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A REVISION OF THE MACARONESIAN GENUS *ARGYRANTHEMUM* WEBB EX SCHULTZ BIP. (COMPOSITAE–ANTHEMIDEAE)

By C. J. HUMPHRIES

SUMMARY

The woody endemic Macaronesian genus *Argyranthemum* is revised. In all, 22 species, grouped into five sections, are recognized, all of which occur in the North Atlantic insular archipelagos of Madeira, the Salvage Islands and the Canary Islands. The generic status and the history of taxonomic treatments in the genus *Argyranthemum* are discussed in relation to other Anthemidean genera of the Chrysanthemum complex. A key to all species and subspecies is given, each taxon is fully described and relevant taxonomic characters are discussed in some detail. Full synonomy is cited and notes on distribution and ecology are provided. Distribution maps for all taxa occurring in the Canary Islands and Madeira are provided excluding only *A. thalassophilum* (Svent.) C. J. Humphries, which occurs in the Salvage Islands. Five new species : *A. lemsii*, *A. haouarytheum*, *A. sventenii*, *A. lidii*, *A. hierrense*, and two new subspecies : *A. frutescens* subsp. *pumilum* and *A. broussonetii* subsp. *gomerense* have been described from the Canary Islands and 22 new combinations are made. The relationship between the different sections and their correlation with ecology and vegetation zones is discussed in detail with particular reference to the Canary Islands.

INTRODUCTION

THE genus *Argyranthemum* is one of a taxonomically difficult group of genera in the Chrysanthemum complex, consisting of 22 closely related species, endemic to Madeira, the Salvage Islands and the Canary Islands.

The taxonomic problems in the genus are due to two main factors, the first being the question of its relationships with other genera in the Chrysanthemum complex, and secondly the classification of narrow endemics which have locally evolved in response to diversity of climatic and habitat conditions in the northern Macaronesian archipelagoes.

Only fairly recently has it been possible, on the basis of differences in morphology, embryo-sac development, fruit anatomy, phytochemistry and distribution data, to recognize the species clusters within the Chrysantheminae. Previous generic classifications were based on one or two unreliable technical characters and tended to fall into two main schools of treatment. At one extreme, for example, the genus *Argyranthemum* was divided up into five distinct genera (Schultz Bipontinus, 1844a) and at the other extreme was included as a small section in a large heterogeneous genus *Chrysanthemum* L. (Bentham, 1873 ; Hoffman, 1889–1894).

The lack of information on the Macaronesian species has made the need to review the genus an urgent task in the light of modern taxonomic studies, which have been centred largely on European and Oriental taxa. To present the right context for discussion of generic delimitation in *Argyranthemum* it has been considered appropriate to include an historical account of this and closely related genera.

The last major taxonomic treatment of infrageneric variation in *Argyranthemum* was carried out by Schultz Bipontinus (1844a). Since that time there have been a number of important collections from the Macaronesian Islands (and particularly from the Canary Islands) such as those of Bourgeau (1844, 1855), Pitard (1905–1906), Sventenius (1947–1973), Lems (1957–1966) and Bramwell (1968–1969), which have included material of *Argyranthemum* ; but undoubtedly, lack of herbarium material has still been a major problem for a comprehensive review. This revision is based mainly on my own collections and field studies in the Canary Islands and includes some data from morphological and cytological studies and biometrical information from comparative cultivation.

The Madeiran species of *Argyranthemum*, especially the polymorphic *A. pinnatifidum* (L. f.) Lowe, are poorly understood. Few specimens are available and none of the species are in cultivation. Generally I have followed Lowe's treatments (1838, 1868), but have included my own data from more recently collected specimens from a number of European herbaria.

The taxonomic section contains descriptions and keys to all taxa, synonomy and nomenclatural notes where relevant, typifications to all taxa, illustrations of new taxa, ecological summaries and distribution maps. Five new species and several new subspecies are described.

MATERIAL AND METHODS

This revision is founded largely on my own field studies, collections and cultivated material, representative specimens of which are deposited at Reading University (RNG) and the British Museum (Natural History) (BM). Descriptions are based on both living and dried material and variation ranges attempt to cover the total variation encountered for a particular taxon. However, where abnormal values have been found these have usually been placed in parentheses either before or after the main ranges of variation. Flowering periods, chromosome numbers, ecological data, locality lists and distribution maps have all been compiled from specimens I have seen and only from literature references when substantiated with authentic material.

In addition to my own collections, specimens from the following herbaria have also been examined (abbreviations following Lanjouw & Stafleu, 1964) :

Botanisches Museum, Berlin-Dahlem, Germany (B).
British Museum (Natural History), London, England (BM).
Botanical Museum and Herbarium, Copenhagen, Denmark (C).
Botany School, University of Cambridge, England (CGE).
Herbarium Universitatis Florentinae, Firenze, Italy (FI).
Conservatoire et Jardin Botanique, Génève, Switzerland (G and G-DC).
Royal Botanic Gardens, Kew, England (K).
Rijksherbarium, Leiden, Netherlands (L).
The Linnean Society of London, England (LINN).
Botany Department, The University of Leicester, England (LTR).

Instituto 'Antonio José Cavanilles', Madrid, Spain (MA).
Museu Municipal do Funchal, Madeira (MADM).
University Herbarium, University of Michigan, Ann Arbor, Michigan, U.S.A. (MICH).
New York Botanical Garden, U.S.A. (NY).
Muséum National d'Histoire Naturelle, Paris, France (P).
Royal Horticultural Society, London, England (RHS).
Department of Botany, University of Reading, England (RNG).
Naturhistoriska Riksmuseum, Stockholm, Sweden (S).
Departamento de Botanica, Universidad de Sevilla, Spain (SEV).
School of Botany, Trinity College, Dublin, Ireland (TCD).
Jardín de Aclimatación de la Orotava, Tenerife (TENE).
Naturhistorisches Museum, Wien, Austria (W).
Botanischer Garten und Institut für Systematische Botanik der Universität Zürich, Switzerland (Z).

I have also had the opportunity to study living specimens collected by the late Dr E. R. Sventenius which are cultivated at the Tafira Botanic Garden, Gran Canaria, Spain.

HISTORICAL SURVEY

The following survey gives a chronological account of contributions to the knowledge of *Argyranthemum* and details of the various conflicting generic treatments applied to the species in critical revisions, floras and systematic surveys. The first account of an *Argyranthemum* species is found in Linnaeus's description of *Chrysanthemum frutescens* L. in his *Hortus Cliffortianus* (1738), although the first accurate record of this taxon is an illustration by Plukenet in his *Almagestum Botanicum* (1696). The second and only other species to be discovered in the 18th century, *Chrysanthemum pinnatifidum* L. f., was described by the younger Linnaeus in his *Supplementum Plantarum* (1781) from material collected by Masson on Madeira in 1778.

Linnaeus's (1737, 1753, 1754) concept of *Chrysanthemum* was an extremely wide one, embracing species now referable to the genera *Leucanthemum* Miller, *Dendranthema* Des Moul., *Chrysanthemum* L. sensu stricto, *Tanacetum* L. and *Matricaria* L. In efforts to improve the heterogeneous nature of this original generic concept, most post-Linnean syantherologists dealing with the Chrysantheminae Less. have invariably attempted to redefine generic limits. The treatments were quite often based entirely on one unreliable diagnostic character, and this has led to an extremely confused situation within the subtribe.

One of the first efforts was that of Zinn (1757), who reclassified species with white ligules, formerly placed in *Chrysanthemum*, into a new genus *Pyrethrum* Zinn. Species included in this new genus were equivalent to the Eurasian *Pyrethrum corymbosum* (L.) Scop. and the Macaronesian *P. frutescens* (L.) Gaertn. Sprague (1934) and Heywood (1954) have both established that *Pyrethrum* Zinn is the first

nomenclaturally acceptable use of the generic name, although binomials were not used in the text. Heywood (1954) has also shown that the subsequent use of *Pyrethrum* during the latter part of the 18th century by authors such as Haller (1768), Scopoli (1772) and Gaertner (1791), invariably included *P. corymbosum* as a component species, whilst *P. frutescens* was occasionally left out. He concluded, therefore, that no matter what rank is acceptable for *Pyrethrum*, *P. corymbosum* must be chosen as the type.

