laminae short-intermediate to intermediate, generally short-intermediate, generally elliptical, length less than, about, or more than, × 2 breadth, base rounded to cordate, sometimes slightly narrowed; upper surface with varying amount of residual indumentum, resin-hairs frequent on both surfaces; petiole-length very variable, frequently 1.1-1.5 cm.; lateral veins also variable, frequently 9 or 10-12 pairs: . . . . . (?×) *M. rufotomentosus* (in part)

hh. Laminae short, elliptical, obovate or ovate, length about or less than × 2 breadth, base rounded to sub-cordate, or narrowed; upper surface glabrous; lower surface with a markedly varying amount of indumentum over veins as well as in meshes; petiole-length 0.4-1.3 cm.; lateral veins 7-10 pairs, with varying relation to leaf-margin: . . . . . (?×) *M. Engleri* × *glaber*

FF. Upper indumentum of typically appressed hairs, more or less persistent at maturity: . . . HOMBLEI tpye

a. Laminae generally intermediate to long, breadth frequently nearly equaling length:

b. Upper indumentum somewhat velvety, of thick-walled simple, with a proportion of tufted, hairs; no extra leaf--glands observed:
(laminae very variable in size, occasionally short-intermediate to long, broadly elliptical or obovate-elliptical to sub-orbicular, base subcordate, rounded, flattened or slightly narrowed; lower surface typically velvety, and rather sparsely-covered with indumentum, stellate hairs in meshes being distinct; petiole-length very variable, from 1.0-3.0, generally from 1.3-2.0, cm.; lateral veins generally from 11--13 pairs): ..... *M. Homblei*

bb. Upper indumentum rough, of stiff, simple hairs; extra leaf-glands observed:
(laminae generally long, sub-orbicular, base cordate; lower surface typically thickly-felted with indumentum; petiole-length typically 2 5-3.0 cm.; lateral veins 9-13 pairs): *M. magnificus*

aa. Laminae short, very rarely short-intermediate, lenght usually somewhat less than × 2 breadth:
(laminae elliptical to slightly ovate or obovate, base typically very slightly cordate, apex flat to rounded, or slightly acuminate to bluntly apiculate; upper surface of mature leaves matte to shining, with scattered long bristly hairs; lower indumentum always present both on veins and in meshes, but very variable in amount; petiole lenght 0.3-0.7, generally 0.4 or 0.5, cm.; lateral veins 7-11, generally 8-10, pairs; inflorescences characteristic, comparatively long, few-flowered and lax, with pedicels up to 1.5 cm.): ..... *M. Gossweileri*

EE. Upper indumentum of short, generally fine, hairs:

G. Upper leaf-surface in young condition finely granular, with many short, round-headed resiniferous hairs; other hairs simple, tufted and stellate, generally somewhat sparse; surface more or less glabrous at maturity: ..... DISCOLOR type

a. Lateral veins anastomosing at leaf-margin:
(laminae intermediate to, generally, long,

generally e liptical, sometimes elliptical-oblong to ovate, length less than × 2 breadth, base rounded to markedly cordate; upper surface light green, often yellow--green in young stages, owing to abundance of resiniferous hairs; lower surface finely and densely felted; petiole-length 1.4-3.8, generally 1.8-2.5 cm.; lateral veins 12-20, generally 14-18, pairs): *M. discolor*

aa Lateral veins generally anastomosing a short distance from the leaf-margin:

b. Lateral and, especially, tertiary venation comparatively regular:

c. Laminae short-intermediate to intermediate, obovate, much narrowed at the base, length less than × 2 breadth, base truncate, rounded or very slightly cordate; upper surface matte and still finely granular at maturity; petiole-length 1.6-2.1 cm.; lateral veins 12-14 pairs, often forking near the leaf-margin:
(fruit-wings distinctly unguiculate): ..... *M. Pearsonii*

cc. Laminae short to short-intermediate, elliptical, or slightly ovate or obovate, length less than, about, or more than, × 2 breadth, base rounded to slightly cordate; upper surface practically glabrous at maturity; petiole-length 0.9-1.6, generally 1.3-1.5, cm.; lateral veins 9-13, generally 11-12, pairs, with tendency to formation of subsidiary laterals:..... ..... *M. oblongifolius*

bb. Lateral and, especially, tertiary venation markedly irregular:
(laminae short to short-intermediate, elliptical with rounded or somewhat narrowed base, length about × 2 breadth; upper surface matte, with remains of indumentum at maturity; petiole-length 2.0-2 9, generally 2.2--2.6 cm.; lateral veins 10-13, generally 11-12, pairs; fruit-wings narrow, red to red-brown, connate at base for 0.1--0.2 cm. of their length):..... ..... *M. Carrissoanus*

