MONOGRAPHIÆ BIOLOGICÆ CANARIENSES

N.º 4

Proceedings of the I International Congress pro Flora Macaronesica

edited by G. Kunkel

Este tomo se dedica a la memoria de Eric R. Sventenius, Director del Jardín Canario "Viera y Clavijo" y Presidente de Honor de este Congreso, que falleció en esta ciudad el día 23 de Junio de 1973.

Excmo. Cabildo Insular de Gran Canaria
Las Palmas, Septiembre de 1973

Monogr. Biol. Canar. 4; 1973

Dirección de la Redacción:
Finca "Llano de la Piedra"
Santa Lucía de Tirajana
Gran Canaria, España

Depósito Legal: GC - 79-1970
Edición 600 ejemplares
Precio de este número: Ptas. 320,—
Imp. Pérez Galdós, c/ Buenos Aires, 38
Las Palmas de Gran Canaria
SP ISSN 0077 - 0647

Indice

* Proots corrected by the editor

Proposals and decisions

Introductión

More than 70 scientists from 30 universities in 13 countries attended a first international botanical meeting held at Las Palmas de Gran Canaria. The Congress was sponsored by the Island Council (Cabildo Insular) and took place between 13 and 18 April 1973.

Twenty six lectures were given on such subjects as flora, conservation, herbaria, and inventories. During a joint excursion participants were introduced to the main plant communities existing on Gran Canaria.

Although the principal purpose of the meeting was to bring together all botanists whose work and interest, directly or indirectly, relates to the vegetation of the Macaronesian Islands, and to review progress of the "Flora Macaronesica" project, conservation of the vegetation with its high percentage of endemics received considerable attention.

The urgent need to protect the large number of endangered species and to preserve unique communities and landscapes on the islands gave rise to the preparation and approval of a general "Appeal" (see "Proposals and decisions"). This will be widely circulated and brought to the attention of institutions and governments concerned. A communication from IUCN/WWF was read, informing the members of a grant allocated for a survey of the natural resources in the eastern Canary Islands.

It was also agreed to create a Macaronesian Botanical Association which would ensure the direction and continuity of the programmes.

The Congress received much public interest and was reported on daily and at length by all local information media. Summarizing reports were also published in "Nature" (vol. 243:261) and in the "Bulletin IUCN" (vol. 4:23). Official speeches pronounced have been published in full in local newspapers.

G. Kunkel

LIST OF PARTICIPANTS

ALEMANIA

Mattick, Prof. Dr. F.; Botanischer Garten und Museum, Berlin-Dahlem
Milbradt, J., cand. phil.; Botanisches Institut, Universität Erlangen-Nürnberg
Paul, Prof Dr. F.; Botanisches Institut, Universität Bonn
Voggenreiter, V., cand. rer. nat.; Botanisches Institut, Universität Erlangen-Nürnberg

DINAMARCA

Hansen, A., cand. mag.; Botanisk Museum København

FRANCIA

Gagnieu, Prof. Dra. A.; Institut Botanique, Université Strasbourg
Linder, Prof. Dr. R.; Institut Botanique, Université des Sciences Lille

GRAN BRETAÑA

Aldridge, A. (Miss); Department of Botany, University Reading
Bramwell, Dr. D.; Department of Botany, University Reading
Gibson, P.; Royal Holloway College London
Heywood, Prof. Dr. V. H.; Department of Botany, University Reading
Moore, Dr. D. M.; Department of Botany, University Reading
Page, Dr. C. N.; Royal Botanic Gardens Edinburgh
Stearn, Dr. W. T.; British Museum (Natural History) London

HOLANDA

De Wit, Prof. Dr. H. C. D.; Laboratory of Plant Taxonomy and Plant Geography, University for Agriculture; Wageningen

ITALIA

Steinberg, Prof. Dr. C.; Herbarium Universitatis Florentinae
Firenze

JORDANIA

Boulos, Prof. Dr. L.; Botanical Institute, University of Jordan
Amman

NORUEGA

Hagen, Dr. A.; Lovenskiolds Gate 4,
Oslo 2
Sunding, Dr. P.; Botanical Garden, University
Oslo 5
Torkelsen, A. E. (Mrs.); Botanical Laboratory, University
Oslo 3

PORTUGAL

Franco, Prof. Dr. J. Amaral; Instituto Superior de Agronomía
Lisboa
Malato-Beliz, Dr. J.; Estaçâo de Melhoramento de Plantas
Elvas
Pickering, Major C. H. C.
Funchal
Da Rocha Afonso, Dra. M. da Luz; Instituto Superior de Agronomía
Lisboa

SUECIA

Eriksson, Dr. O.; Department of Biology, University
Umeå
Nordenstam, Dr. B.; Swedish Museum of Natural History
Stockholm
Sjögren, Prof. E. A.; Växtbiologiska Institutionen
Uppsala

SUIZA

Burdet, Dr. H. M.; Conservatoire Botanique
Geneve
Mendoza-Heuer, Dr. I.; Institut für Systematische Botanik
Zürich

U. S. A.

Etter, Dr. A.; The Morton Arboretum
Lisle, Illinois

Midcap, Prof. J. T.; Department of Horticulture and Forestry Kansas University; Manhattan, Kansas

ESPAÑA (Continental)

Bellot Rodríguez, Prof. Dr. F.; Jardín Botánico
Madrid
Casaseca, Prof. Dr. B.; Departamento de Botánica, Universidad
Salamanca
Clemente Muñoz, M. (Srta.); Esc. Técn. Sup. Ing. Agrónomos
Madrid
Esteve Chueca, Prof. Dr. F.; Departamento de Botánica, Universidad Granada
Gómez Campo, Prof. Dr. C.; Esc. Técn. Sup. Ing. Agrónomos, Cat. de Fisiol. Vegetal; Madrid
Hernández Bermejo, J. E.; Esc. Técn. Sup. Ing. Agrónomos
Madrid
Matías Mayor, Prof. Dr.; Departamento de Botánica, Universidad
Oviedo
Tortosa, M. E. (Sra.); Esc. Técn. Sup. Ing. Agrónomos,
Madrid

ESPAÑA (Canarias)

Acuña González, Prof. Dr. A.; Departamento de Botánica, Universidad; La Laguna
Alonso Socorro, J.; Jardín Canario "Viera y Clavijo" Tafira
Las Palmas
Alvarez, J.-A.; Servicio Municipal de Parques y Jardines,
Las Palmas
Apolinario Navarro, B.; Col. Oficial de Farmacéuticos
Las Palmas
Apolinario Cambreleng, J.; Colegio Oficial de Farmacéuticos
Las Palmas
Barquín, E.; Departamento de Botánica, Universidad
La Laguna
Beltrán Tejera, E. (Srta.); Departamento de Botánica, Universidad
La Laguna
Breitfeld, Ch. (Sra.); La Cuesta
Santa Cruz
Díaz Cruz, Dr. M.; I. C. O. N. A.
Las Palmas
García Correa, L.; A. S. C. A. N.
Las Palmas
González González, Prof. Dr. A.; Dep. de Química Orgánica y Bioquímica, Universidad; La Laguna

González Hernández, Dr. J. M.; I. C. O. N. A.
Santa Cruz
Gallo Llobet, L. (Srta.); Departamento de Botánica, Universidad
La Laguna
Gil Rodríguez, M. C. (Srta.); Departamento de Botánica, Universidad; La Laguna
Hernández Mayor, J. D.; Colegio Oficial de Farmacéuticos
Las Palmas
Hernández Guerra, J.; Colegio Oficial de Farmacéuticos
Las Palmas
Krüss, J.; La Calzada.
Las Palmas
Kunkel, G. (Secretario), Tafira Alta
Las Palmas
Kunkel, M. A. (Sra.), Tafira Alta
Las Palmas
León Pérez S.; Jardín Canario "Viera y Clavijo", Tafira
Las Palmas
López Paláez, S.; A. S. C. A. N.
Las Palmas
Machado Carillo, A.; Departamento de Biología Marina, Universidad; La Laguna
Navarro Valle, F.; Jardín Canario "Viera y Clavijo", Tafira
Las Palmas
Nogales Hernández, Dr. J.; I. C. O. N. A.
Las Palmas
Pérez de Paz, J. (Sra.); Jardín Canario "Viera Clavijo", Tafira
Las Palmas
Pérez de Paz, P. L.; Departamento de Botánica, Universidad
La Laguna
Piepenburg, F. C.; (Teror)
Las Palmas
Sánchez García, Dr. I.; I. C. O. N. A.
Santa Cruz
Santos Guerra, A.; Departamento de Botánica, Universidad
La Laguna
Silva Heuschkel, C.; A. T. A. N. et Dep. de Biología Marina, Universidad; La Laguna
Sventenius, E. R.; Jardín Canario "Viera y Clavijo", Tafira
Las Palmas
Wildpret de la Torre, Prof. Dr. W.; Dep. de Botánica, Universidad
La Laguna

PROGRAMA REALIZADO

Viernes, 13 de Abril

Llegada de los participantes. Registro en la Secretaría (Cabildo Insular, calle Bravo Murillo); informaciones y orientación general.

18.00 Salón de Actos del Excmo. Cabildo Insular: Inauguración Oficial. Lectura del programa; presentación de autoridades y participantes.

19.30 Visita: "III Exposición de Plantas y Flores", organizada por ASCAN (Parque Doramas).

20.30 Recepción por el Alcalde de la ciudad (Pueblo Canario).

Sabado, 14 de Abril

9.00 Casa de Colón (Calle Colón): Ciclo de conferencias

15.30 Casa de Colón: conferencias y discusiones generales

19.30 "Las Palmas de Noche" (salida: Casa de Colón)

Domingo, 15 de Abril

9.30 Casa de Colón: Segundo ciclo de conferencias.

13.00 Almuerzo en las "Grutas de Artiles" (salida 12.30)

15.00 Visita del Jardín Canario "Viera y Clavijo", en Tafira

Lunes, 16 de Abril

Día de Excursión. Salida Parque Santa Catalina (Kiosko de Turismo) a las 8.20. Programa: Cuesta de Silva (Sublitoral) — Los Tiles de Moya (Laurisilva) — Tamadaba (Pinar). Almuerzo en el Parador Nacional Cruz de Tejeda (invitación del Cabildo Insular); y refrescos en "La Silla" (Artenara; invitación de ICONA).

Martes, 17 de Abril

9.00 Casa de Colón: Discusiones del programa de estudios. Sinopsis de la "Flora"; Programa de Conservación; Sociedad Botánica Macaronésica, etc.

18.00 Salón de Actos, Colegio Oficial de Farmacéuticos (Gen. Franco 11, lateral): Segunda Asamblea y Clausura Oficial. Cocktail.

21.00 Cena en el Hotel Villa Edén (Mirador de Escaleritas)

Miércoles, 18 de Abril

Reuniones independientes, excursiones particulares o salida de los participantes.

List of Lectures

The lectures were given in the order as stated below but has been altered for this publication. For technical reasons the text of discussions is not reproduced.

Section FLORA (Chairman: Prof. Heywood)

BRAMWELL & RICHARDSON (Reading): Floristic Connections between Macaronesia and the East Mediterranean Region (read by Bramwell).

SUNDING (Oslo): Endemism in the Flora of the Cape Verde Islands with Special Emphasis on the Macaronesian Flora Element.

PELTIER (Rabat): Endémiques Macaronésiennes au Maroc. Inventaire Bibliographique et Problèmes Taxinomiques (read by Linder).

BRAMWELL (Reading): Studies in the genus Echium from Macaronesia.

BOULOS (Amman): The Endemic Species of Sonchus and Related Genera in the Macaronesian Islands.

MENDOZA (Zürich): La Morfología de Sideritis en Macaronesia y su Grado de Diferenciación.

PAGE (Edinburgh): Ferns, Polyploidy, and their Bearing on the Evolution of the Canarian Flora.

SANTOS (La Laguna): Algunos aspectos de la Vegetación de la Isla de La Palma.

Section REPORTS (Chairman: Prof. Malato-Beliz)

STEARN (London): Philip Barker Webb and the Canarian Botany.

STEINBERG (Firenze): The Macaronesian Collections of Phanerogams in the Herbarium Universitatis Florentinae.

HEYWOOD (Reading): The Umbelliferae of Macaronesia *

ERIKSSON (Umeå): Check-Lists from Punched Cards *

SJÖGREN (Uppsala): Plant Communities of the Natural Vegetation of Madeira and the Azores.

ESTEVE (Granada): Sinopsis de las Alianzas y Asociaciones hasta el Momento Comprendidas en la Clase Cytiso-Pinetea y Orden Cytiso Pinetalia.

WILDPRET (La Laguna): El Piso de Vegetación de la Isla de Tenerife *

GAGNIEU (Strasbourg), LINDER (Lille) & VOGGENREITER (Erlangen): Caryotypes de la Flore Insulaire de Tenerife (read by Linder).

Section CONSERVATION (Chairman: Prof. Wildpret)

GARCIA (Las Palmas): Conservación de los Recursos Naturales en Canarias.

SUTTON (Washington): The Conservation and Use of Endangered Islands (read by Etter).

GOMEZ (Madrid): Hacia un Banco de Germoplasma de Endemismos Vegetales Ibéricos y Macaronésicos.

SJÖGREN (Uppsala): Conservation of Natural Plant Communities on Madeira and the Azores.

KUNKEL (Las Palmas): The Role of Aventitious Plants in the Vegetation of the Canary Islands.

SANCHEZ (Santa Cruz): Regeneración del Bosque Subtropical de Laurisilva.

WILDPRET (La Laguna): Los Problemas de Conservación de los Endemismos Canarios *

GARCIA (Las Palmas): Una noticia Recibida (see p. 176).

---

* = manuscripts not received in time. We hope they will be published in a forthcoming number of "Cuadernos de Botánica Canaria".

AGRADECIMIENTOS

Esta Secretaría expresa su agradecimiento a todos los participantes por su presencia y actuación positiva. Todos nosotros debemos nuestro agradecimiento al Excmo. Cabildo Insular de Gran Canaria, Corporación cuya ayuda económica y apoyo material quedó reconocida. Se agradece, en especial, a D. Juan Pulido Castro y D. Antonio Vega Pereira, sus palabras inaugurales y de clausura, respectivamente. El presidente de la Corporación actuó asimismo como Presidente de la Comisión Organizadora de este Congreso.

Dedemos agradecer, además, al Excmo. Ayuntamiento de Las Palmas, su aliento por la recepción realizada en el Pueblo Canario; a la Caja Insular de Ahorros de Gran Canaria, su ayuda económica; a la Jefatura Regional del Instituto Nacional para la Conservación de la Naturaleza, su participación activa durante el Congreso asimismo como su buena ayuda y la recepción celebrada; al Iltmo. Colegio Oficial de Farmacéuticos de Las Palmas, por la ayuda y la recepción ofrecida; a la Asociación Canaria para Defensa de la Naturaleza que organizó la Exposición de Plantas y Flores y que siempre ha colaborado con esta Secretaría; a los Ayuntamientos de Guía y Moya, a la Dirección y empleados de la Casa de Colón, a la Administración Principal de Correos, a la Dirección y funcionarios del Jardín Canario y a todos los Medios Informativos que colaboraron activamente con nosotros.

A todos, nombrados y no nombrados, nuestro sincero agradecimiento.

1. Philip Barker Webb and Canarian Botany

WILLIAM T. STEARN

Summary

Philip Barker Webb (1793-1854) was a wealthy English landowner, traveller, classical scholar and amateur botanist, whose most important memorial is the **Histoire naturelle des Iles Canaries** published in 106 livraisons (parts) between 1835 and 1850, of which the botanical section in 3 volumes, **Phytographia Canariensis,** remains fundamentally important for the study of Macaronesian plants. On his way from Madeira to Brazil in 1828 Webb stopped at Tenerife, intending to stay only a few days. Here he met Sabin Berthelot (1794-1880). Webb then became so interested in the natural history of the Canary Islands that he stayed instead for two years diligently collecting and recording; he never went to Brazil but returned to Europe and, together with Berthelot, devoted most of the next 20 years to the preparation of their monumental **Histoire naturelle.** He coined the name Macaronesia as a collective term for the Atlantic Islands from Madeira to the Cape Verde Islands. In accordance with his will, his herbarium is now at Florence. This paper outlines Webb's career and work and refers to the elucidation of the dates of publication of the **Histoire naturelle.**

Resumen

Philip Barker Webb (1793-1854) fue un rico propietario inglés, viajero, conocedor de los clásicos y botánico "amateur", cuya obra conmemorativa más importante es la **Histoire naturelle des Iles Canaries** publicada en 106 partes entre los años 1835 y 1850, de la cual los tres volúmenes de la sección botánica, **Phytographia Canariensis,** es aún fundamentalmente importante para el estudio de las plantas Macaronesias. En viaje de Madeira a Brasil en 1828, Webb hizo un alto en Tenerife con la intención de permanecer allí solamente unos pocos días. Es entonces cuando encuentra a Sabin Berthelot (1794-1880). Webb se vuelve tan interesado en la historia natural de las Islas Canarias que permanece allí, en cambio, dos años, colectando y juntando datos diligentemente, nunca llegó a Brasil, sino que regresó a Europa y, junto con Berthelot, dedicó la mayor parte de los 20 años subsiguientes a la preparación de su monumental **Histoire naturelle.** Webb creó el

[Translation supplied by Mrs. J.H. Price (**née** Susan Cabrera)]

nombre Macaronesia como un término colectivo para las Islas Atlánticas de Madeira e Islas de Cabo Verde. De acuerdo a su deseo, su herbario está ahora en Florencia. Este trabajo delinea la carrera y trabajo de Webb, y se refiere a la aclaración de las fechas de publicación de la **Histoire naturelle.**

In the churchyard at Milford, near Godalming, Surrey, England, there stands a pyramidal granite mausoleum inscribed simply 'Philippus Barker Webb sibi suisque'. It is, however, far from being the only memorial of the roving, scholarly and productive life of Philip Barker Webb (1793-1854), whose wanderings extended from Asia Minor to the Canary Islands and whose publications remain models of botanical erudition. Florence treasures the Webb herbarium and botanical library, both of great value and continuing importance; an internationally renowned Italian botanical journal bears the name **Webbia;** at least twenty-five plants of southern Europe and Macaronesia, the Atlantic floristic region so named by him, have received the epithet **webbii** or **webbianus** in his honour, but for botanists studying the flora of Macaronesia his best memorial must always be the truly monumental **Histoire naturelle des Iles Canaries** issued at Paris in 106 parts (livraisons) between 1835 and 1850 in collaboration with Sabin Berthelot (1794-1880) and more especially its volume 3, **Phytographia Canariensis,** dealing with the plants of the Canary Islands. The intent of the present contribution to the **Congresso Internacional pro Flora Macaronésica** is to outline his career and work on Canarian plants.

P. B. Webb was born at Milford House on 10 July 1793, the eldest son of a wealthy English landed gentleman, Capt. Philip Smith Webb, lord of the manor of Milford and Witley. His mother Hannah (**née** Barker, **later** Gooch) was a daughter of a governor of Madras, Sir Robert Barker. He received the best available education of the period, first at a celebrated private school for boys, then at Harrow School, then at Christchurch College, Oxford, where he graduated in 1815, having studied Greek and Latin, then Italian and Spanish, with some botany and geology.

His father died in 1799, leaving his mother with six children as the fruit of eight years of marriage. She was a remarkable woman and undoubtedly shaped well the careers of all her children. Her money helped to pay for the publication of the **Phytographia Canariensis** and Webb dedicated **Aeonium goochiae** to her: '**Matri** carissimae, benemerentissimae, nec rerum naturalium ignarae, nec scientiae amoenae rudi, ... speciem suavem perpulchramque damus, dicamus, dedicamus'. She died in 1853, only a year before Webb himself. His studies at Oxford finished, he went in 1815 to Italy and there began a lifelong friendship with a young Ita-

Philip Barker Webb (aet. c.44) holdings spray of **Webbia canariensis (Hypericum canariense).** Portrait made about 1837 (from W. & B., **Phyt. Canar.,** 1840).

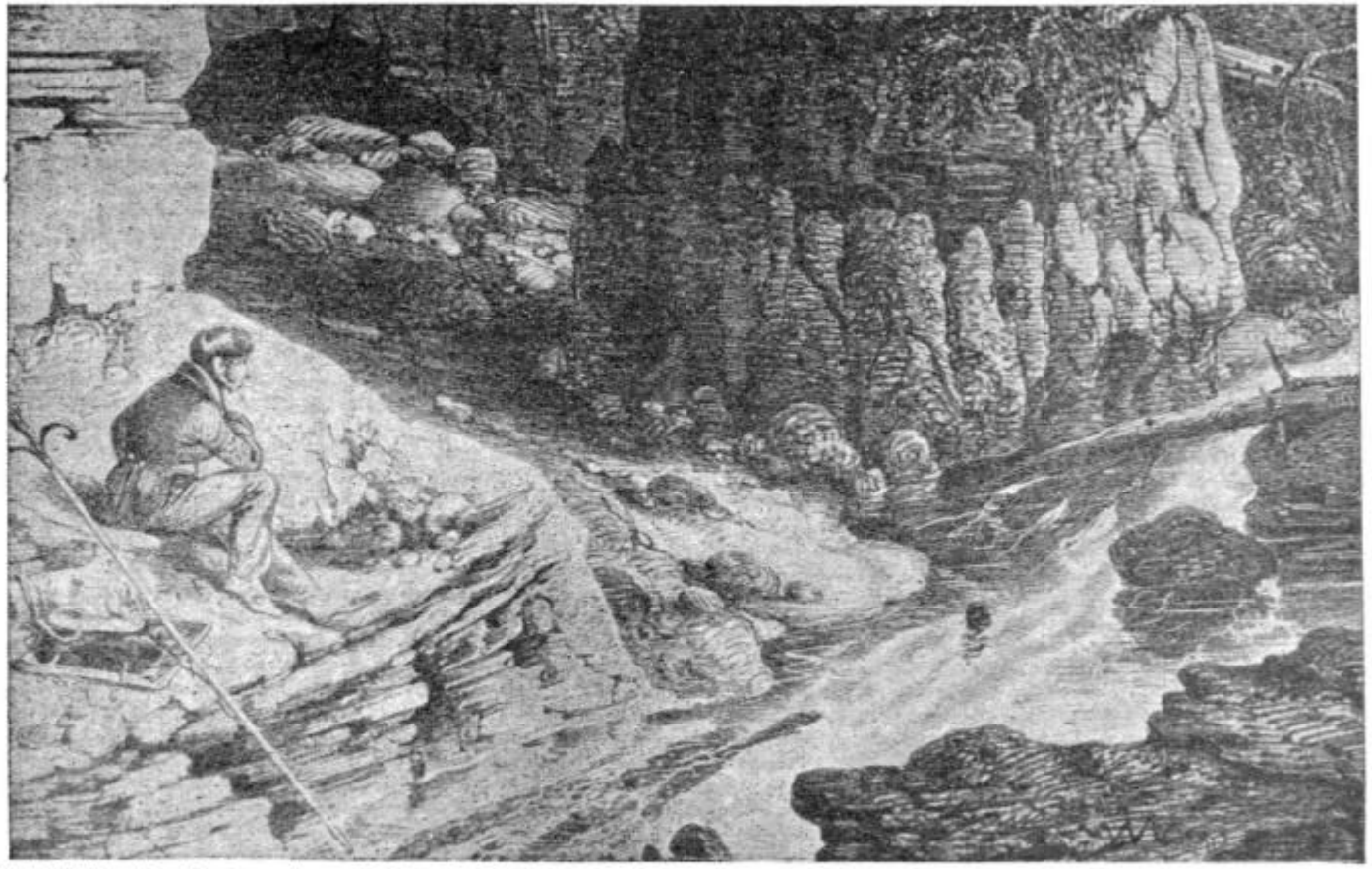
lian nobleman, Alberto Parolini (1788-1867), having similar interests and wealth. Many years later Webb named an endemic Canarian genus **Parolinia** in his friend's honour. Parolini came to England in 1817 and Webb introduced him to Sir Joseph Banks, Robert Brown, Buckland and other naturalists in London, Oxford and Cambridge. Webb's acquaintance with these distinguished men itself indicates the regard which he himself had already gained. Handsome, young and enthusiastic, with much charm and generosity of character, obviously talented and wealthy and of assured social position, Webb was much as young Joseph Banks had been when, nearly fifty years earlier, he had sailed round the world with Captain Cook, but Webb was far more learned. Thus all his life he gained warm friends and willing helpers.

In 1819 Webb and Parolini met again in Italy for a visit to the Ionian Islands in the Adriatic Sea, then under British rule and hence providing a safe refuge for Greeks escaping from the oppression of Turkish rule on mainland Greece. They accompanied the British Commissioner Sir Thomas Maitland on a diplomatic mission, then travelled by way of the Peloponnese to Corinth, Athens and Istanbul, and then across the Bosphorus to Asia Minor for an investigation of the plain of Troy, on which Webb published a work in Italian in 1821. Pirates attacking the English ship aboard which they sailed from Izmir (Smyrna) to Malta were beaten off and from Malta they travelled to Sicily, later visiting Naples, Rome, Florence, Venice and Milan. In 1821 Webb travelled back to England with George Bellas Greenough (1778-1855) the geologist, to whom he later dedicated the Canarian genus **Greenovia.** Not until twenty years later did he again meet Parolini.

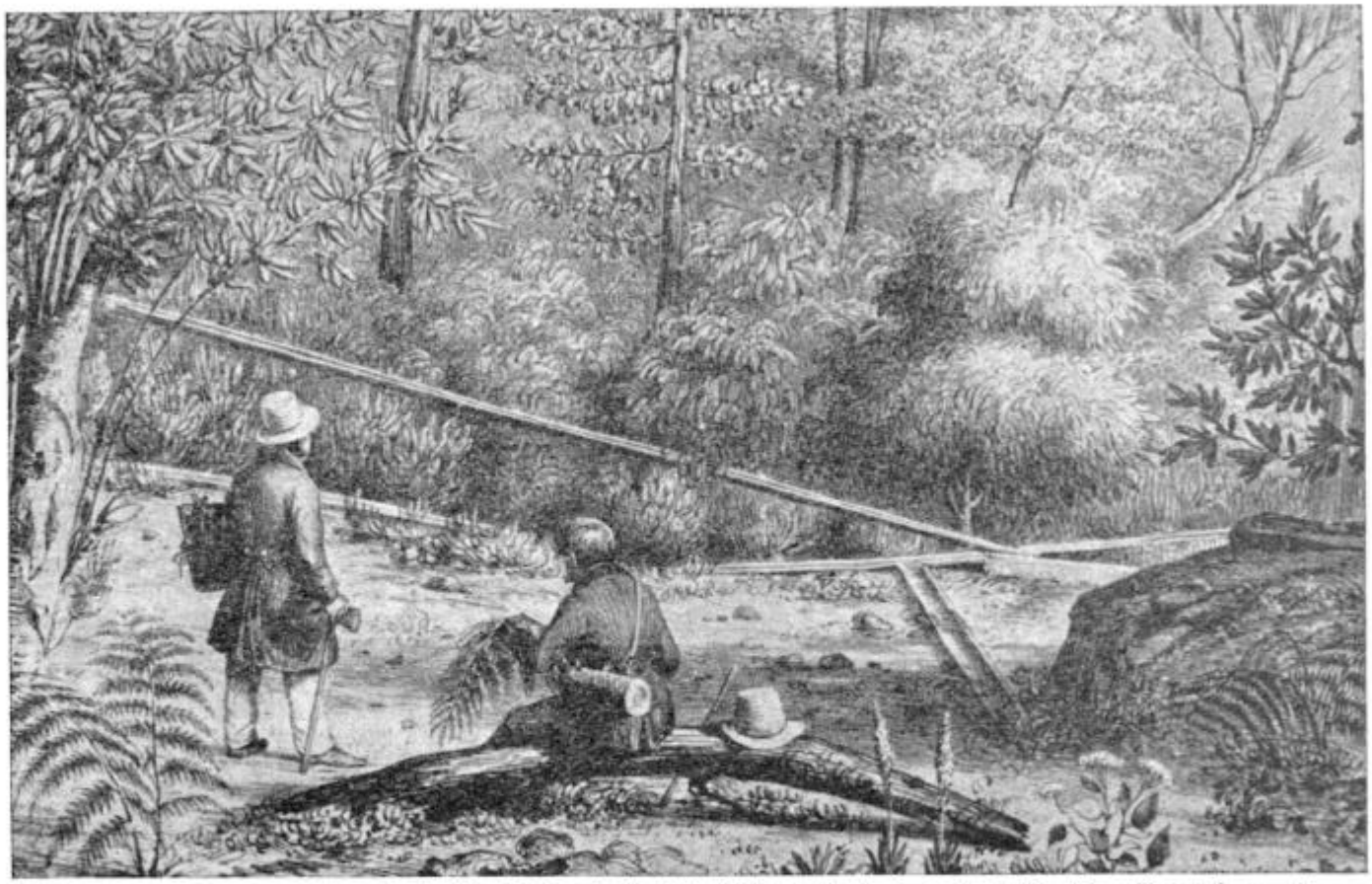
Managing his Milford estate and continuing his botanical and classical studies occupied Webb's attention for the next few years, then he again felt an urge to travel and in 1825, at the age of thirty-two, he set out to investigate the natural history of Spain. He reached Spain in 1826 and there travelled widely. His was the first 19th-century journey into Spain for scientific purposes and led to the later journeys of Durieu, Boissier, Reuter, Bourgeau, Willkomm, Lange and others; it resulted in his **Iter Hispaniense** (1838) and **Otia Hispanica** (1839; 2nd ed., 1853). In 1827 he made a short visit to Tangier, then went to Portugal and spent nearly a year there in botanical exploration before starting for Brazil, by way of Madeira, in May 1828. He quickly gained the friendship in Madeira of the Rev. Richard Lowe and Carl Heineken, both ardent naturalists with a detailed knowledge of the island, and in their company he botanized for several months. Brazil, however, remained his objective. Accordingly, in September 1828 he set out again for Brazil, by way of Tenerife, intending to spend only a

few days there, before sailing to Rio de Janeiro.

In Tenerife, a little incident determined the future course of his life and of Canarian botany. Wearied by two years of Webb's continual wanderings, his Spanish assistant, a young pharmacist from Barcelona, José Naudo, became homesick and decided to return to Spain. Thus Webb needed another helper. Luckily, he found in Tenerife one with such enthusiasm for Canarian natural history that Webb's thoughts turned away from Brazil forever. This was Sabin Berthelot, well-educated and talented Frenchman of about the same age, who had been eight years in Santa Cruz and had collected plants and insects on both Tenerife and Gran Canaria. In Berthelot's company Webb began to explore Tenerife and found its natural history so rich and so fascinating that he decided to stay in the Canary Islands. Had Webb gone to Brazil he would have probably been overwhelmed by the diversity of its flora, would have made nevertheless a notable contribution, but would have been only one among the many contributors to the **Flora Brasiliensis.** Instead he conceived the ambition of preparing a big, many-sided work on the natural history of the Canarian archipelago. There had been earlier works referring to Canarian plants, notably L. von Buch's **Physicalische Beschreibung der Canarischen Inseln** (1825), but nothing approaching in scope and detail Webb's projected one. He and Berthelot spent the next two years gathering material. They spared themselves no exertion, travelling into many places difficult and dangerous of access, exploring ravine after ravine of the intricately riven Canarian islands and probably suffering much discomfort and hardship. Indeed, when gathering on a cliff in La Palma an **Aeonium** with reddish leaves, Webb had so bad a fall that he later named this species **cruentum** (bloody, blood-stained) with reference both to it and himself. A drawing made by Berthelot on 30 May 1830 in the Caldera de Taburiente on the Isla de La Palma portrays Webb sitting at the foot of a cliff with his botanical collecting equipment viz. a cylindrical continental vasculum, a portfolio plant-press and a long-handled crook for pulling down plants otherwise out of reach. Another drawing, by J.J. Williams, illustrates Webb and Berthelot together in the laurisilva of Agua Garcia, Tenerife, likewise with portfolio and vasculum. Apparently no diary of their travels exists. From internal evidence in the **Histoire naturelle** it is evident that from September 1828 to May 1829 they were on Tenerife, from May 1829 to July 1829 on Lanzarote, in August 1829 on Fuerteventura, from August 1829 to November 1829 on Gran Canaria, in 1830 up to August 1830 on Tenerife again, with a visit to La Palma in May 1830. They were unable to visit Gomera and Hierro (Ferro). Leopold von Buch in 1825 had listed 28 ferns,



P. B. Webb with collecting equipment Caldera de Taburiente, La Palma, May 1830. Drawing by S. Berthelot from W. & B. **Atlas, Phytostat.** pl.9).



P.B. Webb & Berthelot at Agua García, Tenerife, Drawing by J. J. Williams (details from W. & B., **Atlas, Phytostatique,** p.4).

76 monocotyledons and 548 dicotyledons, as known from the Canary Islands. In all Webb and Berthelot collected some 1116 species out of the 1800 or so vascular plants now known. In addition, moreover, they collected birds, fish, shells and insects, and made geological, ecological and climatological observations. They particularly deplored the short-sighted increasing destruction of the laurisilva, the unique Canarian laurel forest which it should now be first piority to conserve.

In August 1830 Webb and Berthelot left Tenerife for Europe. Webb realized that the task of preparing a natural history of the Canary Islands was too vast an undertaking for one man. As Berthelot had shared his travels and tasks, so Webb wished him to share the glory of achievement. The planned **Histoire naturelle des Iles Canaries** was to be a joint work, with Berthelot responsible for the ethnography and botanical geography, Webb for most of the botany. They went first to Geneva and Montpellier, helped by A. P. de Candolle, Moquin-Tandon, and A. Saint-Hilaire; then in mid 1833 they settled in Paris. Here Webb bought a large house, built up a rich botanical library and acquired the herbaria of Mercier, Labillardière, Desfontaines, Pavon and others. In addition to his own Canarian collections he later acquired those of Broussonet, Despreaux and Bourgeau. His Madeiran specimens included his own and some from Lowe. From the Azores he had those of H. C. Watson, Guthnik and Hochstetter, from the Cape Verde Islands those of Vogel, J. D. Hooker and Bolle. At Webb's death in 1854 his Macaronesian collection was undoubtedly by far the richest and most representative in the world; it is now at Florence.

He and Berthelot now set to work on the preparation of the **Histoire naturelle des Iles Canaries.** Although Webb appears to have written most of the botanical volumes, the **Phytographia Canariensis,** he was able to enlist the help of friends with a special knowledge of certain groups. Thus F. M. Barnéoud, J. Decaisne, Alphonse de Candolle, Jacques Gay, Joseph D. Hooker, A. Moquin-Tandon, F. de Noé, F. Parlatore, H. G. Reichenbach and C. H. Schultz of Zweibrücken all contributed part of the text. The 287 engraved or lithographed plates of the **Phytographia** remain its most permanently valuable feature; they were drawn by the best botanical artists then available to Webb as helpers, A. Chazal, Despréaux, J. Felix, Rosalia Gay (wife of the botanist Jacques Gay), J. C. Heyland, Fannie Legendre (later Mme Spach, wife of the botanist Edouard Spach), I. J. Legendre, M. Lespiault, Maubert, François Plée, H. G. Reichenbach, A. Riocreux, and Thiolat. Mlle Legendre (Mme Spach), to whom in 1844 Webb and Berthelot dedicated the genus **Legendrea** (congeneric with **Tur-**

Sabin Berthelot (all illustrations courtesy British Museum)

bina Rafin., 1838) also illustrated Edouard Spach's **Histoire naturelle des Végétaux: Phanérogames** (1834-48); Heyland did much work for A. P. de Candolle; Riocreux became one of the greatest botanical draughtsmen of the 19th century; Plée illustrated and published **Types de chaque Famille** (1844-64). Students of Macaronesian botany owe Webb's team of such well-trained and skilled artists a debt of gratitude for their conscientious detailed portrayal of so many then little-known plants.

The **Histoire naturelle des Iles Canaries** consists of 6 Parties, forming 3 Tomes as follows:

Tome I. Partie 1. Ethnographie. Annales de la conquête. 335 pa- + "Table des Matières"; 2 plates. (1840—)1842.

Partie 2. Miscellanées canariennes. 251 pages; 60 plates + 2 portraits of authors. (1838—)1839(—1840.)

Tome II. Partie 1. Géographie descriptive. Statistique. Géologie. 417 pages + "Errata" (1836—)1839.

Partie 2. Zoologie. 1836—44.
Introduction. Mammifères. 12 pages. (1844.)
Reptiles. 5 pages + "Explication"; 1 plate. (1839—44.)
Ornithologie. 48 pages; 4 plates. (1836—42.)
Ichthyologie. 109 pages + "Table"; 26 plates. (1837—44.)
Mollusques, Échinodermes, Foraminifères et Polypiers. 152 pages; 8 + 3 + 3 plates. (1836—42.)
Entomologie (Animaux articulés). 119 pages; 7 + 1 plates. (1837—40.)

Tome III. Partie 1. Géographie botanique. 181 pages + "Table." (1835—42.)

Partie 2. Phytographia canariensis. 1836—50.
Section 1 (Phanèrogames). 220 pages; 49 plates. (1836—41.)
Section 2 (Phanèrogames). 496 pages; 113 plates. (1842—50.)
Section 3 (Phanèrogames). 479 pages; 116 plates. (1844—50.)
Section (4). Plantae cellulares. 208 pages; 9 plates. (1839—41.)

Atlas in folio. (1835—)1838.

Serie 1. Frontispiece + 14 maps and geological profiles. (1836-38.)

Serie 2. 9 plates illustrative of scenery. (1835—36.)
Serie 3. 11 plates illustrative of plant habit. (1835—37.)

Bibliographically, this work was long a kind of librarian's nightmare, defying efforts to ascertain the precise dates of publication of the many new names published in it; since each livraison (part) contained pages and plates belonging to quite different independently paged sections, the livraisons had to be broken up and their contents separated on completion of the whole work, so that this could be bound into volumes according to subject matter; thereby the crucial evidence as to manner of publication was destroyed, and unfortunately the work itself provides no information as to the contents and dates of issue of the livraisons.

Thus the title-page of the **Phytographia Canariensis** Sect. 3, is dated 'MDCCCXXXVI-L', which covers far too long a period for purposes of priority. In 1931, when I frequented the Cambridge University Herbarium, T. G. Tutin called my attention to the complexity and difficulty of the task of ascertaining the dates of publication of the **Phytographia Canariensis** and also the need of such information for taxonomic botanists. Tutin and E. F. Warburg were then studying the plants collected on their expedition to the Azores in 1929. For a paper on **Ilex perado**, later published in **J. Bot. (London)** 71:99-101 (1933), Tutin wanted to know the date of publication of the name **Ilex platyphylla** Webb & Berthelot; between 1836 and 1850 was as near as one could get at the time although now it is known to have been published in 1842. Being then a young bookseller and later a librarian, I took up the challenge presented by this important book, stimulated, I must confess, by the knowledge that it had defeated the great natural history bibliographers, C. D. Sherborn and B. B. Woodward, who, as I later realized, must have had too much else on hand to undertake so time-consuming a labour in detail. As I stated in 1937, 'a copy in the original wrappers as published and bearing on each the date of receipt by the subscriber would tell everything; such a copy probably nowhere exists'. Since then, however, livraisons 1-9, 11-35 in wrappers, as issued, have come into the possession of the British Museum (Natural History). In 1931 the best way of tackling the problem was to search contemporary periodicals for reviews and references to the **Histoire naturelle**; these, however, proved disappointingly few though helpful. In 1934 I accordingly went to Florence, where Webb's library is preserved, in the hope that his correspondence and other documents would yield further information. To my surprise, delight and good fortune, I found there a manuscript list, probably drawn up by Kralik, Webb's

herbarium curator, which stated in what livraisons and when the greater part of the work was published. This did not, however, give dates for the last 20 livraisons. Luckily the British Museum at Bloomsbury purchased the livraisons as they were issued and had preserved in their archives the invoices of book purchases from the bookseller Hippolyte Baillière; search through these invoices was tedious but nevertheless rewarding, for they provided the dates on which Baillière had supplied the livraisons, including the last 20. Checking Baillière's dates against those already known indicated that he probably supplied most livraisons within a month of their issue in Paris. It remained then to correlate the information from these diverse sources and convert it into a form easy for consultation, e.g. by converting sheet-numbers into page numbers, listing the plates in numerical order, and so on. The result, 'On the dates of publication of Webb and Berthelot's Histoire naturelle des Iles Canaries', was published in the **Journal of the Society for the Bibliography of Natural History** 1:49-63 (February 1937). It should be noted that the numbering of the plates bears little relation to their dates of issue and that often the plates were issued ahead of the text relating to them. Since the plates mostly portray floral details, many new names have their first valid publication on the plates rather than in the text. Lack of correlation between plates and text sometimes creates nomenclatural difficulties. Thus **Pimpinella dendrotragium** Webb & Berth., **Phyt. Canar.** 2:t.72 (Nov. 1837) has priority over **P. dendroselinum** Parl. in **op. cit.** 2:152 (Dec. 1842).

The Phytographia Canariensis is a magnificent quarto work with excellent typography, fine detailed plates and very good descriptions and notes, all written in elegant Latin, for no botanist of the period was a better and more erudite classical scholar than Webb; contemporaries rated Stephan Endlicher (1804-49; cf. **J. Arnold Arb.** 28:424-429; 1947) of Vienna as his only equal.

According to Parlatore his friend and biographer, Webb knew perfectly French, German, ancient and modern Greek, Italian, Latin, Portuguese and Spanish and had some knowledge of Hebrew; Hooker stated that 'he has been known at his own table to address different guests in seven different languages'. Webb was a very good, accurate and painstaking botanist with an intimate knowledge of both living and dried plants; his descriptions, particularly in association with the plates, clearly indicate the plants concerned. On account of its wealth of firsthand information so elegantly presented the **Phytographia Canariensis** is thus a classic of systematic botany; for work on the flora of Macaronesia it is fundamental and indispensable.

Webb and Berthelot adopted a rather narrow generic con-

cept, as did many of their contemporaries, more in accordance with Medicus and Moench than Linnaeus and thus stemming from Tournefort but supported by a much greater intimate knowledge of floral and carpological morphology. Thus they separated **Rhodorrhiza** from **Convolvulus; Mnemion** from **Viola; Luteola** from **Reseda; Stephanocarpus** and **Rhodocistus** from **Cistus; Dichroanthus** from **Cheiranthus; Pachypodium** from **Sisymbrium.** In preferring a narrow generic concept they may well have been influenced by their friend Edouard Spach (1801-1879; cf. **J. Soc. Bibl. Nat. Hist.** 1:255-259; 1939), a very careful worker whose **Histoire naturelle des Végétaux,** in preparation at the same time as theirs, broke hitherto accepted genera into much smaller and often more natural groups treated by Spach as independent genera rather than as sections. Such groups, when studied within the bounds of a single floristic region, are usually well-defined. For Webb and Berthelot, essentially concerned only with Macaronesia and south-western Europe, they appeared natural units reasonably accepted as genera. When, however, such groups have many allies outside a given floristic area, these may include taxa intermediate between such groups, thus obscuring the distinctions valid within the area, or else consistent application of the same criteria to these outside taxa may necessitate their division into an inconvenient number of small genera, obscuring more important affinities. Thus in their **Genera Plantarum** (1862-83), based on a world-wide survey, Bentham and Hooker fused many of the Webb and Berthelot segregate genera with previously established genera by adopting a broader generic concept. Such divergences of viewpoint have been many times discussed without partisans on either side being able to convince their opponents of the correctness of one concept as opposed to the other; see, for example, the papers by Rydberg and Skottsberg (1929). Webb and Berthelot were probably most successful in their treatment of the **Sempervivum** group so well represented in Macaronesia. Indeed the Danish plant-geographer J. F. Schouw in 1822 named the Canary Islands, with the Azores, Madeira and the north west coast of Africa, all then little-known botanically, the **Provincia Sempervivorum** from what he regarded as their most characteristic plants. Buch, in 1825 remarked that 'scheint dem **Sempervivum** auf diesen Inseln ein besonders günstige Vaterland zu seyn'. No botanical visitor to the Canarian islands can fail to note the members of the **Sempervivum** group with their rosettes of succulent leaves plastered against cliff faces or with shrubby stems and numerous flowers arising out of rocks or growing on roof-tops. Webb and Berthelot gave them special attention and in consequence later separated them all from the

European genus **Sempervivum** proper, typified by **S. tectorum** L., by placing them in four independent genera **Aichryson, Aeonium, Greenovia** and **Petrophyes** (i.e. **Monanthes**). Since virtually all the morphological diversity of the group as a whole occurs in its Canarian representatives, Webb and Berthelot's survey has not been vitiated by taxa elsewhere and their genera have been maintained by most recent workers, notably by R. Lloyd Praeger in his **An Account of the Sempervivum Group** (1932).

In 1841 Webb met the enthusiastic young Sicilian botanist Filippo Parlatore (1816-77) at whose suggestion Leopoldo II of Tuscany had founded in Florence a central Italian herbarium. Webb, whose love of Italy went back to his youth, became keenly interested in the well-being of the new institution and, after completing the **Histoire naturelle,** he worked at its collections. He gave practical proof of his confidence in its future by bequeathing in 1850 to the Grand Duke of Tuscany and his successors the rich Webb herbarium and botanical library in Paris, his mansion there being sold to provide a fund for their upkeep. Webb died on 31 August 1854 and these collections, so rich in type material and so important for the Macaronesian flora, were accordingly moved to Florence. They include correspondence with most of the leading European botanists of the time. It is very desirable that a list of these letters with their authors and dates should be published even if circumstances do not permit the compilation of a detailed calendar.

As Schouw had done earlier, Webb recognized that the Atlantic Islands including Madeira, Porto Santo and the Azores, the Canary Islands and the Cape Verde Islands, formed a floristic region which, from about 1845 onwards he refered to as the Macaronesian region, Macaronesia and **regio Macaronesiaca.**

The derivation of the term seems nowhere to be stated but obviously Webb coined it from the Greek μακαρ (**makar,** happy, blessed) and νησος (**nēsŏs,** island), the termination **—nesia** indicating a group of islands as in **Macronesia, Melanesia, Micronesia** and **Polynesia,** and so a condensed form of μακαριον νησοι (**makariŏn nēsoĭ,** Islands of the Blest). It alludes to the Roman name, **Insulae Fortunatae** (Fortunate Islands), for the Canary Islands which form the central and most important part of the Macaronesian region and which provided Webb himself with several years of happy exploration and yet many years more of happy study of its astonishing floristic richness monumentally represented in the **Histoire naturelle des Iles Canaries.** The work of such a congress as this devoted to the study and conservation of the Macaronesian flora is a fitting continuation of the labours of this amiable, generous, diligent, internationally-minded English botanical scholar.

Some Sources of Futher Information

BOULGER, G. S. 1899. Webb, Philip Barker (1793-1854). *Dict. Nat. Biography,* 60 : 105-7. London.

GAY, JACQUES. 1856. Notice sur la vie et les travaux de Philippe Barker Webb. *Bull. Soc. Bot. France,* 3: 37-52. Paris.

HOOKER, *Sir* Wm. J. 1854, Philip Barker Webb, Esq., of Milford House, Surrey. *Hooker's Journal of Botany,* 6 : 310-315. London.

[LINDLEY, JOHN]. 1854. Dr. Stocks and Mr. Barker Webb. *Gardeners' Chronicle,* 1854 : 580 (Sept. 9, 1854).

MARTELLI, UGOLINO. 1905, Testamento di Filippo Barker Webb. *Webbia,* 1 : 1-4. Florence.

PARLATORE, FILIPPO. 1856. *Elogio di Filippo Barker Webb.* 113 pages and portrait. Florence.

RYDBERG, P. A. 1929. Scylla or Charybis. *Proc. Int. Congr. Plant Sci. Ithaca,* 1539-51. Menasha, Wisconsin.

SKOTTSBERG, C. 1929. Comments on the spliting of genera. *Proc. Int. Congr. Plant. Sci., Ithaca* 1552-55. Menasha, Wisconsín.

STEARN, W. T. 1937. On the dates of publication of Webb and Berthelot's "Histoire naturelle des Iles Canaries" *J. Soc. Bibl. Nat. Hist.* 1 : 49-63. London.

WEBB, P. B. Unpublished correspondence with J. Gay preserved in the Library of the Royal Botanic Gardens, Kew.

March 1973
Department of Botany
British Museum (Natural History)
London, Great Britain

2. Macaronesian Collections of Phanerogams in the Herbarium Universitatis Florentinæ

C. H. STEINBERG

For everyone who undertakes a critical study of a flora, it is of great help to know where old and fundamental collection are housed, in order to know where to look for the typespecimens. As in the Herbarium Universitatis Florentinae there are some important collections from the Macaronesian Islands, I think it may be of interest to give here a report on them, especially as some of those collections are not known to be in Florence.

The HERBARIUM UNIVERSITATIS FLORENTINAE — which has the international abbreviation "FI" — consists of the General Herbarium, the Herbarium Webb and the Tropical Herbarium. In the tropical Herbarium are no specimens collected in the Macaronesian Islands. Such specimens are all in the Herbarium Webb and the General Herbarium.

The Herbarium Webb is of particular importance, as the botanical part of the "Histoire Naturelle des Iles Canaries" of P. B. WEBB and S. BERTHELOT 1835-1850 was based on it. Also the "Spicilegia Gorgonea" of P. B. WEBB, published in Hooker's Niger Flora 1849, is based partly on specimens in the Webb Herbarium from the Cape Verde Islands.

Webb had kept separate the specimens from the Macaronesian Islands and from Marocco from the rest of his herbarium. Some years ago, over forty packages, were intercalated in the rest of his herbarium, but they were left in separate covers, so that it is quite easy to see on what material he based his "Phytographia Canariensis" and the "Spicilegia Gorgonea".

But the importance of this herbarium is not only due to the fact that all its material was used by Webb in writing his works, but also to the fact that it was open to other botanists in Paris during Webb's lifetime, and later on in Florence. So nearly all the holotypes of Webb's species are at Florence (his handwriting in fig. 9 and 44), but those of other botanists too, who I give here.

The first botanist to be mentioned is RENÉ LOUICHE DESFONTAINES, who probably described some species of Canarian plants, he had in his own herbarium, and which was acquired by Webb after his death in 1834. In his herbarium are some isotypes of the Flora Atlantica — the holotypes are at Paris — and the holotypes of all the other species he described, especially those of

the Catalogus Horti Parisiensis (his handwriting in fig. 3).