In 1791 Desrousseaux amended the generic delimitations of the Chrysantheminae on the basis of pappus morphology. To illustrate the effect of this reshuffle, the Macaronesian taxa, *Pyrethrum frutescens* (L.) Scop. and *Chrysanthemum pinnatifidum* L. f. were both transferred to the newly defined genus, *Matricaria* L. The arrangement had a slight advantage over previous treatments in that the two closely related Macaronesian species were included in the same genus, separated from the heterogeneous *Chrysanthemum*, and removed from the inappropriate *Pyrethrum*. However, there was no real improvement on previous generic treatments as the separation was based on a single, unreliable diagnostic character :

'*Matricaria* – pappus marginatus,
Chrysanthemum – pappus nullus',

and both amended genera included heterogeneous groups of unrelated species, now referable to *Matricaria*, *Tanacetum*, *Chrysanthemum* and *Leucanthemum*.

At the turn of the 19th century, two new major surveys of the Chrysanthemineae appeared in the works of Smith (1800) and Willdenow (1803). Both authors adopted morphological criteria for generic delimitation similar to Desrousseaux's, but unsatisfactorily again used the name *Pyrethrum* instead of *Matricaria* for the species with a marginate pappus. The unreliability of the pappus character was immediately exposed when Willdenow separated the two species of *Argyranthemum* and placed them in different genera!

In 1801, Broussonet, who was at that time the governor of Tenerife, distributed seed material of many Canary Islands genera to the Berlin, Geneva and Leiden herbaria. From cultivated specimens derived from this seed material Persoon (1807) provided a description for a third species of *Argyranthemum*, the spectacular laurel forest species from northern Tenerife, '*Chrysanthemum broussonetii*', which he named in honour of the collector. Of plants grown from this original seed material, Willdenow (1809) described five new species from Tenerife, *Pyrethrum anethifolium*, *P. crithmifolium*, *P. foeniculaceum*, *P. coronopifolium* and *P. grandiflorum*. From examination of his type specimens it is now possible to refer the first three names to one species, *Argyranthemum foeniculaceum* (Willd.) Webb ex Schultz Bip., the fourth is the very rare and distinct species, *A. coronopifolium* (Willd.) Webb ex Schultz Bip., and the last one is conspecific with *A. frutescens* (L.) Webb ex Schultz Bip. subsp. *frutescens*.

One of the most important sources of distribution records for taxa of *Argyranthemum*, particularly on Tenerife, is L. von Buch's treatise, *Physicalische Beschreibung der Canarischen Inseln* (1825). In this work the conclusions of Link and Choisy, who independently examined all of von Buch's material are given, and it provides the earliest records of *Argyranthemum gracile* Schultz Bip. (*P. foeniculaceum* [var.]

bipinnatifidum Choisy) and the poorly known, narrow-leaved upland laurel forest taxon *Pyrethrum adauctum* Link (*Argyranthemum adauctum* subsp. *adauctum*).

Although by this time there had been considerable improvement in the knowledge of the Canary Islands flora, nothing had been done to improve the unreliable generic classification of the Chrysantheminae. Matters were greatly improved, however, when De Candolle (1838) provided multi-character diagnoses for different genera, whilst revising all known species in his monumental *Prodromus*. Here, *Chrysanthemum* remained small and was characterized by the presence of white or yellow ligules and heteromorphic cypselas. The genus, which was divided into a number of sections, contained all known species referable to *Argyranthemum*, five endemics of the South African Cape Province, one North African annual (*Chrysanthemum carinatum* Schousb.) and four European annuals (*C. coronarium* L., *C. segetum* L., *C. roxburghii* Desf. (= *C. coronarium*) and *C. viscosum Desf.* (= *C. viscido-hirtum* (Schott) Thell.)). Microfiche photographs of De Candolle's specimens show that the South African material lacked cypselas, but the taxa were presumably included in the genus *Chrysanthemum* by their superficial resemblance, i.e. their woody habit, to the Macaronesian species of the *Argyranthemum* group. My own unpublished studies of the African endemics have shown that the cypselas are homomorphic, 5–10 ribbed, and distinctly pappose, characters most resembling those of North African species of *Leucanthemum*.

De Candolle described no new Macaronesian taxa but did make several new combinations from taxa previously described by Willdenow (1809), and Link and Choisy (in L. von Buch, 1825).

The remainder of the Chrysantheminae were primarily separated from *Chrysanthemum* on the basis of their homomorphic cypselas. Unfortunately the treatment of the two larger genera, *Pyrethrum* and *Tanacetum*, was very unsatisfactory as it was influenced by the work of previous authors. The genera were kept distinct and separated from one another on unreliable floral characters such as discoid versus ligulate capitula.

A second woody perennial from Madeira, *Chrysanthemum dissectum*, was described by Lowe in 1838.

Probably the most important contribution to the taxonomy of the Macaronesian Chrysantheminae can be found in Webb & Berthelot's *Phytographia Canariensis* (1835–1850).

In 1839 and 1840 Webb and Berthelot published a series of seven plates of Canary Islands taxa, using the generic name *Argyranthemum* for the first time, but not giving it valid publication. Webb obviously thought that the Macaronesian species were quite distinct from all other genera in the Chrysantheminae but the plates give no indication of the characters he chose for separation. He applied a fairly wide species concept, and his plate of *Argyranthemum pinnatifidum* shows representatives of all the broad-leaved taxa with dentate secondary leaf lobes then known from the Canary Islands and Madeira, those now regarded as *A. dissectum*, *A. broussonetii* and *A. webbii*, all of which he regarded as conspecific with the Madeiran endemic to which the name he used applies. He also illustrated *A. frutescens*, with four varieties, *A. foeniculaceum* and *A. anethifolium*, presumably

based on the *Chrysanthemum* species with those epithets, although he misinterpreted Willdenow's *Pyrethrum anethifolium* (= *Chrysanthemum anethifolium* (Willd.) Buch) and applied the name *Argyranthemum anethifolium* to an undescribed sub-alpine species named below *A. tenerifae* C. J. Humphries. There were also plates of two species from Webb's own collections made in the late 1820's that he thought were new, *A. jacobaeifolium* (*A. adauctum* subsp. *jacobaeifolium* (Webb ex Schultz Bip.) C. J. Humphries) from Gran Canaria, and *A. ochroleucum* (= *A. maderense* (D. Don) C. J. Humphries) from Lanzarote.

The account of the Compositae in the text of the *Phytographia Canariensis* was written by Schultz Bipontinus and published in 1844 (Stearn, 1937). Along with his studies on European Chrysantheminae, Schultz Bipontinus (1844b), by using cypsela morphology, provided a set of truly reliable characters on which to rest a generic classification. Perhaps the most significant point to emerge from his work was that no real differences could be found between *Pyrethrum* and *Tanacetum*. He transferred many species into the latter genus as it had nomenclatural priority.

Schultz Bipontinus was over-zealous in his application of cypsela characters to the Macaronesian taxa. Species referable to *Argyranthemum* were placed into five smaller genera, *Argyranthemum* Webb ex Schultz Bip., validly published in this account, *Preauxia* Schultz Bip., *Monoptera* Schultz Bip., *Stigmatotheca* Schultz Bip. and *Ismelia* Cass., with little regard for the overall morphological unity in the group. His diagnostic characters, however, are still of considerable value for separating five distinct species groups within *Argyranthemum* and are thus used as sectional criteria in this revision. He postulated a morphological link with the annual Mediterranean species of *Chrysanthemum* on the basis of the 'smooth' or 'ribless' cypselas, by including the North African *Chrysanthemum carinatum* and the two Canarian endemics, *A. broussonetii* and *A. coronopifolium*, in the genus *Ismelia* Cass.