GG. Upper indumentum of mainly short, close, stellate hairs, generally persistent at maturity: HYPOLEUCUS type

a. Lateral veins anastomosing at some distance from the leaf-margin:

b. Laminae short-intermediate, or generally intermediate to long, elliptical to obovate, length sligtly less than × 2 breadth, base rounded to narrowed, apex slightly emarginate; vein-reticulum plain on lower surface, owing to fineness of grey-white indumentum and thin texture of leaf; petiole-length 1.1-2.5 cm.; lateral veins 11-13 pairs, with occasional subsidiaries:..... *M. hypoleucus*

bb. Laminae short to intermediate, but generally short-intermediate, elliptical, oblong-elliptical, ovate or obovate, length slightly less than, generally about, or sometimes more than, × 2 breadth, base narrowed, rounded or sub-cordate, apex obtuse, rounded, flattened, emarginate, mucronate or acute; vein-reticulum varyingly obscured by close, though fine, greyish to dusky-yellowish indumentum and fairly thick texture of leaf; petiole-length 0.9-2.0, generally 1.3-2.0, cm.; lateral veins typically 10--14 pairs, additional pairs in acute--tipped leaves, subsidiaries frequent:... ..... *M. angolensis*

aa. Lateral veins anastomosing at the leaf--margin:
(laminae elliptical or obovate-elliptical, length less than, about, or more than, × 2 breadth, base rounded, sub-cordate, or narrowed; petiole-length typically 1.0-1.5 cm.; lateral veins typically 11-15 pairs, with tendency to formation of subsidiaries):..... *M. elegans* (typical form)

NOTES ON THE OCCURRENCE AND DISTRIBUTION OF *MONOTES* SPECIES.

Information concerning the ecology of the species of *Monotes*, and also the exact locality of specimens, is somewhat scanty, and it is not possible, at the moment, to give more than a very general idea of the occurrence of the group. *Monotes* species are small, often somewhat gnarled, trees, characteristic of open or fringing forest, and of

savannah woodlands, not infrequently of markedly xerophilous type, such as are to be found on the higher plateaux extending from west to east of South Tropical Africa. Where the altitude is noted on herbarium sheets, it is generally given as 3000 feet or more, except in the case of *M. Kerstingii* Gilg, which is in some cases recorded as occurring at 1000 feet, or even at a lower altitude [1]. It will be remembered that this species is also somewhat isolated in its distribution, being the only form which extends north of the Equator. *Monotes* species are further characteristic, apparently, of stony, or generally sandy, acidic soils; recorded cases are, for example, from granitic sands in the neighbourhood of Salisbury, Southern Rhodesia; from quartzite sands near Ndola, Northern Rhodesia; from the Kalahari Sand, Tropical Bechuanaland; and from a sandstone soil in the Gold Coast area.

Accurate information concerning localities (including latitude and longitude) from which collections have been made, is so frequently lacking, and localities are often so isolated and remote, that a really satisfactory discussion of the distribution of *Monotes* species is not yet possible; such a discussion would, in any case, find its place more appropriately in a complete monographic account of the *Monotoideae* as a whole, including its relationship to the *Dipterocarpoideae*. The following table will, however, be sufficient for the moment, to indicate the general geographical occurrence of the genus, as at present known.

---

1. E. g., *Vigne* 3907 (K), «at 600 feet», and *Vigne* 3000 (IFI), «at 1000 feet», both forms from the Gold Coast. *Schlieben* 6079 (BD), a somewhat unusual specimen, although nearer to *M. Kerstingii* than to any other form, is recorded from Tanganyika, at about 870 feet.