LOUIS MARIE POIRET studied many specimens of Broussonet in the Herbarium Desfontaines and in which there are the holotypes (his handwriting in fig. 6)

CARL LUDWIG WILLDENOW too, studied specimens of Broussonet in the Herbarium Desfontaines, and some of his holotypes are in it. (his handwriting in fig. 10)

Than AUGUSTIN PYRAMUS DE CANDOLLE studied and described plants of the Herbarium Desfontaines and afterwards of Webb.—Some of those plants may be also at Genève, as it seems that Webb sent duplicates of his collections as a gift to De Candolle (his handwriting in fig. 2).

Also ALPHONSE LOUIS PIERRE PYRAMUS DE CANDOLLE described new plants out of Webb's collections, and some of the holotypes are now in the Herbarium Webb (his handwriting in fig. 1).

EDOUARD SPACH had free access to the Webb Herbarium at Paris, and he was also a valuable help to Webb for some time in arranging his Herbarium. He studied some families monographically and many of his typespecimens are in the Webb Herbarium (his handwriting in fig. 8).

CARL HEINRICH SCHULTZ BIPONTINUS studied especially the Compositae of the Herbarium Webb, as well as other families too, and a great part of his holotypes are in the Webb Herbarium. so they are not with autographic labels (see fig. 7).

FILIPPO PARLATORE studied some systematical group of Canarian plants and especially the Gramineae for the Spicilegia Gorgonea of Webb, and the holotypes of his new species are partly in the Herbarium Webb and partly in the General Herbarium (his handwriting in fig. 5)

CHRISTIAN HORACE BENEDICT ALFRED MOQUIN-TANDON studied some plants of the Webb Herbarium, especially the Chenopodiaceae, and he described some new species on them (his handwriting in fig. 4)

There are surely several other botanists of the firsts half of last century, who described new species on the macaronesian collections of the Herbarium Webb, but it would be necessary to go through the whole herbarium in order to find them.

After the death of Webb many botanists have studied in the herbarium and so probably there will be other revisions, which would be worthwhile to be mentioned here, but unfortunately we have no record of them and it is quite impossible to find them, without a complete knowledge of the whole macaronesian literature.

The following macaronesian collections are present in the Herbarium Webb and in the General Herbarium at Florence. They are given alphabetically for the Canaries, the Azores, the Madeira and the Capo Verde Islands. For every collection is given if known — the year of collecting, in which herbarium they are, if the labels are autographic, handwritten by others or printed, and some other observations, if necessary for a better knowledge of the collections.

It is quite likely that there are still some other collections of macaronesian plants, but I have not been able to locate them, as I have been through some families only, seeking for specimens in genera which have many endemic species, as it is not possible to go through the whole Herbarium Webb of over 200.000 sheets, and surely not the General Herbarium of over 2.500.000 sheets.

Collections of the Canaries Islands

- JOHN BALL — 1888. In the General Herbarium there is a certain number of specimens collected by Ball in the Canaries, all with autographic labels (fig. 11).
- SABIN BERTHELOT 1820-1850. The first set of plants collected by Berthelot on the Canaries are in the Herbarium Webb. Few of them have autographic labels (fig. 12), most of them have labels written by some manuense (fig. 13).
- BERNARD FRIEDRICH BLAUNER 1851. There are some specimens in the Herbarium Webb with handwritten labels, on which is printed "coll.Blauner" (fig. 14).
- LOUIS HYACINTHE BOIVIN 1846. Parlatore said there are specimens of Boivin in the General Herbarium and not in the Webb, but it seems there are none in the General but there are instead in the Herbarium Webb. They have handwritten labels but probably not autographic (fig. 16).
- CARL (Karl) AUGUST BOLLE 1856. There are some specimens in the General Herbarium, but with no autographic labels (fig. 17).
- BONOMI 1904. In the General Herbarium are plants collected by Bonomi at the Canaries, which came in through the Herbarium Martelli (fig. 18).
- EUGENE BOURGEAU 1846, 1855. Bourgeau made his first journey to the Canaries in 1846 on Webb's behalf. So in the Herbarium Webb are different specimens of most of the entities collected by Bourgeau, of which one has the original autographic label (fig. 19), and often also a printed one (fig. 20), and than there are sheets without any label, which certainly

are from the same collections as those labeled. A set was given by Webb to the General Herbarium too. The second journey of Bourgeau 1855, was made on behalf of the Museum of Paris and one set was bought for the Herbarium Webb and one for the General Herbarium. The labels of both sets are printed ones (fig. 21).

— PIERRE MARIE AUGUSTE BROUSSONET 1801. There are many specimens in the Herbarium Webb, which arrived from the Herbarium Desfontaines. They have labels on which is written only "Canaries" and "Broussonet" in two different hands, and Broussonet sent them probably to Desfontaines before determinating them and they have been studied afterwards by different botanist (fig. 22).

— O. BURCHARD 1905. One set of the "Plantae exiccatae Canariensis" of Burchard came into the General Herbarium through the Herbarium Martelli (fig. 24).

— HERMANN CHRIST 1884. There are specimens in the General Herbarium with handwritten and probably autographic labels (fig. 25).

— J.M. DESPRÉAUX 1833-1839. Dèspréaux was a correspondent of Webb and sent him many plants from the Canaries. The greatest part of his specimens have only a number and Grande Canaria on the label, some few others have some observations too, they are all autographic (fig. 26).

— OSWALD HEER. In the General Herbarium there are 79 sheets sent by Heer in 1856, with handwritten labels (fig. 28).

— LORENZO PEREZ 1850. There are some specimens in the Herbarium Webb, with labels written by some manuense (fig. 37).

— HENRI RENE LE TOURNEUX DE LA PERRAUDIÈRE 1855. There are some specimens in the General Herbarium with handwritten labels (fig. 38).

— PETRY 1907. Some specimens, distributed by the Association Pyrénéenne, are in the General Herbarium, with handwritten labels (fig. 39).

— C.J. PITARD 1905. There is in the General Herbarium a set of plants distributed by Pitard, with printed labels, which came in through the Herbarium Martelli (fig. 40).

— RIEDLE. It seems that this collection was a part of the Herbarium Broussonet of the Canaries — it has labels on which is written only "Canaries riedlé" in the same hand as those of Broussonet — and came to the Herbarium Webb through Desfontaines (fig. 41).

— PHILIPPE BARKER WEBB 1828-1830. It is the whole collec-

tion of Webb's specimens of the Canaries, of which some duplicates are also in the General Herbarium (fig. 44).

— In the Herbarium Desfontaines, belonging to the Herbarium Webb, there are other two collections, with only few specimens, of which I do not know the collector, as they are neither indicated nor dated (fig. 45 and 46). They are probably from some collector of the end of the seventeenth century.

Collections of the Madeira Islands

— CHARLES MORGAN LEMANN 1837-1838. In the Herbarium Webb there are specimens with autographic labels (fig. 33).

— Rev. RICHARD THOMAS LOWE. Parlatore says that in the Webb Herbarium are specimens collected by Lowe at Madeira, but I have not found any. All specimens of Lowe I saw in the Herbarium Webb are from the Capo Verde Islands.

— GUSTAVE MANDON 1865-1866. There is a set of the "Mandon-Pl. Maderensis" in the General Herbarium, distributed by Cosson (fig. 35), and some other specimens with handwritten labels out of the Herbarium Ball (fig. 36).

— PHILIPPE BARKER WEBB 1828. There are some specimens collected at Madeira and Porto Santo by Webb in his own Herbarium and in the General Herbarium too. They are listed in two manuscripts, which are in the library of the Botanical Institute of Florence.

Collections of the Azores Islands

— HEINRICH JOSEPH GUTHNICK 1838-1950. There are over 100 specimens, sent by Guthnick to Florence in 1850 and 1852, with autographic labels (fig. 27). Parlatore said that there were specimens in the General Herbarium and the Webb Herbarium, but in the last one I have not found any.

— CHRISTIAN FERDINAND HOCHSTETTER 1838. There are specimens with handwritten labels in the Herbarium Webb (fig. 29); and with printed labels, distributed by Fee, in the General Herbarium (fig. 30).

— THOMAS CAREW HUNT 1844-1848. The sheets in the Webb Herbarium belong to the series distributed by the Botanical Society of London. Those in the General Herbarium were sent by Guthnick, with his own collections and determinated by him (fig. 32).

— HEWETT C. WATSON 1842. There are specimens in the Webb Herbarium with printed labels (fig. 43).

Collections of the Capo Verde Islands

— BERTRAND BOCANDÉ. There are specimens in the Webb Herbarium with handwritten labels (fig. 15).

— CARL (Karl) AUGUST BOLLE 1851. There are specimens sent by Bolle, with autographic labels in the Herbarium Webb and in the General Herbarium (fig. 17).

— SAMUEL BRUNNER 1839. There are few sheets with autographic labels in the Herbarium Webb (fig. 23); they are listed in the Spicilegia Gorgonea. There are many other specimens on which is written Senegambia, of which possibly some were collected in the Capo Verde Islands too.

— Sir JOSEPH DALTON HOOKER (Hooker f.) 1839. The specimens are those collected in the Capo Verde Islands in 1839 during the Antartic Expedition, and were studied by Webb and published in the Spicilegia Gorgonea. Most of them are in the Herbarium Webb, but those studied by Parlatore (Gramineae and some other genera) are in the General Herbarium, all with autographic labels (fig. 31).

— Rev. RICHARD THOMAS LOWE 1855-1864. There is a set of duplicates, which was acquired from the British Museum after the death of Webb, and put into his Herbarium. They are all with autographic labels (fig. 34).

— JULIUS RUDOLPH THEODOR VOGEL 1841. The specimens were collected on the trip to Nigeria, where Vogel died, and were sent to Webb for determination and publication in the Spicilegia Gorgonea, which is part of the Niger Flora of W. J. Hooker. The localities are written by Vogel (fig. 42). The greatest part of the specimens are in the Herbarium Webb, but some are also in the General Herbarium, especially those determined by Parlatore.

Conclusions

In conclusion, the macaronesian specimens of the Herbarium Webb and the General Herbarium should be over 50.000 and most of the species existing in those Islands are likely to be present in the two herbaria.

The holotypes of the following botanists, based on macaronesian specimens, are all or partly present at Florence: Alphonse De Candolle, Augustine De Candolle, Desfontaines, Moquin-Tandon, Parlatore, Poiret, Schultz Bipontinus, Spach, Webb and Willdenow, as well as the isotypes of the following botanists: Ball, Bolle, Broussonet, Brunner, Buch, Christ, Cosson, Hochstetter, Lowe, Pitard, Seubert and probably others too.

The cryptogamic collections of Florence are quite important too, especially the briological one, but it would have taken a long time to trace them. Whoever is interested in the cryptogamic flora of the Macaronesian Islands can always get in touch with us, and we shall be happy to give all the possible assistance.

Summary

As complete a report as possible is given of the phanerogamic collections of the Macaronesian Islands existing in the Herbarium Universitatis Florentinae and of the botanists, who studied them and of whom there are typespecimens at Florence.

References

HOOKER, J. D.: Niger Flora — Catalogue of Madeira plants. 78-83. 1849.

PARLATORE, F.: Elogio di Filippo Barker Webb. 1856.

PARLATORE, F.: Les collections Botaniques du Musée Royal de Physique et d'Histoire Naturelle de Florence. 1874.

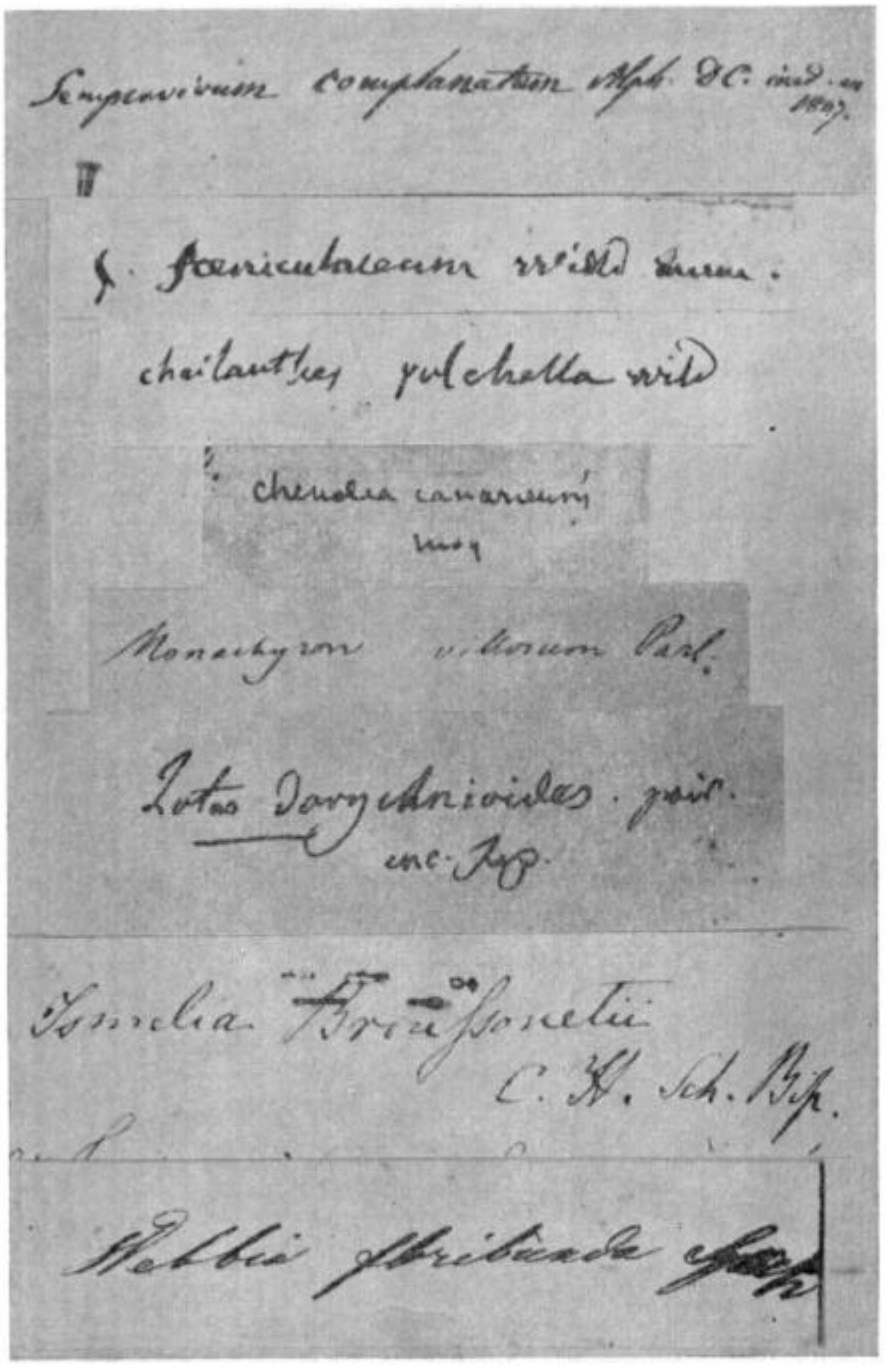
PITARD, J. et PROUST, L.: Les Iles Canaries, Flore de l'Archipel. 1908.

SEUBERT, M.: Flora Azorica. 1844.

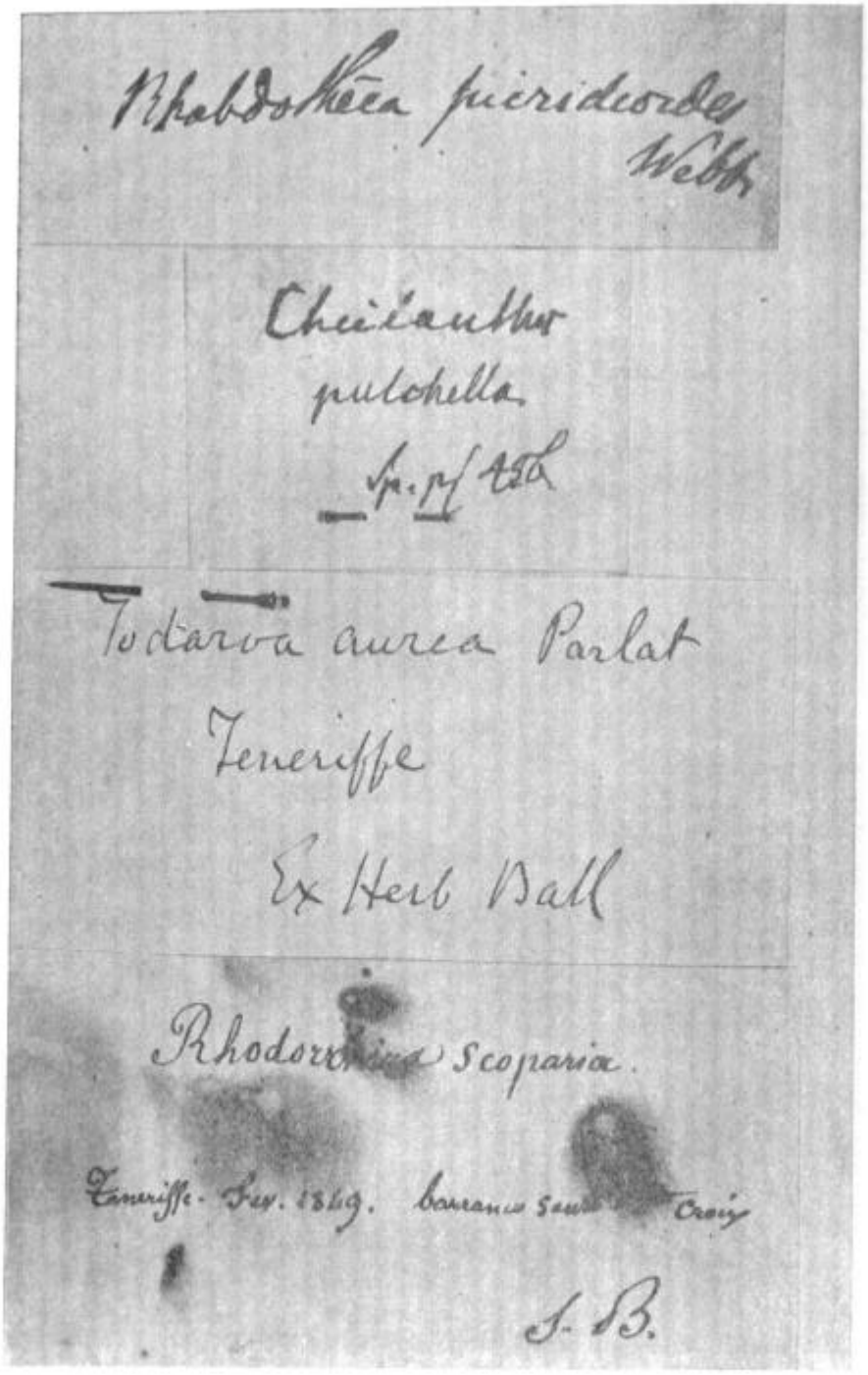
WEBB, P. B. et BERTHELOT, S.: Histoire naturelle des Iles Canaries. 1835-1850.

WEBB, P. B. in HOOKER, J. D.: Niger Flora — Spicilegia Gorgonea. 91-197. 1849.

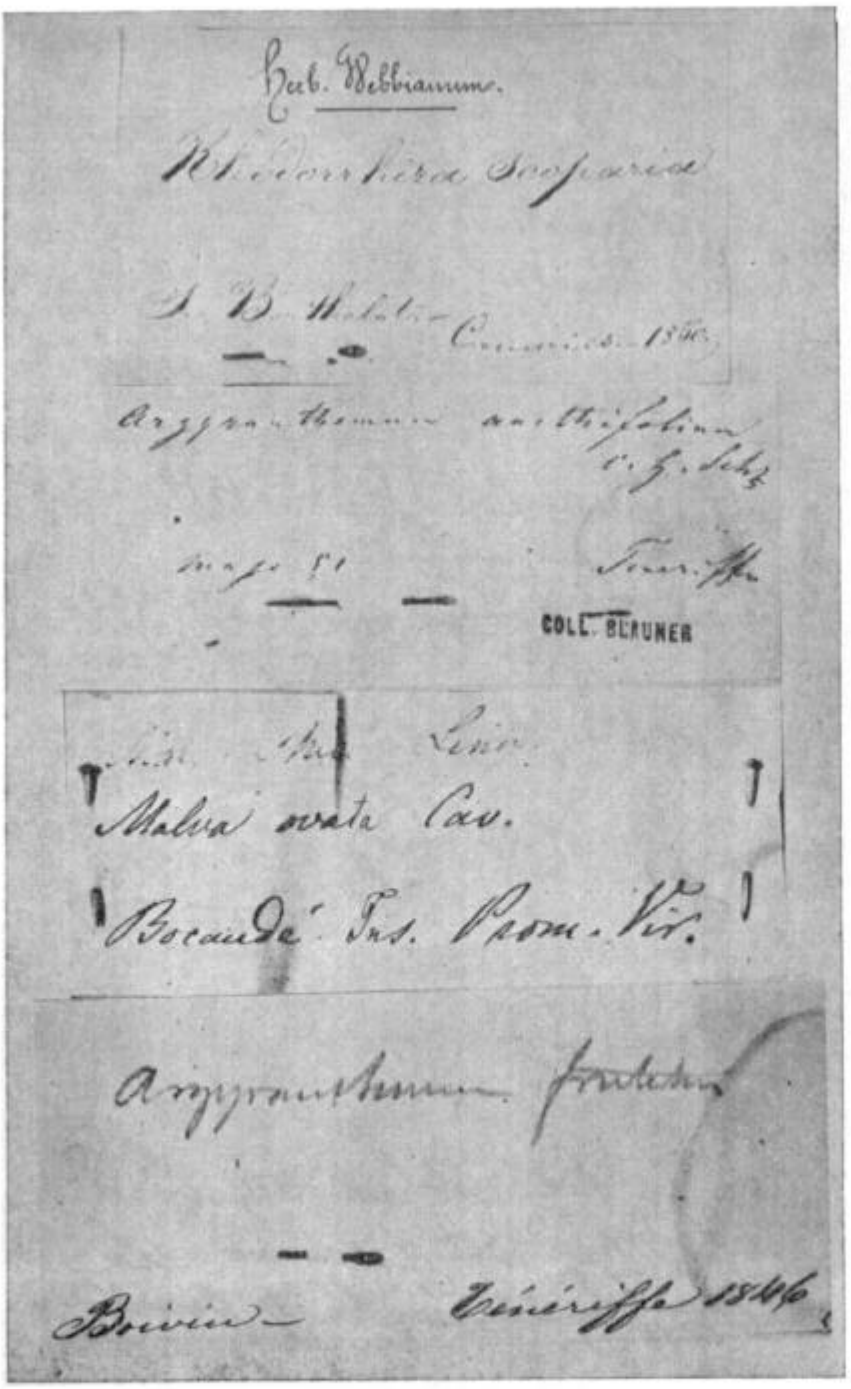
April 1973
Herbarium Universitatis Florentinae
Istituto Botanico
Via Lamarmora, 4
Firenze, Italia



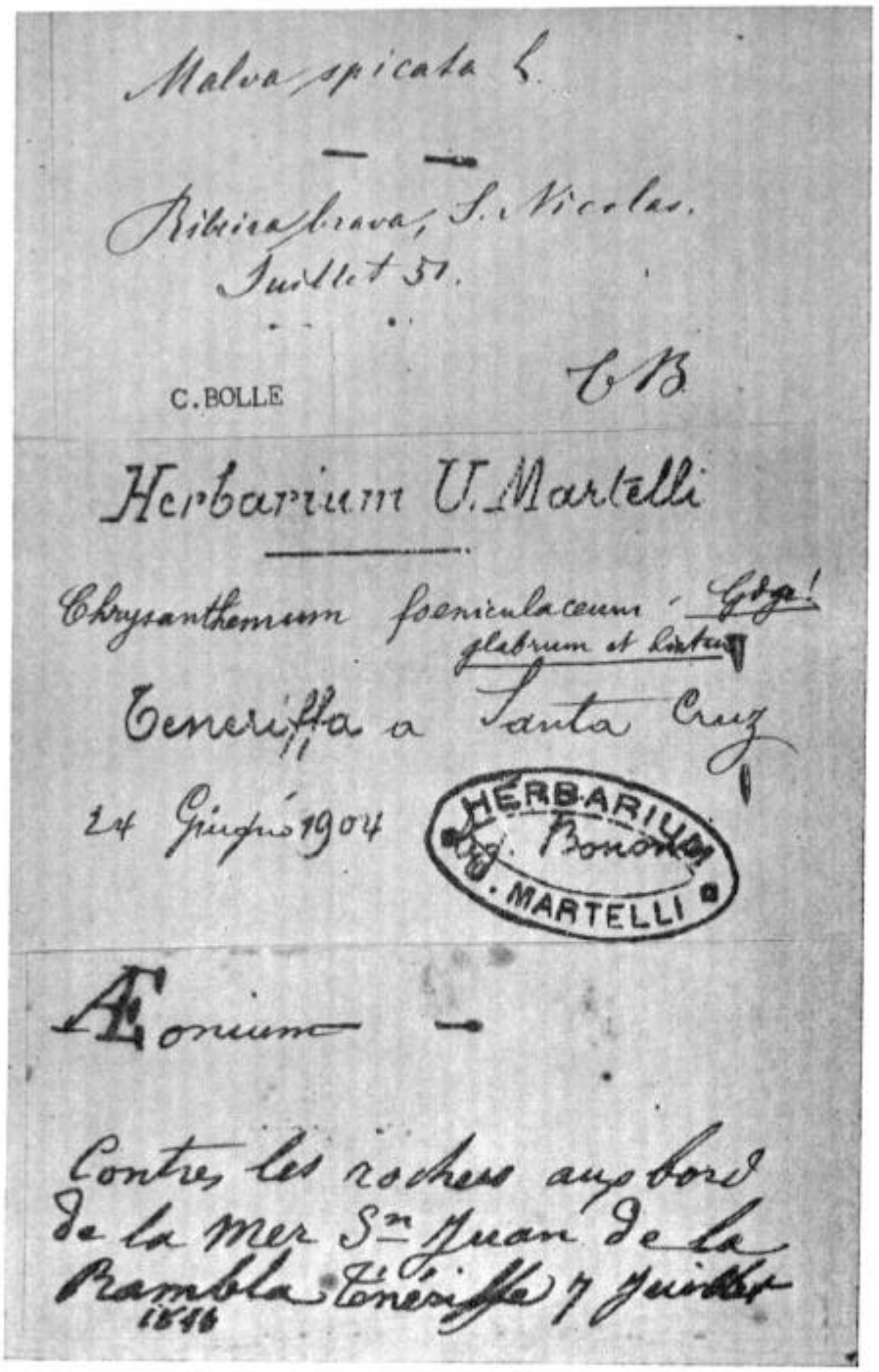
Autographic handwritings of: 1.—Alphonse DeCandolle; 2.—Agustin DeCandolle; 3.—Desfontaines; 4.—Moquin-Tandon; 5.—Parlatore; 6.—Poiret; 8.—Spach; 7.—Non autographic handwriting of Schultz Bipontinus.



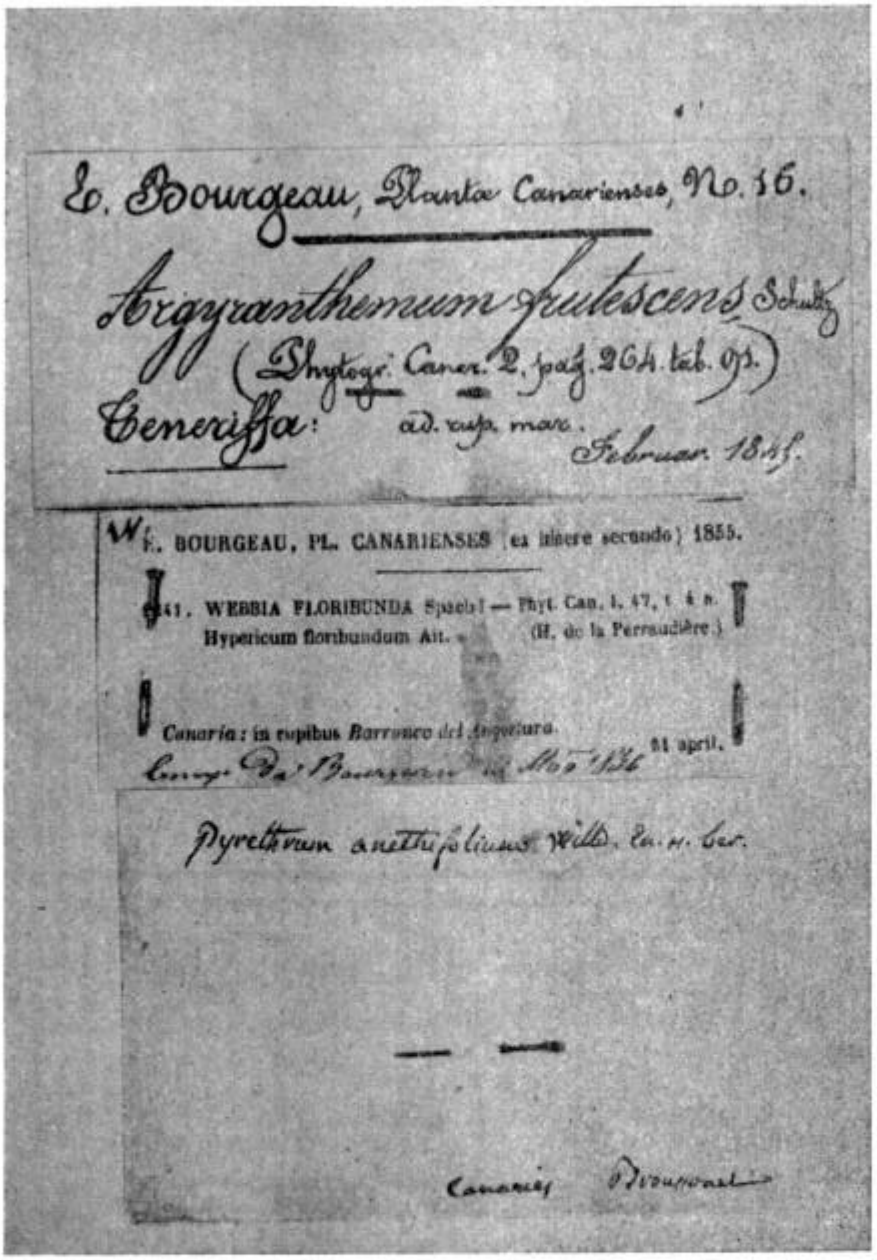
Autographic handwritings of: 9.—Webb; 10.—Willdenow; 11.—Ball; 12.—Berthelot



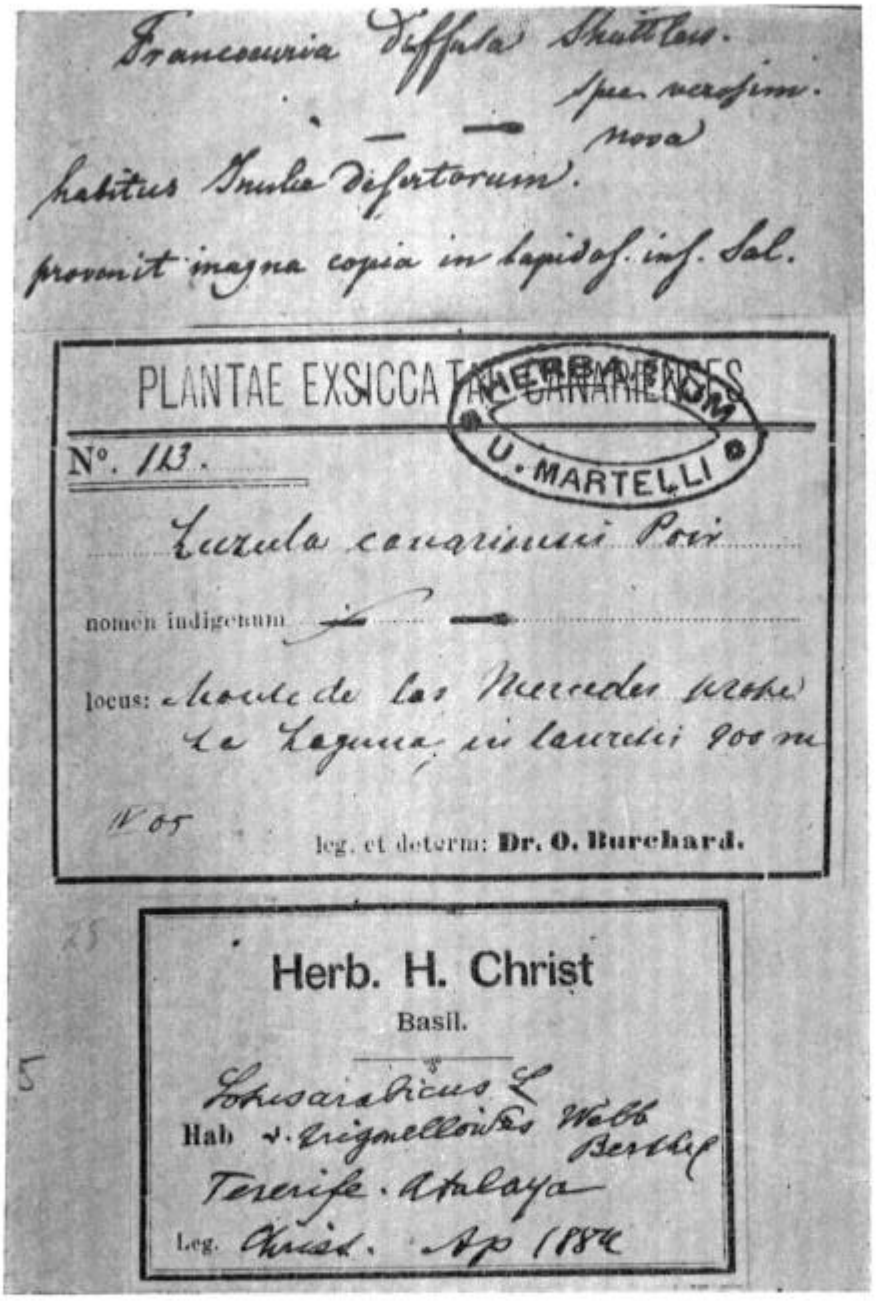
13.—labels of Berthelot, written by a manuense; 14.—labels of Blauner; 15.—label of Bocandé; 16.—label of Boivin.



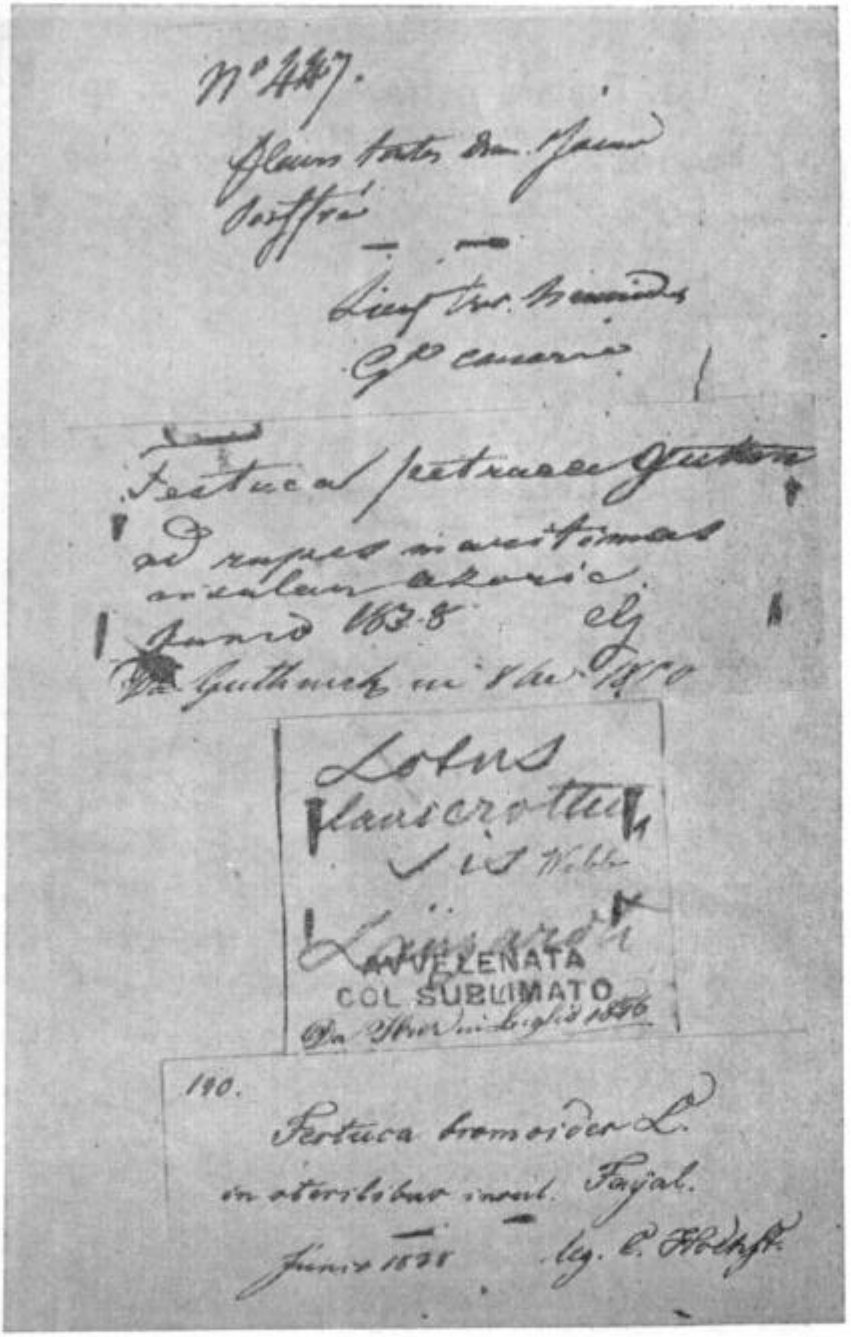
17.—autographic label of Bolle; 18.—label of Bonomi; 19.—label of Bourgeau



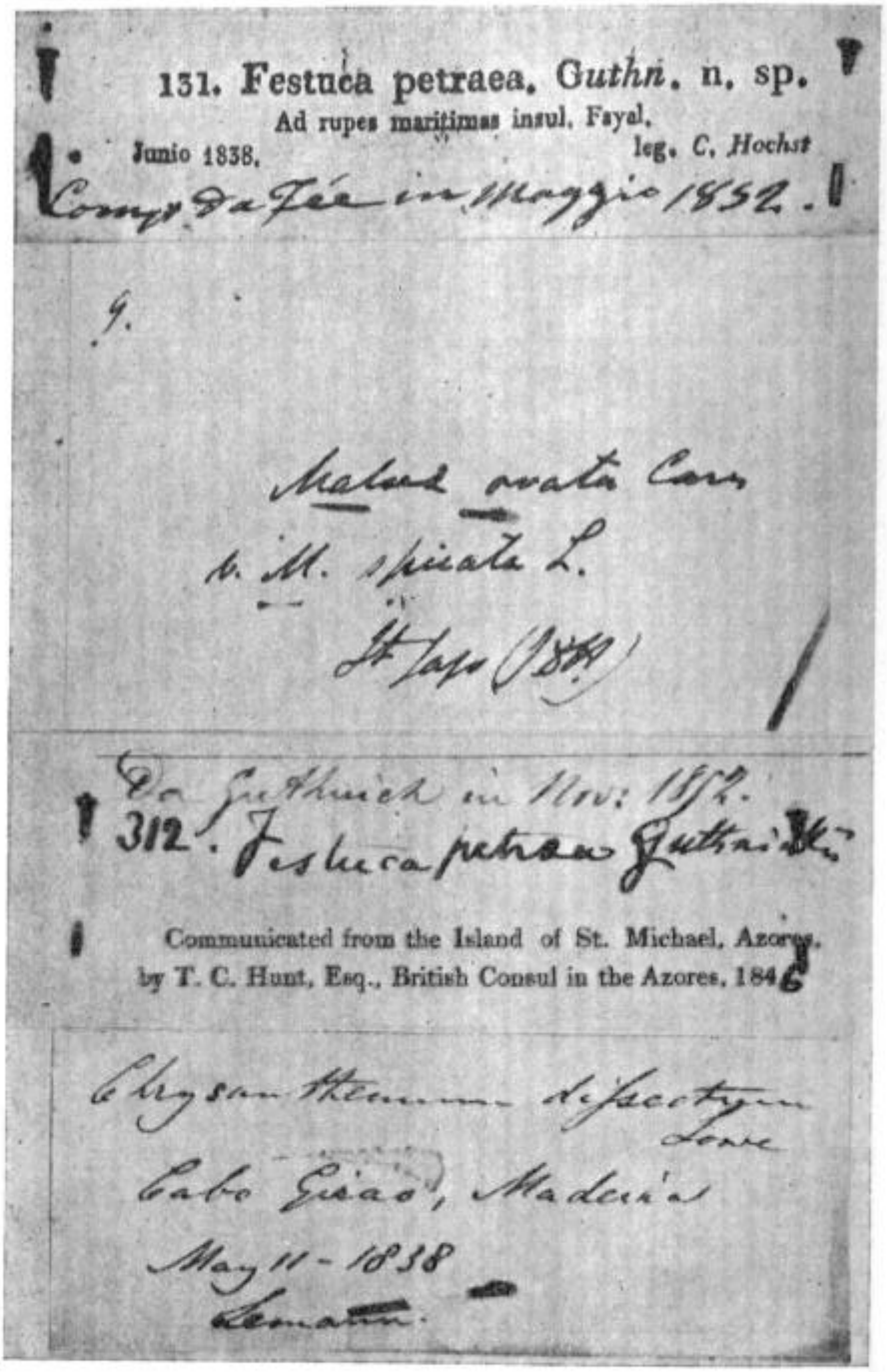
20.—printed label of the first journey of Bourgeau; 21.—printed label of the second journey of Bourgeau; 22.—label of Broussonet.



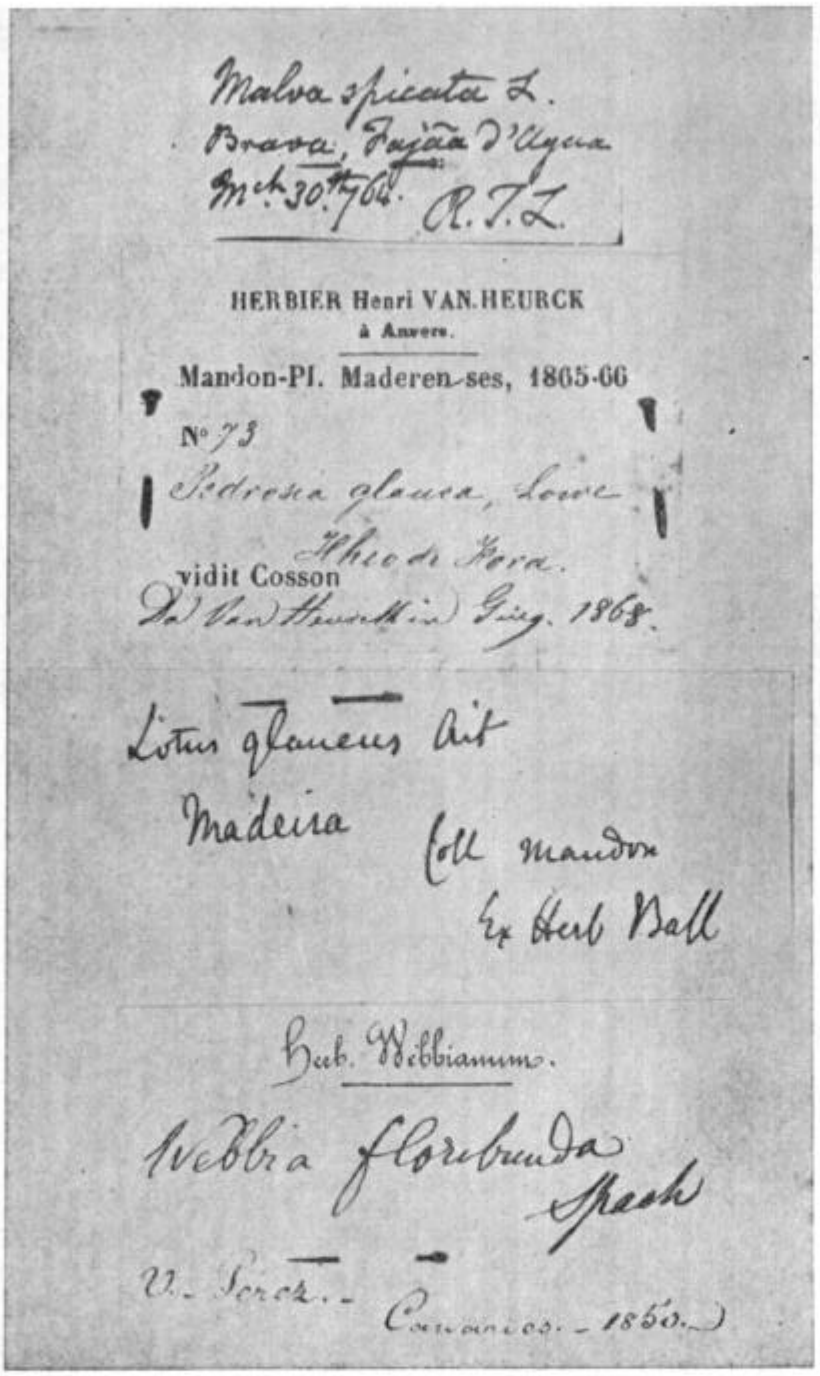
23.—autographic label of Brunner; 24.—label of Burchard; 25.—autographic (?) label of Christ.



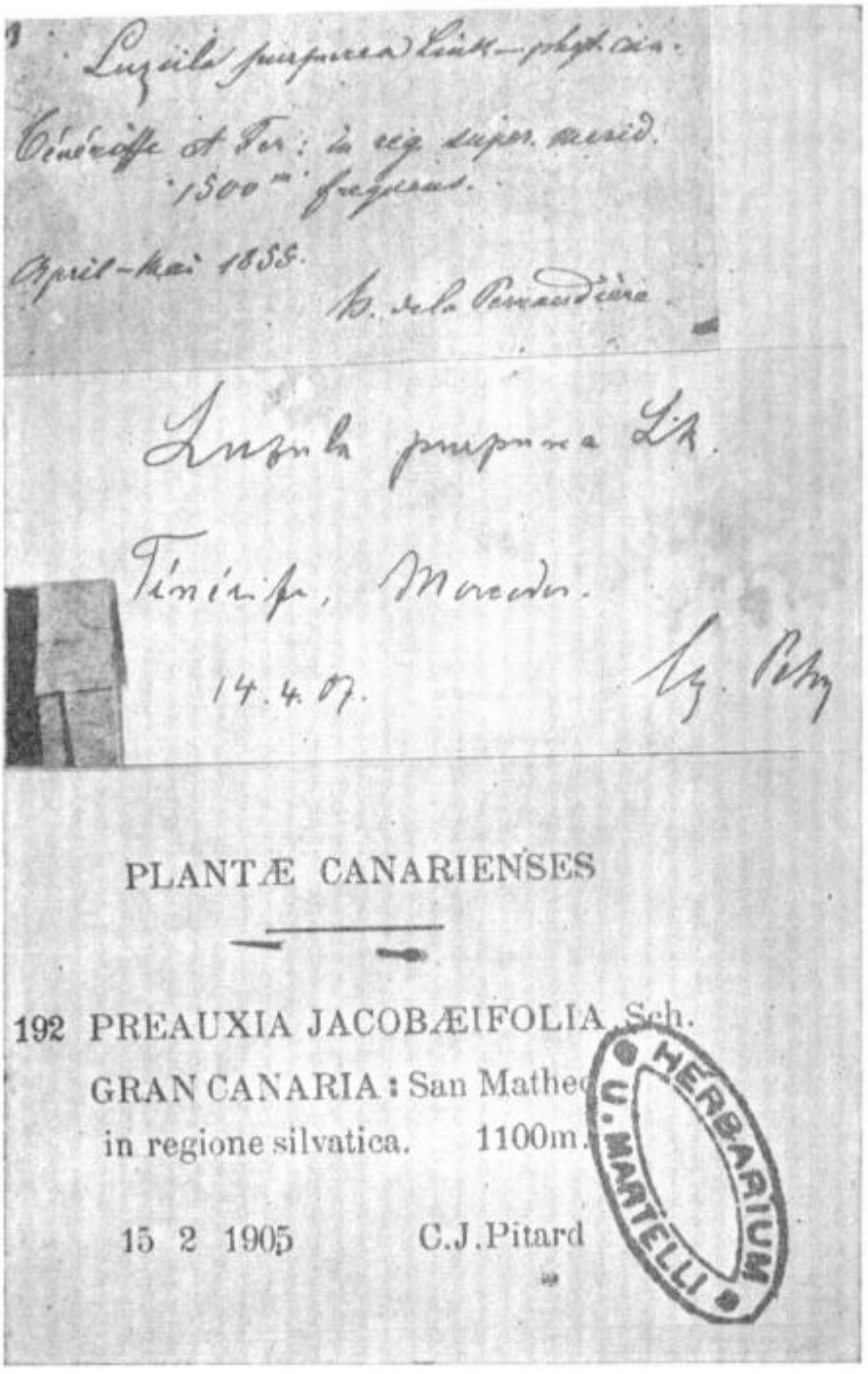
26.—autographic label of Dèspréaux; 27.—autographic label of Guthnick; 28.—label of Heer; 29.—handwritten label of Hochstetter.