Briefly summarizing, we see for the first time some fairly reliable data on which the generic classification in the Chrysanthemum complex can be based, although admittedly there was some unnecessary splitting for the Macaronesian species. The view that these taxa do form a unique morphological group was endorsed by Lowe (1868) when he included the three woody endemic species of Madeira, *Argyranthemum pinnatifidum*, *A. dissectum* and *A. haemotomma*, in the same genus. Apart from their woody habit, he considered that the nature of the convex conical receptacle also supported a separation from *Chrysanthemum*.

Despite the valuable technical basis for generic classification in the Chrysantheminae devised by Schultz Bipontinus, cypsela characters were largely ignored by writers in the latter half of the 19th century, as reliance on them alone gave inconsistent treatments in different groups. Bentham (1873), for example, reverted to an unsatisfactory arrangement by using floret characters in which *Chrysanthemum* remained distinct from *Tanacetum* but contained *Argyranthemum* and *Pyrethrum* as component sections. Hoffman (1889–1894) improved matters slightly by uniting *Tanacetum* with *Pyrethrum*, but also united *Argyranthemum* with the unrelated east European group, *Bracanthemum* DC., and kept it as one of the component sections of a large heterogeneous genus, *Chrysanthemum*, along with species of *Leucanthemum*, *Tanacetum* and *Pyrethrum*.

By the turn of the present century, there were three points of view on the treatment of *Argyranthemum*. The first one accepted Schultz Bipontinus's split of the group into a number of small genera, as endorsed by Pitard & Proust (1908 : 226–233) in an account of some new records for the Canary Islands. The second view was briefly hinted at by Webb in 1839 and 1840 (Webb & Berthelot, 1836–1850) and Lowe (1868), who accepted that the species of *Argyranthemum* were distinct and formed a single homogeneous grouping endemic to the Macaronesian region. The third, more generally accepted, view, which regarded *Argyranthemum* as a component section of *Chrysanthemum*, has prevailed until the present day (Larsen, 1958, 1960 ; Sventenius, 1960 ; Lid, 1967 ; Borgen, 1969, 1970, 1971, 1972).

During this century the generic boundaries in the Chrysantheminae have been re-examined by a number of botanists using the new systematic techniques now available : embryology, phytochemistry, cytology and cypsela anatomy. For the most part this work has been based primarily on European and Oriental taxa but as the summary given below will show it is relevant to the problem of the position and limits of *Argyranthemum*.

In 1916, Briquet and Cavillier published a new classification of the Chrysantheminae for E. Burnat's *Flore des Alpes Maritimes*. In this work, three main genera were recognized on the basis of a detailed morphological and anatomical study of fruit structure. The synthesis separated *Leucanthemum* Miller, *Tanacetum* L. and *Chrysanthemum* L. on the heteromorphic versus homomorphic nature of the cypselas and by the presence or absence of pericarp modifications such as secretory myxogenic cells, mesocarp secretory lacunae and vallecular canals. Briquet's results endorsed the earlier conclusion of Schultz Bipontinus that an association of *Pyrethrum* with *Chrysanthemum*, distinct from *Tanacetum*, was wholly unacceptable. Possibly because the *Flore des Alpes Maritimes* was no more than a regional flora, and the basis for the generic limits adopted in it was not argued at any great length, few systematists have taken up Briquet's and Cavillier's ideas and most have taken up broader, less satisfactory classifications. When anatomical studies have been applied to other floras the results have usually supported Briquet's system. Thus, Giroux (1930, 1933) provided a wealth of data for the Chrysantheminae of North Africa. Horvatić (1935, 1963) has also shown that the criteria hold good for most species in *Leucanthemum*. However, the carpological distinctions between *Tanacetum* and *Leucanthemum* are not particularly clear when applied to critical species, as shown by Heywood (1954) in his account of the Spanish taxa of *Tanacetum* sect. *Pyrethrum* subsect. *Leucanthemopsis* (Giroux) Heywood. Similarly the status of various other groups closely related to *Tanacetum*, *Chrysanthemum* and *Leucanthemum*, such as *Argyranthemum* and lesser known genera, *Hymenostemma* (Kunze) Willk., *Plagius* L'Hér. ex DC. and *Coleostephus* Cass., is difficult to interpret on anatomical criteria alone (Humphries, 1973).

In 1951, Harling provided an extensive treatise on the embryology of the Chrysantheminae and the systematic conclusions derived from this work generally support Briquet's system of classification. In the Chrysanthemum complex mono-, bi- and tetrasporic embryo-sac developments have all been observed. The genera *Chrysanthemum* and *Leucanthemum* are monosporic, all species of *Tanacetum* are tetrasporic

and *Argyranthemum* has a unique bisporic embryo-sac development. Recent studies on *Argyranthemum* and *Tanacetum* sect. *Fruticosa* by Borgen (1971, 1972) confirm the original observations made by Harling, which suggest that *Argyranthemum* is independent of the rest of the Chrysantheminae.

Cytological information has proved to be of little taxonomic use except for studying species relationships within polyploid genera such as *Leucanthemum* and *Dendranthema* (Favarger, 1959; Favarger & Villard, 1965; Polatschek, 1966; Villard, 1970; Shimotomai *et al.*, 1939, 1956, 1957, 1958, 1960; Tanaka, 1959a, b, c). The basic number of the Chrysantheminae is $x = 9$ and the somatic number ranges from $2n = 18$ to $2n = 198$ (Dowrick, 1952). *Argyranthemum* species are all diploid ($2n = 18$) (Larsen, 1960; Borgen, 1969, 1970) with little apparent variation in the karyotype (Humphries, 1973).

Over the last ten years there have been a few papers devoted to the systematic comparison of phytochemical characters within the Chrysantheminae. Bohlman *et al.* (1964), for example, showed that different classes of leaf polyacetylenes closely follow the groupings derived from cypsela studies. Favarger (1966) observed the presence of an anthocyanin pigment in root tips of species in the genus *Leucanthemum*. Finally, Harborne *et al.* (1970) have very recently shown that the reticulate flavonoid distribution within the Chrysanthemum complex fits very closely to Briquet's highly original scheme based on cypsela morphology and anatomy.

THE TAXONOMIC POSITION OF *ARGYRANTHEMUM*

The Anthemideae Cass. ex DC. are a well-defined tribe of the Compositae best characterized by the occurrence of scarious or papery receptacular bracts (phyllaries), a coriaceous or scarious coronal pappus, which is sometimes reduced to an apical aculus or is completely absent, truncate-penicilliate style tips, and strongly aromatic florets and leaves (after Cassini, 1829 : 403).

The tribe is usually divided into two subtribes; the Anthemidinae Dumort. and the Chrysantheminae Less. The Anthemidinae normally have chaffy scarious receptacular scales, invariably subtending the ovary and tubular part of the ray corollas and some, if not all, of the disc florets. Lessing (1831 : 167) considered the Chrysantheminae to be distinct from the Anthemidinae by the presence of naked receptacles, lacking receptacular scales. The division of the subtribes on this basis has recently been shown to be somewhat artificial when Greuter (1968) indicated that certain Cretan species of the genus *Ammanthus* Boiss. contain characteristics of both subtribes. It is inappropriate in this paper to become involved in a detailed discussion of the subtribal classification of the Anthemideae, as all taxa in the Chrysanthemum complex referable to the genus *Argyranthemum* lack receptacular scales and do not have any parallel genera in the subtribe Anthemidinae.

As already indicated in the historical review, generic relationships within the Chrysantheminae are far from being clear, although it is now more easily possible to discern clusters of species which have several distinguishing morphological and anatomical characters and a characteristic geographical distribution (Table 1).