SPECIES Grouped under « TYPES »	Angola	Belgian Congo	N. Rhodesia	Tropical Bechuanaland	S. Rhodesia	Nyasaland	Portuguese East Africa	Tanganyika	Anglo-Egyptian Sudan	Ubangui-Chari-Chad	Cameroons	Nigeria	Dahomey	Gold Coast	French Guinea
1. KATANGENSIS															
M. katangensis	×	×	×												
M. dasyanthus	×	×	×												
(?×) M. obliquinervis			×												
2. GLABER															
M. glaber			×	×	×										
M. xasengensis	×														
3. AFRICANUS															
M. africanus	×	×	×			×		×							
4. GLANDULOSUS															
M. rubriglans	×														
M. glandulosus	×														
M. Delevoyi		×	×				×	×							
M. Hutchinsonianus	×	×													
M. Wangenheimianus								×							
M. adenophyllus								×							
5. CALONEURUS															
M. Noldeae	×		×												
M. caloneurus	×		×												
M. Dawei	×	×													
M. loandensis	×														
M. Kerstingii								×	×	×	×	×	×	×	×
M. Engleri			×		×	×		×							
(?×) M. rufotomentosus			×			×		×							
(?) M. Engleri × glaber					×										
M. elegans	×		×					×							
6. HYPOLEUCUS															
M. hypoleucus	×														
M. angolensis	×														
7. DISCOLOR															
M. discolor	×	×	×			×									
M. Pearsonii	×														
M. Carrissoanus	×														
M. oblongifolius			×												
8. HOMBLEI															
M. Homblei	×	×	×					×							
M. Gossweileri	×														
M. magnificus		×	×					×							

It appears from the foregoing table, that *Monotes* types and species or forms are concentrated in the western and central parts of South Tropical Africa, and that they «thin out» to the east, north and south of this area, the disappearance to the south being somewhat abrupt. These facts may be emphasised by collecting the data in the following manner: —

AREA	TYPES REPRESENTED	NO. OF SPECIES OR FORMS
From W. towards N. E. and E.:—		
	8	**19**
ANGOLA	KATANGENSIS	2—katangensis, dasyanthus
	GLABER	1—xasenguensis
	AFRICANUS	1—africanus
	GLANDULOSUS	3—rubriglans, glandulosus, Hutchinsonianus
	CALONEURUS	5—Noldeae, caloneurus, Dawei, loandensis, elegans
	HYPOLEUCUS	2—hypoleucus, angolensis
	DISCOLOR	3—discolor, Carrissoanus, Pearsonii
	HOMBLEI	2—Homblei, Gossweileri
	7	**15**
NORTHERN RHODESIA	KATANGENSIS	3—dasyanthus, katangensis, (?×) obliquinervis
	GLABER	1—glaber
	AFRICANUS	1—africanus
	GLANDULOSUS	1—Delevoyi
	CALONEURUS	5—Noldeae, caloneurus, Engleri, (?×) rufotomentosus, elegans
	DISCOLOR	2—discolor, oblongifolius
	HOMBLEI	2—Homblei, magnificus
	6	**9**
BELGIAN CONGO (as a whole)	KATANGENSIS	2—dasyanthus, katangensis
	AFRICANUS	1—africanus
	GLANDULOSUS	2—Delevoyi, Hutchinsonianus
	CALONEURUS	1 Dawei
	DISCOLOR	1—discolor
	HOMBLEI	2—Homblei, magnificus
	4	**10**
TANGANYIKA	AFRICANUS	1—africanus
	GLANDULOSUS	3—Delevoyi, Wangenheimianus, adenophyllus
	CALONEURUS	4—Engleri, Kerstingii, (?×) rufotomentosus, elegans
	HOMBLEI	2—Homblei, magnificus