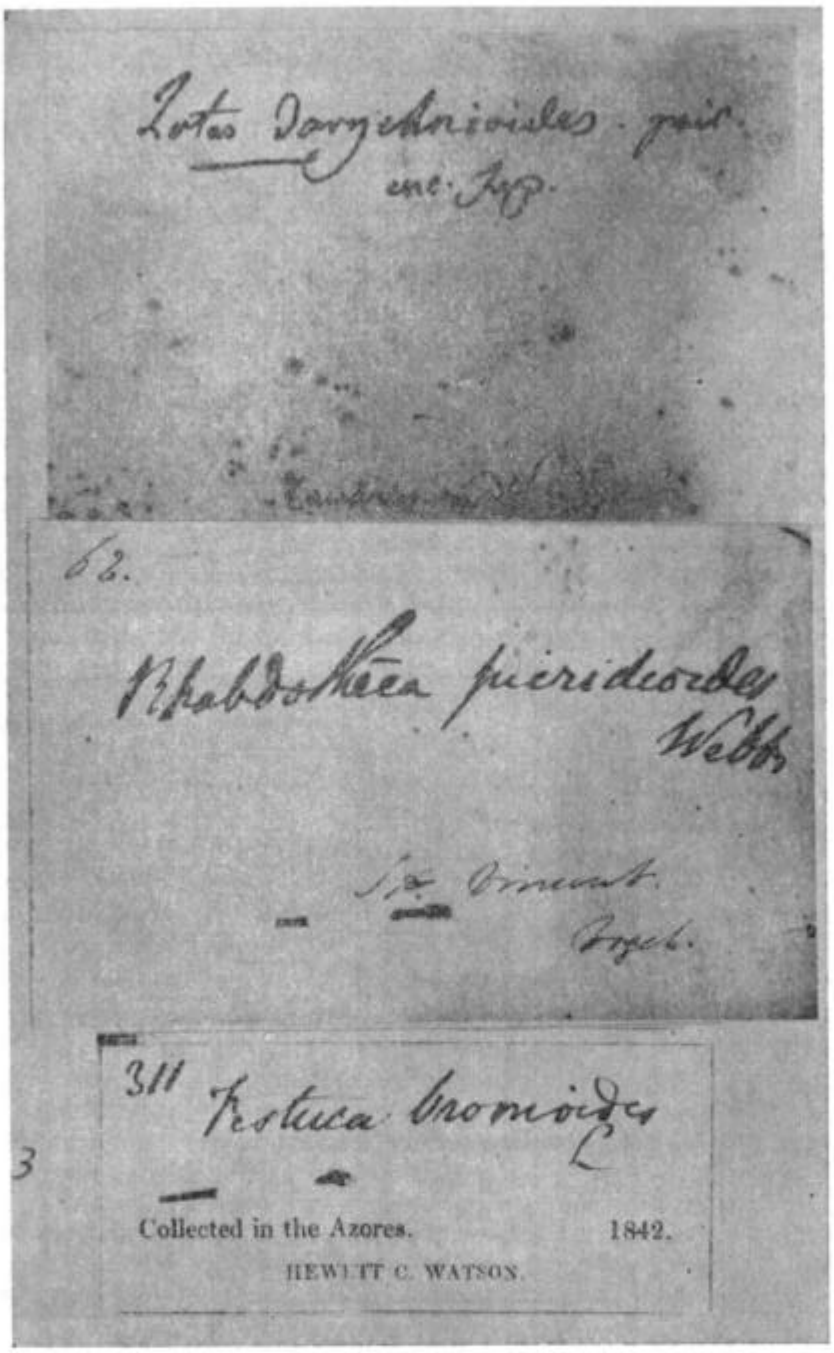
30.—printed label of Hochstetter; 31.—autographic label of Sir Joseph Dalton Hooker; 32.—Guthnick's label of plants collected by Hunt; 33.—autographic label of Lemann.



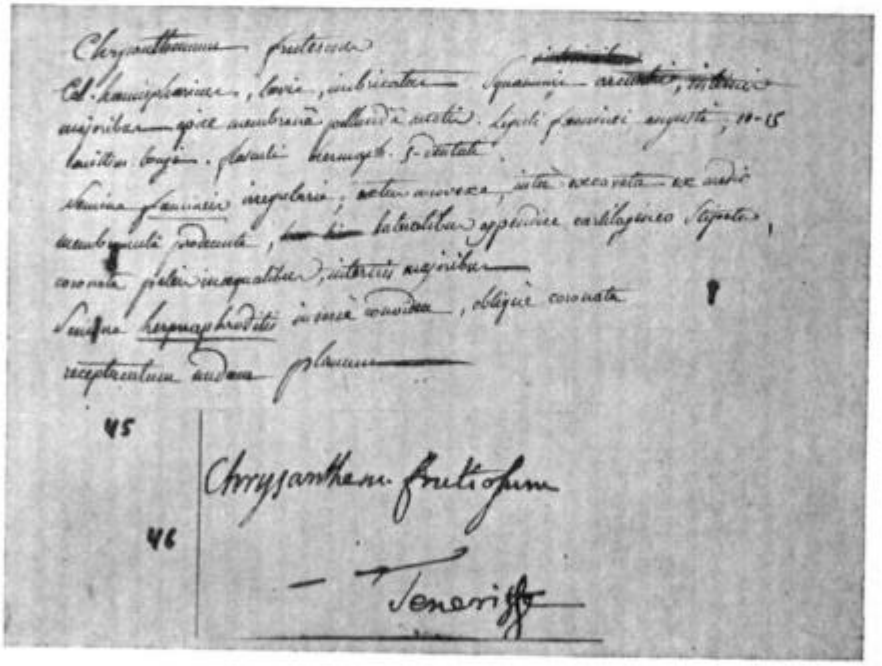
34.—autographic label of Lowe; 35.—label of Mandon-Pl. Maderenses distributed by Van Heurck; 36.—label of Ball's herbarium of Mandon collection; 37.—label of Pérez



38.—label of de la Perraudière; 39.—label of Petry; 40.—label of Pitard.



41.—label of Riedlé; 42.—autographic label of Vogel; 43.—label of Watson.



44.—autographic label of Webb.
45 and 46.—labels of unknown collectors in the herbarium Desfontaines.

3. Canarian Common Names of Wild Plants and their Meaning in Botany and Linguistics

JAMES KRUESS

Ladies and Gentlemen,

Before I worked out this performance I understood as much about plants as a cow about mathematics. But I always was interested in linguistics, and one day I found out, that the work of botanists and linguists can sometimes be supplementary, for example in recognizing plants and plant names.

Accidentally I had one day laying on my writing desk two compilations. One was the "Monumenta Linguae Canariae" 1) by the Austrian professor **Dominik Josef Wölfel**, a work which filled his life and came out posthumously. The other compilation, much smaller, was "Nombres vernáculos de la Flora de Gran Canaria" 2) from the German botanist **Günther Kunkel**, resident in Gran Canaria and the organizer of this congress. Wölfel's intention was to separate the real old Canarian words from words of other origin and to find out pronunciation, writing, meaning and grammatical elements of words, spoken by the old Canarian people, that nowadays are often called **guanches**, although this name was given in former times only to the people of Tenerife. It was Kunkel's intention to find out the common names of (mostly wild growing) plants, as used not only by the aborigines of this archipelago but also by the Canarian people of today. The intentions seem to be in some ways opposite, but they are at the same time supplementary; for both are interested in knowing exactly the plant, to which has been given this or that name and to know exactly that name which symbolizes this or that plant.

As I am now a writer of children's books and luckily endowed with the gift of phantasy, this gift came once more to my aid and enabled me to ask myself, why should not the work of both, the botanist and the linguist, be brought into combination? Now I compared one compilation with the other and found out that 34 names of wild growing plants are more or less similar phonetically, though less similar sometimes in their meaning. I further found out that it really is possible to correct the compilations by comparing one with the other, as I shall try to explain in some examples.

(1) The first plant, that I found in both works, is the well-known "bicácaro", an endemic Campanulacea with red flowers.

In the compilation of **Wölfel** (IV, $ 356) one cronicler says, it was the name of the tomato probably because of its similarity to the edible fruit of the **Canarina,** which is red-orange when ripe and was eaten by the aboriginals. But most of the croniclers are sure, that **Canarina** is meant. This is the plant, which bears today the name: **Canarina canariensis,** a name, that science created from the name of the Canary Islands. So we know exactly the plant and its name. Today this flower is a symbol for ASCAN, the association for nature protection of Gran Canaria. The writing of the name is the same in both compilations, but **Wölfel** also has variants beginning with **v** instead of **b,** for the "instability of labials" (IV, $ 149) is characteristic for berberic languages, as probably was the case in the old dialects of the archipelago. It is also characteristic for the Spanish of today. Wölfel says that the name "bicácaro" may be related to the Latin word **baca** or **bacca,** meaning **berry,** and that it is a mediterranean inheritance. My Latin-German dictionary 3) supposes also that it is a pre-indoeuropean word. (As we shall see other plant names seem to be old mediterranean inheritance too. **Kunkel** has a hispanized variant of the name in "bicacarera" with the typical penultima-accent giving the old word a Spanish form.

In the case of **bicácaro** botanist and linguist have come — except in the etymological aspect — to the same conclusions.

(2, 3, 4) Nearly to the same conclusions have come botanist and linguist also in the case of the plants 2, 3 and 4, the **balo (Plocama pendula,** Rubiaceae), the **vinatico, viñatico** or **viñatigo (Persea indica,** Lauraceae) and finally the **berode, verode, veról** or **beról,** which, though many croniclers speak of **Sempervivum,** today is identified a dwarf-tree, **Kleinia neriifolia,** Compositae. (IV, $ 357, 359, 360) But according to **viñático** and its variants the botanist can tell the linguist, that the Potugese **Ruy Telles Palhinha** in his catalogue of plants of the Acores 4) has for the same plant the name **vinhático.** In this manner the plant is more exactly identified, and the name may come from the Portugese, if it is not an older inheritance.

(5) Much more interesting is the case of **barbusano,** a name still used today for a Lauracea. Wölfel has also the variant **balbusano** (IV, $ 361), because in the Canarian Spanish **r** and **l** can alternate like **b** and **v.** (You often hear **Las Parmas** and **Terde** instead of **Las Palmas** and **Telde.**) The name-giving of this plant is a little detective-story. **Webb** and **Berthelot** (Phytographia, sectio III, 2, p. 223) 5) described the plant as a new species under subgenus **Apollonias** (which was right, as we know today) with the name **Phoebe barbusana.** But the Spanish botanist Cavanilles

had described the plant earlier as **Laurus barbujana,** which Webb and Berthelot, knowing the spelling of the old name, corrected with the remark "per errorem pro **Barbusana**". Willdenow made the plant to **Laurus canariensis,** Nees ab Esembeck to **Apollonias canariensis,** which really would be the best name. But obviously **Laurus canariensis** referred to the endemic Laurus of the Canaries, and our species **barbusano** had to be considered as an **Apollonias,** to which the older species-name available was **barbujana.** 6) So the plant finally got the name **Apollonias barbujana,** and if no botanical congress (for instance this one) decides to correct this obvious original spelling mistake, we and you have to carry on with **barbujana,** a name, that never was used, before a deviating pen created it.

(6, 7) Two more old names, still used today, are given to plants, that are so well-known on the islands, that even touristic guides mention them. The first name, **bejeque,** spelt the same in three sources, has Wölfel from La Palma, Kunkel from Gran Canaria and a Canarian linguist, **Manuel Alvar** (p. 113) 7) from Tenerife. The plant belongs to the Crassulaceae, according to Wölfels croniclers **Sempervivum glutinosum,** according to Kunkel **Greenovia aurea** and **Aeonium** spp. (six are endemic on Gran Canaria). (Wölfel IV, $ 363).

The other plant, **tabaiba,** spelt the same in both compilations, is given to Euphorbiaceae with adjectives like **tabaiba salvaje,** the **wild tabaiba,** a plant without leaves, or **tabaiba dulce,** the **sweet tabaiba,** a plant used for chewing-gum in past times. For the **Euphorbia canariensis** today still is used the name **cardón,** a word, that gave rise — according to some writers — to the word Canaria. But as **cardón** is the Spanish name for **thistle, cardo** (only suffigated with — on) the Romans must have used a Spanish name, before the Spanish language existed, except there is a genetic connexion with the Latin word **carduus,** that was later hispanized. The word **tabaiba,** having no berberic parallels, has to be old Canarian because there are many old place names like **tabaibe, tabaibas, tabaibal** or **timbaiba.** Wölfel brings the word in connexion with the word **tibiabia** and its variants for a queen-like woman, fin des moissons), a doll, used for harvest ceremonies, whilst **Alvarez Delgado** ("Puesto de Canarias en la investigación", La Laguna, 1941) connects the word **tibiabia,** though doutfully, with the Greek-Latin **sibyla.** In this case the botanist cannot help the linguists in finding out who is right, for the other names for the **tabaiba,** compiled by Kunkel, like **leche eterna, eternal milk** (given to **Euphorbia helioscopia),** cannot help either to clear the etymological problem. (Wölfel IV, $ 126, 363). The use

of today of the word **tabaiba** for "people without enterprise, stupid people, spiritless people" a.s.o. seems to be nearer to a doll than to a sibyla. (Sebastián Jiménez Sánchez: Tabaiba, tabaibes..., "El Eco de Canarias, Las Palmas", 8-IV-1973).

(8) But the botanist can really help with the next word, **apio,** that in the nomenclature of the botanists is **Apium** (according to Kunkel **graveolens** et spp.); for he can tell the linguist, that this is a mediterranean plant. However, the linguist can answer that there are in **abuyei** and **buyi** berberic parallels, so that finally we have to suppose, that it is one of these "old mediterranean words", with which the etymologists have so much trouble. (Wölfel, IV, $ 364, 438).

(9) Also for the next plant name, **chinipita,** today **Vicia** spp., Papilionaceae, the botanist can assist in referring to the fact, that in Dr. P. Font Quer's list of Spanish common names for plants 8) this name is lacking (see **Vicia,** p. 479). So it may be an old Canarian word, though Wölfel has no berberic parallels. (IV, $ 365, V, $ 582). But in connexion with place names and the word **garapita** (V, $ 548) Wölfel however believes, that an old root can be hidden in these words. And the botanist can tell him, that **Vicia fába,** the broad - bean, on the islands, is also known by the Spanish name **haba,** that is really very different from **chinipita.**

(10) As to the following plant name, **chiaiotes, achiotes** or **chayota** (Wölfel IV, $ 366), in Kunkel's compilation **chayote** (**Sechium edule,** Cucurbitaceae), Wölfel says, it may be an old Canarian word, because in spite of sounding Romanic there are no Romanic parallels. But in this case the botanist takes his "Dictionary of Gardening", by the Royal Horticultural Society 9) and explains, that this plant as well as its name came from the Westindies, called there **chacha, chaco, chayota** or **chocho-plant.** So the word can be eliminated from the list of Canarian words.

(11) Also for the next plant name, **tedera,** a perennial herb with woody base, in older times called **Asphaltium bituminosa,** today **Psoralea bituminosa,** Papilionaceae, the botanist can explain, that it was imported as a forage plant from Northafrica. Wölfel has berberic parallels like **tareda** for **Psoralia plicata Delile.** In this case probably plant and name came from Northwest-Africa. (Wölfel IV, $ 367).

12) The same thing seems to have happened with the plant name **aderno,** spelt the same by both compilators. Today, says the botanist, this name is given to **Ardisia bahamensis.** In past times, according to the imperfect nomenclature as well as to the diffe-

rent croniclers, the name stood for **Myrsine Heberdenia, Pithosporum conacum caudulatum, Pithosporum con aceum, Heberdenia excelsa** or **Ardisia excelsa.** The botanist knows, that this plant came very late in single examples to the islands, so that the parallels, found by Wölfel, may signify, that the name came together with the plant from a berberic speaking part of Northwest-Africa. (Wölfel IV, $ 368).

(13) A Composite, named **altavaca, altabaca** or **altamaca** (instability of labials), is **Inula viscosa.** This is an invading species from the Mediterranean, growing on wasteland and other disturbed areas. But also here we have interesting berberic parallels, one for instance meaning "to cower" (and you really can hide yourself behind the plant), the other meaning "pasture ground" (and it really is a common plant on pasture grounds). Probably this is a mediterranean inheritance. (Wölfel IV, $ 369). Some Canarian herdmen use the plant still today as litter for dogs, because they believe, that the fleas adhere to the sticky substance of the plant.

(14) As to the last plant and plant name, about which I want to tell you something today, botanists and linguists have been working together already for some time. For **til** or **atil** (a— was a kind of old Canarian article or prefix) was the name of that plant, (Wölfel, IV, $ 369) (more correct: of that tree), to which belonged the holy tree of the island Hierro (formerly Ferro), where this particular tree bore the name **garoe.** (Wölfel IV, $ 115, 370) Many people have written about this tree from the sixteenth century until today. Wölfel himself found after some adventures an old manuscript of the Italian Leonardo Torriani, 10) who explained to the Catholic Kings of Spain something about the history, the customs, the new fortifications and the old language or dialects of the Canaries and their inhabitants. In this manuscript he also found an illustration of the holy tree, and he could, with the help of the botanist **J. Maynar** ("Revista de Historia", 6, 1943, Santa Cruz de Tenerife) recognize the tree as **Ocotea foetens,** Lauraceae, a tree, still known today as **til.** With this word there was some confusion, because the Spanish name for the lime-tree is **tilo.** So it happened, that Miguel de Unamuno, who was exiled in the Canaries, wrote enthusiastically about the wonderfull **tilos,** describing exactly another plant, namely the **til, Ocotea foetens.** My former neighbour in the village, in which I live, Juan del Río de Ayala, a great Canariologist, struggled with effect for the renaming of a wood near the town Moya on Gran Canaria, formerly called **Los Tilos,** to be changed to **Los Tiles** a hispanized plural of the old word **til.** Much more valuable information on

this tree would have been given by Viera y Clavijo, 11) but, unfortunately, these particular pages are missing in his dictionary.

Maybe it is interesting for you to hear something more about this old holy tree from the island Ferro, today Hierro. A French Baron, who visited between 1798 and 1802 most islands off the African shore, **Bory** de **St. Vincent,** tells us, 12) that in past times the **garoe** provided with water all inhabitants of Ferro.

Another cronicler, Jacson (reported on Bory St. Vincent p. 246), tells us from earlier times, about 1618, that he himself saw the tree, thick like an oak, seven to eight yards high (what is much too low, because the tree grows to a height of 25 meters), withered during the day and in the night producing water for 8.000 inhabitants and 100.000 cattle. In one night, he tells us, 100.000 tons of water were distributed all over the island through tubes of lead. I doubt, that Jacson really saw the tree or it must have rained quite a lot during his visit to Ferro. The trustworthiest witness seems to be **Juan de Abreu Galindo,** who tells us in his "Historia de la conquista..." from 1592 (Book I, cap. XVII, new edition 1955, p. 83 - 85), that the trunk had a circumference of about 12 handspans, thus about 2.40 m, a height of 40 feet and a crown with a circumference of 120 feet; its fruits are like acorns, with an aromatic flavour. It was, according to Abreu (who already said, it may be a **til**), an evergreen tree with leaves like laurel, but broader and more undulate, and surrounded by bushes. The water, that the tree produced, came every morning with southern or eastern winds from the sea in form of clouds and exhalations, that drove against the rocks, surrounded the big tree and dripped down in form of water from the smooth leaves. In good years of **Levante** (the eastern wind), the tree gave, according to Abreu, daily 20 **botas** of water. If he means the Spanish wine-measure of 516 liters, we have the considerable quantity of 10.320 liters daily. But as the word **bota** signifies also other measures of capacity (and also **boot)** we cannot know for sure the quantity he meant. In every case we know from many, many croniclers, that the tree really produced water, and we know — thanks to the teamwork between botanists and linguist, that the holy tree of Ferro/Hierro, a so called **til** with the name **garoe,** was **Ocotea foetens.** That shows, that my thesis, teamwork between botanists and linguists may have fruitfull results, was in practice already long before I formulated it for this congress. Thank you.

Literature:

1) DOMINIK JOSEF WÖLFEL: "Monumenta Linguae Canarie", bearbeitet von Alois Closs, Graz, 1965.

2) G. KUNKEL: "Nombres vernáculos de la flora de Gran Canaria" (Cuadernos de Botánica Canaria, Suplemento 2), Las Palmas de Gran Canaria, 1971.

3) LANGENSCHEIDTS Taschenwörterbuch der lateinischen und deutschen Sprache, Berlin, München, Zürich, 11. Auflage, 1969, p. 68.

4) RUY TELLES PALHINHA: "Catálogo das Plantas Vasculares do Açores"; Lisboa, 1965, p. 38.

5) P. BARKER-WEBB et SABIN BERTHELOT: "Histoire Naturelle des Iles Canaries", Paris, 1836-1850.

6) G. KUNKEL: "Plantas Vasculares de Gran Canaria" (Monographiae Biologicae Canariensis 3), Las Palmas de Gran Canaria, 1972, p. 34 f.

7) MANUEL ALVAR: "Estudios Canarios I", Las Palmas de Gran Canaria, 1968, p. 113, n. 9.

8) P. FONT QUER: "Botánica Pintoresca". Barcelona, 1964.

9) "Dictionary of Gardening, by the Royal Horticultural Society", edited by FRED J. CHITTENDEN, Oxford, 1956.

10) LEONARDO TORRIANI: "Die Kanarischen Inseln und ihre Urbewohner", eine unbekannte Bilderhandschrift vom Jahre 1590, im italienischen Urtext und in deutscher Übersetzung herausgegeben von Dr. Dominik Josef Wölfel, Leipzig, 1940.

11) JOSE DE VIERA Y CLAVIJO: "Diccionario de Historia Natural de las Islas Canarias...", Las Palmas de Gran Canaria, 1866.

12) J.B.G.M. BORY DE ST. VINCENT: "Geschichte und Beschreibung der Kanarien-Inseln", Weimar, 1804, photomechanischer Nachdruck mit einem Vorwort von Hans Biedermann, Graz, 1970, p. 245 f.

List of Plant Names not yet Mentioned:

(15) *tea* Acc. to Wölfel pine-torch and incense pine. (IV, 371) Acc. to the botanists and some people I asked on Gran Canaria only the heart-wood of the Canarian pine. Viera y Clavijo says about the wood (p. 196): "...madera solida, incorruptible, olorosa, algo bermeja, cargada de resina." (Durable wood, indestructable, odorous, auburn, coloured, much resin). Wölfel brings the Spanish parallel *tea* (torch, burning-chip) and the Latin *taeda* (pine, torch, acc. to my dictionary also: wedding - torch, deck). Indoeuropean unexplained. So a mediterranean inheritance? Gomara (1), not compilated by Wölfel, says: "...corazón del pino, que llaman tea."

(16) Acc. to Kunkel *guaydil* or *guaydin* for *Convolvulus floridus,* Convolvulaceae. Wölfel has similar names with the same meaning, but no berberic parallels. As Wölfel has 74 words beginning with *guai* or *guay-* it may be an old Canarian word (Wölfel IX, 379).

(17) Wölfel has *algabera* from the islands Fuerteventura and Lanzarote and two berberic parallels. Kunkel has (instability of labials) *algahuera* and *algahuero* for *Chenolea tomentosa,* Chenopodiaceae. Spanish common names from the islands: *algahuera salada* and *algahuera lanuda* (salty and wooly a.) (Wölfel IV, 380) Not to be found in Palhinhas or Font Quer. So maybe old Canarian word. (But. Span. *algaba* = woods, jungle.)

(18) Both compilators have *tagasaste* (Wölfel IV, 384) for *Cytisus proliferus,* Papilionaceae. A berberic parallel: *tagsest* or *taisest* for "a grass with hard leaves". A Spanish variant from the islands *escobón,* birch-broom.

Wölfel speaks often about the "Affix-Klammer" (a parenthesis of affixes) *ta- -te*, used also for substantivating a word. So the root may be *gasas* (*ta — gasas — te*). Now the following plant name in Wölfel's "Monumenta..." is:

(18a) *gasia* (IV, & 385, not to be found in Kunkel s compilation), without berberic parellels, standing for *Cytisus ramosissimus*. Couldn 'it be, that *gasia* formerly stood in relationship to *tagasaste* like Spanish *limón* to *limonero* or *higo* to *higuera* (limon to limon-tree, to fig-tree), that means fruit to fruit-bearer?

(19) Wölfel has *coderno* from Gran Canaria and a variant *aderno* and for the same plant from Tenerife and Hierro *marmolan, mirmulano* or *murmuran* supposing that *coderno/aderno* is of Portugese or Spanish origin. This might be true. However in the Spanish/Portugese compilations the name is missing, and my Spanish encyclopaedia says from *aderno*: "Nombre dado vulgarmente en las Islas Canarias a la *Ardisia excelsa*..." (Common name of the Canary Islands for A.e.). Viera y Clavijo thought that the holy tree from Hierro was of the species *aderno/coderno* o *marmolan* etc. Kunkel has *coderno* and *marmolán* for *Pleiomeris canariensis*, Myrsinaceae. (About *marmolan* and variants see [25]) It seems that the old dialects of the islands, though probably related, had however noticeable differences in parts of their vocabulary. (Wölfel IV, & 386).

(20) Wölfel has *cofe-cofe* as *Mesembryanthemum nodiflorum* Linn. (Wölfel IV, & 388) Viera y Clavijo (p. 219) says: "...from the seed the poor made gofio". (*gofio* is today a roasted flour made from maize.) Kunkel has the same name and plant and a Spanish variant *algazul*, that is the Spanish common name for this plant (Font Quer, p. 435). Other Spanish variants, not to be found in Font Quer: *cosco* or *coscorrón*, the "headpoint of something", and *hierba de vidrio*, "glass-herb".

The fruits of the *Mesembryanthemum edule* are the so named hottentott-figs, the fruits of *Mesembryanthemum forskalii* are used in the Sahara instead of bread. It seems to be an African inheritance, confusing again fruit and fruit-bearer and moreover a flour and its mixture made of these fruits, for Wölfel has for *gofio*, the roasted flour, a Hausa parallel (IV, & 242) *gahuhu* that must have been earlier *gafufu* ("flour mixed with water instead of with milk"), and I found a kushitic parallel *cacafo* from the Amarro in South-Ethiopia, meaning the flour from the *Ensete edule*, mixed with boiled cabbage and butter. 3)

(21) A plant name, which sounds a bit like Spanish *albaricoque*, the apricot, Wölfel gives as *algaritopa* or *alcaritofe* for *Dracocephalum* or *Iracocéphalo canariensis*, old names for *Cedronella canariensis*, Labiatae, which acc. to Kunkel today is called *algaritofe* or *algaritope*. From the island La Palma Wölfel has the variant *ñota*. No Spanish parallels. Wölfel suggests, *al—* maybe a Canarian element, but also Spanish has *al—* as an Arabic inheritance (Wölfel, IV, & 390).

(22) Both compilators have the name *alicaneja* (Wölfel with many variants), today *Anchusa* and *Cynoglossum*, Boraginaceae. Wölfel tentatively suggests that maybe the root is *kanerxa* or *kanefa*. My Spanish encyclopaedia also has *alicaneja* for *Cynoglossum*, Boraginaceae, and the nomenclature of the botanists knows *Alkánna*, Boraginaceae. 4) This comes, acc. to a German compilation of plant names, 5) from Arabic *alhinna*, thus from a semitic root and maybe related to the Persian *Henna, Lawsonia inermis*. The relationship lies in the use of the plant, for the Canarian aborigines painted fibres in yellow, red and black with extracts from *Anchusa and Cynoglossum*, whilst (acc. to Encyclopaedia Britannica, 11, p. 356, edition 1969) "a paste made of powdered henna leaves is of ancient repute as a cosmetic." As I saw myself in the Sahara, today woman still due their fingernails and other parts of their hands and feet an orange-red colour, which is considered to add to their beauty". As Kunkel has a Spanish variant *abremanos*, "hand-opener", for *Anchusa* and *Cynoglossum*, we may assume that the plant was

used for cosmetics by the old Canarian people too. In any case, if the root is Persian (thus indo-european) or semitic, it is not a word of Canarian origin and can be eliminated from the list of old Canarian words from a berberic root (Wölfel IV. & 391).

(23) Wölfel has *amagante* and once *amogante,* mostly for a mallow. Kunkel has *amagante* for *Cistus symphytifolius,* Cistaceae. A berberic parallel is *mâga* (so that *a—, —n—* and *—te* may be affixes: a maga-n-te) for mallow. A Spanish variant is *jara,* found also in Font Quer (p. 524) for Cistaceae. (*Cistus ladaniferus* was the symbol-flower of Spain.) Wölfel thinks —like his cronicler Torriani — linguistically on an origin from the Aegeis, and the botanists think of Mediterranean origin too. (Wölfel IV, & 393).

(24) Wölfel (has (IV, & 394) mostly *mocan,* once the Portuguese form *mocco* and a hispanization *mocanera,* that means the plant if *mocan* is the fruit. Kunkel has *mocán* and *mocanero* for *Visnea mocanera,* Theaceae, thus probably also a name for the fruit and another for the plant. It is told that the old Canarians made honey from a fruit called *mocán.* The name has been adapted by science. In my German compilation (p. 190) 5) the plant is called *Mocanbaum,* mocan-tree, thus the tree, that bears *mocan.* It really seems, as if the fruit bore the name *mocan* or *mocán.* But on the other hand Wölfel has a particular name for the fruit:

(24a) *yoya* (once *hoyaı* for "fruits" and "elder-berries" (IV, & 359). A berberic parallel is *yaya,* "offspring, children, fruit or berries". Font Quer has neither *mocan* nor *yoya.* The name *yoya* seems to be of berberic origin and the name *mocan* because of many place-names, built with this word, of special Canarian origin. (On the Canaries a baby still today is called *guagua.*)

25) Here we come again to the *marmolan, mirmulano* o *murmuran* of Wölfel, the *marmolán* of our botanist, meaning today *Pleiomeris canariensis,* not having berberic parallels (Wölfel IV, & 397). Not to be found in Font Quer.

We have a similar sounding Spanish word *murmurar,* in spelling and meaning also similar to English *murmur,* from indo-european origin: German *murmeln,* old German *murmulón,* Latin *murmurare,* Greek *mormyrein,* old Slavic *mrûmrati,* old Indian *murmura*— (in this case meaning "crackling fire"). The indo-european root is *+mormor, +murmur* with the meaning "murmur, rushing hollow". 6) Maybe the name is given to the plant because of the ruttling noise of its leathery leaves. Though the plant is of Canarian (or maybe Macaronesian) origin) we may doubt that the name originated from the Canaries.

(26) Wölfel has *oroval, horoval* and *oroual* (IV, & 4040), Kunkel *orobal* like Webb Berthelot (sectio III, 2, p. 284), and my Spanish encyclopaedia (IX, p. 1182) *orobal* also. Wölfel describes the plant with the old name *Physalis spp.,* that is today the plant Kunkel describes: *Withania aristata;* Solanaceae. My encyclopaedia has the name for the plants *Withania somnifera* and *Withania frutescens,* saying that the plants grow near the coast of Huelva and Valencia. So the name may come from Spain. Wölfel has no parallels, Kunkel no variants. That *Withania aristata* is an endemic Canarian plant is not sure. Maybe it came together with the name from Spain.

(27) Wölfel has *tarajal* and similar forms, declaring that the word comes from Spanish: For as *taraje* is a secondary form of *taray* (Tamarix), *tarajal* is a secondary form of *tarayal* (plantation of Tamarix). The word came from the first conquered islands Lanzarote and Fuerteventura and spread out with the meaning "Tamarix" all over the archipelago. Kunkel has the forms *tarajal* and *tarahal* for *Tamarix canariensis,* Tamaricaceae. He has a variant with the real Spanish word *taráy,* assuring the linguist that his arguments are right. (Wölfel IV, & 408).

(28) Wölfel has *orixama, orijama* and *orijana* for *Cneorum pulverulentum* Kunkel *orejama* or *orijama* for the today accepted name *Neochamaelea pulverulen-*

ta, Cneoraceae. Kunkel has the Spanish variants (not to be found in Font Quer): *leña blanca, leña buena* and *leña santa*, meaning, white, good and holy firewood. The old Canarians used the wood for conservation of mummies. As there is a Canarian place name *Orijamas*, and as the plant is endemic and its wood used by the aborigines, we can suppose, (though there are no berberic parallelxs) that it is an oldCanarian word.

(29) Wölfel has *escabon*, Kunkel *escobón*, both for *Cytisus proliferus*, Papilionaceae, the same plant, that on the Western islands is named *tagasaste* (18). Wölfel (IV, 410) says, the word seems Spanish, but he cannot find the similar Spanish word. We can: *escobón* = birch-broom.

(30) Wölfel has taginaste and a lot of writings for Echium spp., Kunkel *taginaste*, also for *Echium* spp., Boraginaceae. Common species names are *taginaste azul, - blanco, - negro, taginaste blue - white, - black*. Only for *Echium lycopsis* there are names like *abremanos* (hand - opener, given also to *Anchusa* and *Cynoglossum*), *lengua de buey* (ox-togue), *lengua de vaca* (cow-tongue), *palomina* (pigeon in fem. form) and *viborina* or *vivorina*, probably a deminutive form of *vibora* (viper). In the case of this plant name the affixes *ta- -te* seem, acc. to Wölfel, to have the function of making a deminutive, so that *ta - h - inas* (*h* exstinguishing an open juncture) means a bigger, *ta - h - inas - te* a smaller *Echium*. But then the *ta- -te* from *tagaste* (*Cytisus proliferus*) may have the same function: *gasia* = fruit (smaller), *tagaste* = whole plant (bigger). (In this case *ta- -te* has the function of maximating).

A berberic parallel is *tainast* for *Echium humile*. Wölfels conclusion: *ta-h-inas-te* = *Echium*. The botanists come to the same conclusion. (Wölfel IV, 415).

(31) Both compilators have names like *azaige, azaygo* or *azaico*, but also forms with *t-*: *tazaigo, tasaygo* or *tazaico* for *Rubia spp., Rubiaceae* (Wölfel IV, 414). Kunkel has for this endemic plant also two Spanish variants: *gamarza*, that may be related to *gama*, the scale of colours, and *enrededera*, that simply means a tendril. Wölfel asks, if the *t-* is separable from the stem of the word without being able to give an answer. If we would have a form like *tazaigote*, we could have for the third time *ta- -te*. *But* I could not find a form like this.

(32) Wölfel has the forms *taxora, chajora* (a palatalized *t* often is written *ch* by the Spanish croniclers) and *tajeré*, which, as he indicates, is another plant. Because Berthelot said, it was an "espéce de thym", Wölfel may have searched berberic synonyms for thyme without finding them. But the botanists knows that the name today is give to *Sideritis candicans* and spp., endemic plants forming the group Leucophae, of which 33 are without closer relationship to the Mediterranean. Kunkel has *chagora* and *chahora* (ch probably for palatalized *tJ* for *Sideritis* and related species, Labiatae, and the Spanish variants *salvia blanca* and *salvia de cumbre*, meaning white sage and mountain sage. A berberie parallel with the meaning "hay" is *agar* (Wölfel IV, 417) Spanish *taja* is the cutting, *tajada* the slice and also *tipsiness. But that may be accidental similarity.*

(33) Wölfel has *girdana* and *gildana*, Kunkel only *gildana*, today *Cytisus rosmarinifolius*, Papilionaceae. Two hispanizations are *herdanera* and maybe *hirdana*. Wölfel, because of the Romanic form of the word, was searching Spanish parallels without finding them. Also Font Quer has no parallel. The plant is endemic only on Gran Canaria, but there are very similar species, (Wölfel IV, 418). Place names from Gomera seem to come from this word.

(34) Both compilators have *joriada* for the same plant, named from Wölfel with the old name *Buphtalmum sericeum*, from Kunkel *Asteriscus aquaticus*, Compositae. The word, sounding Romanic, has no Spanish or Portugese parallels acc. to Wölfel and the compilations I used. Maybe a Portugese botanist who reads this article knows a Portugese parallel, continuing the team-work between botanists and linguists, which this article wanted to inaugurate (Wölfel, IV, 419).

Additional Literature:

1) López de Gómara: Historia General de las Indias. Modernización del texto antiguo por Pilar Guivelalde, con unas notas prologales de Emiliano M. Aguilera, Barcelona, 1954, I, p. 374-5.
2) Diccionario enciclopédico Salvat, Barcelona, 1955, I, p. 238.
3) H. Straube: Westkuschitische Völker Süd-Äthiopiens, Stuttgart, 1963, p. 93.
4) Salvat, op. cit., p. 634.
5) Franz Boerner: Taschenwörterbuch der botanischen Pflanzennamen, 2. Auflage, Berlin, und Hamburg, 1966, p. 61.
6) Friedrich Kluge: Etymologisches Wörterbuch der deutschen Sprache, 20, Auflage, bearbeitet von Walther Mitzka, Berlin, 1967, p. 495.

Mayo de 1973
La Calzada
Las Palmas de Gran Canaria
Spain.

4. The Endemic Species of Sonchus and Related Genera in the Macaronesian Islands

L. BOULOS

The distribution of the genus **Sonchus** L. (54 species) shows a remarkable tendency towards endemism in the Macaronesian Islands, with the exception of the Azores. Most of the 19 known species of the subgenus **Dendrosonchus** Sch. Bip. ex Boulos (BOULOS 1972) are endemics of the Canary Islands. Of these, three are endemic in Madeira, one in Cape Verde and one is common to the Canaries and the western coast of Morocco, Moreover, one species of subgenus **Sonchus** is endemic of the Canaries and one is known from the Canaries and western Morocco.

Most related to the 19 species of **Dendrosonchus** are the two genera **Taeckholmia** Boulos (7 species) and the monotypic genus **Babcockia** Boulos; these were earlier treated as **Sonchus** (BOULOS 1965 and 1967).

If the two species which are of common occurrence in the Canaries and Morocco are excluded, being not endemic to the Islands **senso stricto**, then we are left with 27 species out of 64 species of **Sonchus** L. **s.l.**, or about 42%, which are endemic in the Macaronesian Islands. This high percentage of endemics (excluding **Sonchus bourgeaui** Sch. Bip., subgenus **Sonchus**) is accompanied by a stable chromosome number (x=9 and 2n=18), a complete absence of polyloids (ROUX et BOULOS 1972) and a prevalence of frutescent habit.

The distribution of the species of this group within the three Archipelagos is as follows:

Number of species	Island or Islands	Archipelago
1	Fogo, St. Antâo, St. Nicolau, St. Vicente and St. Thiago	Cape Verde
2	Madeira	Madeira
1	Madeira, Porto Santo and Desertas	Madeira
2	Lanzarote, Fuerteventura (and Morocco)	Canaries
4	Tenerife and Gran Canaria	Canaries
7	Tenerife	Canaries
2	Gran Canaria	Canaries
2	Gomera	Canaries
2	La Palma	Canaries
2	Hierro	Canaries
2	Gran Canaria, Gomera and La Palma	Canaries
1	La Palma, Gomera and Hierro	Canaries

In other terms, if we consider the number of species known from each of the Canary Islands, whether endemic to a particular island or known from more than one island, the distribution will be as follows: (the number of asterisks corresponds to the number of islands from which the species is known).

Tenerife: $7^{*} + 4^{**} = 11$
Gran Canaria: $2^{*} + 4^{**} + 2^{***} = 8$
Gomera: $2^{*} + 3^{***} = 5$
La Palma: $2^{*} + 3^{***} = 5$
Hierro: $3^{*} + 1^{***} = 4$
Lanzarote: 2^{**} (including Morocco) $= 2$
Fuerteventura: 2^{**} (including Morocco) $= 2$

It is obvious that the highest number of species of **Sonchus s.l.** within the Canary Islands occurs in Tenerife (11) and Gran Canaria (8). Of these, however, the highest number of endemics occurs in Tenerife (7), while 3 occur in Hierro, 2 in each of Gran Canaria, Gomera and La Palma. Lanzarote and Fuerteventura not only have no endemics, but the two species known from both of them also exist in Morocco.

The available distribution records of this group within the Canaries show that there is not a single species that is known from more than three islands. When a species is distributed over two or three islands, these are neighbouring ones. In three particular cases there is a geographical discontinuity in the distribution: **Taeckholmia heterophylla** Boulos and **T. regis-jubae** (Pitard) Boulos are known from La Palma, Gomera and Gran Canaria. The discontinuity may be attributed to the lack of records from Tenerife. However, the five remaining species of **Taeckholmia** are represented in Tenerife. Future collections may reveal the presence of these two species in Tenerife. It might well be mentioned here that the rare species **Taeckholmia arborea** (DC.) Boulos is only known from a few specimens representing almost one collection, and the author has not seen any authentic material of this species after that collected by Broussonet in 1801. This may suggest an earlier centre of distribution of the genus **Taeckholmia** in Tenerife which is extending outside the island east and westwards.

The third case: **Sonchus bourgeaui** Sch. Bip. var. **imbricatus** (Svent.) Boulos is known from Gran Canaria (La Isleta) and Roque del Este. Here Fuerteventura and the main island Lanzarote represent the discontinuity in the distribution.

From the above discussion, it may be concluded that the main

distribution centre of this group is Tenerife and Gran Canaria. Two other centres come next in importance: Gomera, La Palma and Hierro to the west, Lanzarote and Fuerteventura to the east; the latter centre being much in alliance with the African coastal area east of the Canarian Archipelago. Again, two other groups of Islands with species of discontinuous distribution may come into consideration: La Palma, Gomera, Tenerife and Gran Canaria to the west; Gran Canaria, Fuerteventura and Lanzarote to the east.

The following is a list of the species dealt with. The geographical distribution within the Macaronesian Islands is given. Keys to separate them are provided in previous papers (BOULOS 1968 and 1972).

1. **Sonchus bourgeaui** Sch. Bip. var. **bourgeaui:** Fuerteventura, Lanzarote, La Graciosa (and Morocco).
   1a. **Sonchus bourgeaui** Sch. Bip. var. **imbricatus** (Svent.) Boulos: Roque del Este and Gran Canaria.
2. **S. tuberifer** Svent.: Tenerife.
3. **S. congestus** Willd.: Tenerife and Gran Canaria.
4. **S. acaulis** Dum.—Cours.: Tenerife and Gran Canaria.
5. **S. hierrensis** (Pitard) Boulos: Hierro, La Palma and Gomera.
6. **S. daltonii** Webb: Fogo, St. Antao, St. Nicolau, St. Vicente and St. Thiago (Cape Verde).
7. **S. bornmuelleri** Pitard: La Palma.
8. **S. radicatus** Ait.: Tenerife.
9. **S. gomerensis** Boulos: Gomera.
10. **S. gummifer** Link: Tenerife.
11. **S. ustulatus** Lowe: Madeira, Porto Santo and Desertas.
12. **S. fauces-orci** Knoche: Tenerife.
13. **S. pinnatifidus** Cav.: Fuerteventura, Lanzarote (and Morocco).
14. **S. brachylobus** Webb et Berth. var. **brachylobus:** Gran Canaria.
    14a. **S. brachylobus** Webb et Berth. var. **canariae** (Pitard) Boulos: Gran Canaria.
15. **S. pinnatus** Ait.: Madeira.
16. **S. palmensis** (Sch. Bip.) Boulos: La Palma.
17. **S. canariensis** (Sch. Bip.) ssp. **canariensis:** Tenerife and Gran Canaria.
    17a. **S. canariensis** (Sch. Bip.) Boulos ssp. **orotavensis** Boulos: Tenerife.
18. **S. fruticosus** L.f.: Madeira.
19. **S. lidii** Boulos: Hierro.

20. **S. gandogeri** Pitard: Hierro.
21. **S. pitardii** Boulos: Hierro.
22. **Babcockia platylepis** (Webb) Boulos: Gran Canaria.
23. **Taeckholmia pinnata** (L.f.) Boulos: Tenerife and Gran Canaria.
24. **T. capillaris** (Svent.) Boulos: Tenerife.
25. **T. canariensis** Boulos: Gomera.
26. **T. microcarpa** Boulos: Tenerife.
27. **T. heterophylla** Boulos: Gomera and Gran Canaria.
28. **T. regis-jubae** (Pitard) Boulos: La Palma and Gran Canaria.
29. **T. arborea** (DC.) Boulos: Tenerife.

Acknowledgement

The author wishes to express his thanks to UNESCO for the financial support which enabled him to participate in this congress.

LITERATURE CITED

BOULOS, L. 1965. Babcockia, un nouveau genre de Composées des îles Canaries. *Bull. Jard. Bor. État Bruxelles* 35 : 63-66.

— ,1967. Taeckholmia, a new genus of Compositae from Canary Islands. *Bot. Notisier* 120 :95-108.

— , 1968. The genus Sonchus and allied genera in the Canary Islands. *Cuadernos Bot.* 3 : 19-26.

— ,1972. Révision systématique du Genre Sonchus L. s.l. I. Introduction et Classification. *Bot. Notisier* 125 : 237-305.

ROUX, J. et BOULOS, L. 1972. Révision systématique du Genre Sonchus L. s.l. II. Étude Caryologique. *Bot. Notisier* 125 : 306-309.

April 1973
Faculty of Science
University of Jordan
Amman, Jordan

5. La Morfología de la Sideritis en Macaronesia y su Grado de Diferenciación

ILSE MENDOZA-HEUER

En las Islas Macaronésicas se vienen distinguiendo unas 20 especies endémicas de **Sideritis,** siendo mediterránea la distribución de las otras especies del género. Por lo que se refiere a las especies que integran el grupo macaronésico, existen, entre los autores, diferencias de opinión. BENTHAM incluye todas las especies maraconésicas, conocidas por él, en la sección **Marrubiastrum;** WEBB, en cambio, considera a éstas como a un género propio, al que dio el nombre de **Leucophaë.** La **Sideritis gomeraea** — que para algunos pudiera ser el puente de tránsito entre las especies mediterráneas y macaronésicas — no fue incluída en ninguna de las secciones de BENTHAM, ni en el género de WEBB, por no haber sido conocida aun por estos autores. Esta **Sideritis gomeraea** que no había pasado de ser un **nomen nudum** hasta tiempo de BOLLE, es descrita por él, quien la coloca en la sección **Empedoclea** de BENTHAM, formada por un grupo de taxones, localizados, con preferencia, en el mediterráneo oriental. Con posterioridad son descritas también, por CEBALLOS y ORTUÑO y por SVENTENIUS, dos especies muy afines a la **S. gomeraea** que son la **S. nutans** y la **S. cabrerae;** con lo que la seción **Empedoclea** se ha venido considerando integrada por los taxones mediterráneos, por la **S. gomeraea** y sus afines. Todas las otras especies de Macaronesia pertenecen a la sección **Marrubiastrum** de BENTHAM, o género **Leucophaë** de WEBB. BENTHAM caracteriza las dos seciones del siguiente modo; en su obra LABIATARUM GENERA ET SPECIES, p. 571:

> **"Sect. I. Marrubiastrum. Frutices saepius candidissimi. Folia floralia herbacea, infima caulinis subconformia, superiora minuta-(Canarienses)".**
>
> **"Sect. II. Empedoclea. Suffrutices vel herbae perennes. Folia floralia integerrima, flores amplectentia."**

La diferenciación, pues, de las secciones se basa, sobre todo, en la forma de crecimiento y en el aspecto de las brácteas.

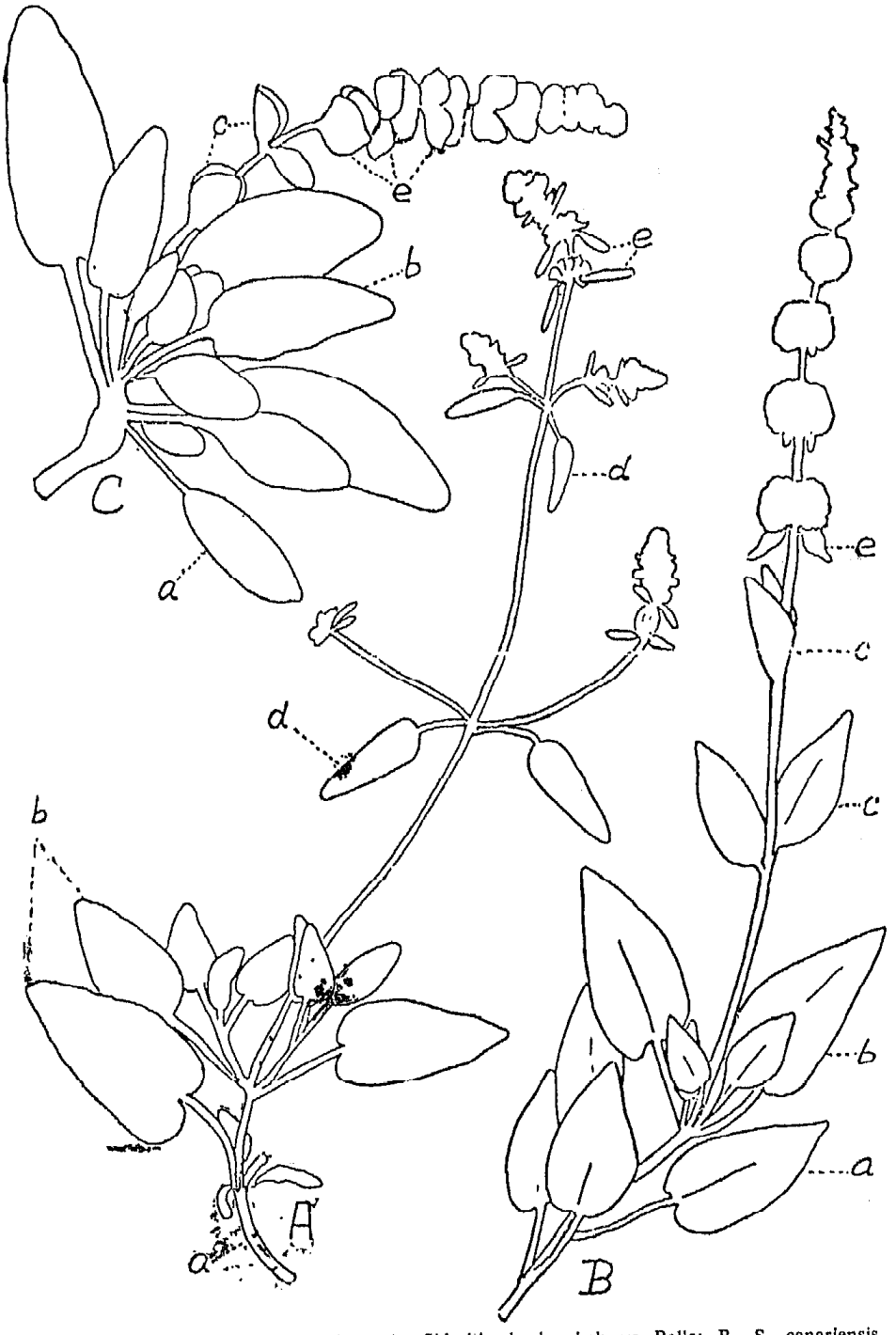
Estudiando el género **Sideritis,** he llegado al convencimiento de que esa agrupación de **S. gomeraea** se acerca más a la sección **Marrubiastrum** que a la **Empedoclea.** Para apoyar este criterio

Este trabajo se publica como "Mitteilungen aus dem Botanischen Museum der Universität Zürich", no. 266.

me permito, en primer lugar, aportar el resultado de los estudios palinológicos de HUYNH, recientemente publicados, en los que éste ha podido poner de manifiesto que el polen de la sección **Empedoclea** (el de las especies mediterráneas solamente), es 6-panto-colpado, siendo, en cambio, tetracolpado el de la sección **Marrubiastrum**, y también el de la **S. gomeraea** y el de la **S. nutans.** Con estas dos últimas especies ha formado HUYNH una nueva sección a la que ha dado el nombre de **Empedocleopsis.**

Para resolver problemas taxonómicos de este tipo, interesa hallar normas generales que se basen en características macromorfológicas accesibles, sin mayores dificultades al menos, y que puedan servir también para el estudio de otros géneros y familias. En la clasificación de la **Sideritis** hemos adoptado el punto de vista de la diferenciación escalonada base apical del ramo floral. La forma de crecimiento en las especies macaronésicas se presta especialmente a un estudio comparativo de los ramos: normalmente, cada ramo que sale de un botón de innovación, acaba en inflorescencia, siendo equivalentes la totalidad de los ramos. HALLÉ y OLDEMAN que han investigado la arquitectura de árboles tropicales, consideran como arcaicas a las formas de ramificación similares a las de la **Sideritis** que estudiamos.