TABLE 1

Morphological characters used for generic delimitation in, and geographical distribution of the genera in the Chrysanthemum complex

	Habit			Leaves						Florets		Receptacle		Cypselas						Embryo-sac			
	annual	woody perennial	herbaceous perennial	opposite	alternate	toothed–entire	dissected	tomentose	glandular	fertile	sterile	plano-convex	convex–conical	homomorphic	heteromorphic	myxogenic cells	basal callus	resin canals	non-secretory canals	pappus present	monosporic	bisporic	tetrasporic	Geographical distribution
Argyranthemum Webb ex Schultz Bip.	–	+	–	–	+	–	+	[+]	[+]	+	–	–	+	–	+	–	–	–	–	[+]	–	+	–	Macaronesia
Chrysanthemum L.	+	–	–	–	+	[+]	[+]	–	–	+	[+]	–	+	–	+	–	–	–	–	+	+	–	–	Mediterranean region
Pinardia Cass.	+	–	–	–	+	–	+	–	+	+	–	–	+	+	–	–	–	–	–	+	–	–	+	S.W. Asia–N. Africa
Leucanthemum Miller	–	–	+	–	+	[+]	[+]	–	–	+	–	–	+	+	–	+	–	+	+	+	+	–	–	Europe–N. Africa
Coleostephus Cass.	+	–	–	–	+	+	–	[+]	–	+	+	+	–	+	–	+	+	+	+	+	+	–	–	Europe
Glossopappus Kunze	+	–	–	–	+	+	–	[+]	–	+	+	–	+	+	–	+	+	+	+	+	+	–	–	Europe
Plagius L'Hérit. ex DC.	–	–	+	–	+	+	–	–	–	+	–	–	+	+	–	+	+	+	+	+	+	–	–	Europe
Tanacetum L.	–	[+]	[+]	–	+	–	+	[+]	[+]	+	–	–	+	+	–	[+]	–	–	–	–	–	–	+	N. hemisphere
Leucanthemella Tzvelev	–	–	+	–	+	–	+	+	–	–	+	–	+	+	–	–	–	–	+	+	?	?	?	Russian Asia
Hymenostemma (Kunze) Willk.	+	–	–	–	+	–	+	+	–	–	+	–	+	+	–	+	–	–	–	+	?	?	?	Europe
Hippolytia Pojark	–	–	+	–	+	–	+	+	+	+	–	–	+	+	–	–	–	–	–	–	?	?	?	Russian Asia
Balsamita Miller	–	–	+	–	+	+	–	+	+	+	–	–	+	+	–	–	–	–	–	+	–	–	+	S.W. Asia–Europe
Prolongoa Boiss.	+	–	–	+	–	–	+	+	–	–	+	–	+	+	–	+	–	–	–	+	?	?	?	Europe
Phalacrocarpon Willk.	–	+	–	+	–	–	+	+	–	+	–	–	+	+	–	–	–	–	–	–	?	?	?	Europe
Dendranthema (DC.) Des Moul.	–	+	–	–	+	[+]	[+]	+	[+]	+	–	–	+	+	–	[+]	–	–	–	–	+	–	–	Oriental Asia

Thus, on the basis of differences in habit, cypsela morphology, cypsela anatomy and embryo-sac development, most of the species of the Chrysanthemum complex can be referred to one of five main genera ; *Tanacetum* L., *Chrysanthemum* L. sensu stricto, *Leucanthemum* Miller, *Dendranthema* (DC.) Des Moul. and *Argyranthemum* Webb ex Schultz Bip. Around these genera one finds a number of species which do not fit into the main groups and should be placed in independent satellite genera. Amongst these are *Plagius* L'Hérit. ex DC., *Hymenostemma* (G. Kuntze) Willk., and *Coleostephus* Cass., closely allied to *Leucanthemum* ; *Hippolytia* Pojark, *Balsamita* Miller and *Leucanthemella* Tzvelev, morphologically similar to *Tanacetum* L. ; and *Pinardia* (Cass.) DC. (to include *Chrysanthemum viscido-hirtum* (Schott) Thell.), very close to the genus *Chrysanthemum*.

The transitions between different genera are very rarely clearly worked out. One of the few groups to be studied in detail is the species group of *Tanacetum* sect. *Pyrethrum* subsect. *Leucanthemopsis* (Giroux) Heywood, in which Harling (1951) and Heywood (1954) show that a transition between *Tanacetum* and *Leucanthemum* occurs in Europe, particularly in plants from the Iberian peninsula.

Argyranthemum most closely resembles *Chrysanthemum* L. sensu stricto and its satellite genus *Pinardia* Cass. The three genera can readily be distinguished from all other taxa in the Chrysantheminae by the possession of heteromorphic (versus homomorphic) cypselas. Also, several other characters which vary in a reticulate fashion in the Chrysanthemum complex, such as the annual or perennial habit, leaf dissection, receptacle shape, cypsela anatomy and embryo-sac development, serve independently to separate *Argyranthemum*, *Chrysanthemum* and *Pinardia* from other genera when used in combination with the heteromorphic cypsela character (Table 1). Further discussion on generic treatments in homomorphic-fruited taxa can be found in the works of Briquet & Cavillier (1916), Tzvelev (1961), Harling (1951), Heywood (1954), Favarger (1966), Jeffrey (1971), and will not be considered in this paper.

In the narrowest sense *Chrysanthemum* contains three annual species, *C. segetum* L., *C. coronarium* L. and *C. carinatum* Schousb., predominantly distributed around the European Mediterranean region, S.W. Asia and N. Africa. The original distribution of the first two species, *C. segetum* and *C. coronarium*, is difficult to establish with certainty however, as they are now found as weeds in most temperate regions of the world.

The genus *Chrysanthemum* can be divided into two sections. Section *Chrysanthemum* contains the two weedy species, *C. segetum* and *C. coronarum*, and is characterized by the presence of yellow florets, secretory lobes on the corolla lobes of the disc florets, and epappose and wingless disc cypselas with 5–10 regularly spaced ribs. The second section, *Ismelia* (Cass.) DC., containing *C. carinatum*, has purple disc florets, red-purple, white and yellow ray florets, unribbed or irregularly ribbed and biwinged disc cypselas with a coroniform pappus. Plants of both sections are glabrous and have a monosporic embryo-sac development (Harling, 1951).

The monotypic genus, *Pinardia* (Cass.) DC., containing *P. viscido-hirtum* Schott, is usually included as a component section of the genus *Chrysanthemum*. It diverges, however, in having viscous glandular hairs on all vegetative parts, cypselas with apical aculei and a tetrasporic embryo-sac development (Harling, 1951).

C. carinatum is undoubtedly the closest extra-Macaronesian species to the genus *Argyranthemum* and on the basis of cypsela morphology is most similar to the large-flowered species of *A.* sect. *Sphenismelia* (Schultz Bip.) C. J. Humphries. The natural distribution of *C. carinatum* in North Africa and the Salvage Islands, thus, provides a phytogeographical as well as a morphological link between the Mediterranean and Macaronesian genera.

Despite the obvious transitions which do exist between the two genera, all species of *Argyranthemum* can consistently be separated from species of *Chrysanthemum* by their woody, perennial habit, and the unique bisporic embryo-sac development (Harling, 1951 ; Borgen, 1972). Recently various phytochemical differences of both the leaves and florets have also been found (Bohlman *et al.* 1964 ; Humphries, 1973). Both morphological characters and geographical distribution indicate that this group of species is a well-delimited and natural one, and species of *Argyranthemum* can be separated from others in the Chrysanthemum complex as consistently as those in other segregate genera of the Anthemideae recently recognized (Briquet & Cavillier, 1916 ; Heywood, 1954, 1958b ; Tzvelev, 1961 ; Favarger, 1966).

MORPHOLOGICAL CHARACTERS

Habit and Growth Form

Many of the endemic genera of the Macaronesian region, and particularly the Canary Islands, contain a high percentage of woody perennials (Lems, 1960). All species of *Argyranthemum* develop woody stems in the first year of growth, being gnarled and frequently ridged towards the base. The degree of woodiness is extremely variable, ranging from a slight thickening at the base of a slender herbaceous stem (e.g. *A. gracile* and *A. filifolium*) to a more or less completely woody trunk in the forest species (e.g. *A. broussonetii* and *A. haouarytheum*).