AREA	TYPES REPRESENTED	NO. OF SPECIES OR FORMS
	3	4
NYASALAND	AFRICANUS CALONEURUS DISCOLOR	1—africanus 2—Engleri, (?×) rufotomentosus 1—discolor
	1	1
PORTUGUESE EAST AFRICA	GLANDULOSUS	1—Delevoyi
S. andS. E. from Northern Rhodesia:		
	1	1
TROPICAL BECHUANALAND	GLABER	1—glaber
	2	3
SOUTHERN ODESIA	GLABER CALONEURUS	1—glaber 2—Engleri, (?) Engleri × glaber
N. and N. W. from Belgian Congo and Tanganyika, along Congo-Nile Watershed, and W. in territory bordering Gulf of Guinea:—		
ANGLO-EGYPTIAN SUDAN **UBANGUI-CHARI-CHAD** **CAMEROONS** **NIGERIA** **DAHOMEY** **GOLD COAST** **FRENCH GUINEA**	1 CALONEURUS, in each case	1 1—Kerstingii, in each case

The indications from the distribution data, as at present known, are thus that central and eastern Angola, with western and eastern Northern Rhodesia and the Katanga, represent a «concentration area» for the genus *Monotes*. It may be suggested that this area is the *locus* of development of the genus, which, as shown in the foregoing account, consists of small, more or less geographically restricted groups of forms, the forms within each group being more or less closely related: the «GLANDULOSUS» type or group, for example, is a close alliance of forms, whereas the «DISCOLOR» type or group is a much looser and more superficial alliance.

Of the eight types, CALONEURUS and GLANDULOSUS seem to be the most successful: they are at least the most widely-ranging, as will readily be seen from the tables. GLANDULOSUS extends across South Tropical Africa from west to east, being represented in Angola itself by *M. rubriglans*, *M. glandulosus* and *M. Hutchinsonianus*, and from the Belgian Congo to Portuguese East Africa by *M. Delevoyi*, which is only doubtfully distinct from *M. glandulosus*.

The CALONEURUS type is represented by the largest group of species and forms, and is by far the most wide--spread: it gives, apparently, in the single species *M. Kerstingii*, the most westerly (French Guinea), the most northerly (Sokoto, N. Nigeria), and — *Schlieben* 6709, from Lindi, Tanganyika, being included under *M. Kerstingii* since it coincides with that species except for its rather smaller leaves — the most easterly records of the genus. In *M. Engleri*, the CALONEURUS type gives also the most southerly record, namely, at Victoria, in Southern Rhodesia [1]. *M. caloneurus* itself is recorded from Benguela the most westerly of the Angolan provinces.

The other six types, with the exception of AFRICANUS — which ranges from Angola to Tanganyika in the various

1. Note that *M. glaber* occurs a little to the N. W. of Victoria, in the Selukwe District, and the putative *Engleri* × *glaber* hybrid has been recorded from Victoria, together with *M. Engleri* itself.

forms of its single species — are comparatively restricted in their distribution, as well as in their content of species. The HYPOLEUCUS type, as here recognised, with two species, does not extend beyond Angola; the KATANGENSIS and DISCOLOR types, the former with two and the latter with three species, and each with a form whose characters suggest its hybrid origin, are concentrated in Angola, the Katanga and Northern Rhodesia, except for a single record of *M. discolor* from Nyasaland; while GLABER, with two species, is restricted to Angola, Northern and Southern Rhodesia and Tropical Bechuanaland. The last type, HOMBLEI, is restricted in one of its species, *M. Gossweileri*, to Angola, while the Tanganyika records of its second and third forms, *M. Homblei* and *M. magnificus*, may be geographically less detached from the Belgian Congo and Northern Rhodesian, and thus from the Angolan, records, than at first sight appears from the distribution-table: unfortunately, comparatively little material of these species is at present known, and insufficient data as to localities, have, in general, been given to make detailed discussion of this point possible.

CONCLUSION

In 1933, the present writer prepared an account of the «Taxonomic History and Geographical Distribution» of the *Monotoideae* (2), as indicated in the literature then available, the purpose of the communication being to form an introduction to a consideration of the wood anatomy of the group (3). The species, as defined by their authors, were thus accepted in the original account; at the writer's request, however, for purposes of checking and authentication, herbarium specimens in most cases accompanied the wood samples sent by Forest Officers; and subsequently, a considerable amount of herbarium material, alone, was sent for identification from various areas. It soon became evident that the characters of much of this material diverged, in greater or less degree, from the

diagnoses already published, principally by GILG, DE WILDEMAN and HUTCHINSON, and a revision of the group was in consequence undertaken.