La forma de crecimiento de las especies macaronésicas es la de arbolitos que comprenden un pequeño tronco leñoso, con su ramificación cimosa. La parte terminal de los ramos leñosos lleva, en general, en el centro, el resto de la inflorescencia del año anterior, flanqueado por dos nuevos ramos que terminarán en inflorescencia también. El eje central, pues, de una nueva planta, forma una inflorescencia, debajo de la cual sale un par de brotes de innovación que, a su vez, más tarde, terminarán en nuevos ramos inflorescenciales, mientras la inflorescencia vieja, central, muere. La parte basal del ramo completo, llegando hasta los botones de innovación, perdura y se lignifica (en general se conoce por su mayor grueso), y la parte superior, correspondiente a la inflorescencia, es anual, o de duración corta. Este modo de innovarse es el habitual y se repite varias veces. En los ejemplares de herbario estudiados hemos podido observar que la mayoría de las veces, se transforman en nuevos ramos completos, solamente un par de botones, siendo raros los casos en que 2 0 3 pares se desarollen al mismo tiempo, quedándose más reducidos unos que otros. En algunos ejemplares de determinadas especies, se encuentra la particularidad de que, en lugar de crecer y formar la inflorescencia los botones de innovación del eje principal, son los botones de segundo orden, de los ramos laterales inflorescenciales, los que producen los nuevos ramos completos; de esta for-



Secuencia foliar en el ramo completo: A.—Sideritis dendro-chahorra Bolle; B.—S. canariensis L.; C.—Sideritis gomeraea Bolle; a.—Hojas basales libres; b.—H. portadoras de ramos de innovación; c.—H. superiores libres; d.—H. portadoras de ramos laterales inflorescenciales; e.—Brácteas s.str.

ma, pueden salir cuatro nuevas inflorescencias, en lugar de las dos corrientes.

Cada ramo completo presenta la misma s e c u e n c i a f o l i a r : En la parte inferior del ramo salen, antes de su lignificación, unas cuantas hojas libres, o con producto axilar pequeñísimo. Estas hojas a las que llamamos "basales" están seguidas, por encima, por uno o varios pares de otras hojas portadoras de ramos de innovación, ya citadas. Ascendiendo en el ramo completo, se llega a la inflorescencia, en la cual nos encontramos, a veces, con hojas portadoras de ramos laterales inflorescenciales, con hojas superiores libres, y siempre con la espiga terminal (=florescencia principal, "Hauptfloreszenz", en sentido de Troll), formada por las brácteas y cimas florales. Especialmente útil en la determinación de los taxones macaronésicos son las hojas superiores estériles que puede haber entre innovación y florescencia principal. Este tipo de hojas parece sustituir al de las portadoras de ramos inflorescenciales laterales. Véase la figura adjunta.

La i n f l o r e s c e n c i a, pues, es bastante variable. Comprende de 0 a 8 pares de ramos inflorescenciales laterales o ramos de repetición, por repetir éstos la estructura del eje principal, en los inferiores al menos; en los superiores faltan las hojas basales, las de innovación y hasta las superiores; permanece sólo la florescencia. La florescencia en la **Sideritis** es una seudoespiga compuesta de unos 8-12 verticilastros, que a su vez están formados por cimas fuertemente condensadas. La forma de la inflorescencia simple, con sólo una espiga (florescencia) terminal, o múltiple, acompañada de varias florescencias laterales, sirve, junto con otras características, para describir un taxon. Como es natural, en la determinación, hay que tener en cuenta también, que sólo ejemplares que han podido desarrollarse en buenas condiciones, presentan un número máximo de ramos laterales inflorescenciales, a lo largo del eje principal. De cierto valor taxonómico es también el grado de ramificación de los mismos ramos laterales, el que, a veces, puede ser de segundo y hasta de tercer orden. Creemos de interés hacer constar que el número de pares de ramos inflorescenciales aparecidos a lo largo del eje principal, así como el de las ramificaciones de segundo o tercer grado que en estos puedan presentarse, es mayor en la especie de Madera que en las de Canarias; la de Madera llega a formar hasta ocho escalones de pares de ramos laterales, y estos a su vez ramificados en segundo y tercer grado. En las especies canarienses, se encuentran algunas con inflorescencia simple; las que forman ramos laterales —que es la norma— en general, llegan solo a producir ramos de segundo orden, apareciendo en pocas especies, con regularidad, hojas superiores. En cuanto a la tendencia a reducir la ramificación inflo-

rescencial, las canarienses se acercan un poco más a muchas especies mediterráneas, dotadas, a menudo, de varias hojas superiores.

La forma de las hojas juega también papel importante en la caracterización de las especies, más bien es su transformación en la secuencia foliar la que nos interesa conocer. La forma del limbo cambia desde la base hasta el ápice del ramo completo. Las hojas basales, por ejemplo, tienen con frecuencia forma ovada con base acorazonada; la de las inflorescenciales es angustiovada, con base truncada, o redondeada, siendo las segundas menos desarrolladas. Otra particularidad, las hojas basales y de innovación de todos los taxones macaronésicos presentan pecíolo; en la gran mayoría de todos los demás tipos de hojas se constata también ese pecíolo, a lo largo del eje principal, hasta en las brácteas; en cambio, la **S. canariensis** por ejemplo, posee a menudo brácteas apecioladas, y el grupo de la **S. gomeraea,** brácteas y hojas superiores apecioladas también. Véase de nuevo figura adjunta. La hoja peciolada es más diferenciada que la sésil. Según lo dicho, hay pues tres grados de desarrollo. La **S. gomeraea** es la que puede menos que las otras.

En cuanto al indumento de las hojas, se puede también aplicar el método de estudiar la diferenciación base-apical del ramo. Pelos ramificados, mezclados, con frecuencia, con algunos glandulíferos, se encuentran en todas las hojas, hasta en las brácteas y el sépalo, en la mayoría de las especies macaronésicas. Una excepción a esta regla la hace también la **S. gomeraea,** con unos pelos ramificados en la parte apical de brácteas y hasta de hojas superiores, estando cubierto el resto y cara externa del sépalo por pelos sencillos, pluricelulares.

El grado de desarrollo que una especie pueda adquirir, se observa, en primer lugar, en las hojas basales y de innovación, al menos en la **Sideritis,** y por otra parte, por el lugar donde aparecen determinadas formas reducidas en el ramo (la hoja superior ya apeciolada de la **S. gomeraea,** pelos sencillos en parte basal de brácteas de esta misma especie, etc.).

Con arreglo a ese concepto de grado de desarrollo, las especies mediterráneas parecen tenerlo menor que las macaronésicas, por presentar ya en la base del ramo, las características apicales llamadas reducidas en las últimas citadas. Las mediterráneas empiezan, por ejemplo, con hojas apecioladas, cubiertas de pelos sencillos, presentando algunas de ellas un tomento tan blanco como las macaronésicas. Los pelos sencillos aparecen en la gran mayoría, por no decir en todas, las especies mediterráneas, extremo este último que no hemos podido comprobar aún por completo.

La **S. gomeraea** y sus afines, en cambio, caen en el grupo ma-

caronésico típico, con su forma de crecimiento igual al resto de las macaronésicas y con sus hojas basales y de innovación cubiertas de pelos ramificados y por su mayor proximidad a la **S. canariensis**, que presenta, en general brácteas sésiles, parecidas a las de la **S. gomeraea** y hasta algunas hojas superiores sésiles que tienden hacia la glabrescencia. La **S. gomeraea** ocupa, dentro de las especies macaronésicas, una posición de las más reducidas, tanto desde el punto de vista morfológico, como el de su área de repartición; mientras que, el grupo de la **S. dendrochahorra** y afines —de mayor desarrollo— podemos encontrarlo en Canarias, en todas sus islas, y en Madera.

El número de cromosomas encontrado por BRAMWELL y otros autores en la **S. gomeraea** es el de 2n=16; el encontrado, en cambio, po LARSEN, en la **S. soluta** Webb (grupo **dentro-chahorra**), es el de 2n=36.

El estudio comparativo de diferenciación escalonada, permite una ordenación de las especies; valiéndose de esto, sería cuestión de definir las categorías taxonómicas, del modo siguiente, por ejemplo, la sección comprende especies que han alcanzado el mismo grado de desarrollo, visible éste en las hojas basales y de innovación. La subsección une las especies que coinciden también en la parte reproductiva del ramo (aspecto de brácteas, etc.). Esto son sólo unas sugerencias para la creación de una clasificación normada, unificada. Pensamos en una clasificación que pueda llevarse a cabo de la manera más breve, por considerar urgente el hacer el inventario al menos de esta flora, antes de que puedan desaparecer muchas de sus especies.

Resumen

Con el fin de caracterizar las especies en las islas, se ha estudiado la forma de crecimiento, la ramificación de la inflorescencia y los diversos tipos de secuencia foliar, la forma y el indumento de las hojas, de la parte basal a la distal del ramo completo. Se pone de manifiesto la utilidad del estudio comparativo de diferenciación escalonada base-apical en la apreciación del grado de desarrollo. Las especies mediterráneas parecen alcanzar el grado menor de desarrollo acercándose así a las más reducidas macaronésicas (**S. gomeraea** y afines) las que, no obstante, caen en la sección **Marrubiastrum.**

Bibliografía

BARKER-WEBB, P. et BERTHELOT, S., 1836-50: *Histoire naturelle des Iles Canaries.* 3. Phytographia canariensis II: 1-477.—París.

BENTHAM, G., 1832-1836: *Labiatarum Genera et Species,* London 1-783.

BOLLE, C., 1860: Addenda ad floram Atlantidis, praecipue insularum Canariensium Gorgadumque IV.—Seemann's *Bonplandia* 8:279-284.

BRAMWELL, D., HUMPHRIES, C.J., MURRAY, B.G. and OWENS, S.J. 1971: Chromosome Numbers in Plants from the Canary Islands.—*Bot. Notiser* 124:376-382.

CEBALLOS, L. y ORTUÑO, F., 1947: Notas sobre Flora Canariense.—*Inst. Forest. Inv. Exp.* 18 (33): 1-31.

HALLÉ, F. et OLDEMAN, R.A.A., 1970: Essai sur l'architecture et la dynamique de croissance des arbres tropicaux. *Coll. Monogr. Bot. et Biol. Végét.* (Dir. P. Champagnat) 6:1-178.

HUYNH, K-L., 1972: Le pollen et la systématique du genre *Sideritis* L. (Labiatae). *Bull. Mus. Nat. Hist. Nat.* 3, nº 45:1-28.

LARSEN, K., 1960: Cytological and experimental Studies on the Flowering Plants of the Canary Islands.—*Biol. Skr.Dan.Vid.Selsk.* 11, nº. 3:1-60.

SVENTENIUS, E.R., 1960: *Additamentum ad floram Canariensem* I.—Agr., Inv. Nat.Hisp.Inst.Madrid: 1-93.

Mayo de 1973
Botanischer Garten und Institut
für Systematische Botanik
CH - 8039 Zürich, Suiza

6. Studies in the Genus Echium from Macaronesia

DAVID BRAMWELL

In the course of preparation of a recent monograph of the genus **Echium** in Macaronesia, a series of experimental studies in flavonoid chemistry, cytology and population biology were carried out. The formal part of this monograph has already been published (**Bramwell,** 1972a) as have some observations on breeding systems of **Echium** species in the Canary Islands (**Bramwell,** 1972b). In general the results of these studies have had considerable bearing on the classification and evolutionary interpretation of the genus in Macaronesia.

The Macaronesian **Echium** species number about 28, all but one, the widespread **Echium plantagineum,** are endemic to the region. Though a handful of the endemic species are herbaceous perennials, biennals or annuals, the group is generally characterised by its woody habit and more or less regular lobing of the corolla, two important characters which link the Macaronesian **Echium** group with the South African genus **Lobostemon.** The distribution of the two genera and the similarities between what appears to be a primitive group of **Echium** species, particularly the **Echium decaisnei** group, and the South African **Lobstemon** species indicate that the two genera may have had a common origin in the land masses surrounding the Tethys probably on the southern side of the sea. Indumentum types in both groups are currently being studied and there appear to be close similarities between them. Flavonoid chemistry and cytological studies of **Lobostemon** might also provide phytogeographically important data in the future.

Flavonoid Chemistry

Very few surveys have been carried out in the family **Boraginaceae** for chemosystematic purposes and there is virtually no published information on the phytochemistry of **Echium.** As a possible aid, therefore, to taxonomic and evolutionary interpretation of the genus in Macaronesia a basic survey of leaf-flavonoids in 16 Macaronesian species was attempted.

Within the Macaronesian frutescent **Echium** group two distinct subgroups occur (Fig. 1), one with a branched 'candalabra' habit and a perennial life-cycle and the other with an unbran-

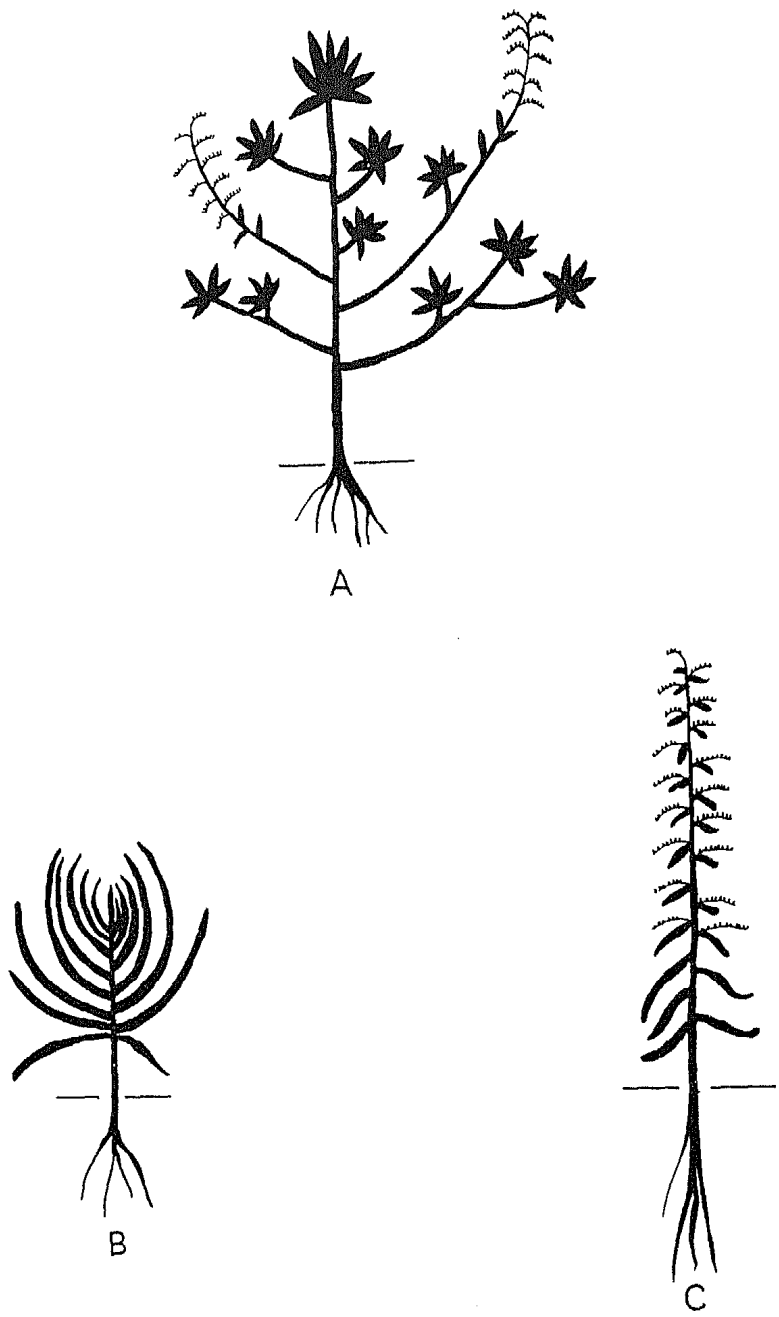


Fig. 1. Growth-forms in Macaronesian *Echium* species A. 'Candalabra' shrub habit; B & C. Monocarpic Unbranched rosette habit.

ched rosette habit and a two or three year monocarpic life-cycle. **Lems & Holzapfel** (1968) consider the monocarpic group of species to be a polphyletic one, the three species making up the group (**E. wildpretii, E. simplex** and **E. pininana**) having acquired their specialized habit independantly from different ancestors in the 'candalabra-shrub' group.

The survey of flavonoid compounds was carried out principally to determine if their distribution supported the fundamental division of the group into candalabra and monocarpic subgroups or if the polyphyletic origin suggested by **Lems & Holzapfel** might be more appropriate. The results of the survey are shown in Fig. 2.

The flavonoids most frequently present in **Echium** are Quercetin 3-rutinoside, Kaempferol 3-rutinoside 7-glucoside and Quercetin 3-glucoside (Fig. 3 A, B, C.)

Within the monocarpic group of species (**E. wildpretii, E. simplex** and **E. pininana**) an unidentified dimethylated flavone compound, which will be referred to for the time being as "SIMPLICEOL" as it was first detected in **E. simplex,** was found in all three species distinguishing the group from all the other species of **Echium** examined with the possible exception of the morphologically anomolous **E. gentianoides** from the high mountains of the Canary Island of La Palma in which small traces of this or a very similar compound were also detected.

The presence of "**Simpliceol**" in addition to the fairly uniform floral morphology and habit within the monocarpic group (**Bramwell,** 1972a, p. 54) suggests that they comprise a group of closely related species and it seems most likely that the group is monophyletic in origin perhaps having been derived from a single "Candalabra-shrub" species. "**Simpliceol**", a flavone, certainly seems to be a more advanced compound than the flavonol compounds (**Harborne,** 1967 p. 313) found throughout the "Candalabra-shrub' group of species.

Within the **E. virescens** group (sect. **Virescentia**) and the **E. giganteum** group (sect. **Gigantea**) the species are identical in their flavonoid patterns, a situation which is parallelled by their morphological similarity.

E. strictum, however, is placed in a different section **Stricta,** on morphological grounds and differs from either of these groups by the presence of Kaempferol and Quercetin 3-rutinoside 7-glucoside.

E. auberianum, the only species of section **Auberiana** (Bram-

SPECIES	FLAVONOIDS							
	1	2	3	4	5	6	7	8
E. bonnetii	+	+	-	-	-	-	-	-
E. strictum	+	+	-	+	+	-	-	-
E. acanthocarpum	+	+	-	-	-	-	-	-
E. handiense	+	+	-	-	-	-	-	-
E. sventenii	+	+	-	-	-	-	-	-
E. virescens	+	+	-	-	-	-	-	-
E. webbii	+	+	-	-	-	-	-	-
E. aculeatum	+	+	-	-	-	-	-	-
E. leucophaeum	+	+	-	-	-	-	-	-
E. triste	+	+	-	-	-	-	-	-
E. auberianum	+	-	-	-	-	-	-	-
E. decaisnei	+	+	-	-	-	+	-	-
E. wildpretii	+	-	+	-	-	-	-	-
E. simplex	-	-	+	-	-	-	+	+
E. pininana	-	-	+	-	-	-	-	+
E. gentianoides	+	+	?	-	-	-	-	-

well, 1972a), differs morphologically from the 'Candalabra-shrub' species by its more or less herbaceous perennial habit and phytochemically by the absence of Quercetin 3-glucoside.

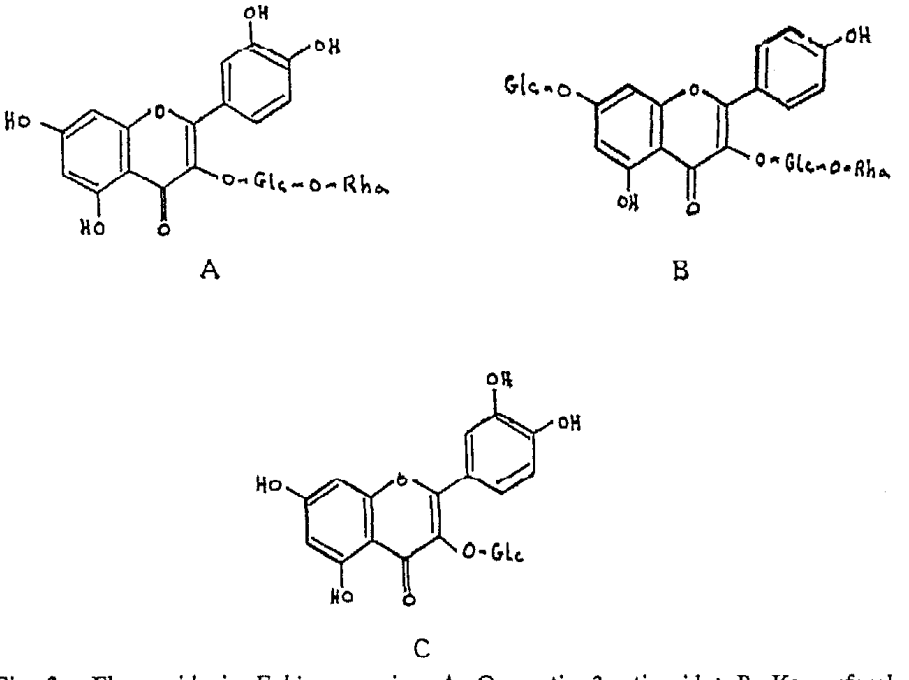


Fig. 3. Flavonoids in *Echium* species. A. Quercetin 3-rutinoside: B. Kaempferol 3-rutinoside 7-glucoside; C. Quercetin 3-glucoside.

E. decaisnei, distinguished from the **E. giganteum** complex by its more regular flowers and distinctive indumentum is also different in that it has the compound Kaempferol 3-glucoside which has not been found in any other **Echium** species examined. This supports the morphological evidence for placing **E. decaisnei** in a separate section **Decaisnea** (**Bramwell**, 1972a).

The data from the phytochemical survey, therefore, generally support the taxonomic treatment based on habit, inflorescence and floral characters used in the recent monograph (**Bramwell**, 1972a). This treatment is itself similar to that outlined by **Christ** (1888) with some of the obvious anomolies removed.

Fig. 2. The distribution of flavonoid compounds in Canarian *Echium* species. Key. 1. Quercetin 3-rutinoside; 2. Quercetin 3-glucoside; 3. "Simpliceol"; 4.Kaempferol; 5. Quercetin 3-rutinoside, 7-glucoside; 6. Kaempferoi 3-glucoside; 7. Apigenin; 8. Kaempferol 3-rutinoside, 7-glucoside.

Cytology

Chromosome numbers have now been determined for the majority of Macaronesian **Echium** species and also for about 20 non-Macaronesian species (**Litardière**, 1943; **Larsen**, 1960, **Michaelis**, 1964; **Linder** & **Lambert**, 1965; **Borgen**, 1969, 1970; **Bramwell** et al, 1971, 1972).

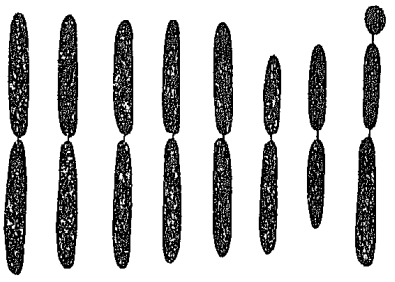


Fig. 4. Karyotype of *Echium acanthocarpum* Svent.

It has not been possible to compare Karyotypes of all these species as the chromosome counts come from such diverse sources but the Karyotypes of the Macaronesian endemics seem to be fairly uniform with metacentric chromosomes and usually a single pair of satellites (Fig. 4). The most consistantly available chromosome characters for **Echium** are, therefore, the observed chromosome number and the base-number (**x**) which can be derived from it.

Within the genus there appear to be 3 basic numbers **x**=6, 7 & 8. The most common basic number is **x** = 8 and this is found

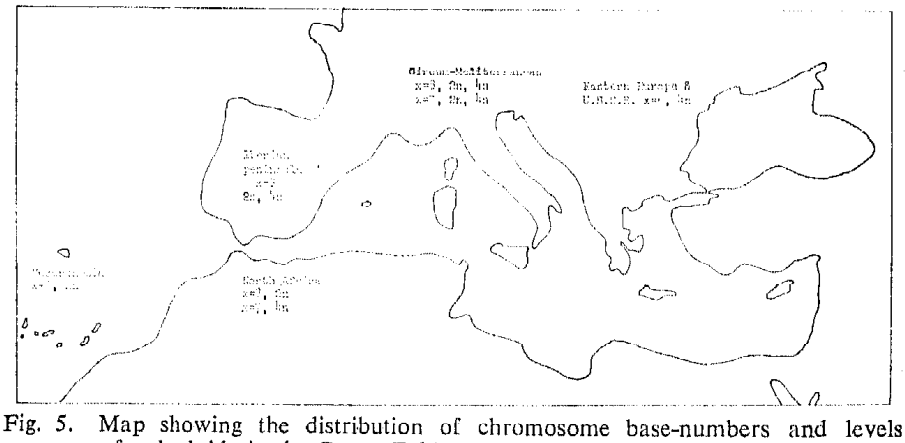


Fig. 5. Map showing the distribution of chromosome base-numbers and levels of polyploidy in the Genus *Echium*.

in species from Macaronesia, N. Africa, the Iberian Peninsula and the Mediterranean basin. The base number **x** = 7 occurs in N.

Africa, the Mediterranean region and E. Europe while $x = 6$ is recorded from the East Mediterranean region and the Southern U.S.S.R. (Fig. 5).

The widespread occurrence of $x = 8$ in species from widely separated parts of the range of the genus suggests that it is the primary basic number from which have been derived, by centromeric loss, $x = 7$ and $x = 6$. Both diploids and tetraploids are know in the $x = 8$ and $x = 7$ series including several cases of intraspecific polyploidy. The $x = 6$ series is polyploid.

The frutescent endemic Macaronesian species are all diploids of the $x = 8$ series and in view of their woody habit can probably best be considered as a basic or primitive group within the genus. **Britton** (1951) considers them to be a cytologically primitive group ancestral to the remainder of **Echium** species.

The Mediterranean and N. African species of the $x = 8$ series are perennial to annual herbs occasionally with a woody stock.

Without further data particularly from the non-Macaronesian species it is only possible to speculate as to the evolutionary implications of changes in chromosome number in **Echium** but the following trends seem to emerge: a) the reduction in woody habit and shortening of the life-cycle has to some extent been accompanied by trends towards increased polyploidy and reduction in the basic number; b) the Macaronesian species seem to be comparatively primitive; c) centres of diversity are found in the Canary Islands, N. Africa and the Iberian Peninsula. In the last two cases only has diversification been accompanied by some degree of polyploidy.

The woody Macaronesian species seem to be self-incompatible outbreeders with a relatively high percentage of gynodioecious individuals in most populations (**Bramwell,** 1972b) whereas the herbaceous species studied (**E. plantagineum, E. bonnetii, E. vulgare** etc.) seem to be self-compatible with only occasional occurrences of gynodioecy.

Baker (1959) pointed out the relationship between woody plants and self-incompatibility and herbaceous, short-lived plants and self-compatibility. As noted by **Baker** (1967), **Lewis & Crowe** (1958) go so far as to suggest that in all cases where two closely related taxa are respectively self-incompatible and self-compatible, the latter may be presumed to be derived from the former by what they describe as a "degradation process". The occurrence of self-incompatibility in the frutescent **Echium** species is further evidence for their probable primitive, ancestral nature when com-

pared with the herbaceous species. This supports the general trends in advancement from Macaronesian to Continental species seen also in morphological and chromosome number characters. Taken as a whole these data indicate that Carlquist's view **(Carlquist, 1965, 1970a, b)**, that based on anatomical studies the frutescent species found in Macaronesia are derived, secondarily woody plants whose ancestors were herbaceous continental species is not supported by data from other fields. The opinion expressed by **Meusel** (1953, 1965) **Boulos** (1960) **Bramwell** et al (1972) that the Macaronesian species seem to be ancestral to many of the modern Mediterranean taxa in the same genera seems, on the basis of these data, a more plausible hypothesis. **(cf. Bramwell, 1.972c.)**

Hybridisation

Observations on the breeding systems of Canarian **Echium** species have shown them to be strongly outbreeding **(Bramwell, 1972b)**. As a result interspecific hybrids frequently occur particularly where two or more species have a sympatric or parapatric distribution. Hybrids in this group are fairly easily recognised

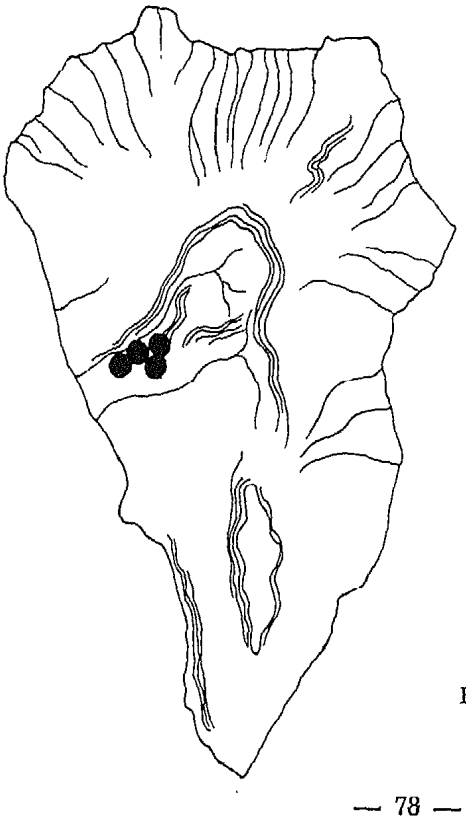


Fig. 6. Map of La Palma (Canary Islands) showing locality of *"Echium bond-spragueí"*.

and few taxonomic problems have resulted from their occurrence. Some years ago, however, **Sprague & Hutchinson** (1914) described a species, **Echium bond-spraguei,** from the western side of the Canary Islands of La Palma in Barranco de Las Angustias (Fig. 6). This species has since been a source of some confusion. It was dismissed as a form of **E. aculeatum** by **Burchard** (1929) and as identical with **E. leucophaeum** by **Lems** (1960, 1968 though there is a specimen of this taxon in the Reading Herbarium (RNG) collected by Lems and identified as **E. strictum. Lid** (1968) recognised it as a distinct species noting that the plants he saw had blue flowers rather than pink as originally reported by **Sprague & Hutchinson.**

Analyses of the **Echium** populations in Barranco de Las Angustias carried out in August 1965, June and July 1969 and April 1971 have shown that a large proportion of the individuals present are, in fact, hybrids or hybrid derivatives of the cross **E. brevirame** x **E. webbii. E. brevirame** is a white-flowered species of section **Gigantea** and is generally confined to the xerophytic region below 500 m. **E. webbii,** on the other hand, is a blue-flowered species of section **Virescentia** occurring in forests and at forest margins usually above 600 — 650 m. In Barranco de Las Angustias the construction of water canals, reservoir areas and mule tracks has led to the extension of the ranges of both species along the margins of canals and tracks and hybridisation has taken place. A hybrid swarm is well established at mid-altitude along the edges of the main water-canal from the Caldera to Los Llanos and about 35 — 40 per cent of the individuals in this swarm are male-sterile thus encouraging further outcrossing so that introgression to populations of the parent species has taken place. Fig. 7 is a pictorial scatter diagram showing the inter-relationships in the hybrid populations of five characters which are used to distinguish the two parent species. A and B represent typical hermaphrodite and male-sterile **E. brevirame** and C and D hermaphrodite and male-sterile **E. webbii.** E and F constitute the hybrid swarm and the type specimen of **E. bond-spraguei** has been plotted on to the diagram (arrowed). This specimen is more or less intermediate between the two parent species and is probably an F1 hybrid. When **Sprague & Hutchinson** collected in this area in 1913 it is likely that there was much less disturbance of habitats as many of the tracks and canals in the area originate from a much later period and it may well be that the hybrid individuals were much more rare and distinctive than at present. Disturbance of the natural habitat in the area seems to be extending the hybrid swarm and also the amount of introgression to populations of the parent species in other parts of the valley.

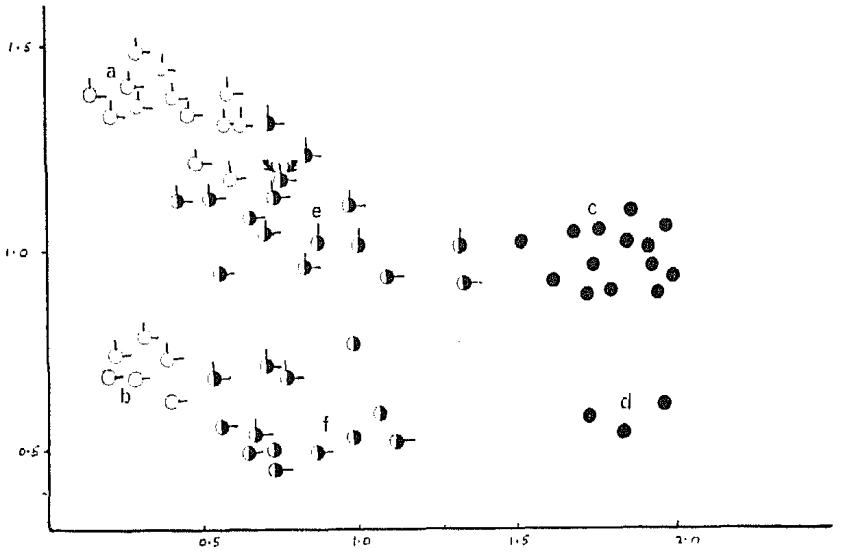


Fig. 7. Pictorial scatter diagram of the Las Angustias *Echium* populations. Key:

- O Corolla white;
- ◑ Corolla pink/pale blue;
- O Corolla lobes ± equal;
- O leaf-margins not spiny.
- ● Corolla blue;
- O Corolla lobers unequal;
- O- leaf-margins spiny;

Summary

This paper presents the results of phytochemical, cytological and some field studies carried out in the course of preparation of a revision of the Macaronesian species of the genus **Echium.**

Flavonoid chemistry has been useful in delimiting some infrageneric groups and in placing some morphologically anomalous species.

Cytological studies have shown the Macaronesian species to be uniformly diploid whereas their continental relatives are diploid or polyploid often with a reduced chromosome base number and a shorter life-cycle. This suggests that the Macaronesian taxa are evolutionarily more 'primitive' than the continental ones, a view supported by breeding system data.

Field studies on populations of **Echium** from the Barranco de Las Angustias on the Canary Island of La Palma have led to the conclusion that **E. bond-spraguei** Spr. & Hutch. is an F1 hybrid of **E. webbii** and **E. brevirame** and that at the present time the main population in this area consists of a hybrid swarm with evidence of introgression to both parent species.

REFERENCES

BAKER, H. G. 1959. Reproductive Methods as Factors in speciation in Flowering Plants. *Cold Spring Harbour Symp. in Quant. Biol.* 24: 177-191.

BAKER, H. G. 1967. Support for Baker's Law - As a Rule. *Evolution* 24:853-856

BORGEN, L. 1969. Chromosome numbers of vascular plants from the Canary Islands with special reference to the occurrence of polyploidy. *Nytt Mag. Bot.* 16:81-121

BORGEN, L. 1970. Chromosome Numbers of Macaronesian Flowering Plants. *Nytt Mag. Bot.* 17:145-161

BOULOS, L. 1960. Cytological studies in the genus Sonchus 2. The genus Sonchus, a general systematic treatment. *Bot. Notiser* 113:400-420.

BRAMWELL, D. 1972a. A Revision of the Genus *Echium* in Macaronesia. *Lagascalia* 2:37-115

BRAMWELL, D. 1972b. Breeding Systems in Canary Islands *Echium* Species. *I. O. P.B. Newsletter* 6:2-9

BRAMWELL, D. 1972c. Endemism in the Flora of the Canary Islands. In. Valentine, D. H. (ed). *Taxonomy, Phytogeography and Evolution* 141-159.

BRAMWELL, D., HUMPHRIES, C.J., MURRAY, B.G. & OWENS, S.J., 1971. Chromosome numbers in plants from the Canary Islands. *Bot. Notiser* 124: 376-382.

BRAMWELL, D., HUMPHRIES, C.J. MURRAY B.G. & OWENS, S.J. 1972. Chromosome studies in the Flora of Macaronesia. *Bot. Notiser* 125: 139-152.

BRITTON, D.M. 1951 Cytogenetic studies on the *Boraginaceae*. *Brittonia* 7: 233-266.

BURCHARD, O. 1929: Beiträge zur Oekologie und Biologie der Kanarenpflanzen. *Bibliotheca Botanica* 98: 1-262, 78 plates.

CARLQUIST, S. 1965. *Island Life*. A natural history of the Islands of the World. 451pp. New York.

CARLQUIST, S. 1970a. Wood anatomy of insular species of Plantago and the problems of raylessness. *Bull. Torrey Bot. Club* 97: 353-361.

CARLQUIST, S. 1970b. Wood Anatomy of *Echium*, (Boraginaceae). *Aliso* 7: 183-199.

CHRIST, H. 1888. Spicilegium Canariense. *Engl. Bot. Jahrb.* 9: 86-172.

HARBORNE, J. 1967. *Comparative Biochemistry of the Flavonoids*. 383pp. Academic Press, London & New York.

LARSEN, K. 1960: Cytological and Experimental Studies on Flowering Plants of the Canary Islands. *Biol. Skr. Dan. Vid. Selsk.* 11, 3: 1-60.

LEMS K. 1960. Floristic Botany of the Canary Islands. *Sarracenia* 5: 1-94.

LEMS, K. & HOLZAPFEL, C., 1968. Evolution in the Canary Islands 1. Phylogenetic Relationships in the Genus *Echium* as shown by Trichome Development. *Bot. Gaz.* 129: 95-107.

LEWIS, D. & CROWE, L. K. 1958. Unilateral interspecific incompatibility in flowering plants. *Heredity* 12: 233-256.

LID, J. 1968: Contributions to the Flora of the Canary Islands. *Skr. Norske Vid. - Akad. Oslo Mat. - Naturv. Kl., N. S.* 23, 1-212, dated 1967. published 1968.

LITARDIERE, R. 1943. Recherches caryologiques et caryo-taxonomiques sur les Boraginacées II. Nombres chromosomiques dans le genre *Echium*. *Boissiera* 7: 155-165.

MEUSEL, H. Uber Wuchsformen, Verbreitung und Phylogenie einiger mediterran-mitteleuropäischer Angiospermen-Gattungen. *Flora* 139: 333-393.

MEUSEL, H. 1965. Die Reliktvegetation der Kanarischen Inseln in ihren Beziehungen zur süd - und mitteleuropaischen Flora. *Gesammelte Vorträge über moderne Probleme der Abstammungslehre* 11: 117-136.

MICHAELIS, G. 1964: Chromosomenzahlen einiger Kanarischer Endemismen. *Planta* 62: 194.

SPRAGUE, T.A. & HUTCHINSON, J. 1914: *'Echiums* from the Atlantic Islands' *Bull. Misc. Inf. Kew* 1914: 116-122, 265-267.

Mayo de 1973.

Department of Botany
The University
Reading, Great Britain

7. Ferns, Polyploids, and Their Bearing on the Evolution of the Canarian Flora

C. N. PAGE

I would like to draw attention to a group of plants which, in discussions on the origins and evolution of individual floras, often receive less consideration than do the flowering plants. These plants are less numerous than are the flowering plants, but like the latter group their life-cycle is dominated by a sporophyte generation which has the 2n chromosome number. The sporophyte likewise is vascular and leafy, and ecologically occupies a wide range of habitats which in general parallel in type those of the flowering plants.

These plants are the ferns.

For the basis of an evolutionary study, technically the ferns have several advantages. In the field, they are relatively easy to collect not only as herbarium material but also in the form of live specimens either as small portions of rhizomes or, better still, as packets of viable spores, from which plants can readily be reared in cultivation. From spores, plants reach maturity within a few years, whilst the spores themselves may stay viable for many years (exactly how long for most species we do not know).

From the scientific point of view, ferns have very many advantages. They occur in their greatest abundance in intimate association with forest communities to which species often seem particularly faithful. As vascular plants they are presumably influenced by much the same evolutionary factors as are most of the other vascular plants with which they occur. Furthermore, ferns show the phenomenon of polyploidy particularly readily, and thanks very largely to the progress made by **Manton** (1950) we can make successful preparations of their chromosomes. Hybrid synthesis is possible, and the study of several European genera such as **Polypodium, Asplenium,** and **Dryopteris,** has shown that analysis of meiotic chromosomes in the hybrids can give much information about the inter-relationships of the parent species. Lastly ferns, as do the pteridophytes as a whole, have a long and good fossil record against which evolutionary inferences may be checked. From studies that have been made on the ferns of large, modern, tropical floras such as those of Ceylon (**Manton** & **Sledge** 1954) West Tropical Africa (**Manton** 1959) and Jamaica (**Walker** 1966) is has been found that a many as 60% of the fern spe-

cies are polyploid, reaching grades of ploidy as high as 12 or 16x. Estimates indicate that 60% may be by no means a high figure for the total percentage of ferns which are polyploid. Even in Europe the floras of both Britain and Hungary give at least 50% polyploidy in their fern floras and reach grades of ploidy of 6x. We know from experimental studies which have been carried out on such genera as **Asplenium** and **Polypodium** in temperate Europe and North America and from studies at present being undertaken on various sub-tropical and tropical fern genera, that polyploidy (and especially allopolyploidy) has been an extremely important evolutionary process in ferns in both types of environment. In the modern tropical floras especially, the very large percentage of polyploid species and the high grades of ploidy achieved indicate the evolutionary potential of this process in pteridophytes, and the strong similarities in the 60% of polyploid species and 12-16x grades of ploidy in the ferns of Ceylon, West Tropical Africa, and Jamaica suggests that this is the degree of polyploidy which can be expected in a modern, actively-evolving tropical fern flora. It thus seems useful to use these results as a yardstick for comparison with other floras.

Let us now turn to the Canary Island fern flora

Over a number of years I have had the opportunity to examine the chromosome numbers of about 70% of the species of ferns in the Canary Islands flora. In doing this, I have tried to sample plants collected from most of the Islands of Archipelago. I do not intend to dwell here on details of methods for individual chromosome counts, as these have been published before (by **Manton** 1950) and the individual counts will appear at a later date. However from the results of these studies, three significant points stand out:

1. Although further sampling may yet reveal the existence of cytological complexes not so-far detected in the Canaries flora, the results of the present study have indicated the presence of very few such complexes. Even superficially variable taxa such as **Polypodium** and **Adiantum reniforme** have proved to be cytologically uniform. Only one fern (**Notholaena vellea**) has been found to exist in more than one cytological form and only one species (**Cheilanthes sventenii**) is so-far suspected of having arisen by allopolyloidy within the islands.

2. In strong contrast to the 60 or perhaps higher percentage of polyploid species typical of a modern tropical fern flora and perhaps more typical also of ferns generally, **more than 70%** of the Canary Islands fern species are **diploids**, and futhermore:

3. Of the few species which are polyploid in the Canary Islands, only very low (4x, 6x) grades of ploidy have so far been detected (cf. 12-16x in the tropics).

The conclusion seems inescapeable that compared with modern, tropical fern floras (and even with modern temperate floras such as those of Europe) there is a notable and highly significant lack of evolution through polyploidy in the Canary Islands fern flora, making it totally different from a modern tropical (or even modern temperate) fern flora.

Why is this?

The contrast between the Canarian ferns and modern tropical/temperate ones is so extreme that it requires special explanation. There exists a number of references in the literature to the existence of an affinity between the living members of the Canary Island laurel forest community and the extinct fossil vegetation known to have existed in Europe during the Tertiary. It is with this laurel forest vegetation in the Canary Islands today that the majority of the fern species are intimately associated ecologically, and like the forest tree species themselves, there are indications in the literature that indeed some of the ferns which now occur in the Canary Island forests also have their nearest affinities with those of Tertiary Europe.

Stimulated by these suggestions, I undertook a survey of the available palaeobotanic data of the ferns known to have existed in the Tertiary vegetation of Europe, and especially of those known to have co-existed alongside the European Tertiary laurel forests. At the same time I carried out a phytogeographical analysis of the present ranges of the Canary Island fern species. Again, I do not propose here to go into lists of species or specific comparisons, as these will appear in detail in due course. May it suffice to say that from the palaeobotanic data, the following conclusions seem apparent. Firstly, taking the whole of the Tertiary period from the Eocene to the Pliocene and the Canary Island ferns at the generic level, it is possible to say that of almost all the genera of ferns which seem remotely likely to be preserved as fossils, almost all do in fact occur as fossils in the European Tertiary.

Furthermore, wherever the fossil material is sufficiently well-preserved for specific determination, certain Tertiary European ferns correspond extremely closely indeed in their morphology to the forms present in (and often largely or entirely restricted to) the Canaries or other Macaronesian archipelagos today.

The phytogeographical analysis, furthermore has led to the

following conclusions. Of the Canary Island fern species that are not endemic few occur elsewhere with broadly continuous ranges. Instead, these species most often exist elsewhere only in geographically remote and often small and isolated stations, many of the species sharing a common general geographical pattern of isolated stations in the West Mediterranean basin in the East African region as far as the Mascarenes, or towards the Himalayas.

One can therefore see that at one and the same time we have in the Canaries a fern flora which at a cytological level appears to have only the most remote relationships with the cytological spectra of modern tropical or temperate fern floras. Ecologically these species appear to be intimately associated with a unique laurel forest community which appears to have its closest relations with the now extinct laurel forest vegetation of Tertiary Europe. At a palaeobotanic level the ferns appear to be similar (probably very similar in the case of some of the well-enough preserved fossils) to the species of the Miocene of Southern Europe (in some places persisting to the Pliocene.) At a phytogeographical level the Canarian ferns show distribution patterns strongly indicative that the plants are relicts. My deduction therefore is that the Canarian fern flora is very largely composed of ancient species which existed in Tertiary Europe, which have survived little changed as relics in the mountains of the Canaries.

Why should this be so?

I would like in conclusion to put forward my reasons why I believe the ferns as part of a whole laurel forest community have survived in the Canary Islands long after their extinction in Europe. The palaeobotanic evidence suggests that these species became extinct in Europe through a combination of two main factors, one of which was the cooling of the European climate towards the end of the Tertiary period which forced these floras to migrate progressively further southward. The other was a progressive drying of the North African region, an influence which undoubtedly forced a northerly migration upon the Tertiary floras. Between these two changing climates these floras were trapped and ultimately became extinguished, apart from individual relict survivors in the present area of the West Mediterranean. I believe that the forests and fern species now in the Canary Islands had entered these Islands before the cooling of Europe and the drying of the North African region occurred and the reasons for their survival here seem likely to be as follows:

1. Because I believe the ferns migrated into the islands together with the vegetation with which they co-existed in Ter-

tiary Europe, there seems little cause to suggest that they suffered any great evolutionary change during immigration.

2. Once in the Islands, isolated not only by sea but also by the increasing aridity of the North African region, these plants were well-protected from further invasion by new competitors.

3. Since the original migration of the vegetation into the islands, because of their geographic position there seems likely to have been a continual oceanity of climate in the archipelago. This has effectively buffered temperature extremes, minimising long-term shifts in temperature means and rendering the environment relatively immune to increasing climatic continentality.

4. The oceanic position has enabled the plants associated with the forest environment also to continuously enjoy relatively moist conditions of frequent light precipitation resulting from the inter-action of impinging cloud on the montane forest vegetation.

5. The great altitude available in the Western Islands has probably allowed the existence of a strong altitudinal banding of vegetation permitting the possibility of short altitudinal shifts to compensate for small long-term changes in climate. Such altitudinal banding has also allowed the intimate intermixture in close juxtaposition of relatively hygrophyllous and relatively xerophyllous conditions such as may well have been the situation in Tertiary Europe.

6. The existence of a whole archipelago of islands has probably greatly helped the chances of survival of intact patches of vegetation acting as reservoirs of species available for recolonisation of areas and islands devastated by volcanic activity.

The Canary Island mountains thus harbour a fern flora which is in all probability a largely intact survivor of the fern flora which existed in Europe during the Tertiary, and as such is a flora very well worth conserving very carefully indeed.

ACKNOWLEGMENTS

I am grateful to Mr. D. M. Henderson (R. B. G., Edinburgh) and Dr T. G. Walker (University of Newcastle upon Tyne) for several useful comments on the manuscript, and to Dr Walker for supervision of the work on which this report is based.

REFERENCES

MANTON, I. 1950. *Problems of cytology and evolution in the Pteridophyta.* Cambridge University Press.

MANTON, I. 1959. Cytological information on the ferns of West Tropical

Africa. In A. H. G. Alston, *The fern and fern-allies of West Tropical Africa*. Suppl. to 2nd ed. of *Flora of West Tropical Africa*, pp. 75-81.

MANTON, I. & SLEDGE, W. A. 1954. Observations on the cytology and taxonomy of the Pteridophyte Flora of Ceylon. *Phil. Trans. R. Soc.* (*B*) 238 : 127-185.

WALKER, T. G. 1966. A cytotaxonomic survey of the Pteridophytes of Jamaica. *Trans. R. Soc. Edinb.* 66 : 169-237.