The habit and branching pattern are closely related to different ecological conditions. North coast chasmophytes of Tenerife and Gran Canaria (e.g. *A. coronopifolium* and *A. frutescens* subsp. *canariae*), for example, develop as low-growing decumbent shrubs, with short, stout fleshy stems, in response to the prevailing wet oceanic northerly winds. Plants with reduced seasonal cycles such as xerophytes of sub-alpine and arid south-facing slopes of Tenerife, Gran Canaria and La Gomera tend to have reduced lignification and develop either as dome-shaped plants branched almost entirely from the base, e.g. *A. tenerifae* and *A. adauctum* subsp. *gracile*, or as slender short-lived perennials, e.g. *A. gracile* and *A. filifolium* (Fig. 1). Inland cliff chasmophytes (e.g. *A. pinnatifidum* and *A. foeniculaceum*) develop a distinct candelabra-like branching pattern which is commonly found in other Macaronesian endemic genera such as *Echium* (Boraginaceae) (Bramwell, 1972) and *Aeonium* (Crassulaceae) (Lems, 1960). The branches diverge from all parts of the main stem at an angle between 45° and 90°, eventually becoming ascending. The capitula develop singly at the tips of the peduncles at more or less the same height (*A. foeniculaceum*), or as lax, globose corymbs (*A. pinnatifidum*). The lower leaves are caducous, and owing to the short internodes the upper leaves are crowded around the peduncles (Fig. 1).

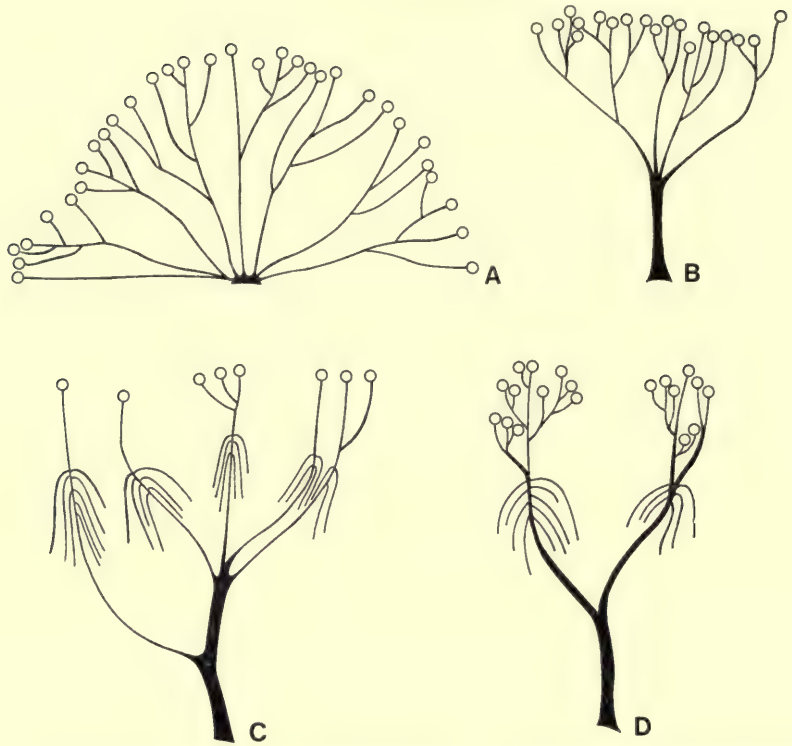

FIG 1. Branching patterns in *Argyranthemum* : A, *A. tenerifae*, *A. adauctum* subsp. *gracile* ; B, *A. gracile*, *A. filifolium* ; C, *A. foeniculaceum* ; D, *A. pinnatifidum*.

The largest plants of the genus are found in sheltered habitats with high rainfall, such as the laurel and pine forests of the western Canary Islands. In Tenerife, individuals of *A. broussonetii* are frequently up to 3 or 4 metres in diameter and well over 1 m in height.

Leaves

The leaves are alternate and are usually differentiated into lamina and petiole, although the latter is absent or reduced in sect. *Preauxia* and *Stigmatotheca*, and in some populations of *A. broussonetii* (Fig. 2N, R, V). The leaves are variously dissected, being sub-entire or with dentate margins (e.g. *A. pinnatifidum*, Fig. 2R), pinnatilobed or bipinnatilobed (e.g. *A. coronopifolium*, *A. maderense*, Fig. 2M, G), pinnatifid or bi-pinnatisect (e.g. *A. adauctum* subsp. *gracile* and *A. foeniculaceum*, Fig. 2V2, D). Many of the differences in outline and dissection are taxonomically useful. For the purpose of description, the main lobes from the rachis are called primary lobes. The primary lobes may be well-defined paired obovate or ovate limbs, with smaller tooth-like secondary lobes (e.g. *A. adauctum*, *A. webbii*, *A. broussonetii*, Fig. 2U, P, N) or the primary and secondary lobes may be of almost

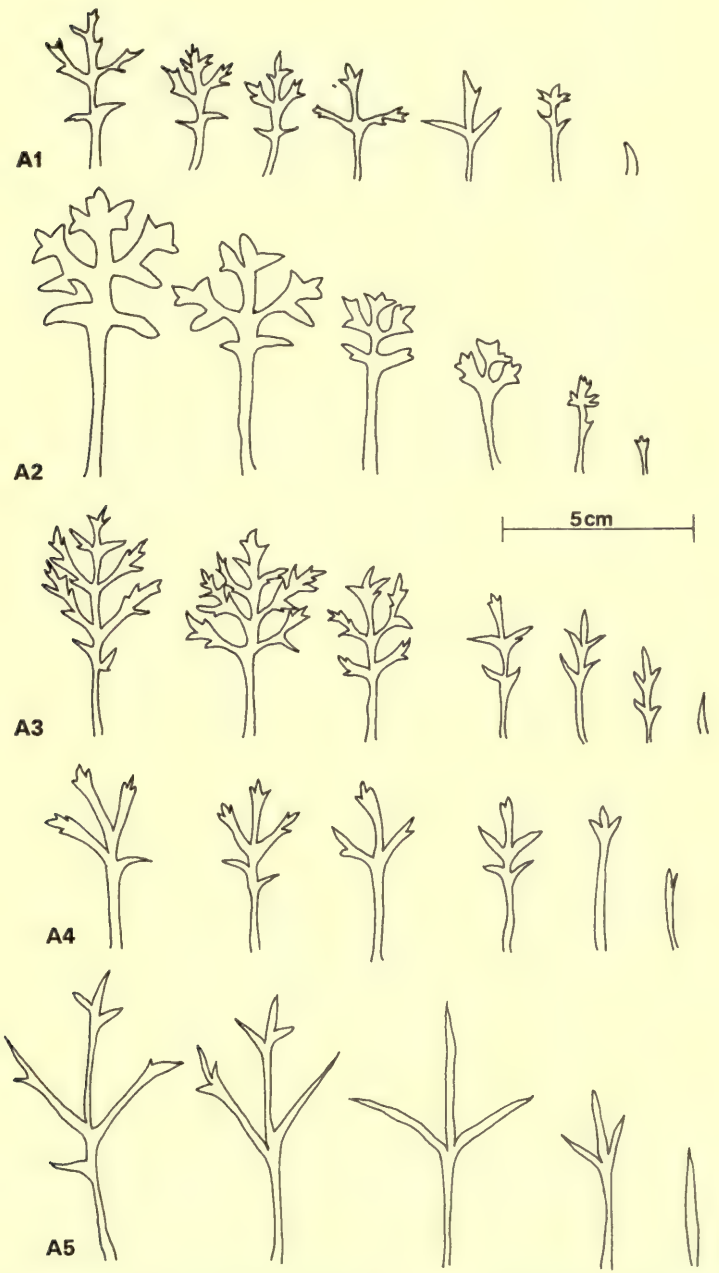

FIG. 2. Leaf morphology in *Argyranthemum* : A 1, *A. frutescens* subsp. *frutescens* ; A 2, *A. frutescens* subsp. *succulentum* ; A 3, *A. frutescens* subsp. *gracilescens* ; A 4, *A. frutescens* subsp. *parviflorum* ; A 5, *A. frutescens* subsp. *foeniculaceum*.