Preliminary results of this revision, so far as the Angolan representatives of the *Monotoideae* were concerned, were published early in 1937, in the «Conspectus Florae Angolensis», under the editorship of the late DR. L. WITTNICH CARRISSO. Since this account was written, however, still more material, particularly of the genus *Monotes* itself, has come to hand from different parts of Tropical Africa, through various Forest Officers and herbaria, and it has thus been possible to re-examine the group more critically.

In the case of *Monotes*, this new material has, in many instances, linked up the series of forms and illuminated obscure points, so that it is necessary to modify the scheme of classification of the genus as given in the Conspectus: it is now, for example, clear that *M. discolor* R. E. Fr. includes the specimen *(Cardoso* s. n.) referred to *M. kapiriensis* De Wild., and that, indeed, *M. kapiriensis* is synonymous with *M. discolor;* further, that *M. glandulosus* Pierre and *M. Hutchinsonianus* Exell are extremely closely linked through *M. Delevoyi* De Wild. These pairs of forms are associated in the key to *Monotes* which appears in the Conspectus, and the close relationship between them is obvious, even without the evidence of new material. Again, it now appears that *M. Dawei* Bancroft is so nearly related to *M. caloneurus* Gilg that it may be regarded as a narrow-leaved form of that species; the two are separated in the original key on account of the rather unusual amount of indumentum on the upper leaf-surface in *M. Dawei:* an examination of further material from different areas has, however, served to link up the two extremes represented by *M. Dawei* and by «typical» *M. caloneurus,* so that in the key to the whole genus proposed in the foregoing pages, the two forms are closely associated.

The most considerable adjustment which has had to be made in the course of revision, consists in the separation of certain of Gossweiler's specimens (namely, 1804, 2934

and 3943) and an un-numbered specimen collected by Admiral Lynes, from *M. hypoleucus* Gilg, which, as thus represented only by *Welwitsch* 1036, is even more closely allied to *M. angolensis* De Wild. than was originally believed — indeed, *M. hypoleucus* and *M. angolensis* not improbably represent the same specific type. Undoubtedly, in the relation of the lateral veins to the leaf-margin, *Gossweiler* 1804, 2934 and 3943 differ from *Welwitsch* 1036, and agree with *Holtz* 1474, the type of *M. elegans* Gilg; the relationship between *M. hypoleucus* and *M. elegans* is indicated by the similarity of type and distribution of the indumentum over the leaf-surfaces. *Lynes* s. n., in the character of the venation and in its somewhat shaggy upper indumentum, is undoubtedly of the CALONEURUS type: it is probably a vigorous shoot of *M. caloneurus* itself.

As the list of Angolan species of *Monotes* now stands, therefore, *M. kapiriensis* is included in *M. discolor*, while *M. elegans* is separated from the specimens originally included under *M. hypoleucus;* so that, with the two new species *M. Carrissoanus* and *M. xasenguensis*, and the new record for *M. katangensis*, the number of species of the genus occurring in the area appears, at the moment, to be nineteen, and each of the eight types, or lines of development, within the genus is represented. Further discoveries will, without doubt, necessitate further adjustments, not only for Angolan species, but for those of Tropical Africa in general.

The writer desires to offer the foregoing revised account of the genus *Monotes* as her contribution to this number of the «Boletim da Sociedade Broteriana», published as a memorial to DR. L. W. CARRISSO, to whose kindness, and to that of his colleagues DR. F. A. MENDONÇA and MR. A. W. EXELL, she owes the opportunity of examining and describing the Angolan Monotoids for the Conspectus Florae Angolensis; she wishes also to express her deep sense of the honour extended to her in the invitation to associate herself with DR. CARRISSO's fellow-workers in thus

commemorating his great interest in the Sociedade Broteriana, and in the work of the Instituto Botânico Dr. Júlio Henriques.

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NUCLEOLI AND SAT-CHROMOSOMES [1]

by

FLÁVIO RESENDE [2]

CONTENTS:

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(1) English translation of a lecture delivered in «Estação Agronómica Nacional, Lisboa» on March 27th, 1938. The portuguese text is published in «Revista Agronómica, Lisboa, 1938».

(2) Equiparado a bolseiro pelo I. A. C., Lisboa.