Junio de 1973

Royal Botanic Garden
Edinburgh
Great Britain

8. Sinopsis de las Alianzas y Asociaciones en la Clase Cytiso-Pinetea y Orden Cytiso Pinetalia

F. ESTEVE CHUECA

Las alianzas y asociaciones hasta el momento comprendidas en la clase Cytiso-Pinetea Riv. Goday et Esteve Chueca 1969 y orden Cytiso Pinetalia Riv. Goday et Esteve Chueca 1969

Características de clase y orden: **Pinus canariensis, Cytisus proliferus, Juniperus cedrus, Dicroanthus (Cheiranthus) scoparius, Andryala pinnatifida, Carlina salicifolia, Tolpis lagopoda, Ferula linkii, Lotus angustissimus, L. campylocladus, Adenocarpus viscosus** var. **frankenioides, Erica arborea** (dif.), **Hypericum canariensis** (dif.)

Alianza **Spartocytision nubigeni** Esteve 1972 y asociación **Spartocytisetum nubigeni** (Oberdorfer 1965) emend. (Tenerife y La Palma).

Características de asociación y alianza: **Spartocytisus nubigenus, Nepeta teydea, Pterocephalus lasiospermus, Tolpis webbi, Chrysanthemum anethifolium, Scrophularia glabrata, Micromeria julianoides, Echium wildpretii, Echium auberianum, Pimpinella buchii, Silene nocteolens, Serratula canariensis, Sideritis (Leuco phae) eriocephala, Centaurea arguta, Micromeria lachnophylla.**

Alianza **Adenocarpo-Cytision proliferi** Est. 1969 y asociación **Adenocarpo-Cytisetum proliferi** Est. 1969 (Tenerife, Gran Canaria y La Palma).

Características de asociación y alianza: **Adenocarpus foliolosus, Ranunculus cortusaefolius, Todaroa montana, Chrysanthemum canariensis, Ch. jacobaeifolium, Galium ellipticum.**

Diferenciales rupícolas: **Greenovia aurea, Aeonium simsii, Aeonium** spp.

Alianza **Cisto-Pinion canariensis** Esteve 1969 (Tenerife, Gran Canaria, La Palma).

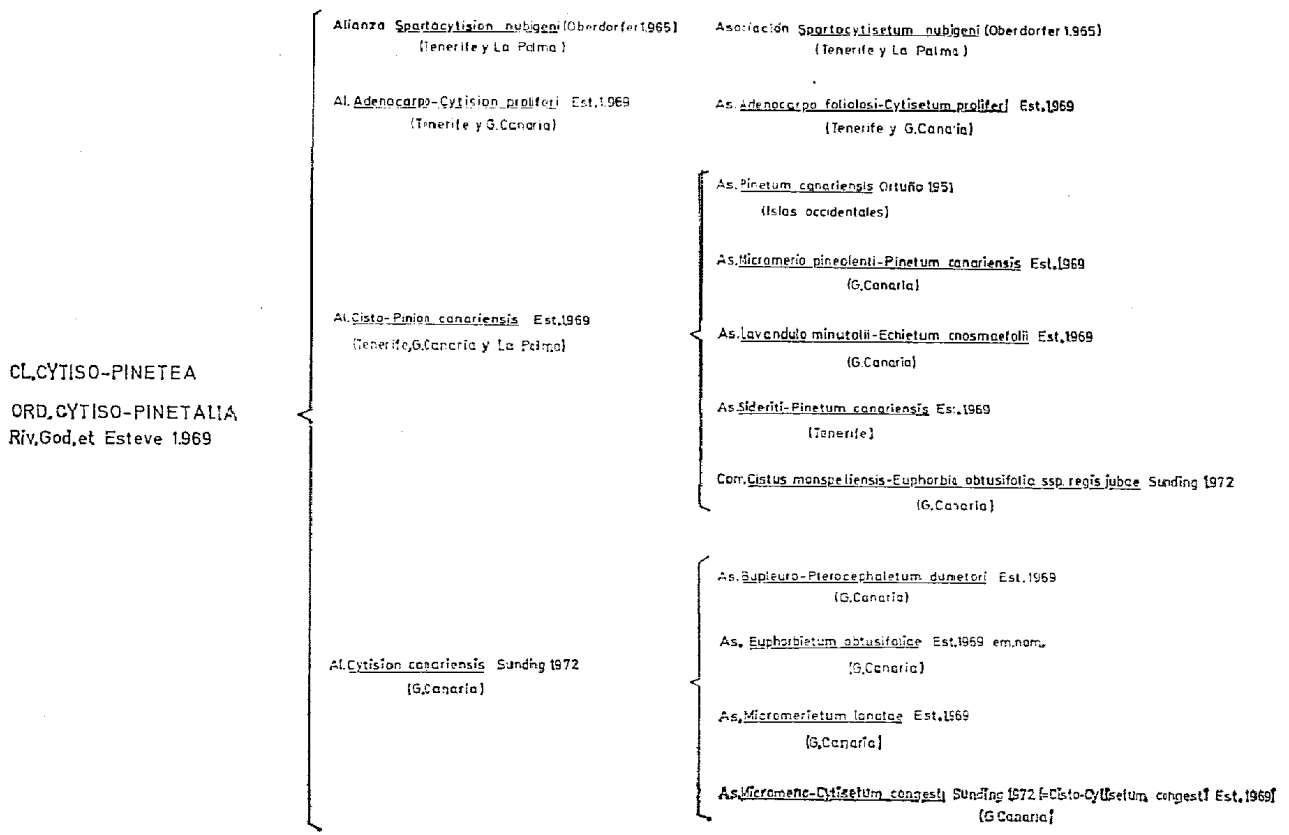
Características: **Cistus symphytifolius, C. symphytifolius** var. **leucophyllus, C. monspeliensis** (p.p.), **Bystropogon origanifolius, B. canariensis, B. plumosus.**

Diferenciales rupícolas: **Babcockia platylepis** y **Aeonium** spp.

Asociación **Pinetum canariensis** Ceballos et Ortuño 1951 (Islas occidentales).

Características: **Carlina canariensis, Lotus spartioides, Neotinea intacta, Orchis patens** var. **canariensis** (en unión con las citadas para la alianza **Cisto-Pinion** según tabla 33 P. Sunding 1972).

COMUNIDADES COMPONENTES DE LA CLASE CYTISO-PINETEA Y DEL ORDEN CYTISO-PINETALIA



(Datos obtenidos hasta el momento actual)

Asociación **Micromerio-Pinetum canariensis** Esteve 1969 (Gran Canaria).

Características: **Cistus symphytifolius** var. **leucophyllus** (C. candidissimus), **Micromeria pineolens, Phillyrea angustifolia.**

Asociación **Lavandulo-Echietum onosmifolii** Esteve 1969 (Gran Canaria).

Características: **Lavandula minutolii, Echium onosmaefolium, Descurainia preauxiana, Parolinia ornata.**

Asociación **Sideriti-Pinetum canariensis ass. nova** (Tenerife, otras islas occid.?).

Características: **Sideritis candicans, S. candicans** var. **stricta, regis-jubae** Sunding 1972. (Gran Canaria).

Comunidad **Cistus monspeliensis-Euphorbia obtusifolia** var. **Echium aculeatum.**

Características: **Cistus monspeliensis, Orchis patens** var. **canariensis, Euphorbia obtusifolia** var. **regis-jubae, Vicia disperma, Asterolinon linum-stellatum, Romulea columnae** var. **grandiscapa** y otras especies de alianza, orden, clase y de la clase **Kleinio-Euphorbietea.**

Alianza **Cytision canariensis** Sunding 1972 (Gran Canaria).

Características: **Sherardia arvensis, Spergula pentandra, Galium parisiense, Salvia canariensis, Chrysanthemum canariense, Adenocarpus foliolosus** var. **villosus** (dif.?) **Bryum validicostatum.**

Asociación **Bupleuro-Pterocephaletum dumetori** Esteve 1969 (Gran Canaria).

Características: **Bupleurum salicifolium** ssp. **acyphyllum, Pterocephalus dumetorum, Micromeria helianthemifolia.**

Asociación **Euphorbietum obtusifoliae** Esteve 1969 emend.. (Gran Canaria).

Características: **Euphorbia obtusifolia, Salvia canariensis** (dif.).

Asociación **Micromerietum lanatae** Esteve 1969 (Gran Canaria).

Características: **Micromeria lanata, Carlina xeranthemoides** var. **canariensis.**

Asociación **Mycromerio-Cytisetum congesti** Sunding 1972 (Gran Canaria).

Características: **Cytisus congestus, Dicroanthus (Cheiranthus) scoparius, Sideritis (Leucophae) dasygnaphala.**

SYNOPSIS OF THE CYTISO-PINETEA CLASS IN THE CANARY ISLANDS

(Summary)

The CYTISO-PINETEA class has been formed up to now by the following groups of plants:

ORDER CYTISO - PINETALIA CANARIENSIS Riv. Goday & Esteve 1960

Alliance Spartocytision nubigeni (Oberdorfer 1965) *emend.*

Association Spartocytisetum nubigeni (Oberdorfer 1965) emend.

Alliance Adenocarpo - Cytision proliferi Esteve 1969

Ass. Adenocarpo - Cytisetum proliferi Esteve 1969

Alliance Cisto - Pinion canariensis Esteve 1969

Ass. Pinetum canariensis Ceballos & Ortuño 1951

Ass. Micromerio - Pinetum canariensis Esteve 1969

Ass. Lavandulo - Echietum onosmifolii Esteve 1969

Ass. Sideriti - Pinetum canariensis ass. nova

Community Cistus monspeliensis - Euphorbia obtusifolia var. regis jubae Sunding 1972.

Alliance Cytision canariensis Sunding 1972

Ass. Bupleuro - Ptercocephaletum dumetori Esteve 1969

Ass. Euphorbietum obtusifoliae Esteve 1969 emend.

Ass. Micromerio - Cytisetum congesti Sunding 1972

Ass. Micromerietum lanatae Esteve 1969

BIBLIOGRAFIA CONSULTADA

BURCHARD, O. Beiträge zur Ökologie und Biologie der Kanarenplanzen. *Bibl. Bot.* 98., 1929

CEBALLOS, L & ORTUÑO, F. *Estudio sobre la vegetación y flora forestal de las Canarias Occidentales. Madrid,* 1951.

ESTEVE CHUECA, F. Estudio de las alianzas y asociaciones del orden Cytiso - Pinetalia en las Canarias Orientales. Madrid 1969.

KUNKEL G. y otros autores. *Cuadernos de Botánica Canaria.* Las Palmas de G. Canaria, Cabildo Insular. 1967-1972.

LEMS, K. Floristic summary of the Canary Islands. *Sarracenia* 5, 1964.

OBERDORFER, E. Pflanzensoziologische Studien auf Tenerife und Gomera (Kanarische Inseln). Karlsruhe, 1965.

PITARD, J & PROUST, L. *Les Iles Canaries. Flore de l'archipel.* Paris 1908.

RIVAS GODAY, S. & ESTEVE CHUECA F. Ensayo fitosociológico de la Crassi-Euphorbietea macaronesica y estudio de los tabaibales y cardonales de Gran Canaria. Madrid 1964.

SVENTENIUS, E. Additamentum ad floram canariensem. Madrid, 1960.

SUNDING, P. The vegetation of Gran Canaria. Oslo, 1972.

WEBB, P. B. & BERTHELOT, S. Historie naturelle des îles Canaries III. Botanique (Phytographia canariensis. Paris 1836.

Junio de 1973
Departamento de Botánica
y Ecología Vegetal
Universidad de Granada
Granada, España

9. Algunos Aspectos de la Vegetación de la Isla de La Palma

A. SANTOS GUERRA

Resumen

Breve reseña de las principales características florísticas de los distintos pisos de vegetación en la Isla de La Palma, señalando algunos de los endemismos insulares típicos de los diferentes niveles.

La isla de La Palma, la más noroccidental del archipiélago canario, con sus 727 qkm de superficie y sus 2.430 m. de altura máxima, ocupa dentro de la fitogeografía de estas islas una posición destacada, presentando la mayor parte de los tipos de vegetación en Canarias, desde el cinturon de halófilas hasta el matorral de leguminosas de alta montaña.

Con su especial configuración costera, en la cual predominan los acantilados con grado de inclinación elevado, y donde están ausentes completamente las formaciones de arenas rubias que desde las Canarias Orientales (Lanzarote y Fuerteventura), se continúan en Gran Canaria y Tenerife y llegan a alcanzar una pequeña extensión en la isla de Gomera, su vegetación halófila, está caracterizada por la presencia de **Astydamia latifolia** y la ausencia total de **Zygophyllum fontanesii** y **Euphorbia paralias** como especies típicas en las formaciones de arenas rubias. **Crithmum maritimum,** es muy escaso, habiéndose de señalar como más frecuentes en esta vegetación halófila, las comunidades de **Limonium pectinatum** y **Frankenia ericifolia,** que presentan su mayor distribución en las costas del sur y sureste, acompañadas en el norte por **Limonium imbricatum.**

Las costas más bajas de la isla, se hallan casi en su totalidad en la mitad sur. Se caracterizan por la presencia de los tabaibales y cardonales, puros y mixtos, de composición florística simple, especialmente cuando se desarrollan sobre suelos de escasa pendiente, aumentando la riqueza florística con el grado de inclinación. En orientaciones sur y SO, el tabaibal se ve caracterizado por una alta presencia de **Retama raetam,** que en algunas localidades imprime un caracter especial a las comunidades.

Los tabaibales son asimismo frecuentes en la vertiente NO, donde llegan a ocupar grandes extensiones, mientras que en las orientaciones N, solo se hallan en contadas localidades, dependiendo de una mayor iluminación y menor altitud. Aquí, los cardonales muy degradados por el pastoreo, se ven relegados a los escarpados de los acantilados o los barrancos.

En las costas inferiores, tuvieron que haber jugado un papel importante en la vegetación potencial de la isla, los bosques de **Juniperus phoenicea,** a juzgar por los frecuentes restos que aún pueden observarse en distintas orientaciones y en los cuales intervienen interesantes especies, tales como **Visnea mocanera, Catha cassinoides, Olea europea** var. **cerasiformis** y **Apollonias barbujana** (cuya presencia en estos niveles llega a ser mayor que en la zona de laurisilva) entre las especies arboreas, estando el matorral formado por numerosas e interesantes especies tales como **Polioden-dron. Jasminum, Dorycnium,** etc.

Dracaena draco y **Phoenix canariensis,** tuvieron asimismo, una amplia distribución insular. Mientras que en la zona de Breña Baja son frecuentes ambas especies, **Dracaena** alcanza su máxima representación en diversos puntos de la mitad N y NO de la isla (Barlovento y Garafía), donde pueden observarse varios grupos con más de 40 ejemplares, y **Phoenix** llega a ser abundante en algunos puntos de Tijarafe, donde **Dracaena** está ausente.

En la zona inferior comentada, hay que destacar el grupo de **Ephedra fragilis** presente en las costas de Mazo, siendo la especie más escasa en otros puntos del sur. Aunque la composición de los tabaibales y cardonales es bastante pobre, como ya hemos indicado, algunos endemismos tales como **Aeonium nobile** y **Echium brevirame** son exclusivos de ellos y otras especies tales como **Polycarpaea smithii** y **Aeonium goochiae** son frecuentes en algunas de estas comunidades, especialmente en fisuras de rocas.

La laurisilva, ocupó en la isla, una gran extensión, especialmente en las orientaciones N, NE y E, desde Mazo hasta Garafía. Sin embargo, la frecuencia de talas llevadas a cabo, han reducido en elevado porcentaje la extensión de tan interesantes formaciones arboreas. Así, todos los montes de Mazo, han quedado reducidos a fayal-brezal, ocurriendo lo mismo en los montes de Breña Baja y en gran parte de los de Breña Alta, donde los escasos restos de laurisilva aún presentes, n e c e s i t a n p r o t e c c i ó n i n m e d i a t a.

No menos alarmante, es la situación en el resto del dominio potencial de esta formación. Mientras los lugares de menos inclinación han sido repetidamente talados, restos de laurisilva han permanecido refugiados en las laderas y cauces de los barrancos más profundos, algunos de los cuales, tales como los montes sobre La Galga donde **Echium pininana** (endemismo de la laurisilva en esta isla) alcanza su mayor distribución, están siendo talados en estos meses, y otro tanto ocurre con las laderas de los barrancos de San Juan y Herradura en Los Sauces. La misma situación puede observarse en los montes de Barlovento y Garafía, con necesidad apremiante de protección para los restos más puros que aún se con-

servan, no sólo por el interés de las especies botánicas sino también por el de las especies zoológicas, especialmente las diversas especies de aves, endemismos insulares y de la fauna del archipiélago. Los escarpados rocosos de estos bosques, presentan gran diversidad florística, enriquecida recientemente, con el descubrimiento de una nueva especie de **Centaurea** de la sección **Flaviflora**, la cual será dada a conocer con el nombre de **Centaurea sventenii.** Aunque la especie está presente en el límite inferior de la laurisilva, alcanza su máxima representación en cotas inferiores.

El pinar, ocupa una gran repartición, llegando en diversas localidades hasta el borde del acantilado, tal y como ocurre en algunos puntos de Fuencaliente, Tijarafe, Puntagorda y en la vertiente NO de Garafía. Se distribuye regularmente en el interior de la Caldera de Taburiente y en gran parte de la vertiente O de la Cumbre Nueva. Asimismo, cubre las cumbres del S (Cumbre Vieja), toda la formación montañosa de Bejenado y los niveles por encima de la laurisilva. Los abundantes riscos en el pinar, presentan en ocasiones numerosas e interesantes especies, cuyo número total rebasa ligeramente las cuarenta y en las cuales, las crasulaceas, especialmente **Greenovia diplocycla** y **Aeonium palmense** son muy abundantes.

El pinar da paso finalmente al matorral de **Adenocarpus viscosus** var. **spartioides** y a la vegetación rupicola de alta montaña, donde los numerosos endemismos se hallan continuamente amenazados, de manera especial el interesantísimo **Cytisus benehoavensis,** principalmente por el ganado cabrío y otras especies no sólo por el ganado, sino también por los frecuentes corrimientos de tierra que en estos escarpados tienen lugar.

Junto a los ya conocidos endemismos de estos hermosos lugares tales como **Echium gentianoides, Viola palmensis, Cerastium sventenii,** etc., hay que añadir los recientes descubrimientos de **Nepeta, Ephedra, Bufonia** y **Bencomia,** todos ellos haciendo aún mayores las relaciones florísticas existentes entre las cumbres de Tenerife y las de La Palma, donde **Juniperus cedrus** alcanza la mayor representación en el archipiélago, siendo frecuentes los viejos y retorcidos ejemplares, algunos de los cuales llegan a alcanzar el metro de diámetro, en las zonas más altas del interior de la Caldera de Taburiente y en los escarpados de su borde exterior.

Junio de 1973
Departamento de Botánica
Facultad de Ciencias
Universidad
La Laguna, Tenerife
España.

10. Regeneración del Bosque Subtropical de Laurisilva

I. SANCHEZ GARCIA

1. Resumen

La manifestación más característica y espléndida que ofrece la Región Floral denominada Macaronésica-Archipiélagos Atlánticos de Azores, Madeira, Canarias y Cabo Verde, la constituye el tipo fisionómico denominado Laurisilva. Formación arbórea de frondosas, del tipo laurel, siempre verde, relativamente umbrófila y termófila, que en su forma climácica ofrece gran densidad en el estrato superior con escasez de elementos en el subsuelo, caracterizado por la presencia de helechos y musgos. De tendencia mesófila presenta características subtropicales, con una composición botánica heterogénea, no perceptible a primera vista, dada la semejanza de caracteres morfológicos.

Sólo en Madeira y Canarias podemos encontrar manifestaciones de estos bosques, donde alcanzan su máximo esplendor vegetativo y florístico. Dentro del Archipiélago Canario, en las Islas Occidentales Tenerife, Palma, Gomera y Hierro, aún podemos encontrar más o menos intactas, reliquias de esta flora terciaria, que lograron sobrevivir los fríos de finales de dicha era y las glaciaciones del cuaternario.

Dado el interés científico y cultural que presenta la subsistencia de estos vegetales anacrónicos, escasos y casi desconocidos, el Servicio del ICONA, Instituto Nacional para la Conservación de la Naturaleza, en la Provincia de Santa Cruz de Tenerife, en las Islas Canarias, inició a partir de 1970 una campaña de recomposición vegetativa y florística de la laurisilva, dentro de su política de protección y conservación de la naturaleza.

Para ello eligió la Isla de La Gomera, donde mejores y más puras se encuentran estas manifestaciones. En vivero situado en el límite inferior de uno de sus montes se obtuvieron plantas de laureles y viñátigo, **Laurus canariensis** W. B. o **azorica** y **Persea indica Spreng**, respectivamente, mediante semillas, brinzales y estaquillas.

El pasado año se continuaron los trabajos con brinzales de paoo-blanco-**Notelaea excelsa** W. B. y estaquillas, de barbuzano y mocán **Apollonias barbujana** y **Visnea mocanera** L., respectivamente. Idénticos trabajos se realizaron en otro vivero de la Isla de Tenerife (Aguamansa) con estaquillas de hija-**Prunus** o **Laurocera sus lusitanica** L- y con el naranjo salvaje-**Ilex platyphylla** W. B.

Los excelentes resultados de producción de plantas obtenidas de semillas y brinzales, así como de estaquillas de laureles, viñátigo, hijas y naranjo salvaje, aseguran la posibilidad de obtener la planta necesaria para llevar a cabo la regeneración del bosque de laurisilva mediante repoblación artificial, allí donde ecológicamente sea compatible.

Estos trabajos se iniciaron en el año 1971 y se han continuado en la campaña de 1972 y 1973 dentro de su dominio natural.

2 Síntesis

Como consecuencia del interés científico, cultural y económico que supone la regeneración del bosque de Laurisilva, el Servicio de ICONA en Santa Cruz de Tenerife, se ha propuesta llevar a cabo la repoblación artificial de las especies constituyentes de aquella formación vegetal, dentro de su área potencial en las Islas Canarias.

Para ello ha sido necesario utilizar en vivero diferentes métodos de reproducción de las frondosas integrantes en dicha comunidad vegetal, con el objeto de determinar el mejor sistema de obtención de plantas precisas ara la repoblación. Las técnicas tradicionales, de experiencias anteriores, han servido de base para ello.

3. Introducción

Una de las características de nuestra década, dentro de las nuevas directrices de la política española, es la conservación, protección y defensa de la naturaleza. Dentro de su faceta social destaca el interés de mantener, o en su caso recuperar, el ambiente forestal del óptimo de vegetación posible, allí donde lo permitan las actuales condiciones del medio y que pueda suponer un gran atractivo científico, cultural y económico.

En el caso de nuestros Archipiélagos Macaronésicos, destacamos el bosque subtropical de Laurisilva, verdadero museo, donde se conservan en mayor o menor grado, gran número de tipos vegetales antiguos, fósiles supervivientes que sucumbieron en latitudes más septentrionales, y que a causa de su aislamiento han dado lugar, posteriormente a muchos endemismos propios de cada Archipiélago y que han alcanzado gran valor florístico.

Quizás sea Madeira quien represente el óptimo vegetativo de Macaronesia, pero son las Islas Canarias quienes alcanzan el óptimo florístico. Ambos Archipiélagos constituyen el dominio floral de transición entre el Reino Holártico (a través de Azores) y el Paleotropical (a través de Cabo Verde).

Con él nombre de L a u r i s i l v a se conoce una formación de frondosas arbóreas o arbustivas, con hojas persistentes, coriaceas y lustrosas, de color verde intenso, que presupone gran abundancia de clorifila y una activa asimilación de sustancias.

El nombre de la formación alude a la organización general de tipo laurel de las especies componentes, algunas de ellas pertenecientes a las familias de las Lauráceas. Estas formas, que constituyen el "tipo laurel" de Humboldt, Laurenholtz de Hayek, Laurilignosa de Brokman, o la Laurisilva de Jerosch, han visto regulada su distribución, aparte de razones antropógenas, por los factores edáficos y climáticos, y dentro de éstos, por la temperatura y humedad, de acuerdo con el temperamento relativamente termófilo y umbrófilo de los mismos.

En los bosques Canarios el estrato arbóreo presenta como especies fundamentales o accesorias:

Laurus canariensis W. B. (Loro) (*)
Persea indica Spr. (Viñátigo)
Ocotea foetens W. B. (Til)
Ilex canariensis Poir (Acebiño)
Rhamnus glandulosa Ait. (Sanguino)
Visnea mocanera L. fil. (Mocán)
Arbutus canariensis Veill. (Madroño)
Myrsine heberdenia Roem. et. Sch. (Aderno)
Myrsine canariensis Spreng. (Marmolán)
Notelaea excelsa W. B. (Palo blanco)
Ilex platyphylla W. B. (Naranjo salvaje)
Prunus lusitanica L., (Hija)

Del factor relieve depende en mucho la naturaleza, cuantía y desarrollo del estrato arbustivo, que entremezclado con el árboreo, completa la cubierta del suelo, siendo los elementos más característicos:

Viburnum rugosum Pers. (Follao)
Parietaria arborea L.
Catha cassinoides W. B. (Peralito)
Sambucus palmensis Chr. Sm.
Salix canariensis Chr. Sm.

Caracteriza el subsuelo musgos **(Fissidens, Bryum,** etc.) y helechos **(Pteris arguta, Aspidium aculeatum, Woodwardia radicans** etc.) La representación de fanerógamas está integrado por especies de acreditado umbrofilía: **Urtica morifolia, Viola silvestris, Geranium anemonaefolium, Scrophularia smithii,** etc. Participan en las formas de óptimo unas series de especies que aún mostrando

(*) Nota de la redacción: Los nombres de esta contribución no siempre corresponden a los de listas modernas.

determinadas exigencias de luz, son de tendencia umbrófila y carácter netamente selvático, tales como: **Ranunculus cortusaefolius** Willd., **Ixanthus viscosus** L., **Senecio appendiculatus** Schp. Bip., **Digitalis canariensis** L., **Senecio cruentus** DC. Las plantas volubles están representadas por **Semele androgina, Canarina campanula, Convolvulus floridus, Hedera canariensis** y **Smilax canariensis.** Es difícil encontrar muestras o residuos del bosque de Lauráceas en los que no estén presentes **Myrica faya y Erica arborea.** En los bosques de Madeira, intervienen las cuatro Lauráceas arbóreas: **Laurus canariensis, Persea indica, Arbutus canariensis, Ocotea foetens,** así como **Notelaea excelsa, Prunus lusitanica** y **Myrsine heberdenia,** apareciendo algunos elementos canarios, tales como **Visnea mocanera** y **Rhamnus glandulosa.** Se adornan con endemismos más exclusivos, tales como **Pittosporum coriaceum, Isoplexis sceptum** y **Clethra arborea,** está desaparecida de Canarias.

Sin embargo en el Archipiélago de Azores la Laurisilva está extinguida casi por completo, donde debieron intervenir con abundancia **Laurus canariensis, Notalaea excelsa** y **Myrica faya,** especies de las que aún se conservan verdadera reliquias, siendo un poco más frecuente **Persea indica.**

Este tipo de bosque vive perfectamente en las exposiciones septentrionales. Requiere climas húmedos. Se desarrolla entre 600 y 1.300 metros de altitud, pudiendo bajar más en Madeira y Azores. Las precipitaciones son del orden de 1.500 m/m. entre la normal y la horizontal. No tolera fríos intensos. Prefiere suelos sueltos y de naturaleza sílicea, neutros o ligeramente ácidos, con gran cantidad de materia orgánica. De porte erguido con copa ovoidal o globosa. Puede alcanzar los 30 metros de altura y diámetro de 40 centímetros, aún cuando las tallas medias oscilan entre 10 y 20 metros, con copas bien desarrolladas. La reproducción por semillas se produce con muy poca iluminación no tolerando luces excesivas. Es usual la propagación de renuevos.

La rentabilidad de las inversiones forestales en Canarias, es difícil de evaluar, ya que la mayor:a de sus beneficios son indirectos, destacando:

a) La fijación del suelo mediante repoblación, evitando pérdidas de tierra y mejorando el suelo con la creación de una capa vegetal.

b) La revalorización del paisaje natural con el consiguiente atractivo turístico

c) El incremento del agua captada por el bosque, al condensar en la superficie de su follaje las partículas de agua que constituyen las nubes del alisio, e infiltrada con aprovechamiento inmediato.

Todos estos puntos se alcanzan con la formación de Laurisilva. Este tipo de bosque fue explotado en épocas anteriores y en ciertas zonas, de una manera anárquica, y las especies se regeneraban casi exclusivamente por rebrote. Por ello la capacidad de reproducción de las cepas se agotaba, con lo que casi desaparecieron las formas arbóreas, dando paso a masas regresivas de fayal-brezal. Solo se conoce una enfermedad criptógamica denominada "madre del loro" y producida por el hongo **Exobasidium lauri.**

Se considera difícil el progreso de la Laurisilva fuera de las zonas donde se manifiesta pujante. Actualmente la mayoría de las masas son regresivas. En los últimos años las Entidades propietarias, Organismos Oficiales, Gremios Sindicales, Especialistas Botánicos, los Centros Universitarios, están de acuerdo en la necesidad de defender y conservar, en primer lugar, estas reliquias vegetales, y en incrementar su área, allí donde ecológicamente sea posible, hasta tal punto, que se pretende declarar dichos bosques, Sitios de Interés Natural, de acuerdo con la vigente Legislación Forestal Española. Las técnicas de obtención de plantas mediante cultivo en vivero y la experiencia, corta en los métodos de repoblación ensayados permiten alcanzar paulatinamente el objetivo deseado.

Aún cuando estos trabajos se llevan a cabo en la Isla de La Gomera, con magníficos antecedentes en el año 50 en La Laguna (Tenerife), no creemos que haya inconveniente en extender nuestro campo de actuación al resto de las Islas o Archipiélagos, donde el clima y el suelo lo permitan. Máxime dada la analogía climática de los mismos, situados en las regiones templado-cálidas del Hemisferio Boreal, y sometidos a la influencia del alisio del N. E., a quien debe unirse la edáfica, resultante del común origen volcánico de ellos.

4 Método y resultados

Al objeto de llevar a cabo la repoblación de las especies vegetales que constituyen el bosque de Laurisilva se hizo necesario obtener en primer lugar la planta necesaria. Se tomó como base las experiencias realizadas en el año 1.950 por los Servicios Forestales en los viveros de La Laguna con semillas y brinzales de madroño, loros y viñátigos. Para ello se ha iniciado un estudio métódico y experimental de los procesos de cultivo en vivero y de las plantaciones realizadas.

En un principio, Primavera de 1.970, se colocaron semillas en envases de polietileno. Las excelentes plantas de loros y viñátigos obtenidos por este sistema, 30 ctms. de altura al cabo de un período vegetativo, se plantaron en los primeros meses del año 1971 en

dos parcelas del Monte de Vallehermoso a cota de 1.250 metros y exposición S. O. Las observaciones de dichas plantaciones al cabo de dos años ofrecen resultados optimistas. En Primavera de 1.972 se colocaron en envases de polietileno y en el mismo vivero, plantas procedentes de brinzales diseminadas en masas selváticas naturales. Las plantas obtenidas de loros y viñatigos alcanzaron los 50 ctms. de altura al cabo del período vegetativo y ofrecían un aspecto inmejorable. A finales de año se utilizaron en la repoblación de pequeñas parcelas en los Montes de San Sebastián y Vallehermoso, en exposiciones Sur y Norte, a cota de 1.300 metros y 650 metros, respectivamente, dentro de su habitat potencial. En Abril del mismo año y también en bolsas de polietileno se colocaron estaquillas de faya, viñatigo, acebiño, barbuzano, til y mocán. En idéntica fecha se cultivaron en Tenerife estaquillas de las mismas especies, además de la hija y naranjo salvaje, obteniéndose buenos resultados con estas dos últimas especies.

La tierra utilizada para el llenado de las bolsas fue de excelente calidad y procedente de las capas superiores del suelo del habitat natural.

En líneas generales las estaquillas procedieron de brotes o chupones bien desarrollados, nacidos en los fustes; de los renuevos de un año, procedentes de árboles padres y de ramas extraídas de la parte alta de árboles jóvenes y vigorosos. El diámetro osciló entre 10 y 20 mm. y la longitud entre los 20 y 40 ctms. Fueron recolectados a finales del invierno y principios de primavera. Tanto la semilla como los brinzales y estaquillas se colocaron en bolsas de 14 ctms. de diámetro y 20 ctms. de altura, colocándose en albitanas preparadas, de unos 5 metros de largo y 1 metro de ancho, separadas entre sí por pasillos de 50 centímetros. La frecuencia de los riegos fue de una vez al día normalmente, y de dos veces en verano. No fue necesario utilizar sombrajos artificiales.

La elección del vivero se pensó en función del temperamento de estas plantas subtropicales en lo referente a la germinación de la semilla, con poca iluminación, y a las exigencias relativamente umbrófilas y termófilas de aquellas. Cota de 845 m. Exposición Norte y dentro del habitat natural de la Laurisilva. El arranque se efectuó a mano y se trasplantaron al final del período vegetativo, repicándose unas semanas antes de enviar al monte.

A efectos de facilitar el arraigue de la planta a la hora de repoblar, convino equilibrar la copa con el sistema radical, eliminando algunas hojas de las plantas obtenidas. El transporte desde el vivero hasta el lugar definitivo de su plantación se efectuó en envases de madera con capacidad para 40 bolsas.

La plantación se efectuó a mano y después de romper el fondo de la bolsa se colocaron en hoyos previamente preparados de dimensiones 40 x 40 x 40 y en una densidad de 2.500 plantas por ha. No se efectuó roza del matorral y en aquellas zonas carentes de vegetación se protegieron las plantas con un castillete de piedras o empalizada de matorral, a fin de suministrarles sombra y humedad, dado su temperamento. El coste de la repoblación es del orden de las 12.500 ptas. Ha. incluyendo obtención de plantas en vivero, transporte, plantación y protección.

De cada una de las parcelas elegidas para la repoblación así como de algunos puntos representativos del habitat natural de la Laurisilva se tomaron datos administrativos y geográficos; fitogiráficos y desonómicos; edafológicos y climáticos. Algunos ejemplares de viñatigos cultivados se están utilizando por el Servicio de Extensión Agraria en Tenerife como patrón de injertos con aguacate —**Persea gratissima**— con la finalidad de obtener especies resistentes a la enfermedad criptográmica denominada "tristeza", producida por **Phytophthorea cinamomi,** así como de extener su cultivo a zonas altas.

Marzo de 1.973
ICONA
Santa Cruz de Tenerife
c/ San Isidro, 3
Islas Canarias, España

11. The Role of Adventitious Plants in the Vegetation of the Canary Islands

G. KUNKEL

Resumen

"El papel de las plantas adventicias en la vegetación de las Islas Canarias". — Sobre el origen y distribución de elementos florísticos introducidos, y su importancia dentro del mosaico de vegetación de las islas. Especial atención se presta a ciertos elementos agresivos como **Opuntia, Agave, Ageratina, Nicotiana, Inula, Oxalis y Rubus**, cuyo grado de agresividad pasa el límite de lo tolerable y cuyo control se recomienda como acción de prioridad.

As is any other terrestrial part of our world, species have always been travelling about, becoming introduced into new surroundings. Only extreme environments such as mountain regions, arctic zones and deserts, or dense habitats like tropical rain forests may be found more or less free of foreign and invading elements. Introduced plants play an important part especially where fragile biotic systems have suffered severe disturbances. In some zones it is now almost impossible to decide whether a given species has, originally, been introduced or not.

Plants are introduced voluntarily or by accident. Seeds of certain species came by wind or by sea; others travelled with birds or have been brought by other animals. Some arrived by the extension of the original habitat (not in islands!), and of course seeds of many others appeared in company with those of species imported for cultivation. A final group of plants, originally cultivated, have escaped cultivation and have become established. Examples exist, for every group, even in the Canary Islands.

Probably over a third part of all plants growing wild in these islands, in one place or another or, in some cases, in several or on all islands, are considered to be introduced elements. Some of these species have established themselves to such an extent that without these plants certain landscapes would be hardly recognizable.

This is the case of **Oxalis pes-caprae**, a South African invader, of the Mediterranean **Chrysanthemum** species on northern and eastern slopes, and of **Opuntia** and **Agave** covering some of our semi-arid countrysides.

Our "Checklists" have become rather voluminous. Entire plant families concern only these "newcomers", and names such as Basellaceae, Cactaceae, Fagaceae, Myrtaceae, Nyctaginaceae, Oxalidaceae, Portulacaceae, Sapindaceae, Simaroubaceae, Tropaeolaceae, Ulmaceae and Lemnaceae are most familiar, although all species of these families are considered as introduced. Most of them are established in certain limited or special places only, but some cover considerable areas and species of **Castanea, Eucalyptus, Ulmus** etc., form new forest zones, replacing the — now destroyed — original woodlands. This refers also to the Almond tree and to the at present extending exotic Pine species.

Except the afore mentioned species of **Opuntia** and **Agave,** some of these new elements are hardly noticed, in extension or as dangerous. But this cannot be said of others, the true invaders which, thanks to their vigorous growth and free germination have become a pest in our islands. This is the case of **Rubus ulmifolius** s.lat. and of **Ageratina adenophora;** the former being a cosmopolitan "disease", the latter a rather showy-flowered North American species, maybe originally introduced as a garden plant. Both species now occupy large areas in the laurel belt, extending further every year and presenting a serious challenge to the survival of the natural flora. On La Palma a second species of **Ageratina** (ex-Eupatorium) has also become common. Hardly any seedling of the original and still surviving vegetation has a chance and — I believe — only manual action can control these invaders. The already mentioned **Oxalis,** on the other hand, should be controlled by means of hormone treatment; this species now spreads even faster especially as it grows in every local nursery and plants from these nurseries are carried daily into new and — until then — uninfested surroundings.

Typical for recently disturbed areas are two woody invaders: **Nicotiana glauca** from South America, and the Mediterranean **Inula viscosa.** Both species appear soon after earth has been moved and the soil structure of the surface been modified; this happens even in the Pine forest belt. A third species, **Ricinus communis** is in the process of extension.

Naturally, most invaders tend to keep to certain environmental conditions. Only **Nicotiana, Opuntia** and **Agave** have attained any importance in the more arid eastern islands of the archipelago. **Oxalis, Ageratina, Ricinus** and **Rubus** are in need of moisture, in the ground and in the atmosphere. Nevertheless, this is the actual situation; invading species spread further and are highly adaptable, even in quite extreme environments.

Most of the species mentioned have been established in the islands for centuries. Some more recent introductions (or recent escapes from cultivation) are **Albizia lophantha, Acacia farnesiana, Ailanthus altissima, Mirabilis jalapa, Eschscholzia californica, Erigeron karvinskianus, Datura** spp., and some Australian species of **Atriplex.** They are now very much established and, in some cases, only dramatic action could control their way into the wild countryside.

As common invaders in fields and gardens, along road sides and appearing in far off localities, plants like **Bidens, Carduus, Carthamus, Silybum, Scolymus** and **Xanthium** are to be mentioned. Certain grasses have spread fast and became naturalized. And like **Oxalis,** a common Cyperaceae — **Cyperus rotundus** — is on the way to becoming an uncontrollable and serious problem. The first specimens are reported now even from arid Lanzarote and Fuerteventura.

We know (according to books published) that **Neurada procumbens** was introduced from Africa on camel's feet; it is quite common on low ground, between dunes in the south of Gran Canaria. In the same region several palm species are established, all belonging to the genus **Phoenix,** all hybridizing with our native **Phoenix canariensis.** There exists a complex of three or four species, interesting but unresolved, and which need urgent investigation before the Palm groves are destroyed (!). Something similar applies to **Tamarix,** a complex of species which might have been introduced from Africa; several species are well established now, especially in Gran Canaria and in the eastern islands and are considered as established components of our vegetation community. And there is the case of an introduced grass, **Pennisetum setaceum,** from North Africa, known in Tenerife and Gran Canaria. Originally a casual roadside weed and now spreading according to its preferance — along roadsides; the species is extending its area year by year more, and certain control must be suggested.

—oOo—

Problems exist, and problems remain. Considering the importance of introduced plants or say foreign elements in our flora, it is suggested that an inter-island commission to investigate introduction and spreading of neo-elements be established, to study means of their control and — being optimistic — their possible elimination.

Many plants have invaded these islands, and more are likely to do so in the near future. This seems an inevitable fact. From the conservationists point of view invading plants should be classified in two categories: The tolerable and the dangerous invaders. Distinction is necessary for any control programme although none of them — the tolerable ones nor the dangerous invaders — are desirable elements.

April 1973

Camino Viejo 15, Tafira Alta
Las Palmas de Gran Canaria
Canary Islands, Spain

12. Plant Communities of the Natural Vegetation of Madeira and the Azores

E. A. SJÖGREN

ABSTRACT

Madeira: Communities distinguished are I. **Aeonio-Lytanthion** with A. **Hyparrhenietum hirtae**, B. **Euphorbietum piscatoriae**, C. **Biserrulae-Scorpiurietum.** II. **Clethro-Laurion** with A. **Vaccinio-Sibthorpietum**, B. **Deschampsietum argenteae**, C. **Campylopo-Airetum**, D. **Ericetum cinereae.** Zonation; in the S of the island 0-300 m: (Ia) Coastal vegetation, **Aeonio-Lytanthion.** 300-700 m: (Ib) **Ae.-Ly.** mixed with cloud-zone species, 700-1200 m: (IIa) **Laurus-Erica-Vaccinium** shrub forest, **Clethro-Laurion**, 1200-1850 m: (IIb) **Erica** scrub above cloud-zone, grassland ass. of the **Cl.-Lau.** In the N of the island 0-100 m (Ia), 100-300 m (Ib), 300-1300 m (IIa), 1300-1850 m (IIb).

Azores: Communities distinguished are I. **Festucion petraeae** with A. **Polygonetum maritimi**, B. **Euphorbietum azoricae**, C. **Ornithopo-Gaudinietum.** II. **Litorello-Eleocharion.** III. **Juniperion brevifolii** with A. **Anagallidetum tenellae**, B. **Erico-Myrsinetum**, C. **Festucetum jubatae.** Zonation; 0-100 m: **Festucion petraeae**, 100-500 m: **Myrica faya (Pittosporum undulatum)** zone, 500-1350 m: **Juniperion brevifolii** and **Litorello-Eleocharion**, above 1350 m: **Calluna- Daboecia-Thymus** zone (above 1700 m, characterized by **Rhacomitrium, Gymnomitrium, Andreaea**).

The field work which comprised differentiation of the plant communities of the natural vegetation of Madeira and the Azores was carried out between 1964 and 1970.

On Madeira the minimum area needed for a description of the communities was found to be at least 25 m2. Differential species with variously high differential values were used for the characterization of the communities.

The coastal vegetation on Madeira is confined to cliffs and loose eroded or deposited volcanic soil. It forms an endemic community called the **Aeonio-Lytanthion.** The alliance is physiognomically characterized by species of the families Sempervivaceae and Crassulaceae, and includes shrubs of the Globulariaceae, Boraginaceae and Euphorbiaceae. There is only a small number of bryophytes in the bottom layer of the community. Differential species with a high differential value are for example **Euphorbia piscatoria, Sonchus ustulatus** and **Plantago arborescens** var. **ma-**

derensis. The alliance has some differential species in common with the coastal alliance in the Azores, for example **Crithmum maritimum** and **Asplenium marinum**. The **Aeonio-Lytanthion** grows along the S coast of Madeira, rarely above 300 m, and on the N coast rarely above 50-100 m. In these habitats precipitation is generally not over 750 mm per year and air humidity is usually about 60-70 %. The position of the upper limit for the complete **A.-L.** is irregular, especially in the south of the island. Parts of the all. in this area extend up to 500 m in river valleys where local climatic conditions near the valley bottoms are rather unfavourable because of temperature inversions.

Succession within the **A.-L.** begins with a stage of grasses and other herbs. A more effective soil-stabilizing stage of low shrub follows, and finally forms a stratified field layer. The all. is now found in small areas not occupied by fields or by forest plantations.

Between 700 and 1400 m on Madeira there is a zone which has a very wet climate. This is characterized by an indigenous shrub-forest which still covers fairly large areas. The laurisilva of Madeira differs from that in the Azores and in the Canary Islands. The community has been called the **Clethro-Laurion** (abbrev. **C.-L.**). In inaccessible areas this all. may have a continuous tree layer, but generally there is only a shrub layer. Field and bottom layers are rich in species. The mean number of vascular plant taxa within the sample plots of the all. is 20.

Nearly 50 % of the total number of diff. spp. with a high differential value for the all. are endemic to the island, so the **C.-L.** is an endemic plant community of Madeira. The fact that there are some diff. spp. in common with the cloud-zone all. in the Azores supports a possible arrangement of the two Macaronesian communities under a higher rank sociological unit.

Studies of the distribution of the **C.-L.** have led to the conclusion that the all. requires precipitation of at least 1700 mm per year and permanently high relative air humidity values to reach complete development. These conditions can be found in the S of the island at about 700 m and in the N at about 400 m. The lower limit of the **C.-L.** corresponds to these altitudes. The upper limit for the dense cloud-zone shrub-forest is 1200 and 1300 m respectively.

The lower limit of the all. is irregular in the S of the island, owing to local climatic conditions in the deep river valleys. Exclaves of the **C.-L.** frequently occur in these valleys at altitudes far below the lower limit of 700 m of the all. The coastal plant communities also extend their distribution to higher altitudes in

the river valleys than on the ridges between because of the frequent temperature inversions in the valleys.

The zonation of cloud-zone vegetation on Madeira and in the Azores was found to have a similar correlation with climate. The lower limit in the Azores is 500 m in the central part of the archipelago, 700 m in the eastern, and 300 m in the western. At all these altitudes, precipitation reaches values of 1700-2000 mm per year.

Natural succession in the **C.-L.** above 800 m on slopes of volcanic deposits is very rapid. The moss layer reaches a high degree of cover after only 3 years, followed by the vascular plant cover. The first drought-tolerant species to colonize are replaced after 2 or 3 years by large shading ferns. Conditions are then favourable for the development of a shrub stage. The final succession towards a complete **C.-L.**, however, seems to take place very slowly.

Macaronesian vegetation in the Azores is endemic, though it includes several species which also grow on Madeira. Minimum areas of the alliances were found to be 25-40 m2.

The coastal community has been given the name **Festucion petraeae.** It occurs on all the islands. It has a rather small number of grasses, a small number of other herb taxa and practically no shrubs. This vegetation has a slow rate of succession, changed abruptly only by erosion or by volcanic eruptions producing lava streams or deposits of volcanic ash. The sociological weakening of the all. becomes clear at altitudes above 100 m. Localities of single diff. spp. have, however, been recorded up to 300 m in open habitats. The associations of the **F.p.** are fairly drought-tolerant and have a strong tolerance against salt water sprinkling.

The micro-zonation within the **F.p.** is uniform in the archipelago. From the coastline there is first a dominance of **Juncus acutus, Asplenium marinum, Crithmum maritimum, Euphorbia azorica** and **Festuca petraea.** Above this follows a micro-zone dominated by **Plantago coronopus, Lotus subbiflorus** and **Ornithopus pinnatus.** Further inland a successively denser shrub vegetation of **Myrica faya** develops with abundant **Pteridium aquilinum** and **Rubus ulmifolius.**

The all. **Litorello-Eleocharion** (abbrev. **L.-E.**) on lake shores is sociologically sharply distinguished. The size of sample plots should not be smaller than 16 m2. Most lakes in the Azores are situated at altitudes above 500 m. The lake shore all. has a rather uniform composition in the archipelago. There is, however, a clear physiognomic variation between lakes of the same island and on different islands. For example **Scirpus fluitans, Eleocharis multicaulis** and **Polytrichum commune** are rare round the lake

in the caldera of Faial. **Hypericum elodes** has not been recorded there whereas **Chamaemelum nobile** var. is dominant in several localities. This species has no physiognomic importance in the **L.-E.** round lakes on Pico. **H. elodes** is on the other hand most frequent there. **Nardus stricta** only characterizes the highest micro-zone round lakes on Pico.

The natural vegetation in the Azores above 500 m is a dense **Laurus-Erica-Vaccinium-Juniperus** shrub vegetation. The sucession rate in this tree-shrub layer is extremely slow. The vegetation has been ranged to an alliance called the **Juniperion brevifolii** (abbrev. **J.b.**). A fairly large number of diff. spp. for the all. is the common feature of ecologically quite different localities at altitudes above 500 m. The size of sample plots for the registration of the complete **J. b.** can rarely be smaller than 40 m2. The all. can rarely be recorded below 500 m or above 1350 m. The upper altitude limit can only be studied on Pico. On Flores the base limit reaches 300 m; on S. Miguel the complete **J. b.** will on the contrary rarely be found below 700 m. These differences can easily be correlated with climatic conditions, especially with precipitation and with increasing relative humidity from E to W in the archipelago.

One association of the all. can be found in open habitats generally on a thick humus layer, on tuff layers, or on rather loosely accumulated sand or gravel deposits. In the bottom of shallow ravines there is for example a dominance of **Juncus effusus** and **Anagallis tenella.** On dryer ridges between, on the other hand, there is often a dominance of **Agrostis castellana** and **Luzula purpureo-splendens.** The ass. **Erico-Myrsinetum** has colonized and survived in a completely developed form mainly on young lava flows. The number of species reaching high cover degrees in the field layer is high. Most of the characteristic species of the ass. have a low drought-tolerance. At altitudes above 1350 m on Pico the ass. will gradually loose diff. spp. towards the peak of the volcano. Precipitation increases above 1350 m to more than 3000 mm per year but only provides the vegetation with small amounts of water. The rainwater rapidly percolates into the black ash deposits.

The most exotic ass. of the Azorean vegetation is the **Festucetum jubatae.** Localities of this ass. are few and comparatively very small. They are mainly restricted to deep, narrow ravines, calderas, parasitic cones, and explosion holes in lava flows. These habitats are characterized by good protection from exposure. The ass. contains the highest number of Azorean and Macaronesian endemic vascular taxa compared with the other described communities. Localities have recently become easier to reach

from new roads. Differential species are for example **Lactuca watsoniana, Euphorbia stygiana** and **Ranunculus cortusifolius.** The **Festucetum jubatae** is the phytocoenosis with the highest number of species in the archipelago. A characteristic feature is the nearly permanent presence of epiphyllous hepatics. The epigeic moss cover, often dominated by **Sphagnum** spp., covers the nearly vertical slopes and often falls down to the base of the slopes, forming a hillock of mosses with litter, sand and boulders several m high.