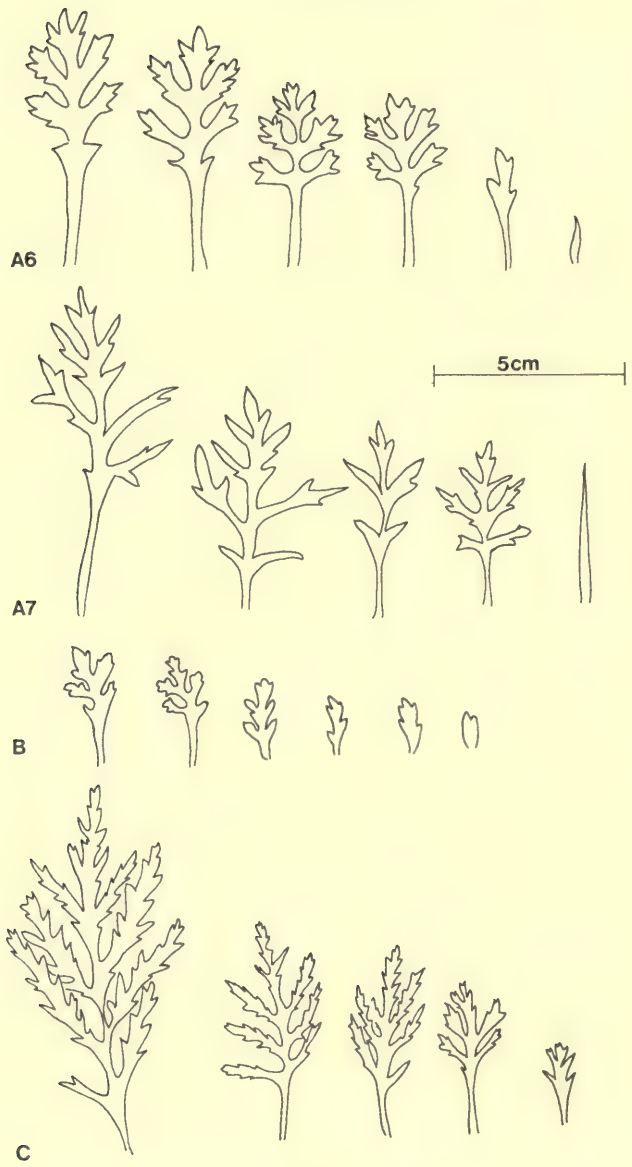

FIG. 2 (cont'd). Leaf morphology in *Argyranthemum* : A 6, *A. frutescens* subsp. *canariae* ; A 7, *A. frutescens* subsp. *pumilum* ; B, *A. lemsii* ; C, *A. haouarytheum*.

equal dimensions (e.g. *A. filifolium*, *A. foeniculaceum*, Fig. 2S, D). The number of leaf-lobes is normally very variable (e.g. *A. frutescens*) and is of little taxonomic use, although *A. gracile* invariably has trisect leaves (Fig. 2E). There is wide variation in absolute leaf size, from the short, narrow leaves of *A. lemsii* (Fig. 2B) to the extremely long, wide leaves of *A. broussonetii* and *A. pinnatifidum* (Fig. 2N, R).

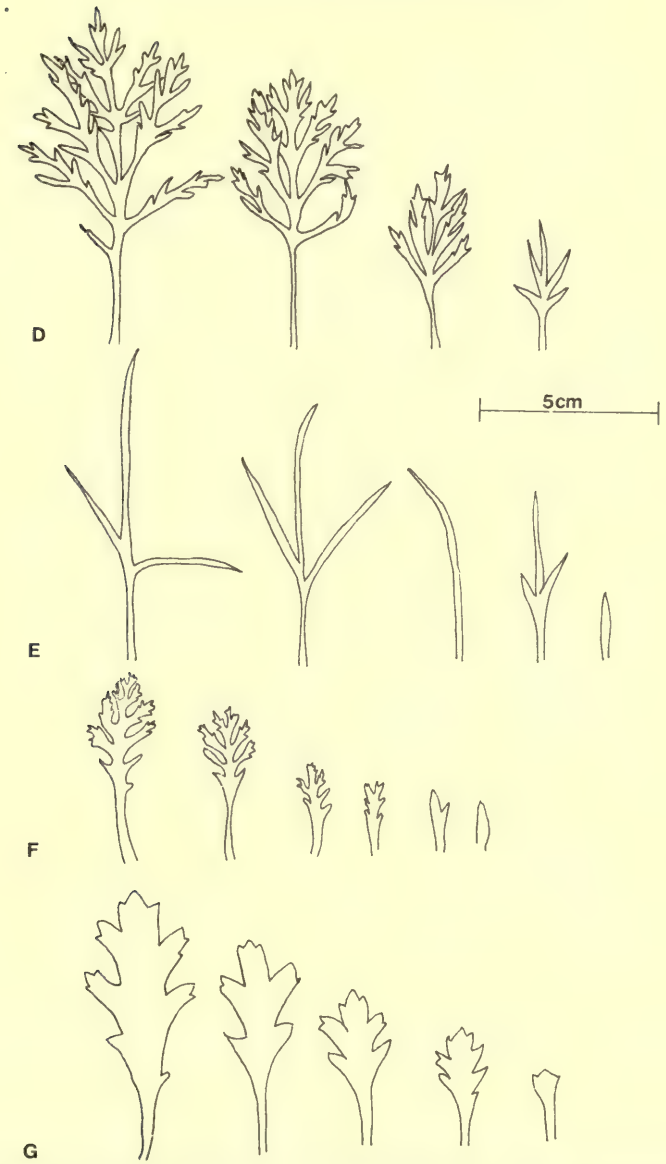

FIG. 2 (cont'd). Leaf morphology in *Argyranthemum* : D, *A. foeniculaceum* ; E, *A. gracile* ; F, *A. tenerifae* ; G, *A. maderense*.

Leaf characters provide the best examples of conspicuous responses to natural selection. Thus, in the widespread species *A. frutescens*, *A. adauctum* and *A. pinnatifidum* there is considerable variation in the dissection of the leaves, which is related to habitat and climate. The differences are maintained in cultivation and are rarely, if ever, due to environmentally induced plasticity (Fig. 2A, V). Leaves

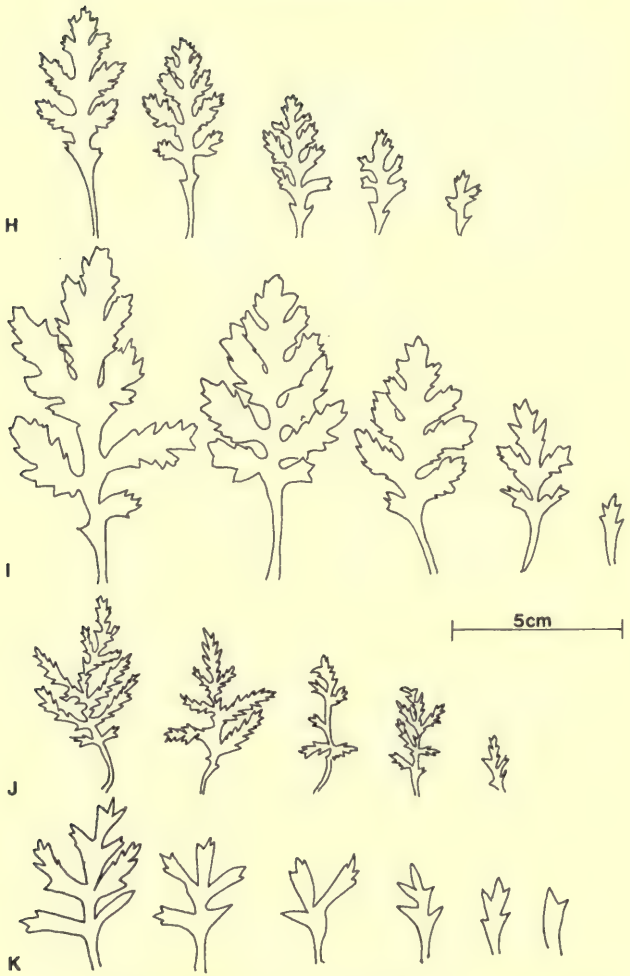

FIG. 2 (cont'd) Leaf morphology in *Argyranthemum* : H, *A. winteri* ; I, *A. lidii* ; J, *A. dissectum* ; K, *A. thalassophilum*.

of *A. frutescens* from the north coasts of Tenerife and Gran Canaria have broad, obtuse, fleshy lobes. Plants of xeric habitats on the south coast of Tenerife and the south-east and north coasts of Gomera have slender leaves with many narrow, acute leaf-lobes. Similarly, so do the forest populations of *A. adauctum*, particularly from north-facing slopes and alpine habitats. In *A. pinnatifidum* subsp. *succulentum* the fleshy texture of coastal populations increases with salinity ; the shortest, most succulent-leaved, individuals grow permanently in the spray zone along the coast (Fig. 2R2). As there is obviously a limited repertoire of leaf shape in the genus there is clearly convergence in morphology in particular environments. Thus, in the arid environments of the southern slopes of Gran Canaria and Tenerife, the

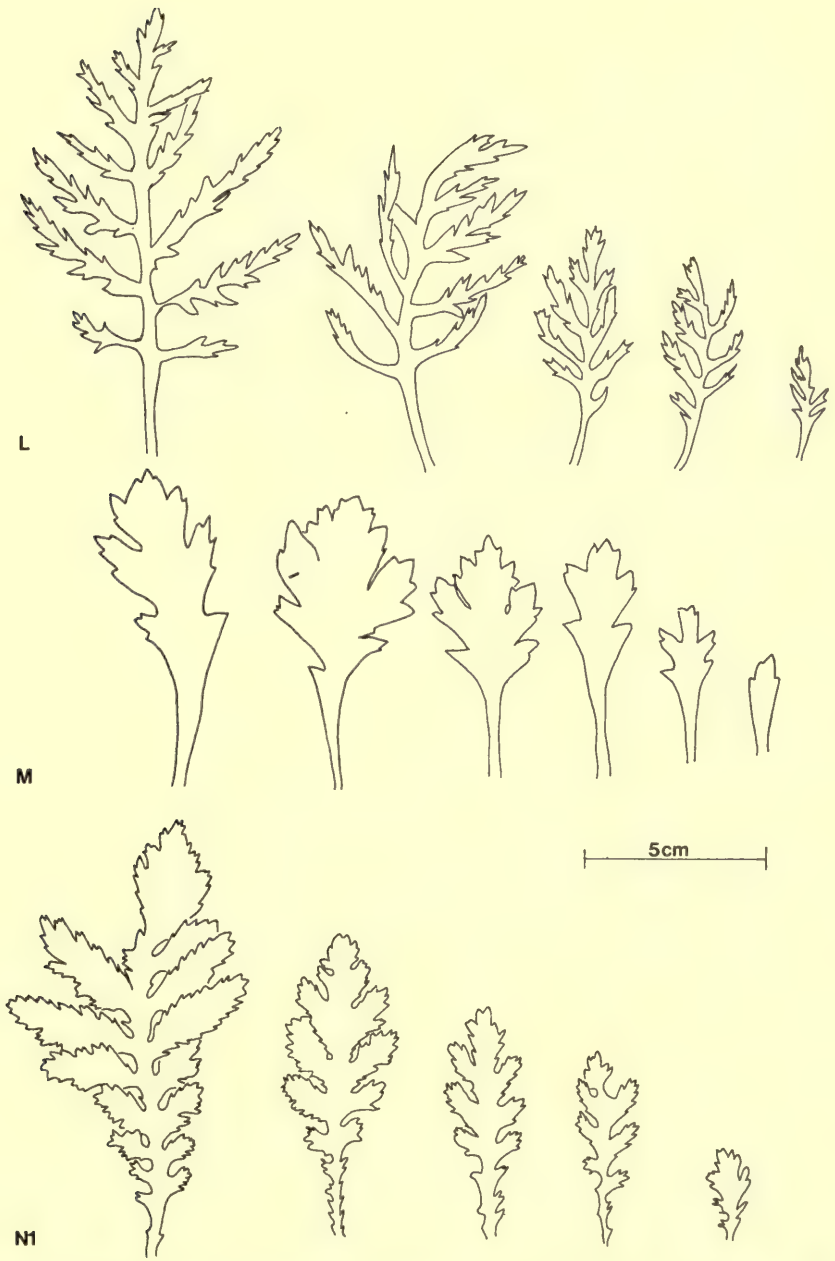

FIG. 2 (cont'd) Leaf morphology in *Argyranthemum* : L, *A. callichrysum* ; M, *A. coronopifolium* ; N 1, *A. broussonetii* subsp. *broussonetii*.