The zonation of the natural vegetation in the Azores is difficult to summarize because of differences in climate between the individual islands. The coastal zone with the **Festucion petraeae** is confined, however, to altitudes below 100 m throughout the archipelago. Up to 500 m. there is generally a **Myrica faya-Pittosporum undulatum** — dominated zone. Above 500 m and below 1350 m follows the **Juniperion brevifolii.**

An eco-sociological investigation of the natural vegetation of Madeira and the Azores can not of course be separated from the influences of the cultural landscape. I have, however, chosen to deal with these influences separately in a paper on "Conservation of natural plant communities".

April 1973

Växtbiologiska Institutionen
(Institute of Ecological Botany)
Box 559
Uppsala 1, Sweden

13. Endemism in the Flora of the Cape Verde Islands, with Special Emphasis on the Macaronesian Flora Element

P. SUNDING

Abstract

In most classifications of the world's major flora regions the Cape Verde Islands are referred to the Holartic flora region, but at the same time being placed near the border to both Palaeotropis and Neotropis, thus indicating the varying character of the flora of the archipelago. In the present paper a phytogeographical analysis of the islands' vascular flora (651 species) has been carried out. In contrast to what is the case in the Canary Islands, the Mediterranean flora element is only weakly represented, whereas the tropical elements constitute more than half of the entire flora. Macaronesian species are few. A total of 92 species are endemic to this single archipelago, partly (53%) showing strong affinity to other Macaronesian islands (**Aeonium** spp., **Echium** spp., etc.), primarily to the Canary Islands.

The biogeographical concept "Macaronesia" was introduced by the botanist Philip Barker Webb about one hundred and twenty years ago, to designate the five archipelagos of the Azores, Madeira, the Salvage Islands, the Canary Islands, and the Cape Verde Islands. The exploration of these archipelagos by natural scientists has been most varied, depending upon the accessibility of the various islands, and on the attraction their nature has had upon these scientists. Whereas the Canary Islands have eagerly been visited and explored for centuries by natural scientists, the Cape Verde Islands have been studied far less. Botanically they are the least known of the Macaronesian archipelagos, apart from the small Salvage Islands group. There are several reasons for this: 1) more difficult access and fewer facilities (communications, accomodation) in the Cape Verdes for such work, 2) the irregular climate of the islands, with frequent absence of rainfall for long periods resulting in extreme drought, and 3) the rather poor flora in general. In relation to their area, the islands possess a low number of species of vascular plants, as shown in Table I. The Cape Verde Islands have the lowest number of species of all the island groups concerned — again, excepting the Salvage Islands, which, however, are rather small.

Table I

Table I. Land areas and number of species of vascular plants in the Macaronesian archipelagos. (Data from ERIKSSON 1971, HANSEN 1969, 1970, 1971a, 1971b, 1972, and 1973, PALHINHA 1966, PICKERING & HANSEN 1969, SUNDING 1973, SVENTENIUS 1969, and WESTERMANN 1969).

Azores	2,304 qkm.		760 spp
Madeira (incl. Porto Santo and the Desertas)	728 "		1,135 "
Salvage Islands	< 15 "		91 "
Canary Islands	7,273 "	±	1,800 "
Cape Verde Islands	4,033 "		651 "

The species number offered in the table for the Cape Verde Islands is that given in the recently published "Check-list of the vascular plants of the Cape Verde Islands" (SUNDING 1973). This check-list is based on CHEVALIER'S important flora of 1935, with additions from various other botanists, and partly includes experiences from my own work in the archipelago in the autumn of 1972. The list may give grounds for an analysis of the vascular flora of the archipelago, its composition and phytogeographical character, and for comparisons with the other Macaronesian archipelagos.

The Cape Verde flora is complex and heterogenous, composed of representatives of various flora elements, as one could expect from the island's geographic position near the borderlines of several large flora regions. In the well-known map of the world's vegetation and major flora regions in Strasburger's "Lehrbuch der Botanik", the Cape Verde Islands has been placed within the Holarctic flora region, but close to the border of both the Neotropical and the Palaeotropical regions. From the distribution areas of the vascular plant species, and from the number of species thus attributed to the various flora elements, the floristic spectrum for the Cape Verde Islands will be that given in Table II. The table comprises 611 species; 40 species that are only rarely seen outside of cultivation are excluded. The geographic designations are not always easy to fix, and several subjective conclusions may certainly

Table II. Distribution of Cape Verde Islands' vascular plants on various flora elements.

Endemics	92 spp.	15 %	
Macaronesian species	20 "	3 %	
Atlantic species	2 "	0 %	
Mediterranean species	76 "	12 %	
Saharo-Sindian species	42 "	7 %	
Palaeotropical species	174 "	29 %	
Neotropical species	75 "	12 %	54 %
Pantropical species	79 "	13 %	
South African species	4 "	1 %	
Cosmopolites	47 "	8 %	
	611 spp.	100 %	

be questioned. Nevertheless, it is believed that the picture given in Table II will be correct in its main outlines.

The table may cause some reflections, especially when we make comparison with the Canary Islands and the other Macaronesian archipelagos:

The number of **endemics** in the Cape Verde Flora is lower than, for instance, in that of the Canary Islands — only 15 % againts about 33 % of the Canary flora.

Macaronesian species, i.e. species also found in more or less the same form in one or more of the other archipelagos of Macaronesia, are few. I will return to this group of species later.

The **Mediterranean** species form a surprisingly small group. In the Canary Islands, this group occupies about 56 % of the entire flora (SUNDING 1970).

On the other hand, we find that the bulk of **tropical** species becomes very large, constituting more than half of the entire vascular flora of the Cape Verdes. These are primarily species of a palaeotropical distribution, although the neotropical and the pantropical species also add reasonably well to the picture. It may be noted, however, that the group of neotropical species in the Cape Verde flora is to a large extent made up of cultivated ornamental or economic species that grow more or less naturalized in the islands. The tropical elements in the flora, besides being evident directly through the large number of species, are also prominent in the strong representation of certain tropical families and genera, such as the **Rubiaceae** and genera within the **Papilionaceae.** Temperate families, such as **Ranunculaceae** and **Rosaceae,** which are still fairly well represented in the Canaries, are poorly represented in the Cape Verdes.

Let us return to the Macaronesian species and to the endemic flora. The comparatively few (20) Macaronesian species in the Cape Verde Islands flora are shown in the following list:

Adiantum reniforme
Asparagus scoparius
Beta procumbens
Ceterach aureum
Davallia canariensis
Dracaena draco
Dryopteris aitoniana
Frankenia ericifolia
Frankenia latifolia
Fumaria montana
Lobularia intermedia
Lolium canariense
Lotus bollei
Micromeria varia
Polycarpaea nivea
Sideroxylon marmulano
Tamarix canariensis
Teline stenopetala
Traganum moquini
Zygophyllum fontanesii

Macaronesian species have here been understood widely, including those that are also found in the so-called Macaronesian enclave on the African mainland and partly even in a few localities in the

southwest of the Iberian peninsula. **Adiantum reniforme** is also found in islands off the southeast coast of Africa.

Judged from the list of species above, the relationship of the Cape Verde vascular flora to the flora of other Macaronesian islands can hardly be said to be especially pronounced. Some Macaronesian species, however, like the Dragon's-blood Tree, **Dracaena draco,** will certainly weigh more heavily than others in most botanists' minds to connect those islands botanically.

Table III. Phytogeographic affinities of the Cape Verde endemics.

Macaronesian affinities	49 spp.
Mediterranean affinities	14 "
Saharo-Sindian affinities	4 "
Palaeotropical affinities	18 "
Neotropical affinities	3 "
Affinity unclear	4 "
	92 spp.

The relationship between the Cape Verde flora and for instance, the Canarian flora is more obvious when we look at the Cape Verde **endemics** and their phytogeographic affinities. The 92 insular endemics among the vascular plants form a heterogenous group, composed of species of evident Macaronesian character, as well as those of quite different affinities (Table III). With its 49 species, the group of Macaronesian-related endemics is by far the largest:

Aeonium gorgoneum
Aeontum webbii
Artemisia gorgonum
Asparagus squarrosus
Asteriscus daltoni
Asteriscus smithii
Asteriscus vogelii
Campylanthus benthami
Campylanthus glaber
Campylanthus spathulatus
Echium hypertropicum
Echium stenosiphon
Echium vulcanorum
Erysimum caboverdeanum
Euphorbia tuckeyana
Globularia amygdalifolia
Helianthemum gorgoneum
Lavandula rotundifolia
Limonum braunii
Limonium brunneri
Limonium jovi-barba
Lotus setc. *Pedrosia,* 10 spp.
Melanoselinum, 5 spp.
Micromeria forbesii
Periploca chevalieri
Phoenix atlantica
Polycarpaea gayi
Sinapidendron, 5 spp.
Sonchus daltonii
Sonchus gorgadensis
Tolpis farinulosa
Tolpis glandulifera

The Macaronesian-related group of insular endemics thus includes species of genera like **Aeonium, Asteriscus (Odontospermum), Campylanthus, Echium, Globularia (Lytanthus), Limonium, Lotus** spp. of the section **Pedrosia,** and **Sonchus,**-all well-known genera in the Macaronesian flora, and especially in the archipelago that lies closest to the Cape Verde Islands, namely, the Canaries. Fre-

quently, the actual taxa in the list above are closely related vicariant taxa to the Canarian ones.

The remaining endemics are distributed as follows:

Species of Mediterranean affinity, 14 species:

Arenaria gorgonea
Campanula bravensis
Campanula jacobaea
Eragrostis insulatlantica
Kickxia brunneri
Kickxia dichondraefolia
Kickxia webbiana
Launaea melanostigma
Launaea picridioides
Papaver gorgoneum
Phagnalon melanoleucum
Umbilicus schmidtii
Verbascum caboverdeanum
Verbascum cystolithicum

Species of Saharo-Sindian affinity, 4 species:

Fagonia albiflora
Fagonia mayana
Forsskaolea procridifolia
Forsskaolea viridis

Species of palaeotropical affinity, 18 species:

Aristida cardosoi
Aristida funiculata
Chloris pilosa
Conyza, 7 spp.
Cyphia stheno
Enteropogon rupestris
Gongrothamnus bolleanus
Gossypium capitis-viridis
Ipomoea sancti-nicolai
Pluchea bravae
Sarcostemma daltonii
Tephrosia gorgonea

Species of neotropical affinity, 3 species:

Ipomoea webbii
Paronychia illecebroides
Stachytarpheta (Ubochea) dichotoma

Species of uncertain phytogeographic affinity, 4 species:

Carex antoniensis
Cuscuta nothochlaena
Festuca gracilis
Pogonia bollei

In conclusion, it may be stated that the incorporation of the Cape Verde archipelago in the 'Flora of Macaronesia' area will result in the inclusion of a fairly large group of tropical plant species that we do not meet in the other Macaronesian archipelagos. On the other hand, the evidence given by the Macaronesian species and the Macaronesian-related insular endemics viewed together makes it clear that the Cape Verdes **should** be included in the Macaronesian area. In spite of a distance from the Canary Islands of approx. 1,400 km. the relationship between the vascular floras of those two archipelagos is quite clear.

As stated in the beginning, there is still much to be done on the Cape Verde Islands' flora in the basic disciplines of botany — taxonomy and floristics. Little is known so far about the early history of the island group and the origin and evolution of its flora and fauna. Whereas a former connection between the Canary Island and the African mainland may be seriously discussed (SUN-

DING 1970), the Cape Verde Islands are considered to be true oceanic islands which, in the course of time, have received their plants and animals from elsewhere in various ways, including through man's own activities. Let me conclude by drawing attention to a large gap in our knowledge of one particular aspect of the Macaronesian flora, namely, the scarce knowledge we possses of the **dispersal ecology** of the Macaronesian taxa. When we have advanced so far as to know somewhat more about the dispersal mechanisms that are or may have been active in the establishment of the floras of the various Macaronesian islands, this factor could be considered more seriously in phytogeographical discussions besides the present-day distribution patterns, to arrive at conclusions on possible paths of migration.

Literature

CHEVALIER, A., 1935. Les iles du Cap Vert. Flore de l'Archipel. — *Rev. Bot. Appl.* 15: 733 - 1090.

ERIKSSON, O., 1971. *Check-list of vascular plants of the Canary Islands.* — Umeå. 36 pp.

HANSEN, A., 1969. Checklist of the vascular plants of the archipelago of Madeira. *Bol. Mus. Munic. Funchal* 24. 1-62.

— 1970. Beiträge zur Flora der Inseln Madeira, Porto Santo und Ilheu Chao (Desertas). — *Bocagiana* 25: 1-18.

— 1971a. Contributions to the flora of the Madeira archipelago.—*Ibid.* 27: 1-14.

— 1971b. Contributions to the flora of the Azores.—*An. Soc. Brot.* 27: 87-112

— 1972. Contributions to the flora of the Azores. II.—*Bol. Soc. Brot.*, 2. sér., 46: 219-238.

— 1973. Contributions to the flora of Madeira.—*Bocagiana* 32: 1-13.

PALHINHA, R.T., 1966 *Catálogo das plantas vasculares dos Açores.*—Lisboa. 186 pp.

PICKERING, C.H.C. & HANSEN, A., 1969. Scientific expedition to the Salvage Islands July 1963. IX List of higher plants and cryptogams known from the Salvage Islands.—*Bol. Mus. Munic. Funchal* 24: 63-74.

SUNDING, J., 1970. Elementer i Kanarioyenes flora, og teorier til forklaring av floraens opprinnelse.—*Blyttia* 28; 229-259.

— 1973. *Check-list of the vascular plants of the Cape Verde Islands.*—Oslo 36 pp.

SVENTENIUS, E.R.S., 1969. Plantae macaronesienses novae vel minus cognitae. *Ind. Sem. Hort. Acclim. Plant. Arautapae* (Orotava) 1968/69: 43-60.

WESTERMANN, G., 1969. *Lexikon der Geographie.*

June 1973
Botanical Garden
University of Oslo
Oslo, Norway

14. Floristic Connections Between Macaronesia and the East Mediterranean Region

D. BRAMWELL & I. B. K. RICHARDSON

The Macaronesian flora can readily be divided into a number of floristic or phytogeographic elements based on the external or non-Macaronesian affinities of the taxa making up the flora.

Amongst the floristic elements are, for example, an American element consisting of Macaronesian taxa such as the endemic species of **Drusa** (Umbelliferae), **Bystropogon** (Labiatae) and **Heberdenia** (Myrsinaceae) with their nearest relatives on the American continent; an East African group such as **Aeonium** (Crassulaceae) and **Canarina** (Campanulaceae) with their nearest relatives in th highlands of Ethiopia and Somalia; and a Southern African group such as **Lyperia** (Scrophulariaceae) and **Phyllis** (Rubiaceae) whose closest affinities lie with the floras of the subtropical and temperate zones of Southern Africa.

Cain, in the early 1940 s, expressed the view which most modern phytogeographers would accept, that "...Major discontinuities in distribution result from the extinction of members of the now discontinuous group in the area now constituting the disjunction as a result of climatic or other changes so that the explanation of most, if not all, disjunctions is to be found in historical rather than contemporaneous biological causes".

A considerable amount has been written about the American and African elements in the Macaronesian flora and Meusel (1952, 1965) has paid particular attention to growth-forms and evolution in the Mediterranean elements.

The Mediterranean region is of particular interest as it is a key region in the history and development of the European Flora. The Mediterranean sea is a remnant of the Tethys (Sylvester-Bradley, 1967), the ancient sea which separated the Cretaceous land masses of Laurasia and Gondwana and authorities such as Wulff (1950) and Takhtajan (1969) have already pointed out that much of the modern Macaronesian endemic flora is a relict survivor of the Tethyan-Tertiary flora.

An equivalent of the contemporary laurel forest of Macaronesia is well represented in the Miocene and Pliocene palaeofloras of areas such as the Barcelona region of Spain, the Rhône Valley, lowland Hungary and South Russia (Depape, 1922; Sunding, 1971). There are a number of relictual, living taxa in the Mediterranean and Mediterranean/Atlantic regions which are also

components of or have very close relatives in the forest floras of Macaronesia, and these seem to be survivors of the Tethyan-Tertiary Flora. They include such classical examples as the Macaronesian/Atlantic **Myrica faya** (Myricaceae), **Culcita macrocarpa** (Dicksoniaceae), **Davallia canariensis** (Davalliaceae) and **Laurocerasus lusitanica** (Rosaceae); **Hypericum caprifolium** (Guttiferae), an Iberian species, is closely related to the Canarian endemic **H. coadunatum**, and the Iberian endemic **Digitalis obscura** (Scrophulariaceae) has as its nearest relatives species of the Macaronesian endemic genus **Isoplexis** (Bramwell, 1972). These all tend to be West Mediterranean plants and probably formed part of the flora of this area in the Middle Miocene to Early Pliocene when there was still a land-link between North Africa and the south of Spain.

There are, in addition, a number of floristic connections between the eastern part of the Mediterranean region and Macaronesia. These are often completely disjunct between the two areas but in some cases there are sporadic steps between them, for example in **Woodwardia radicans** which occurs in Crete (with one station in Tunisia) and Macaronesia and in a few relict localities in the Iberian peninsula.

Some examples of Macaronesian-East Mediterranean connections and their discontinuities are discussed in the following paragraphs.

Complete disjunctions occur in a number of genera. **Ranunculus cortusifolius** (Ranunculaceae) is restricted to Macaronesia and has a closely related species **R. creticus** in Crete (Fig. 1). The relationships between these two species were discussed by Lowe (1857). **Sideritis** section **Empedoclea** (Labiatae) has a number of species such as **S. syriaca, S. clandestina, S. scardica** and **S. perfoliata** in the East Mediterranean from Sicily to Palestine and three species, **S. gomerae, S. cabrerae** and **S. nutans**, endemic to the Canary Island of La Gomera. The Canarian species have recently been transferred, on rather dubious grounds, to a separate section **Empedocleopsis** (Huynh, 1972) in view of their sessile rather than shortly pedicellate flowers. The two groups are, nevertheless, much more closely related to each other than to any of the remaining sections of the genus. In the genus **Bosca** (Amaranthaceae) there are some four species, two in South East Asia, one, **Bosea cypria,** in Cyprus and one, **Bosea yervamora,** in the Canary Islands. **Cyclosorus dentatus** (Thelypteridaceae), a pteridophyte species from Macaronesia has also recently been discovered in Crete (Greuter, 1972).

A second group of East Mediterranean/Macaronesian taxa are those which also have sporadic distributions between the two areas.

The species of **Erysimum** (Cruciferae) section **Cheiranthus** are centred on the East Mediterranean region, Greece and the Aegean Islands (Snogerup, 1967). A single species **E. cheiri** also occurs in the West Mediterranean but is probably introduced. These frutescent perennials have their nearest relatives in section **Cheiroides**, a Macaronesian section also consisting of woody shrubs.

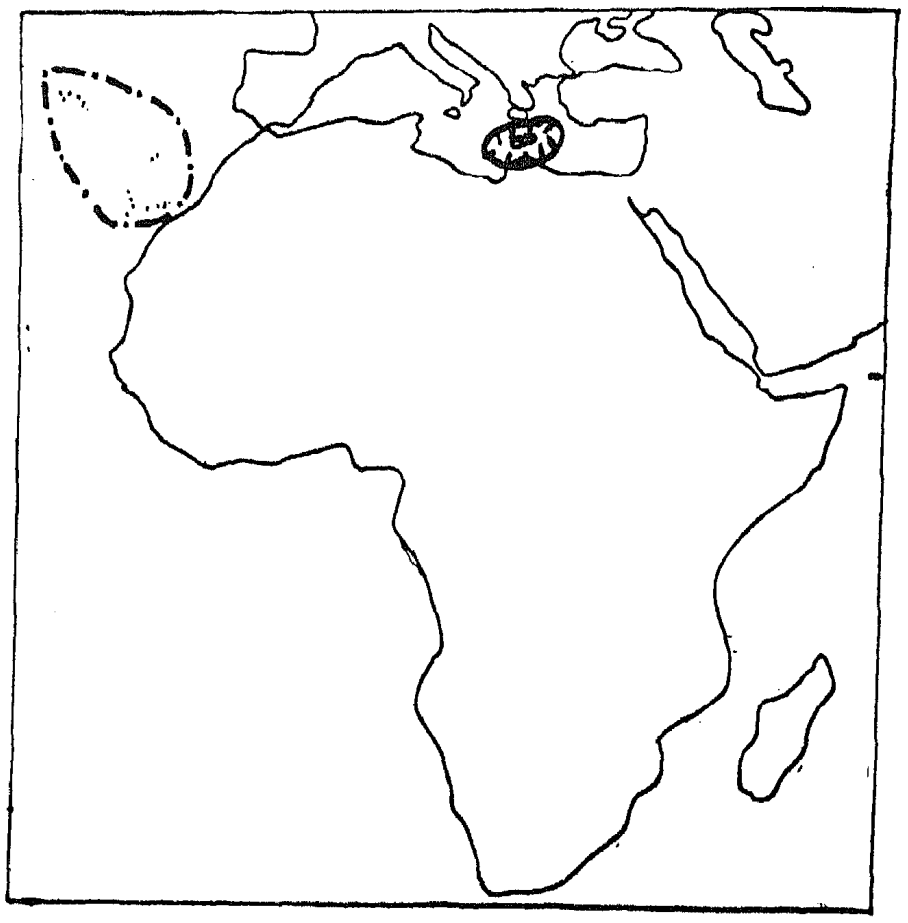


FIGURE 1. The distribution of *Ranunculus cortusifolius* (including *R. grandifolius* Lowe) -.-.- and *R. creticus* _|_|_|_

Another genus with a predominantly East Mediterranean/Macaronesian distribution is **Chamaecytisus** (Leguminosae) with over 30 species in the East Mediterranean from Italy to the Ukraine and two very variable species **(C. proliferus, C. palmense)** endemic to Macaronesia. **Micromeria (Labiatae),** has a bimodal dis-

tribution in this region with one centre in the East Mediterranean (extending to S.W. Asia) where there are about 30 species of which two or three extend into the West, and a second centre in Macaronesia and Western Morocco with 20 Macaronesian endemics and about 10 Moroccan species. **Pistacia atlantica** s.l. (Anacardiaceae) extends sporadically in the East from North East Greece and Crimea southwards to Palestine and eastwards to West Pakistan. On the Mediterranean there are a few stations westwards from Libya to Algeria, in the Hoggar and on the west side of Morocco. It is also locally frequent in the Canary Islands, for example on Tenerife at Ladera de Guimar. Similar distribution patterns are found in the **Ammodaucus - Psammogeton** group of spiny-fruited Umbellifers with **Ammodaucus leucotrichus** reaching the Canary Islands (Tenerife), and in the **Convolvulus caput-medusae** (Convolvulaceae) group. This group has species such as **Convolvulus fruticosus** and **C. leiocalycinus** in South West Asia, **C. hystrix** in the South East Mediterranean region, **C. trabutianus** (recently incorrectly united by Sa'ad (1967) with **C. caput-medusae)** in Western Morocco, particularly in the Anti-Atlas region, and **C. caput-medusae** itself which is endemic to the Canary Islands. David & Hedge (1971) in a paper on South West Asian and North West African links, suggest a probable pre-pleistocene origin for taxa with a similar type of distribution.

The genus **Androcymbium** (Liliaceae) is also distributed sporadically along the south side of the Mediterranean region from Palestine to the Canary Islands **(A. psammophilum)** and S. E. Spain. This genus also has a second centre of distribution in East and South Africa (Burtt, 1971). The Date Palm genus **Phoenix** (Fig. 2) also extends from Southern Asia across the south side of

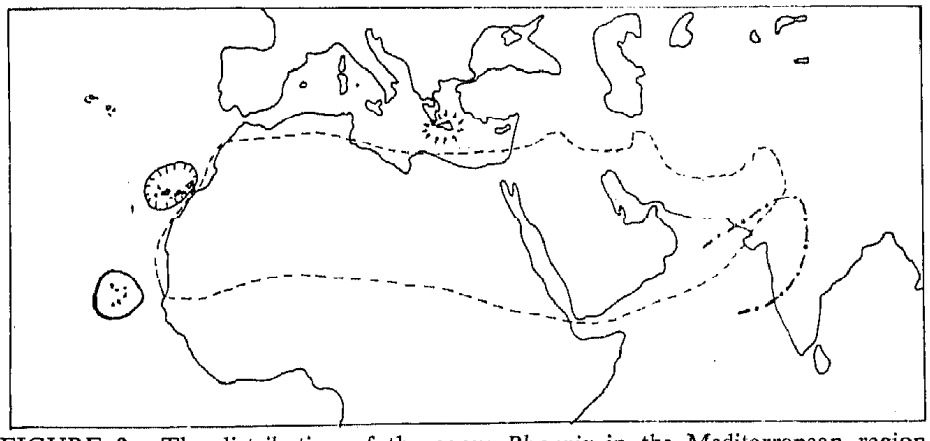


FIGURE 2. The distribution of the genus *Phoenix* in the Mediterranean region. ——— *P. atlantica*; | | | | *P. canariensis*; ---- *P. dactylifera*; !!!! *P. theophrastii*; -.-.-.- *P. sylvestris* (modified after Meusel, 1965).

the Mediterranean (Meusel, 1965) with **P. sylvestris** in the East, **P. dactylifera** widespread from the Arabian Gulf to Morocco, **P. theophrastii** endemic to Crete and **P. canariensis** and **P. atlantica** confined to Macaronesia.

Having looked at some of these distribution patterns it is interesting to consider their possible causes. An appreciation of both physical and historical geography is essential for understanding distributions. The overriding influence on plant distribution in the Mediterranean region has been the series of climatic changes in the Pleistocene but the Tertiary history of the area and the changes in dimensions and positions of land bounding the Para-Tethys during its transformation to the Proto-Mediterranean Sea are also very important. Fig. 3 shows the probable position of landmasses

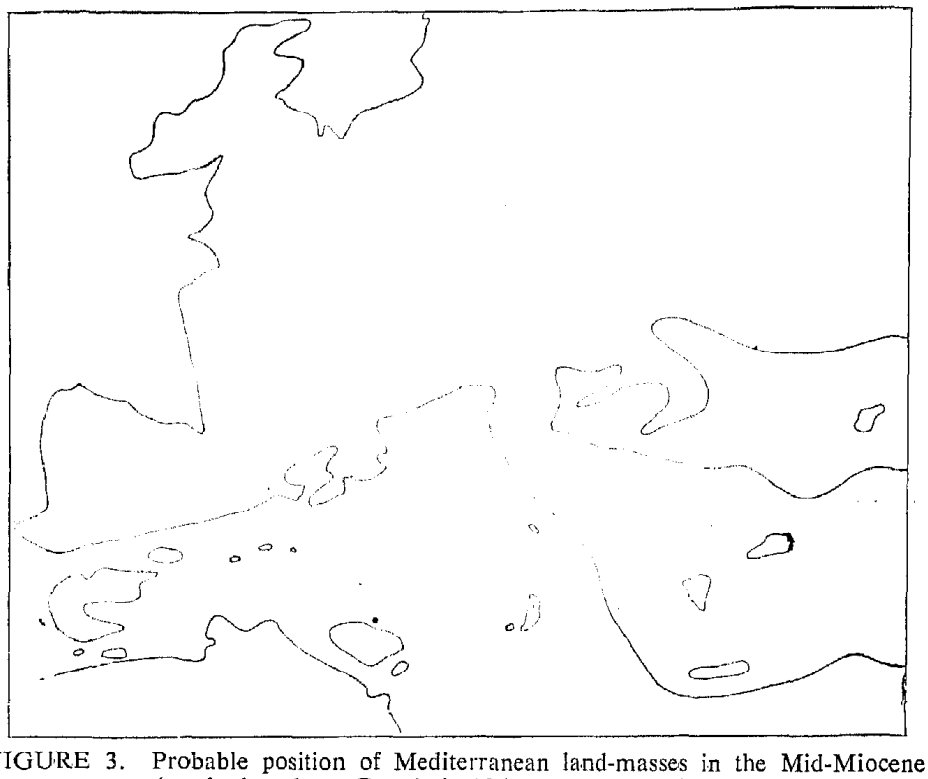


FIGURE 3. Probable position of Mediterranean land-masses in the Mid-Miocene (partly based on Ruggieri, 1967; Fernex et al, 1967, and Greuter, 1970).

at some time in the Mid-Miocene. The climate at this time was warmer and less seasonal than at present (Lamb, 1961), perhaps rather like that now found in warm-temperate and subtropical areas of the eastern margins of large land-masses such as some

parts of South Eastern North America and Northern China (Daley, 1972). The vegetation was a broad-leaved laurel-type of forest (Depape, 1922; Tahktajan, 1969), relictual forms of which are still found today in Macaronesia. The Sahara desert occupied a more southerly position so that there was probably a well developed subtropical forest belt on the southern shores o fthe Para-Tethys and considerable scope for E-W or W-E migrations of plants, in general it is likely that there was a fairly uniform flora throughout southern Europe and the Mediterranean region with some links with South West Asia to the East.

During the Pliocene period (10 million to about 1 million years ago) the climate cooled somewhat and there was probably considerable differentiation of vegetation types on the mountains of S. Europe; the distribution of land in the Mediterranean basin became more recognisable with Corsica and Sardinia taking up their present positions relative to the newly emergent Italy (Alvarez, 1971; 1973). The western outlet of the Mediterranean Sea was also established in its present position finally isolating the Iberian peninsula from North Africa (Fig. 4).

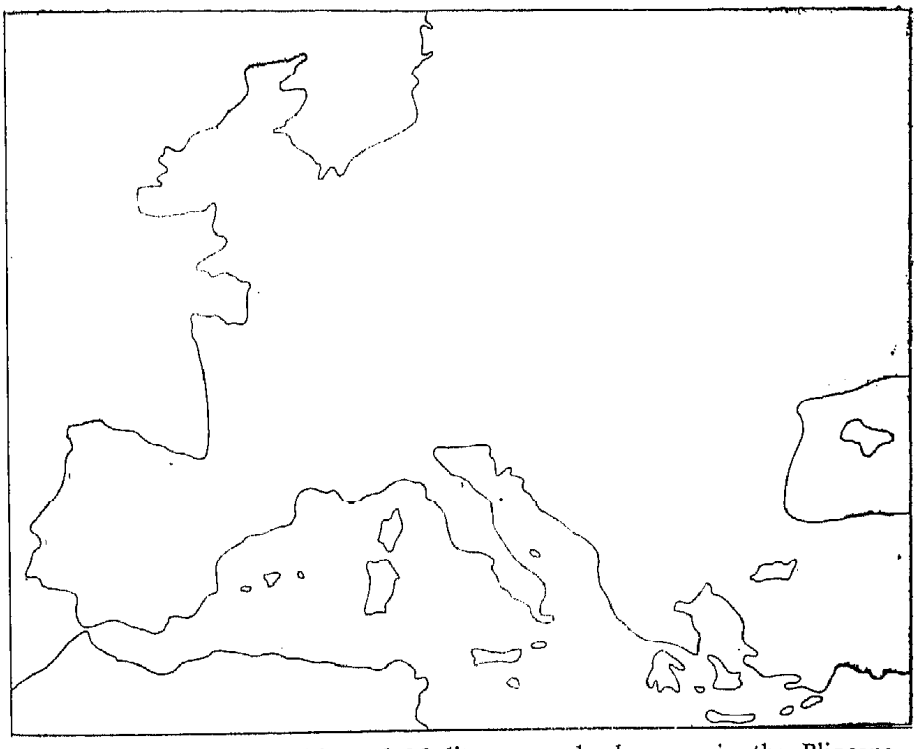


FIGURE 4. Probable position of Mediterranean land-masses in the Pliocene.

About 1 million years ago came the first Ice Age and the beginning of the Pleistocene. Not only did this mean a cooling of climates in the area but it also brought changes in seasonality of the weather and in rainfall (Lamb, 1961). This, of course, resulted in major changes in the vegetation of the Mediterranean region. With the southwards displacement of zones of vegetation the laurel-leaved forest zone was virtually obliterated; limited dryness to the south and cold to the north it managed to survive only in a very limited and modified form in a few places in the Iberian Peninsula (Western Portugal, Cadiz Province) and to some extent in parts of the Balkan region. Connections betwmeen East and West along the north side of the Mediterranean were severed by the establishment of boreal montane vegetation at lower altitudes in the mountain belts, (the Alps and Pyrenees). Probably much of what survived of the broad-leaved forest has since been destroyed by man and replaced by Macchie. The forest flora survived in Macaronesia due to the buffering effect of the oceanic position.

The Holocene dessication of the present Sahara region probably finally destroyed any connections between the East and West Mediterranean along the south side of the sea leaving us with the position more or less as we see it today with considerable vicariance both between the Iberian Peninsula and the Balkans and between Iberia and North Africa, as a result of isolation and differential evolution since links were cut. Our Macaronesian/East Mediterranean disjunctions with their links along the south side of the Mediterranean Sea are often put into the categories Irano-Turanian or Saharo-Sindian and both these "floristic elements" seem to be closely tied in with the Tethyan-Tertiary elements. The wider disjunctions to the Himalayan region, for example in **Pinus canariensis** and **Pinus roxburghii** and in **Teucrium** section **Pycnobotrys** (Madeira, E. India, Japan) (Bramwell, 1973) seem to indicate a further and perhaps older extension of the Tethyan Tertiary flora.

Clearly a consideration of the phytogeography of Macaronesia and the Mediterranean region can lead to a better understanding of the floras of both areas.

References

ALVAREZ, W. (1972), Rotation of the Corsica-Sardinia Microplate. *Nature Phys.* 243: 10-11.

ALVAREZ, W., FRANK, S. G., & NAIRN, A. E. M. (1973), Palaeomagnetism of Plio-Pleistocene Basalts from North-West Sardinia. *Nature Phys. Sci. Sci.* 243: 10-11.

BRAMWELL, D. (1972) Endemism in the Flora of the Canary Islands. in D. H. Valentine ed. *Taxonomy, Phytogeography and Evolution* 141-159. Academic Press. London & New York.

BRAMWELL, D. (1973) The Endemic Flora of the Canary Islands: Distribution, Relationships and Phytogeography. *Monographiae Biologicae* (in Press).

BURTT, B. L. (1971), From the South: an African view of the Floras of Western Asia. in Davis P. H., Harper P. C. & Hedge I. C. *Plant Life of South West Asia* 135-154. Edinburgh.

CAIN, S. A. (1944). Foundations of Plant Geography. New York.

DALEY, B. (1972). Some Problems concerning the early Tertiary Climate of Southern Britain. *Palaeogeog., Palaeoclim., Palaeoecol.* 11: 177-190

DAVIS, P.H. & HEDGE, I.C. (1971). Floristic Links Between N.W. Africa and S.W. Asia. *Ann. Naturhistor. Mus. Wien.* 75: 43-57.

DEPAPE, G. (1922), Flore pliocène de la Vallée du Rhône. *Ann Sci. Nat.* Ser. 10, 4: 73-265

GREUTER, W. (1970), Zur Paläogeographie und Florengeschichte der sudlichen Agäis. *Feddes Repertorium* 81: 233-242.

GREUTER, W. (1972), Floristic report on the Cretan area. *Floristic & Taxonomic Reports VII Symp. Flora Europea Coimbra, May* 22-31. 1972

FERNAX, F., MAGNE, J. & MONGIN D. (1967), The Paleogeography of the eastern Betic ranges of southern Spain during the Cainozoic. In Adams C.G. & Ager D.V. Aspects of Tethyan Biogeography. *Systematics Assoc. Publ.* No. 7, 239-246.

HUYNK, K.L. (1972), Le Pollen et la systematique du genre *Sideritis* L. (Labiatae). Bull. Mus. Nation. Hist. Nat. (Paris) 3e sér., No. 45 *Bot.* 1. 28p.

LAMB, H.H. (1961), Fundamentals of climate. In: A.E.M. Nairn (ed.), Descriptive Palaeoclimatology. *Interscience,* New York, pp. 8-44.

LOWE, R.T. (1857). On *Ranunculus creticus, cortusaefolius* and *grandifolius* of Authors. *J. Bot & Kew Gard. Misc.* 9. (65): 65-75

MEUSEL, H. (1952): Uber Wuchsformen, Verbreitung und Phylogenie einiger mediterran - mitteleuropäischer Angispermen-Gattungen. *Flora* 139: 333-393

MEUSEL, H. (1965). Die Reliktvegetation der Kanarischen Inseln in ihren Beziehungen zur sud — und mitteleuropaischen Flora. Gesamm. *Vortrage uber moderne Probleme der Abstammungslehre* 1: 117-136

RUGGIERI, G. (1967), The Miocene and later evolution of the Mediterranean Sea. In Adams C.G. & Ager D.V. Aspects of Tethyan Biogeography. *Systematics Ass. Publ.* no. 7, 283-290.

SA'AD, F. (1967), The Convolvulus species of the Canary Islands, the Mediterranean region and the Near and Middle East. *Meded. Bot. Mus. Herb. Rijks. Univ. Utrecht.* 281: 1-287

SNOGERUP, S. (1967) Studies in the Aegean Flora VIII. *Erysimum* sect. *Cheiranthus.* A. Taxonomy. *Opera Botanica* 13. Lund.

SUNDING, P. (1970), Elementer i Kanarioyenes flora, og teorier til forklaring av floraens opprinnelse. *Blyttia* 28: 229-259

SYLVESTER-BRADLEY, P.C. (1967), The Concept of Tethys. In Adams C.G. & Ager, D.V. Aspects of Tethyan Biogeography. *Systematics Ass. Publ.* no. 7,1-4.

TAKHTAJAN, A. (1969). Flowering Plants: Origin and Dispersal. Edinburgh

WULFF, E.V., (1950). An Introduction to Historical Plant Geography. Mass. U.S.A.

May, 1973
Dept. of Botany,
The University,
READING, Great Britain

15. Caryotypes de la Flore Insulaire de Tenerife

A. GAGNIEU, R. LINDER et V. VOGGENREITER

La Macaronésie présente un attrait particulier pour le Botaniste, le Biologiste et tous ceux que préoccupe le problème de l'évolution des espéces. La singularité de sa végétation relève de deux ordres de phénomènes:

— l'endémisme très poussé qui se présente sous la forme d'une véritable explosion de certains genres,

— l'impressionnante convergence des adaptations xérophytiques.

La recherche d'explication d'une situation si curieuse conduit à s'orienter vers une analyse caryosystématique aves l'espoir de voir de dégager une esquisse des relations entre les aptitudes écologiques exceptionnelles et la variation caryologique. On pense notamment au rôle éventual de la polyploïdie.

Depuis une vingtaine d'années une convergence d'intérét pour les canariennes se manifeste chez plusieurs caryologistes. En 1961 l'un de nous, R.L., s'est associé à P. MICHAELIS pour réaliser une prospection botanique à Ténérife et faire une ample connaissance avec la flore canarienne. L'année suivante, en 1962, un séjour prolongé a permis de fixer presque toutes les endémiques ténérifiennes. Cette récolte partiellement exploitée eut la valeur d'un sondage effectué sur quelques endémiques (Bull.Soc.Bot.France 1965, 112, 5-6); se sondage révèle que la polyploïdie ne semble pas jouer un rôle de premier plan dans la caryologie de la végétation canarienne.

En 1972 V. VOGGENREITER a mis à notre disposition sa collection de plantes canariennes obtenues à partir de semences récoltées dans des localités précises à Ténérife lors de deux séjours en 1968 et 1971. Des échantillons furent ramenés fin septembre 1972 de Regensburg à Strasbourg, oú, maintenus en serre, ils furent examinés durant l'hiver 1972-73.

La prospection caryosystématique des Canariennes a donc été reprise avec la perspective de contribuer efficacement à l élaboration de la Flora macaronesica.

La liste des plantes est présentée dans l'ordre alphabétique des genres et espéces, pour lesquels nous avons suivi la nomenclature des "Cuadernos de Botánica Canaria" et la "Checklist of Vascular Plants of the Canary Islands" de O. ERIKSSON.

avec la collaboration technique de M.-Madeleine BAEHL.

* Read by R. Linder, Lille.

Le numéro qui précède chaque espèce est celui de la récolte; il indique les lieux de prélèvements sur la carte topographique. Toutes les localités se trouvent sur l'île de Ténérife (T); les coordonnées indiquées entre parenthèses (lettre-chiffre) permettent de repérer le lieu de récolte. L'altitude et la date de récolte des graines, fruits ou boutures, sont également mentionnées. Par souci de préservation et de protection, les localités de certaines plantes rares ne sont pas précisées.

Méthodes. Les indications obtenues sont le résultat de l'analyse caryologique effectuée sur étalements directs dans le Carmin ferrique, après hydrolyse avec H Cl (N). Dans quelques cas, la réaction de Feulgen a précédé l'étalement.

— Le nombre somatique 2n est obtenu à partir d'images de mitoses dans les méristèmes de racines ou de jeunes pièces florales.

— Le nombre haploïde n résulte de l'analyse des figures de méiose.

Dans tous les cas, la fixation a été faite au moyen du mélange 3/1, alcool/acide acétique.

Cette liste comporte la détermination du nombre chromosomique de 72 espèces: 42 sont des confirmations d'observations antérieures, 17 sont inédites et 13 sont singulières ou ne concordent pas avec les résultats d'autres auteurs.

Déterminations inédites.

Ceropegia dichotoma 2n = 22; nombre connu dans le genre. D'autres espèces ont 2n = 22 et 44.

Erysimum heritieri 2n = 32; les nombres de base sont x = 7 ou 8. Pour 9 autres espèces, 2n = 32.

Euphorbia canariensis 2n = 60; le nombre de base du genre est x = 10. L'hexaploidie est répandue chez les espèces crassicaules d'Afrique du Sud qui peuvent montrer 2n = 100 ou 200. L'endémique canarienne, **E. regis-jubae** a 2n = 20.

Festuca bornmülleri 2n = 14; conforme au nombre de base du genre, x = 7.

Gonospermum fruticosum n = 9, détermination originale, mais conforme puisque **G. gomerae** montre aussi 2n = 18 (LARSEN, 1963).

Greenovia gracilis 2n = 36; ce nombre s'intègre sans surprise dans les résultats connus.

Lavatera phoenicea 2n = 14; conforme au nombre de base x = 7 du genre qui comporte plusieurs espèces polyploïdes et une autre à 2n = 14: **Lavatera trimestris.**

N° récolte cf. carte	Espèce	Localité, Date de récolte	n = Méiose 2n = Mitose
138	Aegilops cf. ovata L.	T (L-6) Igueste de Candelaria, 500 m, 6.6.71	2n = 28
68	Aeonium canariense (L.) W.& B.	T (L-4) Mña. Guerra, 620 m, 8.9.71	2n = 36
66	Aeonium ciliatum (WILLD.)W.& B.	T (O/P-2) Roque Enmedio, 420 m, 9.8.71	2n = 36
37	Aeonium cuneatum W.& B.	T (P-2) Pijaral, 720 m	2n = 36
95	Aeonium holochrysum W.& B.	T (M-6) Bco. Moradillas, 300 m, 30.5.71	2n 50
91	Aeonium lindleyi W.& B.	T Anaga 1968	2n = 36
90	Aeonium sedifolium (WEBB) PIT. & PROUST	T Teno 1968	2n = 36
92	Aeonium spathulatum (HORNEM.) PRAEGER	T (E-7) Malpais Mña. Negra, 1100 m, 19.7.68	2n = 30
15	Aeonium smithii x spathulatum PRAEGER	T (J-8) 1550 m, 1971	2n = 36
105	Aeonium tabulaeforme (HAW.) W.& B.	T (D-7) Tanque, 300 m, 1.9.71	2n = 36
135	Aichryson dichotomum (DC)W.& B.	T (N-3) Mña. Cruz de Taborno, 800 m, 21.8.71	n = 15
12	Anagyris latifolia BROUSS.	T (I-10), 18.7.71	2n = 18
32	Artemisia canariensis (BESS.) LESS.	T (O/P-2) Roque Enmedio, 400 m, 9.8.71	2n = 18
140	Asparagus umbellatus LINK in BUCH	T (J-5) Bco. Hondo, 200 m, 18.8.71	2n = 20
106	Astydamia latifolia (L.f.) O.KUNTZE	T (C-6) Finca La Costa, 20 m, 28.8.68	2n = 20
2	Bencomia caudata (AIT.)W.& B.	T (L-6) 4.8.71	2n = 28
35	Brachypodium silvaticum (HUDS.) P.B.	T (C-7) Mña. Talavera, 600 m, 19.8.68	2n = 18
87	Bystropogon canariensis L'HERIT.	T (L-6) Bco. Hondo, 1050 m, 4.8.71	2n = 48
240	Centaurea canariensis WILLD. var. subexpinnata BURCHARD	T (B-7) Teno, 10.8.68	2n = 30
61	Centaurea taganananensis SVENT.	T (Q-3) Anaga, 100 m, 29.6.71	2n = 28
82	Ceropegia dichotoma HAW.	T 1968, localité non précisée	2n = 22
58	Chrysanthemum foeniculaceum (BROUSS.) WILLD.	T (J-6) Ladera de Sta. Ursula, 700 m, 19.8.71	2n = 18
75	Chrysanthemum frutescens L. var. crithmifolium LINK.	T (C-6) Finca La Costa, 25 m, 6.8.68	n = 9

57	Convolvulus canariensis L.	T (O-2) Fraile,600 m, 5.9.71	2n = 22
25	Crambe scaberrima WEBB in BOURGEAU	T (B-7) Roque Tosción 1968	n = 15
60	Cynara cardunculus L. var. ferocissima LÖWE	T (N-4) Cabezo Mesas,460 m, 15.8.71	2n = 34
48	Dracunculus canariensis KUNTH	T (I-6) Mña. Frailes,240 m, 9.7.71	2n = 24
166	Drusa glandulosa (POIR.) BORNM.	T (E-12) Bco. Taucho,420 m, 4.7.71	2n = 16
6	Echium simplex DC.	T (O-2) Anaga,430 m, 23.7.71	2n = 16
78	Echium wildpretti PEARSON ex HOOK. fil.	T (G-10) Refugio del Club Montañero, 2000 m.	2n = 16
125	Erysimum bortiori KUNTZE var. virescens (WEBB)MENDOZA-HEUER	T (C-7) Bco. Chupaderos,300 m,17.8.68	2n = 32
71	Erysimum scoparium (WILLD.) WETTST.	T (D-8) El Retamar, kilomètre 85, 820 m, 28.8.68	2n = 28
50	Euphorbia atropurpurea BROUSS.	T (E-11) Bco. Ajabo, 750 m, 4.7.71	2n = 20
63	Euphorbia canariensis L.	T (F-14) Mña. Cho,200 m, 23.8.71	2n = 60
10	Festuca agustini LDGR. ssp. agustini var. bornmülleri (HACK.) HANSEN	T (J-6) Bco. Rio,800 m, 18.8.71	2n = 14
51	Gesnouinia arborea (L.f.) GAUD.	T (D-7) Bco. Agua-Cochinos,500 m, 28.7.71	2n = 20
26	Gonospermum fruticosum LESS.	T (M-3) Mesa Tejina,250 m, 3.7.68	n = 9
41	Greenovia gracilis BOLLE	T, Pico Cueva Blanca, Anaga, 1.9.71	2n = 36
23	Hypericum canariense L.	T (C-7) El Pleito,200 m, 8.8.68	n = 20
77	Isoplexis canariensis STEUD.	T (C-7) Mña. Talavera,650 m, 19.8.68	2n = 16
19	Jasminum barrelieri W.& B. = J. odoratissimum L.	T (C-7) Bco. Bujamé,260 m, 7.8.68	2n = 24 n = 12
43	Kleinia neriifolia HAW.	T (F-6) El Frontón,80 m, 10.9.71	2n = 20
53	Launaea arborescens (BATT.)MURB.	T (L-7) Crio. Hidalga,270 m, 18.4.71	2n = 14
39	Lavatera phoenicea VENT.	T, entre Icod et Los Silos, 2.9.71	2n = 14
75	Limonium fruticans (WEBB in BOURGEAU) KUNTZE.	T (C-7) Teno, 4.9.68	n = 7
86	Limonium pectinatum (AIT.)KUNTZE	T (L-9), 10 m, 23.8.71	n = 6
7	Lobularia intermedia W.& B.	T (J-6/7) Ladera Sta. Ursula, 1050 m, 20.8.71	n = 11
55	Lugoa revoluta DC.	T (Q-2) Casas Blancas,150 m, 26.6.71	2n = 18

191	Melica cf. teneriffae HACKEL	T (D-6/7) San Pedro de Daute,200 m, 1.9.71	2n = 18
192	Melica cf. teneriffae HACKEL	T (E-11) Ouest Mña. Teresme,1350 m, 25.8.71	2n = 18
102	Mesembryanthemum crystallinum	T (L-7) Los Tescales de Viuda,60 m, 8.8.71	2n = 18
85	Monanthes laxiflora (DC.) BOLLE	T, 1968	2n = 36
207	Pancratium canariense KER ex W.& B.	T (C-6) Finca La Costa,50 m, 28.1.71	2n = 22
81	Periploca laevigata AIT.	T (K-4) Sauzal,200 m, 11.7.68	2n = 22
16	Persea indica (L.) SPRENG.	T (N-3) Mte. Mercedes,800 m, 11.9.71	2n = 24
43	Pinus canariensis CHR. SM. ex DC. in BUCH	T (F-10) Bco. Tagara, 1980 m, 4.2.71	2n = 24
44	Pterocephalus lasiospermus LINK ex BUCH	T (G-10) La Catedral, 2000 m, 27.8.71	2n = 18
211	Ranunculus cortusaefolius WILLD.	T (O-3) Roque Pasos, 880 m, 24.6.71	2n = 16
17	Reichardia ligulata (VENT.)ASCHERS.	T (F-13) Roque Higara, 23.8.71	n = 8
18	Reseda scoparia BROUSS.	T (G-14/15) Las Galletas, 10 m, 11.5.71	2n = 30
73	Rubia fruticosa AIT. ssp. fruticosa	T (L-6) Igueste de Candelaria, 450 m, 6.6.71	2n = 44
80	Rumex lunaria L.	T (M-3) Mesa Tejina, 250 m, 3.7.68	2n = 40
79	Rumex maderensis LÖWE	T (E-7) Malpais Mña. Negra, 1100 m, 1968	2n = 20 +
47	Salvia canariensis L.	T (N-4) Pico Cho Canino, 470 m, 15.8.71	2n = 22
42	Scilla haemorrhoidalis W.& B.	T (N-5) Bco. Grande, 200 m, 6.4.71	2n = 32
40	Schizogyne sericea (L.f.) DC. var. sericea	T (E-13) Fya Troya, 23.8.71	2n = 18
46	Scrophularia glabrata AIT.	T (F-10) Bco. Tagara, 2000 m, 29.8.71	2n = 60
11	Scrophularia cf. langeana BOLLE	T (J-6) Ladera Sta. Ursula, 1050 m, 20.8.71	2n = 50ã60
41	Senecio populifolius (LAM.)DC. non L.	T (N-3) Mña. Cruz de Taborno, 800 m, 21.8.71	2n = 16
13	Silene cf. nutans L.	T (G-10) Bco. Riachuelos, 2100 m, 14.9.71	2n = 24
36	Tolpis lagopoda CHR. SM.	T (G-12) Bco. Chija, 800 m, 29.8.71	n = 9
101	Tolpis webbii SCH. BIP. ex W.& B.	T, Cañadas, semis 29.4.71, localité non précisée	n = 9
38	Vieraea laevigata WEBB	T (D-7) Roque Poyos, 400 m, 1.9.71	2n = 16

Lugoa revoluta 2n = 18; nombre nouveau, conforme au nombre de base du genre **Gonospermum.**

Melica cf. **teneriffae** 2n = 18; conforme au nombre de base du genre **Melica.** Ces échantillons requièrent un complément d'étude, en particulier la certitude de diagnose.

Pancratium canariense 2n = 22; détermination originale pour l'espèce, mais les nombres 22 et 20 sont connus pour **P. maritimum.**

Periploca laevigata 2n = 22; encore inconnu pour cette espèce, le nombre 22 est répandu dans le genre, mais aussi 2n = 24 (x = 11 et 12).

Persea indica 2n = 24; nombre conforme à celui de 8 autres espèces du genre.

Pinus canariensis 2n = 24; nombre conforme à celui de 16 autres espèces du genre **Pinus.**

Pterocephalus lasiospermus 2n = 18; détermination originale qui correspond au nombre de base du genre; **P. plumosus** a aussi 2n = 18.

Reichardia ligulata n = 8; nombre inconnu, mais d'autres espèces du genre **Picridium** montrent 2n = 14, 16 ou 18.

Scrophularia cf. **langeana** 2n = 50 à 60; nombre non connu, dificile à préciser.

Senecio populifolius 2n = 16; nombre insolite pour ce genre oú on trouve couramment 2n = 20 ou 40, mais aussi 4 espèces à 2n = 10, et une à 2n = 18.

Cas singuliers ou non concordants avec les déterminations antérieures:

Aeonium holochrysum 2n > 50; UHL, 1961, signale 2n = 36.

Aeonium spathulatum 2n = 30; UHL, 1961, trouve 2n = 36.

Aeonium smithii x spathulatum 2n = 36, nombre qui est prévisible si on considère que les 2 parents ont 2n = 36; mais notre échantillon de spathulatum a montré 2n = 30.

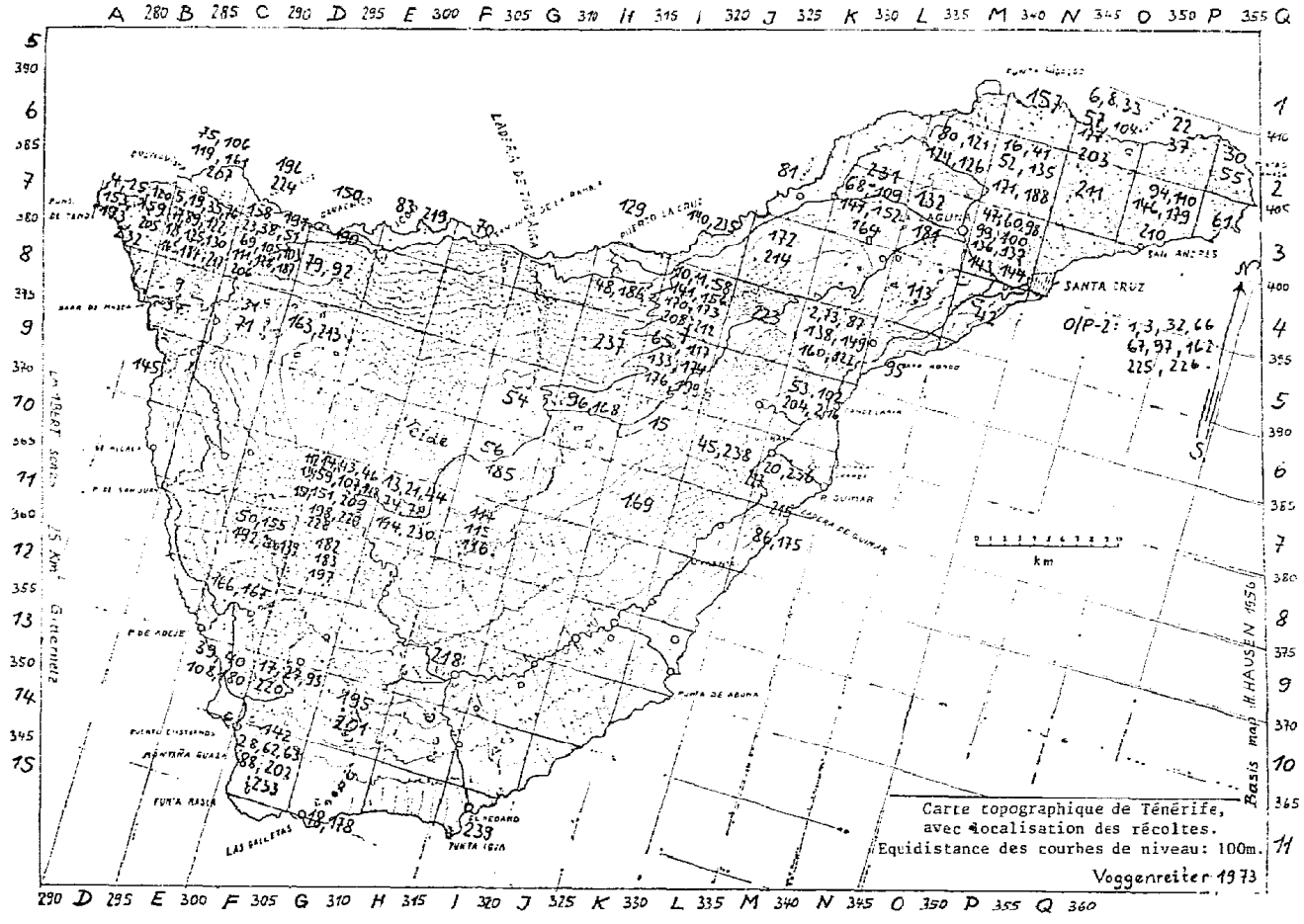
Astydamia latifolia 2n = 20; LARSEN, 1958, signale 2n = 22.

Bystropogon canariensis 2n = 48; LARSEN, 1963, trouve 2n = 42.

Centaurea tagananensis 2n = 28; BRAMWELL, 1971, trouve 2n = 45.

Dracunculus canariensis 2n = 24; LARSEN, 1960, cite 2n = 28.

Isoplexis canariensis 2n = 16; nombre insolite pour une digitale; HEYWOOD nous signale avoir trouvé 2n = 16 il y a 10 ans (non publié). HAASE-BESSELL, 1932, cite 2n = 56. Nous



avons prélevé l'espèce en boutons dans l'Anaga, au Pico Inglese, le 24.4.73: la méiose a bien montré n = 28 bivalents, sans ambiguïté. On voit ici l'intérêt des localisations précises.

Jasminum barrelieri 2n = 24, n = 12. Plusieurs auteurs signalent 2n = 26, et LARSEN, 1958, n = 13. Notre échantillon est un cas intéressant d'aneuploïdie viable, s'isolant en un nouveau caryotype distinct.

Rumex lunaria 2n = 40; LARSEN, 1960 et BRAMWELL, 1972, trouvent 2n = 36; JARETSKY, 1928, signale 2n = 20. Un cas à revoir!

Rumex maderensis 2n = 20 + 1; LARSEN, 1962, signale 2n = 20. Notre matériel montre un chromosome B en plus.

Scilla haemorrhoidalis 2n = 32; nombre encore inconnu pour cette espèce; GIMENEZ-MARTIN, 1959, cite 2n = 28. Dans le genre, le nombre de base x varie de 6 à 11. Beaucoup d'espèces ont 2n = 28, mais aussi 2n = 32.

Scrophularia glabrata 2n = 60; LARSEN, 1960, signale 2n = 56.

Conclusion

Cette liste numérative constitue la première étape d'un travail en cours dont le but est d'aller au-delà de la recherche du seul nombre chromosomique. L'idée directrice est de recueillir le plus possible d'informations sur le cycle chromosomique et le déroulement de la méiose avec l'aptitude de la reproduction par graine; c'est en effet à cette condition que peut être assurée la continuité dans la descendance d'un type biologique qui peut alors être considéré comme un véritable taxon.

Le fait important de la variation du caryotype est également une des préoccupations de cette recherche. Dans cette perspective il ressort que ce premier échantillonnage ne permet pas d'apprécier toute l'ampleur de la variation caryologique, ni de connaître les mécanismes qui ont joué dans l'endémisme d'un si grand nombre d'espèces. Il apparaît en tout cas d'après les résultats acquis que la polyploïdie n'a pas été le moteur dans l'évolution de l'isolat canarien.

Junio de 1973
Institut Botanique
Université Strasbourg
Institut Botanique
Université des Sciences, Lille
Botanisches Institut
Universität Erlangen-Nürnberg

16. Endémiques Mácáronésiennes au Mároc Inventáire Bibliográphique et Problèmes Táxinomiques

J. P. PELTIER

Il n'existe aucun travail récent précisément consacré à la flore macaronésienne au Maroc. La seule publication, fort incomplète d'ailleurs, est celle que J. GATTEFOSSÉ écrivit en 1941 à l'occasion d'essais d'acclimatation qu'il poursuivait à Ain-Sebâa. Tout au plus peut-on signaler la note de Ch. SAUVAGE (1952) sur la végétation du littoral atlantique. J. BRAUN-BLANQUET et R. MAIRE (1924) ainsi que L. EMBERGER (1934), à l'occasion d'études plus générales sur la végétation et la flore marocaines, donnent également d'utiles renseignements.

Or, dans le cadre de nos recherches phyto-écologiques sur le bassin versant de l'o. Souss nous avons été amené, durant ces deux dernière années, à recenser la flore macaronésienne caractéristique du litoral. Ce travail posant un certain nombre de problèmes taxinomiques, il nous a semblé utile d'en publier l'essentiel.

Monsieur le Professeur R. NEGRE, de la Faculté des Sciences de Marseille et J. MATHEZ, de l'Institut scientifique chérifien, ont accepté de lire cette note; je leur dois de nombreux et utiles conseils. Le résumé en langue anglaise a été rédigé par Monsieur CHKIRID; nous le remercions bien vivement.

1 - Définition et origine de la Macaronésie

On donne le nom de Macaronésie à cinq groupes d'îles situés au large des côtes NW de l'Afrique. Ce sont du N. au S:

— les Açores, au nombre de dix îles;

— Madère, l'île de Porto Santo et les îlots inhabités des Desertas et des Selvagens;

— le petit archipel des Salvages situé presque à mi-chemin entre Madère et les Canaries comprenant trois îlots, tous inhabités;

— les Canaries comprenant treize îles, de loin les plus riches au point de vue de la flore;

— les îles du Cap Vert, au nombre de quatorze, situées en face de la côte sénégalaise.

Communicated by R. LINDER (Lille)

Deux théories relatives à la formation de ces îles et archipels ont été soutenues. Pour J. **Pitard** et L. **Proust** (1908: 71) et d'autres, ces îles ne seraient que les restes d'un vaste continent qui se serait abîmé plus ou moins complétement sous la mer. Pour A **Chevalier** (1935: 746) ces terres auraient émergé des flots sous l'effet de l'activité volcanique.

Plus récemment, R. **Dietz** et P. **Sproll** (1970: 1044) en se basant sur la réflexion et la réfraction des ondes séismiques concluent à la possibilité de séparer les Canaries en deux blocs. Les cinq îles les plus occidentales à l'W seraient purement volcaniques et reposeraient sur la croûte océanique. Les autres les plus orientales à l'E, séparées des premières par une faille longeant Fuerteventura, reposeraient sur la croûte continentale et se rattacheraient à l'Afrique.

En rapprochant les continents Américain et Africain (sur la base de l'isobathe 1620 m) on constate que la fosse d'Ifni subsiste, celle-ci ne pouvant être comblée que par un décrochement de 190 km vers le NE du bloc Fuerteventura-Lanzarote; ce bloc pourrait donc être considéré comme un micro-continent ou une portion détachée de l'Afrique du Nord.

Le détachement aurait pû se faire au début de la séparation Amérique-Afrique (Trias moyen). On peut penser aussi à un détachement plus tardif (tertiaire récent) lié à la surrection atlasique sur la foi des ressemblances du Crétacé des îles et de l'Afrique.

Dernièrement, la découverte, par P. **Rothe**, de coquilles d' oeufs de Ratites (grands oiseaux incapables de voler, du type autruche) aux îles Canaries (E. G. **Franz Sauer** et P. **Rothe**. 1972: 43) montre que ces oiseaux habitaient la région il y a au moins une douzaine de millions d'années. Des données géologiques complément aires, et particulier, la mise en évidence, dans les séries volcaniques de sédiments secondaires appartenant à la croûte continentale les amènent à conclure dans le même sens que précédemment.

2 - La flore macaronésienne au Maroc

Une des particularités la plus remarquable de la biogéographie du Maroc est l'existence d'une zone dénommée par les phytogéographes "enclave macaronésienne" qui intéresse la côte atlantique depuis la province de Tarfaya au S jusqu'à Safi au N. Une première moitié de cette enclave, qui va de Tarfaya au N du Cap Ghir, est de loin la plus typique, une deuxième, qui remonte jusqu'à Safi est beaucoup plus influencée par la végétation méditerranéenne (Ch. **Sauvage**, 1952: 8).

Au Maroc, on dénombre 17 taxons endémiques communs entre cette partie de la côte et les îles de la Macaronésie. A ces endémiques macaronésiennes s'ajoutent des vicariantes qui sont au nombre de 12.

Nous n'avons pas cru bon de préciser la répartition des espèces à l'intérieur de la Macaronésie car l'inventaire de la flore canarienne est en cours (G. **Kunkel,** 1970-71-72).

a - Endémiques macaronésiennes

Pour chacune des espèces citées, la répartition à l'intérieur du Maroc (1) est suivie éventuellement d'un commentaire d'ordre taxinomique ou biogéographique, lorsque la sous-espèce ou la variété est précisée c'est évidemment cette dernière qui est endémique. L'ordre systématique est celui du Catalogue des Plantes du Maroc d'E. **Jahandiez** et R. **Maire** (1931 à 1934).

1 — **Asparagus pastorianus** Webb et Berth.
Tout le secteur macaronésien, de Safi à Tarfaya.

2 —**Rumex vesicarius** L. var. **rhodophysa** L.
Connue du Maroc occidental et du Sahara océanique.

3 — **Bassia tomentosa** (Lowe) Maire et Weiller
Commun sur les rochers et sables du littoral, d'Essaouira à Tarfaya.

4 — **Traganum moquinii** Webb
Couronne des dunes du littoral depuis le Cap Sim (15km au S. d'Essaouira) à Tarfaya.

D'après A. **Chevalier** (1935: 77) c'est vraissemblablement par omission que J. **Pitard** et L. **Proust** ne le citent pas avec **T. nudatum** Del. dans la Flore des Canaries. Plus récemment, G. **Kunkel** (1972: 31) considère, à l'inverse de cet auteur et de R. **Maire** (1962: 119), que ces deux espèces n'en font qu'une malgré des caractères morphologiques bien tranchés (R. **Maire, loc. cit.**) en rapport peut-être il est vrai avec leur écologie.

5 — **Polycarpaea nivea** (Aiton) Webb
Sables et rochers, de Casablanca à Tarfaya.

6 — **Lobularia marginata** Webb **ex** Christ
Rochers des montagnes du Maroc désertique, en particulier: Anti-Atlas, montagnes d'Ifni et province de Tarfaya.

R.**Maire** (1967: 256) considère que cette espèce, à graines largement ailées, une fois mieux connue, devra sáns doute être rattachée au **L. maritima** (L.) Desv., à graines aptères ou très étroitement ailées.

---

(1) Pour cela nous nous sommes servi des principaux travaux scientifiques cités en bibliographie et de nos notes inédites de terrain.

7 — **Euphorbia obtusifolia** Poiret subsp. **regis-jubae** (Webb) Maire
Falaises et collines maritimes du Cap Safi à Tarfaya. En outre, connue des Zaër, de l'Anti-Atlas et des Tekna.

Selon J. **Vindt** (1953: 45) la plante marocaine appartient, en partie, au var. **pseudodendroides** (Lindb.) Maire qui s'éloigne du type des Canaries par des différences portant sur la forme des feuilles et le nombre de rameaux dans l'inflorescence. Ces caractères, ajoute-t-il, sont très variables et la plante dans l'attente d'une révision générale comme le souhaite G. **Kunkel** (1972: 50), peut être considérée comme une endémique macaronésienne.

8 — **Zygophyllum fontanesii** Webb et Berth.
Rochers et sables du littoral, de Rabat à Essaouira.

9 — **Rhus albidum** Schousboe
çà et là, le long de la côte d'Essaouira à Tarfaya.

D'après A. **Chevalier** (1935: 809), c'est par omission que la plante n'est pas citée par J. **Pitard** et L. **Proust** dans la Flore des Canaries.

10— **Hypericum coadnatum** Chr. Smith.
Connue seulement du Grand-Atlas où la plante a été récoltée par R. **Maire** et L. **Emberger** en 1922, 1925 et 1932 dans les schistes humides au dessus de Demnate et dans la vallée de l'o. Ourika.

11— **Helianthemum canariense** (Jacq.) Pers.
Fréquent sur les falaises, de Safi à Tarfaya.

12— **Drusa glandulosa** (Poiret) Bornm.
Récoltée dans les rochers quartzitiques des gorges de l'o. Cherrat (35 km au SE de Rabat), à l'o. Noun et dans le Tazeroualt (région montagneuse au SE d'Ifni).

13— **Bupleurum canescens** Schousboe
Littoral océanique, de Safi à Tarfaya.

14— **Mairetis microsperma** (Boiss.) Johnston (=**Lithospermum microspermum** Boiss.)
Dunes maritimes et pâturages sablonneux, surtout sur le littoral.

Le genre monospécifique **Mairetis** se sépare des **Lithospermum** (**Johnston,** 1953: 4) par la présence à maturité d'un long tube calicinal, de grains de pollen sphériques à 8 pores équatoriaux et de nucules presque droites, éparsemment tuberculées.

15— **Bubonium odorum** (Schousboe) Maire
Commun dans le Maroc steppique occidental et sur le littoral, de Safi à Tarfaya.

16— **Artemisia reptans** Chr. Smith
Falaises du littoral atlantique, de Safi à l'o. Dra.

17— **Sonchus pinnatifidus** Cav.
Falaises calcaires aux environs d'Essaouira, du Cap Safi et d' Agadir.

b - Endémovicariantes macaronésiennes

Ce sont des taxons qui résultent de la différenciation lente et progressive d'un taxon primitif dans les diverses parties de son aire. J. **Contandriopoulos** (1962: 280) propose le terme de schizo-endémiques, en précisant que ces taxons ont toujours le même nombre chromosomique; faute de n'avoir encore pu faire les comptages chromosomiques, nous préférons conserver le terme plus général de H. **Gaussen** et C. **Leredde** (1949: 58).

Ne sont mentionnées ici que les plantes ayant fait l'objet d'une étude taxinomique publiée; entre parenthèses sont indiquées les sources auxquelles nous nous référons. Il est en effet probable qu' un bon nombre d'endémovicariantes nous sont encore inconnues, mais aussi que certains couples sont à réétudier.

1 — **Scilla latifolia** Willd.
Falaises maritimes de Safi à Agadir. Récoltée aussi un certain nombre de fois plus au S: par R. **Maire** au j. Ineter, au S de Tiznite (Anti-Atlas occidental) et par Ch. **Sauvage** et J. **Mathez** dans la province de Tarfaya.

A rapprocher selon J. **Gattefossé** (1941: 2) de **S. haemorrhoidalis** Webb et Berth. Cette dernière a été indiquée par erreur au Maroc par J. **Pitard** et L. **Proust** dans **la Flore des Canaries** (1908:361). Par son fruit baccien, **S. latifolia** se sépare nettement des autres espèces du genre, ce qui a conduit R. **Maire** (1931: 69) à en faire le type d'un sous-genre nouveau qu'il nomma **Sarcoscilla.**

2 — **Lotus maroccanus** Ball var. **maroccanus** (=**L. m.** var. **eumaroccanus** Maire).
Commun dans le secteur macaronésien, le Maroc occidental, le Grand-Atlas, l'Anti-Atlas et le Haouz.

Ce lotier est très polymorphe, certaines formes sont bien difficiles à distinguer des variétés canariennes du **L. glaucus** Aiton; le **L. mascaensis** Burchard est également très voisin (E. **Jahandiez** et R. **Maire,** 1932: 399).

3 — **Euphorbia resinifera** Berger.
Connue du Haouz, du SW du Moyen-Atlas, de l'Oum er Rbia, du Haut-Atlas central du M'Goun et du Kest; toujours par peuplements isolés.

4 — **Euphorbia officinarum** L. var. **beaumierana** (Hooker fil. et Cosson) Maire.

Falaises maritimes, des environs de Sidi Bou Laalem (30 km au S d'Essaouira) à l'o. Souss; arganeraie sublittorale au SE du bled Ksima (Souss), ainsi qu'au N de l'o. Massa, peu après l' embranchement vers Tassila. Cette dernière localité marque la limite méridionale de l'espèce.

5 — **Euphorbia echinus** Hooker fil. et Cosson.
Commun dans la plaine du Souss, l'Anti-Atlas central et occidental, dans les Tekna et dans la province de Tarfaya.

Selon J. **Braun-Blanquet** et R. **Maire** (1924: 65) ces trois euphorbes sont à rapprocher de l'**E. canariensis** L. des Canaries.

J. **Gattefossé** et J. **Vindt** (1954: 70) dans une note sur les euphorbes cactiformes au Maroc rapprochent plutôt **E. officinarum** et **E. echinus** de **l'E. handiensis** Burchard de Fuerteventura, du fait que les formes de passage apparaissent selon les conditions culturales.

G. **Ponsinet** et G. **Ourisson** (1968), dans une contribution à l'étude de chimio-systématique du genre **Euphorbia,** regroupent **E. resinifera, E. officinarum, E. echinus** et **E. canariensis** dans le groupe des **Polygonae** caractérisé par un latex à euphol. Cependant **E. echinus** et **E. officinarum** ont un latex plus complexe que les deux autres, ce qui les amène à penser que ces deux dernières appartiennent à un rameau évolutif séparé. Mais il font remarquer que leurs résultats d'analyses sont en contradiction avec ceux de A. G. **Gonzalez** et R. **Barrera,** si bien qu'ils concluent à la nécessité d'un examen nouveau, critique, des euphorbes marocaines, tant du point de vue morphologique et morphogénétique que du point de vue chimique.

Par contre, ils excluent l'**E. handiensis** du groupe des Polygonae, la rapprochant plutôt de celui des **Tetracanthae.**

6 — **Euphorbia balsamifera** Aiton subsp. **balsamifera** var. **rogeri** (N. E. Brown) Maire.
La sous-espèce est connue de la province de Tarfaya et des collines des Tekna (en particulier çà et là entre l'o. Assaka et l'o. Dra).

Diffère surtout de l'**E. b.** typique des Canaries par les feuilles un peu plus larges et la diécie (**J. Vindt,** 1953: 46).

7 — **Levisticum latifolium** (L. fil.) Batt. var. **ifniense** (Caball.) Maire, çà et là le long de la côte de Safi à Tárfaya.

"les caractères invoqués par **Caballero** pour séparer la plante marocaine de la plante canarienne (var. **canariense** (DC.) Maire) sont peu constants" (R. **Maire,** 1934: 227).

8 — **Argania spinosa** (L.) Skeels.
Caractéristique du SW marocain; connue aussi de la haute vallée de l'o. Grou, entre Tedders et Marchand, au SE de

Rabat et du versant N du Massif montagneux des Beni-Snassen (non loin d'Oujda).

Vicariant d'un arbre de Madère, le **Sideroxylon marmulano** Lowe (2); trouvé seulement une fois aux Canaries dans l'île Ténérife en 1902. Présent au Cap Vert où il est en régression (A. **Chevalier**, 1935: 927).

Selon Ch. **Baehni** (1965: 126) le genre Arganier n'est pas essentiellement différent des **Sideroxylon**, cependant chez l'Arganier ce n'est pas un seul ovule qui se développe mais plusieurs, "on serait donc en droit de considérer les Arganiers comme des proto-Sideroxylon, n'ayant pas achevé leur réduction du nombre des embryons".

9 — **Caralluma burchardii** N. E. Brown var. **maura** Maire.
çà et là dans le Souss; récolté à l'o. Assaka, prés du poste d'Oued Noun (Tekna).

Le type est signalé à Fuerteventura. Selon J. **Gattefossé** et J. **Vindt** (1954: 70) l'espèce est polymorphe aussi bien au Maroc que dans l'île avec des variétés parallèles et peut-être identiques.

10 — **Bubonium imbricatum** (Cav.) Litard.
Littoral océanique, d'Essaouira à l'o. Dra.

A rapprocher selon J. **Gattefossé** (1941: 2) d'**Asteriscus sericeus** (L. fil.) DC. (= **Odontospermum sericeum** (L. fil.) Sch. Bip.). Selon J. **Briquet** (**in Burnat**, 1916-17) le genre **Bubonium** se sépare des **Asteriscus** par des caractères carpologiques extrêmement saillants. En particulier, présence dans chacun des angles de l'akène d'une colonne de poches sécrétrice, doliformes et volumineuses, au nombre de plus de dix dans chaque colonne.

S'il s'avère que les akènes d'**A. sericeus** possèdent bien ces caractères, l'espèce canarienne devra être rapportée au genre **Bubonium**.

11 — **Senecio anteuphorbium** L.
De Safi à Tarfaya; se retrouve dans quelques stations au pied N du Grand-Atlas.

L'espèce a donné dans les cultures à Casablanca, au contact de **S. Kleinia** (L.) Less. des Canaries, l'hybride fertile **S. hintermanii** Gatt. et Maire (R. **Maire** 1937: 350).

12 — **Andryala canariensis** Lowe.
Secteur macaronésien, ainsi que de Safi à Casablanca; se retrouve dans la basse vallée de l'Acif Rdat (Grand-At-

(2) Ch. **Baehni**, à qui l'on doit une très sérieuse étude sur les Sapotacées, aurait écrit **S. mermulana**; l'ouvrage ayant eté publié à titre posthume on peut se demander s'il ne s'agit pas d'une erreur de transcription.

las) et à Saïda (Beni-Snassen).

La plante et ses cinq sous-espèces se rattachent à l'**A. pinnatifida** Aiton des Canaries dissociée en un nombre considérable de variétés dans la Flore de **Webb** et **Berthelot** (E. **Jahandiez** et R. **Maire,** 1934: 840 et J. **Pitard** et L. **Proust,** 1908: 253).

Il eût été du plus grand intérêt d'entreprendre l'étude taxinomique des vicariantes et de traduire aussi bien sur le plan morphologique que cytologique leur parenté avec les taxons macaronésiens. Mais une telle étude, à laquelle nous pensons nous consacrer à l'avenir, du moins pour certains couples dont la parenté est à préciser, sortait du cadre de cette note et renvoyait la rédaction de cet inventaire à une date fort lointaine.

RESUME

A l'aide de données essentiellement bibliographiques, l'auteur après avoir rappelé les théories les plus récentes relatives à le formation de ces îles et archipels, donne pour chacune des endémiques citées la répartition à l'intérieur du Maroc suivie éventuellement d'un commentaire d'ordre taxinomique ou biogéographique. Sur les 29 endémiques recensées, 12 sont des endémovicariantes. Pour certaines de ces dernières leur parenté avec les taxons macaronésiens est à préciser.

SUMMARY

By means of the bibliographical data, and after having recalled the more recent theories concerning the formation of these islands and archipelagos, the author gives for each one of the above mentioned endemics the distribution in the interior of Marocco. This is then followed by a commentary of a taxonomic or bio-geographical order. Among the 29 endemics checked, there are 12 vicariants whose relationship with Macaronesian taxa is still to be specified.

OUVRAGES CONSULTES

BURNAT, E., 1916-1917. — *Flore des Alpes maritimes;* vol. VI. — Genève et Bale, Georg et Cie, 344 p.

BRAUN-BLANQUET, J. et MAIRE, R., 1924. — Etude sur la végétation et la flore marocaines. 1er partie. — *Mém. Soc. Sc. nat. Maroc,* 8: 1-244.

CHEVALIER, A., 1935. — Les îles du Cap Vert. Flore de l'archipel. — *Rev. Bot. appl.,* 15: 733-1090.

CONTANDRIOPOULOS, J., 1962. — Recherches sur la flore endémique de la Corse et sur ses origines. — *Annal. Fac. Sc. Marseille,* 32: 1-354.

DIETZ, R. S. et SPROLL, W. P., 1970. — East Canary island as an microcontinent within the Africa-North America. Continental drift fit. — *Nature,* 226: 1043-1045.

EMBERGER, L., 1934. — La végétation et la flore du Maroc. — *La Science au Maroc*: 169-180.

EMBERGER, L. et MAIRE, R., 1941. — *Catalogue des plantes du Maroc*; supplément aux vol. 1, 2 et 3. — Alger, 267 p.

SAUER, F. E. G. et ROTHE, P., 1972. — Ratite eggshells from Lanzarote, Canary Island. *Science,* 176 (4030): 43-45.

GAUSSEN, H. et LEREDDE, C., 1949. — Les endémiques pyrénéo-cantabriques dans la région centrale des Pyrénées. — *Bull. Soc. Bot. Fr.,* 96: 57-83.

GATTEFOSSE, J., 1941. — La flore des Canaries au Maroc. — *Bull. Soc. Hort. Accl. Maroc,* 116: 286-295.

GATTEFOSSE, J. et VINDT, J., 1954. — Les Euphorbes cactiformes du Maroc. — *Cactus,* 41: 65-72.

JAHANDIEZ, E. et MAIRE, R., 1931 à 1934. — *Catalogue des Plantes du Maroc.* Vol. 1, 2 et 3. — P. Lechevalier, 913 p.

JOHNSTON, J. M., 1953. — Studies in the *Boraginaceae* XXIV. Three genera segregated from *Lithospermum.* — *J. Arnold Arboretum,* 34: 1-16.

KUNKEL, G., 1970. — Florula de la isla de Lobos. — *Monogr. Biol. Canar.,* 1: 1-60.

KUNKEL, G., 1971. — La vegetación de La Graciosa. — *Monogr. Biol. Canar.,* 2: 1-67.

KUNKEL, G., 1972. — Plantas vasculares de Gran Canaria. — *Monogr. Biol. Canar.,* 3: 1-86.

MAIRE, R., 1931. — Contribution à l'étude de la Flore de l'Afrique du Nord, fasc. 17. — *Bull. Soc. Hist. nat. Afr. Nord,* 22: 30-325.

MAIRE R., 1934. — Contribution à l'étude de la Flore de l'Afrique du Nord, fasc. 24. — *Bull. Soc. Hist. nat. Afr. Nord,* 27: 203-270.

MAIRE, R., 1937. — Contribution à l'étude de l'Afrique du Nord, fasc. 28. — *Bull. Soc. Hist. nat. Afr. Nord.* 30: 327-370

MAIRE. R., 1962. — *Flore de l'Afrique du Nord.* vol. VIII. — París, P. Lechevalier, 303p.

MAIRE, R., 1967. — *Flore de l'Afrique du Nord,* vol. XIII. — Paris, P. Lechevalier, 365p.

MATHEZ, J. et SAUVAGE, CH. — *Catalogue des plantes de la province de Tarfaya.* — Sous-presse.

PITARD, J. et PROUST, L., 1908. — *Les îles Canaries, Flore de l'archipel.* — Paris, Librairie Sc. nat., P. Klincksieck, 502p.

PONSINET, G. et OURISSON, G., 1968. — Les triterpènes des latex d'*Euphorbia.* Contribution à une étude chimio-systématique du genre Euphorbia. — *Adansonia,* sér. 2, 8 (2): 227-239

SAUVAGE, CH., 1952. — La végétation du littoral atlantique marocain. — *Bull. scient. Océan. études côtes Maroc,* 1 (sér. 2): 3-10.

VINDT, J., 1953. — Monographie des Euphorbiacées du Maroc; première partie: révision et systématique. — *Trav. Inst. scient. chérif.,* 6: 1-217.

WEBB, P. B. et BERTHELOT, S., 1836-1850. — Histoire naturelle des îles Canaries. — *Phytog. Canar.,* III (2è *partie,* 1 et 2), Paris.

Janvier 1973
Laboratoire de taxonomie et
d'écologie des végétaux supérieurs
Institut scientifique chérifien
Rabat, Maroc

17. Hacia un Banco de Germoplasma de Endemismos Vegetales Ibericos Macaronesicos

C. GOMEZ CAMPO

INTRODUCCION

Un Proyecto dedicado a la conservación de plasma germinal de endemismos vegetales ibéricos y macaronésicos está en marcha desde la temporada pasada (1972) y abierto a la colaboración de todos aquellos botánicos que lo deseen.

Se trata de elaborar una colección de semillas encapsuladas en condiciones físicas idóneas para alcanzar una máxima longevidad. Con ello se pretende potenciar la riqueza florística de las regiones mencionadas, facilitando su estudio científico y sus posibles aplicaciones. Para aquellos taxones que se encuentran de algún modo amenazados, por desgracia abundantes entre los endemismos, la existencia de reservas de semilla en un Banco de Germoplasma constituye en sí un método complementario de Conservación capaz, en su caso, de evitar posibles extinciones.

El Proyecto está patrocinado y financiado por el Instituto Nacional para la Conservación de la Naturaleza (ICONA), corriendo la coordinación del mismo a cargo del Laboratorio de Fisiología Vegetal de la Escuela T. S. de Ingenieros Agrónomos (Universidad Politécnica de Madrid) que también se ocupará de la encapsulación de las semillas.

A continuación se describen las líneas generales del Proyecto, para conocimiento de posibles colaboradores.

RECOLECCION DE SEMILLAS

La recolección de semillas estará en general a cargo de los botánicos que conozcan bien las Floras locales, de modo que sus salidas al campo con diversos fines puedan rendir simultáneamente algún producto a este Proyecto en forma de muestras de semillas. Las principales instrucciones a tener en cuenta en estas recolecciones son:

1) A efectos de este Proyecto serán válidas las muestras de semilla correspondientes a taxones de cualquier categoría (especie, subespecie, variedad o forma) que crezca espontánea y exclusivamente en la Península Ibérica (España y/o Portugal) y/o las Islas Baleares y/o las Islas atlánticas que constituyen la región Macaronésica (Azores, Madeira, Salvajes, Canarias y Cabo Verde). Excepcionalmente se podrá admitir algún taxon que sin ser

exclusivo de las áreas apuntadas tenga una representación muy pobre fuera de ellas.

2) Se procurará en todo caso no perjudicar con la recolección la supervivencia del taxon correspondiente, cosa posible en algunos casos extremos.

3) Se procurará que la muestra proceda del mayor número de individuos dentro de la población en que se recolecta. Se elegirán en lo posible poblaciones sanas, libres de plagas y enfermedades.

4) Se recogerán semillas y no frutos, salvo en los casos en que paea" (Cambridge University Press) en el caso de la Península caracteres que distingan al endemismo de los taxones más afines.

5) No serán aptas para encapsular las muestras que no se hayan recogido dentro de la temporada en curso y hayan por tanto envejecido aunque sólo sea un año.

6) El tamaño de la muestra es muy importante, por lo que deberán estas limpiarse lo suficiente para que su volumen pueda ser medido con poco error. Deben dar para la confección de por lo menos 100 cápsulas cada una con un mínimo de 12-15 semillas cuando estas sean de tamaño grande y 50-100 para tamaños medios o pequeños. De semillas como las de la col p. ej. debería haber por lo menos 20 cc. mientras que para tamaños como el del trigo serían necesarios unos 150 cc.

7) A cada muestra se adjuntarán los datos sobre fecha, lugar, etc. siendo muy importante precisar al máximo el lugar, para hacer todo más fácil si hubiera que repetir la recolección en el futuro. Se adjuntarán si es posible las coordenadas UTM del lugar. En los casos que lo merezcan y justifiquen se guardará el debido secreto sobre estos datos.

8) Se pondrá el máximo cuidado en la determinación botánica, sobre todo para taxones de categoría inferior a la especie. Para especies y subespecies se utilizará la nomenclatura de "Flora Europaea (Cambridge University Press) en el caso de la Península Ibérica y de la "Flora Macaronésica" actualmente en preparación para las islas atlánticas, utilizándose mientras se publica esta última obra, la "check list" del Dr. Eriksson de Umea (Suecia).

9) Con cada muestra se enviará un pliego herborizado que no requerirá ser perfecto, aunque sí suficientemente expresivo de los caracteres que distingan al endemismo de los taxones más afins.

ENCAPSULACION

Las semillas recolectadas se deberán enviar al Laboratorio de Fisiología Vegetal de la Escuela T.S. de Ingenieros Agrónomos. Madrid 3, para ser encapsuladas. Con las variantes que se hagan

necesarias, el método a emplear es el desarrollado por este Laboratorio para una colección análoga especializada en la tribu Brassiceas en los últimos años. (GOMEZ-CAMPO 1972).

En resumen, se basa en la utilización de cápsulas individuales de vidrio cerradas a la llama para cada muestra elemental (Figuras 1 y 2). Previamente se ha creado un ambiente anaerobio cambiando la atmósfera por otra de anhidrido carbónico. Una cierta cantidad de gel de sílice actúa como absorbente de humedad y además como indicador de posibles poros o roturas de las cápsulas. Las cápsulas son almacenadas a unos 2° C bajo cero.

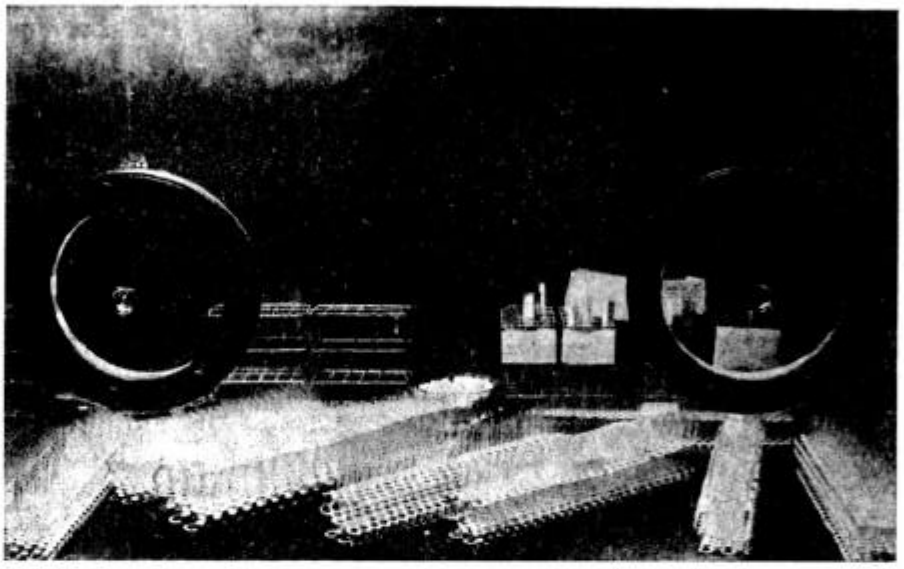


Figura 1. Gradillas con cápsulas en una cámara de pre-desecación, esperando a ser cerradas a la llama. Previamente se cambia la atmósfera por anhidrido carbónico y se pone en cada cápsula una cantidad de gel de sílice para absorber la humedad.

FINANCIACION

El Instituto Nacional para la Conservación de la Naturaleza (ICONA) ha tenido a bien financiar este Proyecto al menos en su primera fase, de modo que durante algún tiempo será posible compensar económicamente a los recolectores de los gastos realizados para procurarse las semillas.

Ante la dificultad de valorar con exactitud los gastos de desplazamientos que las más veces tendrán un caracter mixto en cuanto a sus objetivos, se utilizará un baremo según la categoría de la muestra que se recoja, siempre en el supuesto de que cum-

pla las condiciones antes expresadas. Sobre una cifra base, que actualmente se sitúa en 2.000 ptas. por cada muestra válida, se aplicarán los siguientes coeficientes:

Géneros monotípicos	1.2
Especies y Subespecies	1.0
Taxones inferiores (variedades, formas)	0.5

Para muestras no recibidas por primera vez, pero que por su procedencia geográfica más o menos distante o por otras razones que merezcan ser incluídas en la colección, se aplicará un coeficiente 0.2 multiplicado sobre los anteriores.

Las liquidaciones se harán a final de temporada. Caso de sobrar fondos se dedicarán a organizar expediciones a las regiones donde los botánicos locales hubieran respondido peor.

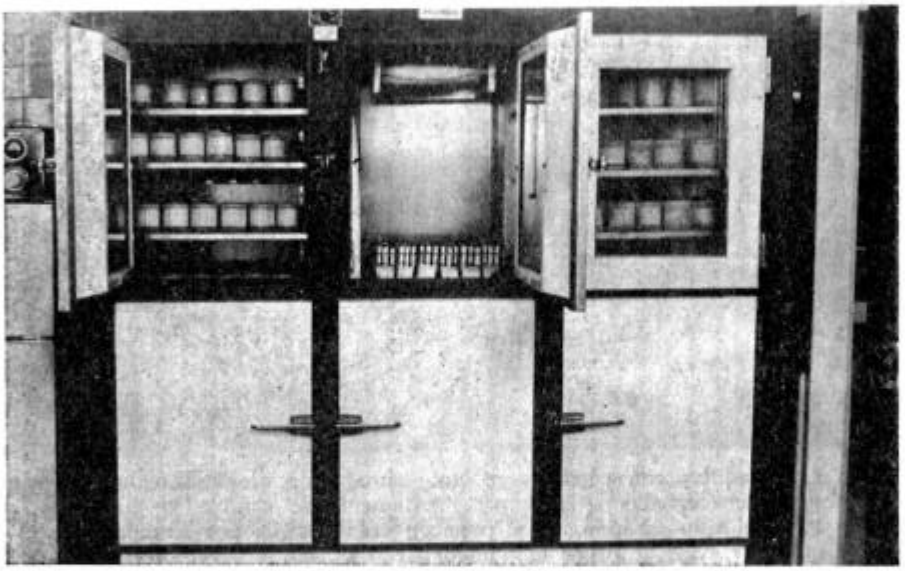


Figura 2. Armario frigorífico conteniendo una colección de semillas encapsuladas de la tribu "brassiceas"; de cada taxon se hacen cien cápsulas, cada una con 12 a 200 semillas, según su tamaño. Llegar a mantener de esta forma una colección de endemismos ibéricos y macaronésicos, muchos de ellos gravemente amenazados, será sin duda un paso positivo y tranquilizador.

INFORMACION y COORDINACION

Al final de cada temporada se elaborará una lista de taxones ya encapsulados para orientar a todos los colaboradores sobre la marcha del Proyecto y evitar la dilapidación de esfuerzos. A partir del tercero o cuarto año se piensa editar un Index en forma, en-

viándolo a posibles usuarios de esta colección y atendiendo en el futuro sus peticiones de material de modo gratuito como es norma extendida en el mundo. En las listas o índices figurarán como coautores los botánicos que hayan proporcionado un mayor número de muestras, y en todo caso cada taxon llevará entre otros datos el nombre del recolector, no solo como reconocimiento a su colaboración, sino también por la responsabilidad que le corresponde en la determinación botánica de aquél.

La coordinación, con sede en el Laboratorio de Fisiología Vegetal de la ETSIA antes citado, correrá a cargo de un grupo de botánicos que para ello se han ofrecido voluntariamente. Ellos dictaminarán en último término sobre la validez de las muestras recibidas para encapsular, y remitirán periódicamente a los colaboradores la información necesaria para la buena marcha del Proyecto.

BIBLIOGRAFIA

GOMEZ CAMPO, C (1972) Biological Conservation 4; 355-360.

Junio de 1973

Escuela T. S. de Ingenieros Agrónomos
Universidad Politécnica
Madrid 3., España

18. Conservation of Natural Plant Communities on Madeira and in the Azores

E. A. SJÖGREN

Until recently reasons for conservation have been mainly of an economic kind consequent upon the need to maintain highly productive grazing lands by the prevention of erosion. The invasion of a few foreign species also helped to promote conservation, as they became obstacles to the extension of grazing land and even to the construction of roads and the development of forest plantations. However, this background has provided a useful platform for the gradual promotion of preservation concepts based on more scientific desires.

The Macaronesian islands provide the various branches of biological science with important subjects of study. The vegetation of Madeira and of the Azores provides scientists concerned with the history of vegetation a flora which contains several taxa closely related to taxa which grew in middle and southern Europe in Tertiary times.

A problem which is gradually more and more important, viz., the balance between the natural and the cultural landscape, can be studied on the islands against the background of the known time of colonization by man.

This paper attempts to describe some of the factors which threaten the survival of original plant communities in the two archipelagos of Madeira and the Azores. The coastal plant community first covered only very small areas as many of the suitable areas were probably originally covered by a sparse **Myrica faya** and **Erica scoparia** scrub.. During the first century of colonization by man, opening up of the landscape resulted in larger areas becoming available for the coastal vegetation. The rapid expansion of the cultivated landscape subsequently considerably diminished the areas available. Today the original coastal vegetation has only a few refuges, in places where cultivation is impossible.

The survival of the **Aeonio-Lytanthion** is threatened. It should, however, be stressed that this threat applies not only to the areas occupied by the community but also to the composition of the community. - All isolated islands subject to rapid colonization by man have been influenced to a greater or lesser extent by a problem, common to islands viz., the deliberate or accidental introduction of alien animals and plants.

The coastal climate on Madeira, which is suitable for both tropical and subtropical plants, has allowed a continuous introduction of flowers from all over the world. Several species have been restricted to gardens and fields but several have escaped and become extremely well naturalized along the coasts. Examples of such species are **Senecio mikanioides, Opuntia tuna** and "weeds" such as **Erigeron karwinskianus, Galinsoga parviflora** and **Eupatorium adenophorum.** There are now few areas of coastal vegetation not colonized by at least one or two of these species. **Opuntia tuna** competes very successfully against the indigenous shrubs, and is a particularly serious threat to the **Aeonio-Lytanthion.**

Further extension of cultivated areas does not threaten the natural communities of the coast but the further spread of introduced plants, and of plants which may be introduced, is a very real threat. There is an urgent need for Madeira to establish stricter controls on the introduction of ornamental flowers and plants for cultivation and on the accidental introduction of more or less cosmopolitan "weeds". A network of permanent sample plots should be set up to monitor the changing conditions within the vegetation. These areas could be subjected to different treatments in order to follow as many aspects as possible of the influence of cultural activities on the indigenous vegetation.

During the first three centuries of human colonization, the laurisilva of Madeira was the natural source of timber for building and fuel heating. It was also an obstacle to the clearance of land for agriculture. The continuous cultural influence has mainly been that of cutting, burning and grazing. Secondary changes in composition and succession within the **Clethro-Laurion** include erosion and colonization by non-indigenous plants.

All these influences have caused a continuous reduction in the area suitable for the laurisilva and have caused a change in its composition. The natural shrub-forest develops very slowly and recolonization of felled areas is very slow. The complete ecosystem requires shelter and high air humidity and tolerates only limited erosion. The following is a consideration of the various cultural influences to which the vegetation is subjected.

Extensive felling has eliminated the forest randomly from all localities, irrespective of the ecological conditions. This means that the lower limit of the laurisilva zone is no longer natural and does not correspond to suitable ecological conditions required by plants and groups of plants. Further, the felling has favoured some tree species and brought others, such as **Juniperus cedrus** and **Picconia excelsa** close to extinction. The competitive balance

between the original trees and shrubs has thus become severely upset.

Burning of the original forest started shortly after colonization of the island and has continued from time to time up to the present day in order to improve or establish grazing land. The largest areas so changed are at altitudes above 1400 m. The roof of the cloud cover is usually situated at this altitude, so that ecological conditions for the laurisilva are successively impaired towards the peaks. The burning of **Erica**-scrub was usually intended to affect only a selected limited area but has frequently become extended beyond this area by accident. The combination of burning meant that there was very little possibility of recolonization of the grazing land by the former laurisilva scrub.

Grazing has affected all the laurisilva areas to some extent but its main effect has been above 1400 m. Grazing has evidently gone on there since the first colonization. However, it was only after the middle of the last century that it became heavy, seriously affecting the soil and vegetation; the population increase at that time was very rapid and overgrazing led to bad consequences for the economic situation of several islanders. Grazing pressure at high altitudes increased to about 36.000 sheep and goats in 1940, equivalent to about 3 animals per ha. This is now reduced to approximately 2 animals per ha but the overgrazed grassland-scrub is now only capable of supporting less than 1 sheep or goat per ha, and in certain areas much less.

The grazing influenced vegetation in the same way as felling, eliminating certain species and favouring others. **Erica** shrubs, for example, are more resistant to grazing than **Laurus** and **Vaccinium**. Grasses have been favoured at the expense of other herbs. **Pteridium aquilinum** has locally attained dominance, together with grasses and mosses.

Secondary influences mentioned above include the accidental introduction of alien taxa, and erosion. The invasion of aliens into the **Clethro-Laurion** has been accomplished by a smaller number of species than in the coastal zone. **Erigeron karwinskianus** and **Eupatorium adenophorum**, species with a Central American origin, now pose a severe threat to the field layer vegetation of the cloud-zone.

Erosion is a worldwide problem, on continents as well as on islands, and in places where cultivation and other activities have been too severe and not properly adjusted to the complex of ecological conditions. Grazing and burning of highland vegetation on Madeira has brought about extensive erosion, reaching irreversible stages in certain areas.

Slope gradient has proved to be a factor of predominant importance in the investigation of the relationships between grazing and erosion. It has been found that overgrazing leading to a 50 % elimination of grasses and other herbs in favour of bryophytes brings about the start of severe erosion if the slope is more than 30 %. Erosion usually begins with the formation of a large number of small terrarcettes. Overgrazing finally leads to the complete removal of the plant cover over small areas, frequently leading to wider vegetation destruction downslope. The final stage of erosion of large areas is characterized by the rapid removal of the finer fractions of the soil in the rain water, leaving only coarse material and bare rocks.

Problems of conservation of natural vegetation in the Azores have been generally similar to those of Madeira. Ecological conditions on these young volcanic islands are, however, somewhat different from on Madeira.

The influence of man on the coastal vegetation has been as severe as on Madeira. Settlements are concentrated at altitudes below 300 m. For centuries the Azores was a stopping place for North Atlantic ships sailing between Europe and America. In the 20th century it has become an essential landing place for transatlantic air traffic. These conditions have brought about a very large and rapid increase in the Azorean flora in the last 150 years and a change in the vegetation of the archipelago. The flora, now including about 700 taxa, probably increased by nearly 100 % in only 150 years. This increase mainly affected coastal vegetation by the invasion of more or less cosmopolitan anthropochorous species. Coastal areas lacking such species are now few. However, they are easy to protect as they are generally of no potential use for cultivation. Unfortunately, however, the current governmental policy for protection on these islands is directed only towards the cloud-zone vegetation.

The effect of man's activities in the cloud-zone have been the same as on Madeira but felling for fuel and wood probably did not reach the same intensity. However, there are few old trees remaining nowadays. The endemic **Juniperus** and **Erica** were particularly selected for cutting as sources of excellent wood for building. Felling had an evident influence on the natural competitive balance in the cloud-zone.

Burning of the scrub was carried out on old lava fields and volcanic deposits, combined with felling in order to clear new land for grazing. These activities are still going on, although mainly in order to clear new land for grazing, since there has been a gradual reduction in the requirement of wood for domestic fuel, owing to

the present widespread use of gas.

Grazing has never been the same destructive problem in the Azores as on Madeira, since cows have always been the most important animals. On slightly sloping old lava streams, overgrazing was rarely the cause of erosion. However, in certain places the effects of overgrazing can be seen on slopes where the soil consists of coarse volcanic deposits. The vegetation on such slopes, especially if steeper than 30%, is extremely susceptible to overgrazing. The soil easily begins to slide downwards, forming terraces or, in certain cases, causing landslides leaving the soil completely bare.

Thus grazing problems in the Azores, unlike on Madeira, are not mainly concerned with erosion. Instead there are special problems causing the continued prevention of recolonization by shrubs and trees. On this soil and in this climate, felling often leads to the formation of swamps, and to an increasing accumulation of **Sphagnum** species, which become totally dominant in the bottom layer. In this way a number of wet shallow peatlands have recently been formed. A decrease in the grazing pressure would probably not bring about recolonization by the cloud-zone vegetation in such localities. Natural successional flow has been changed or stopped completely.

The transformation of vegetation as a consequence of the addition of deliberately or accidentaly introduced taxa has been mentioned in connection with coastal vegetation. The cloud-zone vegetation in the Azores is affected by introduced species, as is the equivalent vegetation on Madeira. To some extent, the same species are involved, such as **Eupatorium** and **Erigeron.** A greater threat to the natural vegetation of these islands is that of **Hedychium gardnerianum**, of north Indian origin, introduced as an ornamental plant; the shrub **Pittosporum undulatum,** of Australian origin; and **Hydrangea grandiflora,** of Chinese origin. These species locally attain complete dominance in the cloud-zone vegetation. **Pittosporum** has now strongly pushed back the original **Myrica faya** shrub from the coasts up to altitudes of about 600 m. Azorean natural endemic vegetation is thus noways physiognomically greatly influenced by a group of Chinese-Mexican-Indian plants which are a serious threat to its survival.

Interest in the conservation of natural vegetation on the islands was aroused earlier than on Madeira. Several Azorean islands afforded good practical conditions for conservation as large areas of them are owned by the state and can therefore be treated in different ways by the Forestry Service. Complete protection of some volcanic cones and some volcanic craters has already been achieved. Unfortunately, however, conservation is still to a large extent centred on rare plants and geologically and topographically

interesting areas. Interest in the conservation of mature plant communities is still lacking in the minds of the goverment.

Conservation should be restricted to a few large areas which have well-differentiated communities. The conservation of lake vegetation, volcanic ash cones and explosion craters is especially urgent. These provide important material for both the qualitative and quantitative study of the differences in the vegetation on the different islands of the archipielago. This differentiation is clear in the Azorean Islands, although not as evident as in the well known Galapagos Islands.

Some of the reasons for the urgent conservation of natural vegetation on the two Macaronesian island groups of Madeira and the Azores have been put forward in this paper. The islands offer several types of vegetation suitable for sociological studies as well as for genetic studies of the successive differentiation of several taxa. The classical problems of primary colonization by plants and animals of isolated archipelagos should not be forgotten. Problems which will become more and more important, namely the balance between the natural and cultivated landscape, can be studied against the background of a known time of colonization of the islands by man.

A scientifically based conservation of the natural vegetation of Madeira and the Azores is urgent if science is to be able to take advantage of the rich resource of original fauna and flora in future investigations.

April 1973

Växtbiologiska Institutionen
(Institute of Ecological Botany
Box 559
Uppsala 1, Sweden

19. The Conservation and Use of Endangered Islands

M. D. SUTTON

1. Islands in Danger

The definition of an island is here considered to include terrestrial, pelagic, and benthic communities whose organisms function in a more or less interrelated manner. Islands are not simply land. Maritime resources may be vital to the preservation of the total natural heritage of islands. Internationally, marine life is considered equal in importance to terrestrial life - especially from a tourism - economics - ecological point of view. Oceanic, tidal and inshore communities can be vulnerable to residues discharged from terrestrial communities, including those of man. Iguanas may feed on aquatic vegetation in benthic zones. Hence, the actions of man on land can have a serious effect on the quality of aquatic life systems around islands.

This appears to be true also from actions at sea, such as ocean dumping, including the discharge of petroleum wastes. Parts of the northern coast of Gran Canaria Island, in the Canary Islands of Spain, have suffered depletion of tidal life because of petroleum deposits, which float in the water and eventually collect in black balls on shore. This same complaint is heard on other islands, especially where the petroleum washes up on tourist - oriented bathing beaches. The menace is virtually worldwide.

Some islands have experienced growth of human population that encroaches on the natural ecosystems, destroys sand dunes, results in polluted waters, damages archeological and historic sites, and otherwise depletes the national heritage, reducing oportunities for benefits from tourism. Urbanization, industrialization, road construction, logging, fishing, hunting and other factors may contribute to the deterioration of fragile and balanced ecosystems or of cultural and historic treasures. Many islands are suffering from the introduction of exotic animal species such as goats, pigs, donkeys and other species that have devastated parts of the Galápagos Islands. In a few cases, scenic islets have been subjected to bombardment during military exercises.

Perhaps the most widespread cause of this abuse, and the principal reason for decline in quality of natural and human environments on islands, is absence of adequate planning.

* Communicated by A. ETTER, Lisle, Ill.

2. Master Planning and Conservation of Island Ecosystems.

A major step toward the rational use and conservation of all resources is the preparation of a land-use plan for each island in an archipielago, and the coordination of this plan with nationwide land-use plans. The island of Lanzarote, in the Canary Islands, has been carefully mapped and divided into natural reserves, zones of urbanization, zones of agriculture, and others. An Ecuadorian planning commission is studying future uses of the Galápagos Islands, most of which have been designated as a national park. The government of the Seychelles Islands has issued a white paper establishing policies related to conservation of natural resources and establishment of national parks. The Republic of Chile is considering measures to protect certain parts of Easter Island and the Juan Fernandez Islands. The Island of Dominica, West Indies, is attempting to find a balance between utilization of forest resources and preservation of prime vegetative features. Several national park units have been established in the U. S. Virgin Islands to protect coral reef resources and to restore the natural forest, which was severely altered after the coming of man. The Government of American Samoa some years ago developed plans for park preservation. Venezuela established island parks in the Caribbean for nesting bird colonies and for recreational use by tourists. There are many similar examples of work in progress.

Attempts are also being made to reverse the deterioration of natural resources. A wildlife restoration project has helped to bring back the néné goose to Hawaii. New Zealand authorities are diligently attempting to remove exotic vegetation and non-native feral animals from their national parks. The control and removal of domestic goats is being carried out in the Galápagos Islands, Hawaii and New Zealand. Master plans have been prepared for the national parks of New Zealand and other countries. Pollution control projects are being funded and constructed, as in the Canary Islands. The effects of excessive hunting and fishing are being studied, and restrictive regulations placed in effect.

A máster plan for the conservation and use of an island or group of islands should contain such elements as fauna and flora, ecology, geology, history, archeology, recreation, economic interests, environmental education, training, financing and stages of development, all in sections prepared by experts. Upon approval by high officials, governmental authorities would prepare specific plans for each national park or related reserve within an archipelago. Such individual plans for parks and reserves should deal with significance, history and natural history, access, climate, land use and ownership. Visitor facilities, boundaries, protec-

tion, public information and education programs, and staff organization should also be dealt with. All plans should be based thoroughly on the most competent scientific information.

Benefits from this kind of planning may readily be observed in Hawaii. The City of Refuge was established as a national historical park in 1961 to preserve and make available to the public the Place of Refuge at Honaunau, a small site important in the history of Hawaii. Restoring the park's 160 acres to their original condition, the U. S. National Park Service removed exotic thorny vegetation and replaced it with either native vegetation or no vegetation at all, in accordance with historic records. Old structures in ruins were stabilized, and a temple reconstructed. Rangers and archeologists were assigned to provide information and protection. With such arrangements, more tourists could visit the site without damage to the resources for which it was established. In 1964 the number of visitors to City of Refuge was 38,700. The following year the number jumped to 138,500. By 1971 it had reached 243,000 per year...all without deterioration of the natural or historic values.

3. The Uses of Islands

Thus it is clear that several significant benefits are being derived from the proper planning and conservation of island resources. Fragile and usually unique parts of the national heritage, when preserved, help to maintain the original character of the habitat. The public may use such areas freely, without damage, if facilities and public activity are well-planned and carefully controlled. Economic benefits will grow from non-consumptive tourism uses. Scientists may conduct studies that would ultimately improve the quality of life. Public educational sites can be increased to broaden the learning of citizens. In short, the saving and improvement of natural processes will not only be of benefit to wild plants and animals but to human citizens as well.

Action on the international scene is increasing. In addition to the ocean dumping convention and wildlife agreements, a convention concerning the Protection of the World Cultural and Natural Heritage has been approved by UNESCO. It calls for the preservation of sites of outstanding universal value and provides for a fund that would help governments improve the protection and administration of such areas.

Scientists at several international meetings have endorsed the principle that certain islands, usually remotely situated and uninhabited, should be reserved for scientific investigation before they are occupied and developed by man. Accordingly, a conven-

tion has been drafted to promote these "islands for science." The philosophy is that because of isolation, small size and other environmental factors, islands tend to develop specialized but relatively simple biotic communities; because of this, they are especially valuable in the study of evolution, genetics, population dynamics and other disciplines. But they are also fragile and vulnerable to disruptions caused by unwise human uses.

Fortunately, hundreds of islands and islets have been incorporated, at least partly, into systems of national parks and wildlife reserves. Research stations have been established to promote studies in geology and ecology. Tourism controls are being applied, and earnings from a well-planned tourism program are beginning to pour in. It is a highly commendable trend, and the governments responsible for such actions should be congratulated for their wisdom and foresight.

March 1973

National Park Service
Division of International Affairs
U.S. Department of the Interior
Washington, D.C., U.S.A.

20. Conservación de los Recursos Naturales en Canarias

L. C. GARCIA CORREA

Ante tan importante Congreso pláceme, en primer lugar, el honor de dirigirme a ustedes, PROHOMBRES responsables del futuro de la vida natural de todos nosotros, que es, sin duda alguna, el fin de todo este importante y científico trabajo que en este primer Congreso se hace.

En segundo lugar el presentar, brevemente, a ASCAN, la Asociación Canaria para Defensa de la Naturaleza, ente nacido hace dos años, aproximadamente y que no es otra cosa que lo que su nombre describe: Asociación Canaria de hombres que desean defender la Naturaleza y lo hacen en la medida de sus posibilidades, sintiéndonos responsables de la herencia recibida en flora, fauna y paisajes.

Otra razón para nosotros es, y como bien saben todos ustedes., el hecho de tener la flora Canaria altísima proporción de especies endémicas, siendo, realmente, un fósil viviente de la flora que hubo hasta incluso en zonas del Mediterráneo; una flora terciaria ya hoy, desgraciadamente, desaparecida en aquella zona.

A estas razones añadimos la de la localización de los endemismos en zonas y números muy reducidos. Por todo esto, y junto a la desaparición de ciertas especies en algunas localidades, nos obliga a dar el grito de alerta ante tamaña barbarie.

Multiples han sido las causas que han motivado la desaparición de aquellas especies. Causas como: La utilización de los bosques para carbón y astilleros; utilización masiva del terreno para usos agrícolas por parte de una población siempre creciente y, en especial, el desconocimiento, por parte del pueblo, de la LEY VITAL DEL EQUILIBRIO ECOLOGICO.

Esto es en lo que al pasado se refiere, y hoy: La Sociedad de Consumo ha hecho caer ante el hombre el telón de la insensibilidad frente a su medio natural. La desaparición de paisajes silvestres, la contaminación del ambiente, la especulación del suelo, etc., son claros exponentes de lo que acabamos de mencionar.

Ante estos problemas, y teniendo en cuenta este mundo tan materializado, ASCAN consideró que había que intentar sensibilizar al pueblo como primera medida, y como medio para ello: todos los de información; pero eso sí, intentando, siempre, hacerlo por valores éticos.

Sabemos que aún estamos lejos del estado ideal de conserva-

ción en estas islas, pero ya contamos con la realización de las primeras reservas biológicas.

Así ICONA, Instituto Nacional para Conservación de la Naturaleza, que ha sido creado como respuesta a los problemas del medio ambiente, tiene, entre sus misiones la de adaptar las medidas precisas para asegurar la fertilidad de los suelos, la pureza de la atmósfera y de las aguas, para conservar los ecosistemas naturales y para mantener los equilibrios biológicos. Con estas misiones y viendo, con gran esperanza, como ICONA sabe que los problemas ecológicos, que si han merecido atención anteriormente, hoy lo son de la máxima atención y que el desarrollo económico y la alta tecnología si no se compaginan con otras consideraciones ambientales y de la comunidad, se puede correr el riesgo de que lleguen a ser una amenaza para nuestro ambiente natural, como ya lo es en algunas partes de nuestro planeta.

A esta esperanza que acabamos de mencionar, añadimos las de: que ICONA en su política de conservación no es estática, ya que por ejemplo, en esos ecosistemas que los hombres ya hemos modificado, de recursos naturales renovables basa su política en una racional utilización de los mismos, de tal forma que esos recursos proporcionen la máxima satisfacción social y económica a la comunidad, pero eso sí, con una adecuada conservación. Siguiendo con las misiones tiene ICONA la de salvaguardia de los valores estéticos y geomorfológicos de los espacios naturales, la defensa del paisaje, y algo que nosotros le damos la máxima importancia es: su apertura hacia fuera ¿No estarán desapareciendo los paternalismos? Ya que desean obtener la más amplia información de los problemas ecológicos de cada región de la colaboración de organismos, asociaciones y personas interesadas en estos asuntos.

Esto en cuanto a ICONA, organismo de ambito nacional, y en cuanto a organismo local tenemos que hacer mención al Cabildo que, consciente de los problemas y deseoso de buscar y poner solución a los mismos, ya estableció la reserva del último reducto del famoso bosque de laurisilva Doramas, Los Tiles de Moya; a parte de patrocinar el estudio que se programa de un plan maestro, de una filosofía de conservación para esta provincia.

En resumen, la preocupación de ICONA, Cabildos, Ayuntamientos, entidades y asociaciones particulares están abriendo un esperanzador sendero de la imprescindible cooperación de la comunidad. Sabemos y deseamos que las mismas finalidades que nos une en estas islas, nos conecten, estrechamente, con todas las demás de esta nuestra región Macaronesia. Sabemos que nos falta recorrer un largo camino, pero no tenemos dudas que las metas se conseguirán, el futuro es alagueño, ya que hoy nos sentimos acom-

pañados por todo la que este Congreso, y cada uno de ustedes, significan porque como bien oir decir: "No se puede proteger lo que no se conoce" y ustedes, nos ayudarán a conocer lo que debemos proteger como a seguir en ese esperanzador sendero y así como dijo el poeta:

Se hace camino al andar.

Abril de 1.973
Finca La Cruz
Tamaraceite
Las Palmas de Gran Canaria
España

21. A New Publication on the Canary Islands Flora

G. KUNKEL

Our Island Government (Cabildo Insular de Gran Canaria), the Institution generously patronizing this First Macaronesian Meeting on Macaronesian ground, has decided to publish a series of volumes on native plants of this islands: "Flora de Gran Canaria". The work will include approximately 550 to 600 species, all of which are depicted in full colour and natural size. It is understood that of larger species only essential parts are shown.

Each plate will be complemented by technical data (publication data, synonymy, notes on ecology and distribution) and full description. The originals are being painted by my wife, MARY ANNE KUNKEL. The work will be printed by Seix y Barral, Barcelona.

The work as intented will comprise ten volumes, divided by classification based on growth habit; families are arranged in systematical order. The first volume (of 50 plates), dealing with trees and larger bushes, is actually at the printers and is expected to be available towards the end of this year.

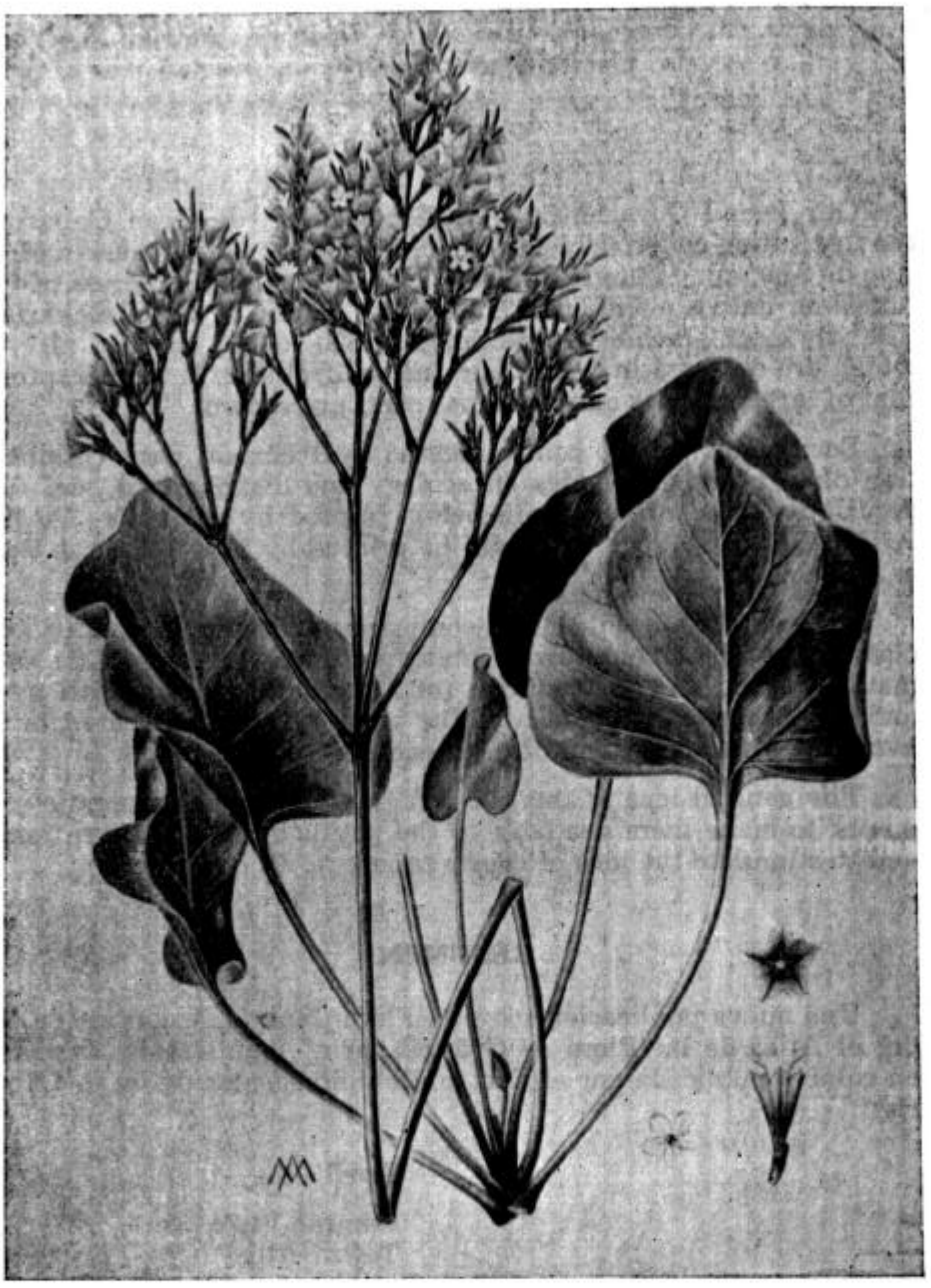
The general idea of this proyect is to record our endemic elements, to make them available to the public in an attractive form, and to stimulate the idea of conservation.

RESUMEN

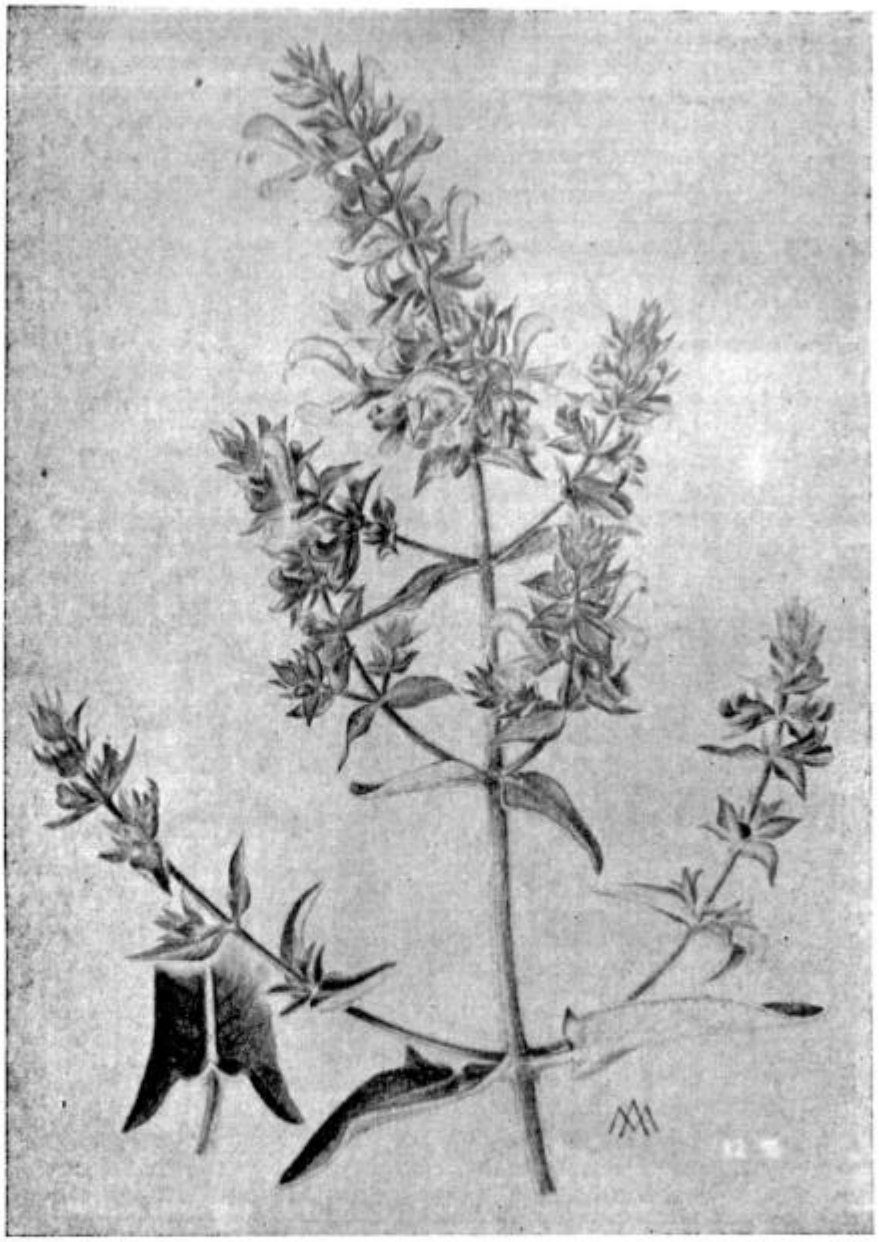
Una nueva publicación sobre la Flora Canaria: Información sobre el Atlas de la "Flora de Gran Canaria", publicación ilustrada en color y publicada por el Excmo. Cabildo Insular de Gran Canaria.

April 1973

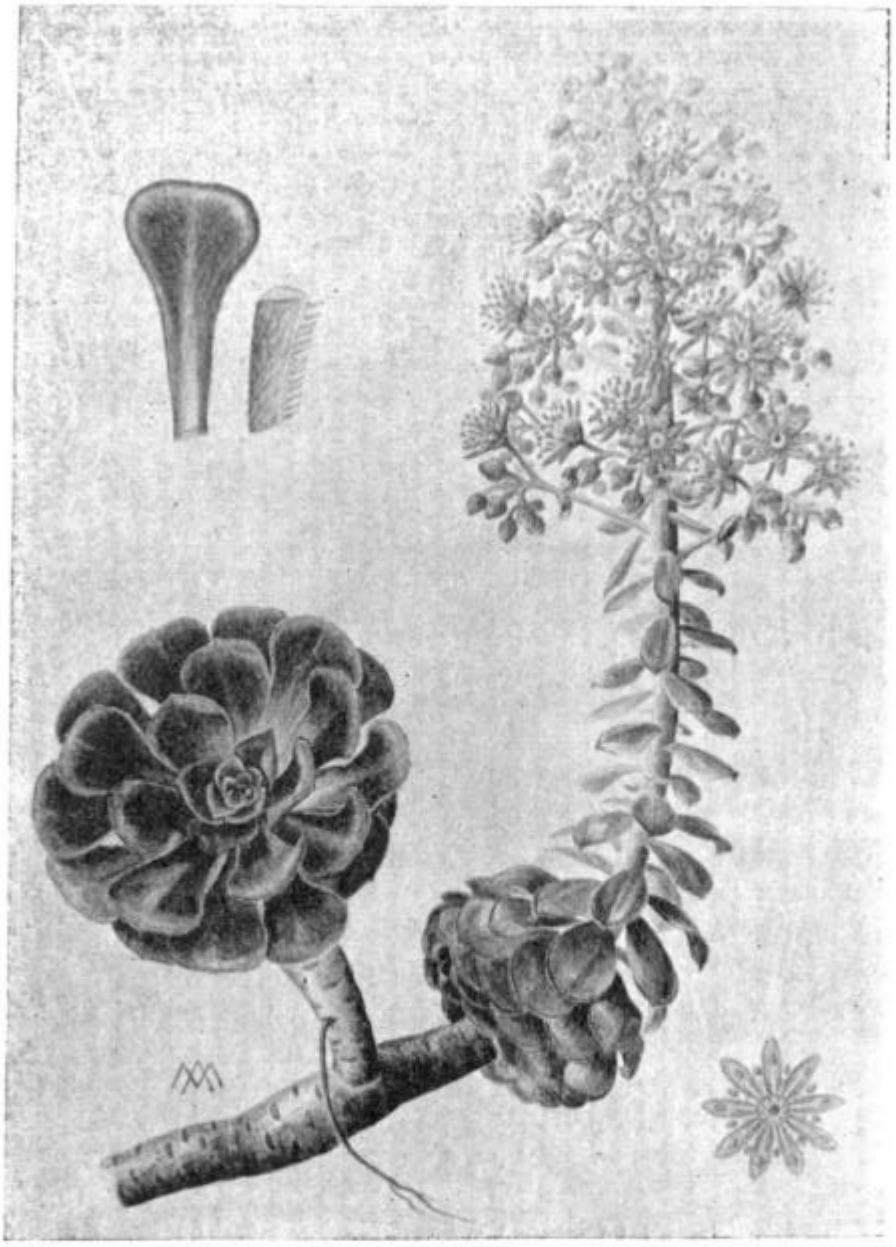
Camino Viejo, 15
Tafira Alta
Las Palmas de Gran Canaria
Spain



Lám. 1: **Limonium rumicifolium** (Svent.) Kunkel & Sunding. Reproducción (del original, por Mary Anne Kunkel): Cortesía del Excmo. Cabildo Insular de Gran Canaria.



Lám. 2: **Salvia canariensis** L. (véase lám. 1)



Lám. 3: **Aeonium manriqueorum** Bolle (véase lám. 1)

Flora of Macaronesia Project
A Progress Report

D. BRAMWELL & D. M. MOORE

INTRODUCTION

Discussions about a proposed Flora of Macaronesia have taken place over several years and following informal conversations between a number of interested botanists who had the opportunity to meet during 1972, a general programme for preparing such a Flora got under way. During the past 12 months the organizing group has been able to look at some of the problems which are involved in setting up a procedure for preparing such a Flora. It seems clear that this project is feasible and, furthermore, it has been possible to obtain a substantial measure of agreement amongst botanists actively interested in Macaronesia as to the way in which this project could be undertaken.

This paper outlines the current state of the scientific aspects of the project. It should provide the necessary information upon which to base decisions about the next phase of operations. During the preceding months various suggestions concerning organization etc. have been made and notes circulated to interested parties. A short note indicating the scope of the project and the possibilities for its future development was published in **Taxon** (21: 730-731 (1972)).

Our knowledge of many parts of the Macaronesian region is still somewhat limited and a number of species are known only from a few specimens collected last century. New discoveries are regularly made and the recent finding of two new genera, **Heywoodiella** and **Kunkeliella**, in the Canaries serves to emphasize this. The taxonomic concepts employed by different authors working on the Macaronesian Flora vary (the authors of this report are in the process of preparing a memorandum on species concepts in relation to insular situations with the hope that this will help attain some degree of uniformity in the Flora), complex nomenclatural problems remain to be solved and some of the important literature is extremely rare. The aim of the project is to synthesize available information in an easily accessible form by preparing a synoptic Flora which will clarify taxonomic and nomenclatural problems, many of which apply to the whole region and cannot be considered solely within the context of a single island group.

Up to now there has been relatively little co-ordinated study of the Macaronesian collections which are held by Herbaria throu-

ghout the world. As part of the project it is hoped to produce a list of Herbaria with Macaronesian collections and an index to type specimens of endemic species.

PROGRESS TO DATE

Specimen accounts

The Flora will be synoptic and diagnostic like **Flora Europaea**, rather than monographic in style but more ecological and distributional data must be given. The presentation used by Munz in "A California Flora", with altitudinal range, vegetation type or zone and also indication of Flowering period, if known might be a possible model.

A code-list for citation of islands in each archipelago has already been circulated as has a specimen account of parts of the genus **Echium.** This account is provisional, pending further discussion on the presentation of ecological data.

Generic Lists

Lists of genera for both Dicotyledons and Monocotyledons have been circulated to members of the organizing group and other interested people and potential authors have offered to prepare accounts for many genera. In Volume 1, **Pteridophyta to Umbelliferae,** there are **352 genera** in **69** families.. Provisional authors have been found for **300** of these genera.

In Volume 2, **(Diapensiaceae to Compositae** and **Monocotyledons)** there are **349** genera (**192** with authors) in **53** families of Dicotyledons and **212** genera in **25** families of Monocotyledons.

It is hoped that after meetings of the organizing group to discuss certain problems it will be possible to proceed quickly with the preparation of accounts for Volume 1.

The preparation of a generic list for Pteridophyta has been put in the hands of Dr. C. N. Page (R. B. G. Edinburgh) who in collaboration with Mr. C. Jermy (British Museum) and Mr. G. Kunkel (Las Palmas) will be responsible for accounts in this group.

Accounts of Gymnosperms will be prepared by Professor J. do Amaral Franco (Lisboa).

Literature

A basic literature list has been compiled and circulated. To it should be added the check-list of the plants of the Cape Verde Islands very recently prepared by Dr. Per Sunding (Oslo).

A botanical bibliography of Macaronesia is being compiled and arrangements are being made to publish it as part of the project.

Research

Active research on the Macaronesian region has been carried out in recent years at several centres in Norway, Switzerland, Spain, Portugal, Denmark, Sweden, Germany and Great Britain and there has been an enormous increase in publications on Macaronesia in the past 10 years. A number of research projects have been carried out at the University of Reading over the past 5 years and the following theses (partly unpublished) have been presented or are in progress:

BRAMWELL, D. (1971) Studies in the Flora and Vegetation of the Canary Islands. 355 pp. (Ph. D.)

HUMPHRIES, C. J. (1973) A Taxonomic Revision of the Genus *Argyranthemum* in Macaronesia. 368 pp. (Ph. D.)

DAVIS, D. H. (1971) Studies in the *Lotus glaucus* - *L. sessilifolius* complex in Macaronesia. 100 pp. (M. Sc.)

DAR, M. (1972) Taxonomic Studies in the genus *Tolpis* from the Canary Islands. (M. Sc.)

ALDRIDGE, A. (In progress) Studies in the Evolution and Systematics of *Sonchus* with special reference to Macaronesia. (Ph. D.)

SMITH, V. W. (1973) Taxonomic studies in the Genus *Kickxia*. (sect. *Valvatae*) from the Canary Islands and North Africa. (M. Sc.)

SCOTT, A. (1973) A Numerical Contribution to the Study of *Lotus* sect. *Pedrosia*. (M. Sc.)

May 1973

Department of Botany
Plant Science Laboratories
The University
Reading, Great Britain

Project "Flora Macaronesia"

(as approved during FM-Meeting; 17.IV.1973)

EDITORIAL COMMITTEE

Joint Chairmen

J. do Amaral Franco (Lisboa)
W. Wildpret de la Torre (La Laguna)

Committee Members

A. Hansen (Copenhagen)
G. Kunkel, (Las Palmas)
J. Malato - Beliz (Elvas)
D. M. Moore (Reading)
P. Sunding (Oslo)
T. G. Tutin (Leicester)

I International Congress pro Flora Macaronesica

(Las Palmas, 1973)

CONSERVATION APPEAL

"The endemic plants of the Canary Islands as also of Madeira, the Azores and the Cape Verdes are a unique, precious and irreplaceable heritage of the people of these islands which needs to be safeguarded on scientific, cultural and historic grounds for the enjoyment, interest and use not only of the present but of future generations."

Due to evergrowing population and demand, to rapid exploitation and subsequent exhaustion of natural resources, and because of common misunderstanding of basic natural and ecologic laws,

A large number of species and entire plant communities are endangered. Their actual survival is only a question of time and little hope and no guarantee can be given for the safety of these units. Even in the Macaronesian Archipelagos a considerable number of species have been entirely exterminated in certain places. The number of specimens of some endemic taxa amounts to less than fifty.

Considering the unique value of native and/or endemic plant species, the high number of little-known local endemics, and considering the human need of wilderness and recreation parks and landscapes,

The members of this "I International Congress pro Flora Macaronesica" propose to local authorities and to the Governments of Portugal and Spain

—to form a bilateral, international Study Commission to prepare an inventory of remaining natural resources in the Azores, Madeira and Salvages, Canaries, and Cape Verdes;

—to establish and enforce a strict code of protection in all Macaronesian Islands and to preserve selected ecologically intact or otherwise valuable countrysides, even before the results of the above mentioned survey are given;

—to urge educational programmes in schools and in public information media, in order to increase general awareness for the need of conservation.

The text of this "Appeal" has been published in the *Bulletin IUCN* vol. 4 No. 6 (1973).

Both Governments concerned might be assured of technical assistance from all scientific institutions involved or that are otherwise interested in the natural history of these islands. If found desirable, the members of this meeting will second any application for special programmes aided by UNESCO and IUCN/ WWF.

Las Palmas de Gran Canaria,
17-IV-1973

Versión original por G. Kunkel
Texto inglés leído por J. M. González

PROGRAMA DE CONSERVACION

Las plantas endémicas de las Islas Canarias como de las demás Islas Macaronésicas (Azores, Madeira y Salvajes, Cabo Verde) presentan una herencia única, apreciada e irreemplazable para los habitantes de estas islas y que requiere urgente protección por razones tanto culturales como históricas, para su disfrute y por su interés como acompañantes de la vida plena y feliz de la Humanidad, no solamente en este tiempo presente, sino también para las futuras generaciones.

A causa del aumento creciente de la población, de la demanda para una explotación rápida de los recursos naturales con el peligro de su extinción y por una muy profunda falta de comprensión de las leyes naturales y ecológicas, un gran número de especies y comunidades enteras de plantas se encuentran en peligro. Su misma supervivencia es solamente un problema de tiempo. Muy poca esperanza y ninguna garantía se puede tener sobre la seguridad de estas comunidades; incluso en los archipiélagos macaronésicos, un número considerable de especies se han exterminado completamente en algunos lugares. El número de individuos de algunos taxa endémicas no llega ni a 50.

Considerando el valor único de las especies nativas y, ó de plantas endémicas, el número muy importante de endemismos locales poco conocidos, y considerando las necesidades humanas de zonas silvestres, para su utilización recreativa y de protección, los miembros de este I Congreso Internacional pro Flora Macaronésica proponen a las autoridades locales y a los Gobiernos de Portugal y España:

— Formar una comisión de estudio bilateral e internacional, para preparar un inventario de los recursos naturales existentes en Azores, Madeira y Salvajes, Canarias y Cabo Verde;

— Establecer y obligar el cumplimiento de unas normas estrictas de protección en todas las islas macaronésicas, así como a preservar comarcas ecológicamente intactas o valiosas por algún otro concepto, incluso antes de que se conozcan los resultados del inventario antes mencionado;

— Hacer patente la necesidad de llevar a cabo programas educacionales urgentes en las escuelas, y en los medios sociales de comunicación, para incrementar el interés general por la necesidad de un programa de conservación de la Naturaleza.

Ambos gobiernos implicados en este tema pueden tener seguridad de una asistencia técnica por todas las instituciones científicas interesadas, o por aquellas que cualquier formar tienen interés en la historia natural de las islas; si fuera deseable, los miembros de este Congreso apoyarían decididamente cualquier petición que se hiciera para programas especiales a apoyar por la UNESCO y por la Unión Internacional para la Conservación de la Naturaleza - Fondo Mundial para la Conservación de la Vida Salvaje.

Traducido por J. M. González y J. Nogales.
Leído por J. Nogales.

Programa de Conservação

As plantas endémicas quer das Ilhas Canárias quer das demais Ilhas Macaronésicas (Açores, Madeira e Selvagens, e Cabo Verde) apresentam un valor único, apreciado e insubstituível para os habitantes destas ilhas, e que requer urgente protecção por razões tanto culturais como históricas, para seu desfruto e pelo seu interêsse como companheiras de vida plena e feliz da Humanidade, não sòmente no tempo presente como también no futuro.

Em resultado do crescente aumento da população, da busca para uma rápida exploração dos recursos naturais com o perigo da sua extinção e por uma mui profunda falta de compreensão das leis naturais e ecológicas, um grande número de espécies e comunidades inteiras de plantas encontram-se em perigo. A sua própia sobrevivência é apenas uma questão de tempo. Muito pouca esperança e nenhuma garantia se pode ter quanto à segurança destas comunidades; incluso nos arquipélagos macaronésicos, um número avultado de espécies foi completamente exterminado nalguns lugares. O número de individuos de determinados táxones endémicos não chega a 50.

Considerando o valor único das espécies autóctones e o número muito importante dos endemismos locais, ou de plantas endémicas, pouco conhecidos, e considerando as necessidades humanas de zonas silvestres para sua utilização com fins recreativos e de protecção, os membros deste 1º Congresso Internacional pro-Flora Macaronésica propõem às autoridades locais e aos Governos de Portugal e Espanha:

—Constituir uma Comissão de estudo, bilateral e internacional, para preparar um inventário dos recursos naturais existentes nos Açores, Madeira e Selvagens, Canárias e Cabo Verde;

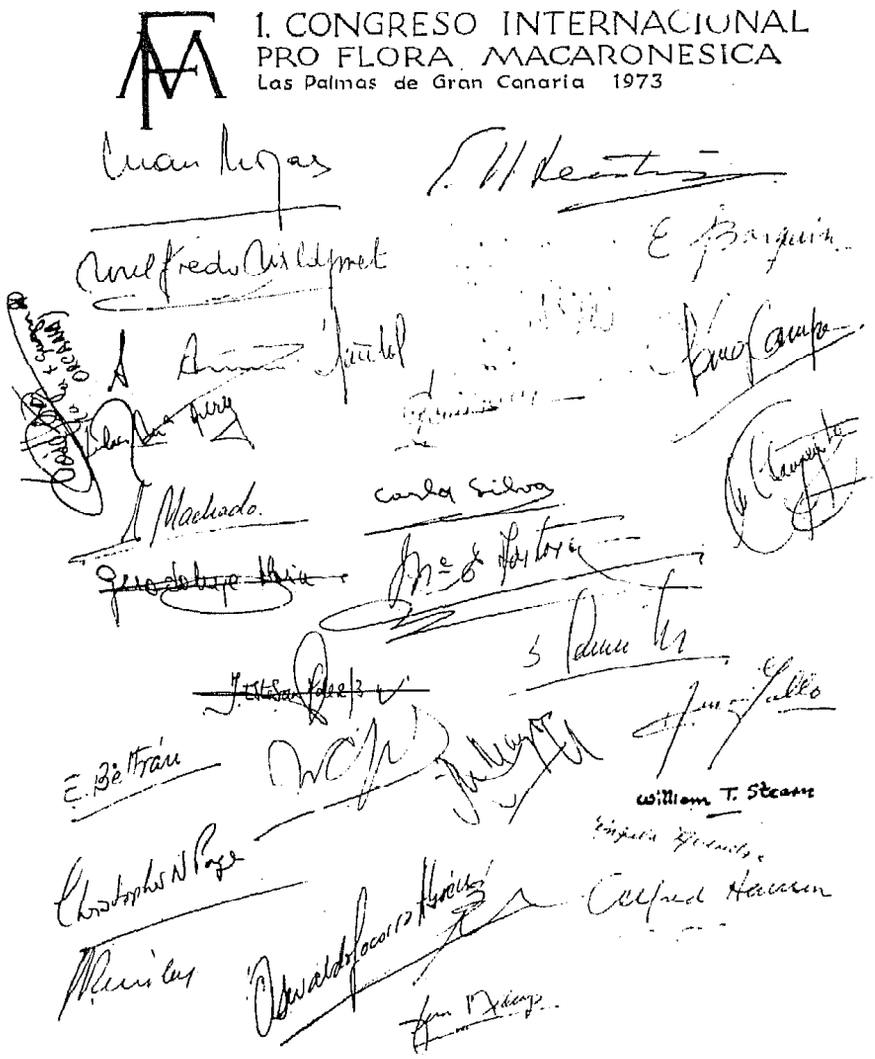
—Estabelecer e obrigar ao cumprimento dumas normas apropiadas de protecção em todas as ilhas macaronésicas, assim como de preservar áreas ecològicamente intactas ou valiosas sob outro ponto de vista, até mesmo antes de serem conhecidos os resultados do inventário antereferido;

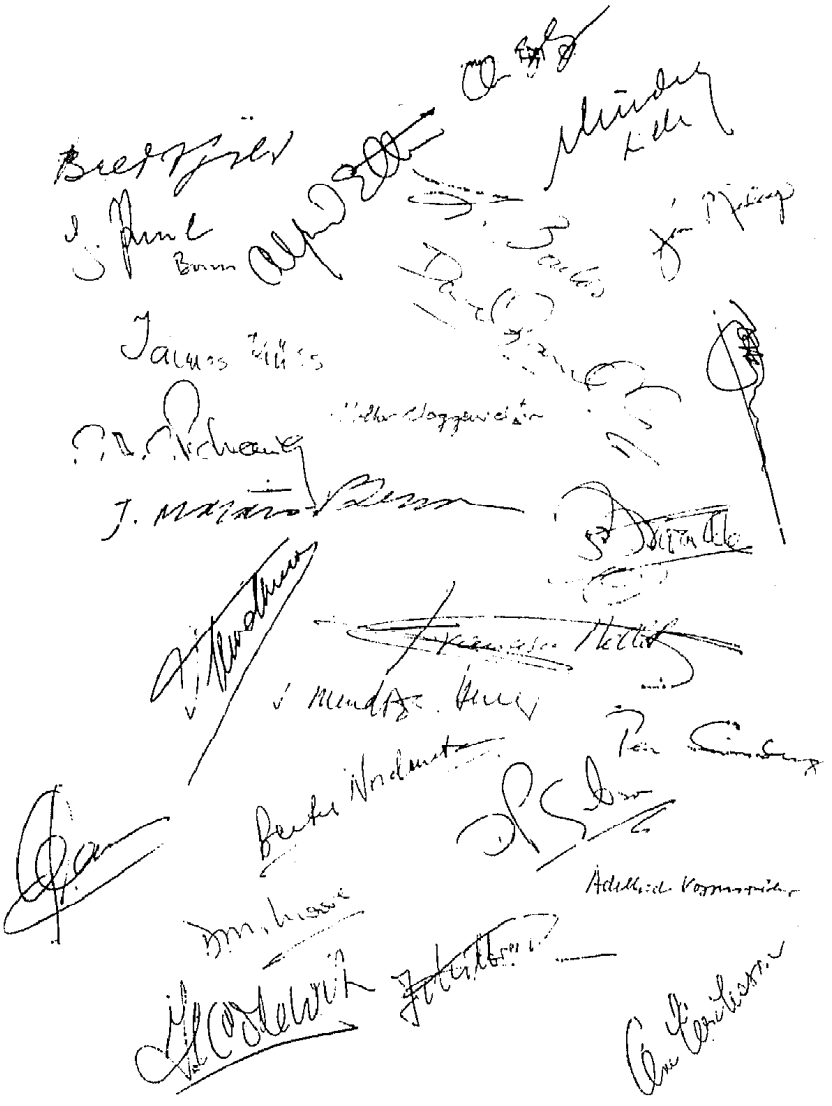
—Tornar patente a necessidade le levar a cabo programas educacionais urgentes nas escolas e nos meios sociais de comunicação, para incrementar o interêsse geral pela necessidade dum programa de conservaçao da Natureza.

---

* Traduzido por J. do Amaral Franco

Ambos os governos interessados neste tema podem contar com uma assistência técnica por parte de todas as instituiçoes científicas interessadas, ou daquelas que por qualquer forma se interessem pela História Natural das ilhas; se desejável, os membros deste Congresso apoiariam decididamente qualquer petição para programas especiais a apoiar pela UNESCO e pela União Internacional para a Conservação da Natureza — Fundo Mundial para a Conservação da Vida Selvagem.





FOUNDATION OF THE MACARONESIAN BOTANICAL SOCIETY

Draft copy (by G. Kunkel), read by V.H. Heywood, chairman

This communication received much interest and was discussed at length. However, it has been found necessary to modify the proposed name to MACARONESIAN BOTANICAL ASSOCIATION.

The Assambly named J. do Amaral Franco (Portugal), W. Wildpret de la Torre (Spain), D. Bramwell (Great Britain), and G. Kunkel (Germany), to form a commission to study the matter and to present their results as soon as possible.

It is proposed to discuss and put into effect the foundation of the "Macaronesian Botanical Society". To avoid delay and unnecessary paperwork, the foundation of this society should take place during the meetings of the I INTERNATIONAL CONGRESS PRO FLORA MACARONESICA, held in Las Palmas, between 13 and 18th April, 1973.

Aims of the "Society"

To strengthen contacts between all botanists who's professional work, directly or indirectly, is concerned with the flora and vegetation of the Macaronesian Islands. All botanical disciplines should be presented in the Society's Membership, including monographers and plant geographers.

To act in an advisory capacity on the preparation and publication of the "Flora", and to sponsor also work being done in lower categories of plants (i.e. mosses, lichens, fungi, etc.)

To assist and encourage educational programmes, and to be mediator when protection of species or conservation of landscapes and communities are projected.

Constitutional Code

The "Macaronesian Botanical Society" should be of a trully international character and change its headquarters every two (three ?) years.

The Officers of the "Society" will serve as both technical and regional advisors, and will meet once a year.

The Code adopted by the "Society" should transcend national, political and religious concerns.

Communications and publications prepared by members and approved by the Officers of the "Society" shall be auto-financed, although financial contributions are to be welcomed from any source.

Additions and modifications, and final approval should be presented before April 18th.

Las Palmas de Gran Canaria, 17-IV-1973

INTERNATIONAL UNION
FOR CONSERVATION OF NATURE
AND NATURAL RESOURCES

WORLD WILDLIFE
FUND

IUCN / WWF Joint Project Operations

P.O. Box 169
1110 MORGES, Switzerland
Tel. : (021) 71 44 01
Cable : Unicorn Morges

IUCN/WWF Project
817 (37-2)

Sr. L.C. Garcia Correa
Presidente, ASCAN
Colmenares 3.
Las Palmas de Gran Canaria
Islas Canarias.

10 April 1973

Dear Mr. Garcia Correa,

It is my pleasure to inform you that the World Wildlife Fund has been able to make a grant of US$ 3,000 to the project "Conservation Survey of the Gran Canaria Islands". This money can be paid out immediately and I would be grateful if you would let me know the bank account to which this money should be transferred.

I hope that the survey can be undertaken soon and that some local support will be made available towards transportation, field expenses and publication of the report.

I look forward to hearing from you at your earliest convenience.

Yours sincerely,

Paula Gryn-Ambroes (Mrs)
Project Officer

cc: Mr. G. Kunkel
Dr. H. Jungius

PGA/ms/2

I hope that this comes in time for you and I wish you every success for your big conference

P Gryn Ambroes

IUCN — Provides the scientific and technical advice on joint projects based upon its network of contacts and experts in world conservation.

WWF — Provides financial support for such projects as a result of its education, publicity, and fund-raising campaigns.