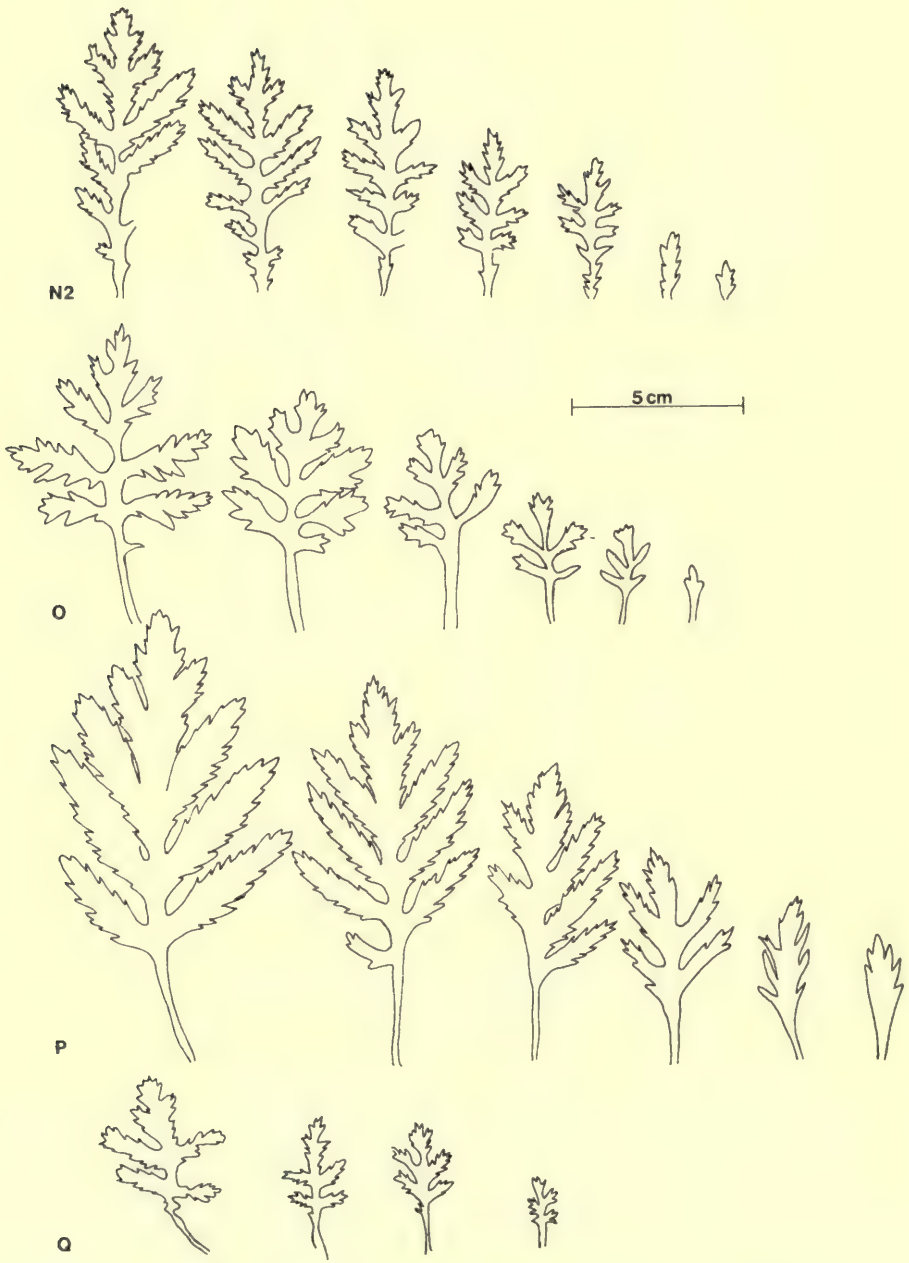

FIG. 2 (cont'd). Leaf morphology in *Argyranthemum* : N 2, *A. broussonetii* subsp. *gomerensis* ; O, *A. hierrense* ; P, *A. webbii* ; Q, *A. haemotomma*.

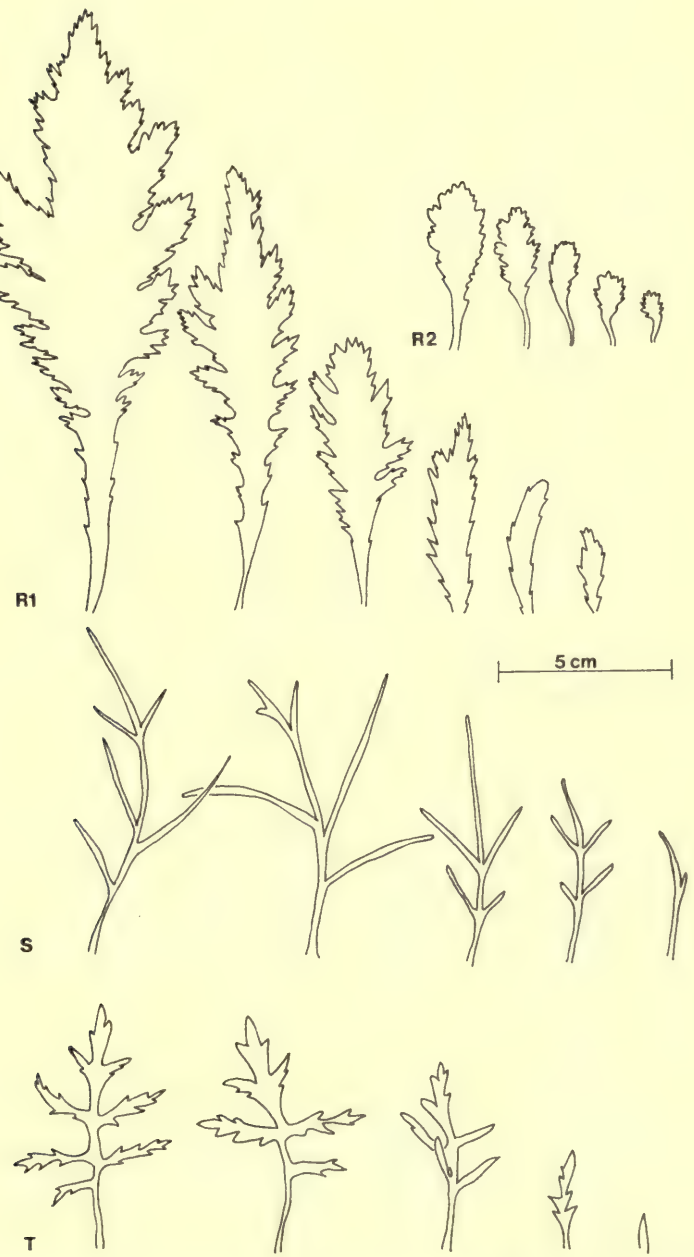

FIG. 2 (cont'd). Leaf morphology in *Argyranthemum*: R 1, *A. pinnatifidum* subsp. *pinnatifidum*; R 2, *A. pinnatifidum* subsp. *succulentum*; S, *A. filifolium*; T, *A. escarrei*.

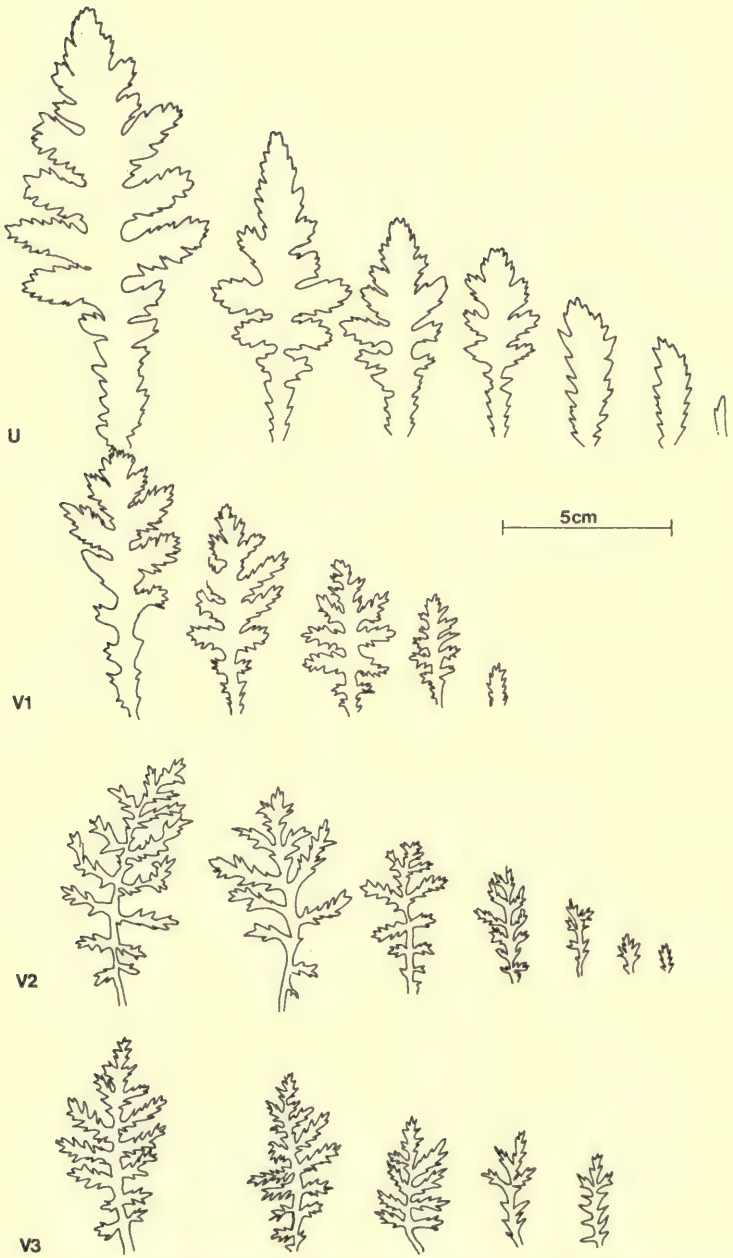

FIG. 2 (cont'd). Leaf morphology in *Argyranthemum*: U, *A. adauctum* subsp. *jacobaeifolium*; V 1, *A. adauctum* subsp. *canariense*; V 2, *A. adauctum* subsp. *gracile*; V 3, *A. adauctum* subsp. *dugourii*.

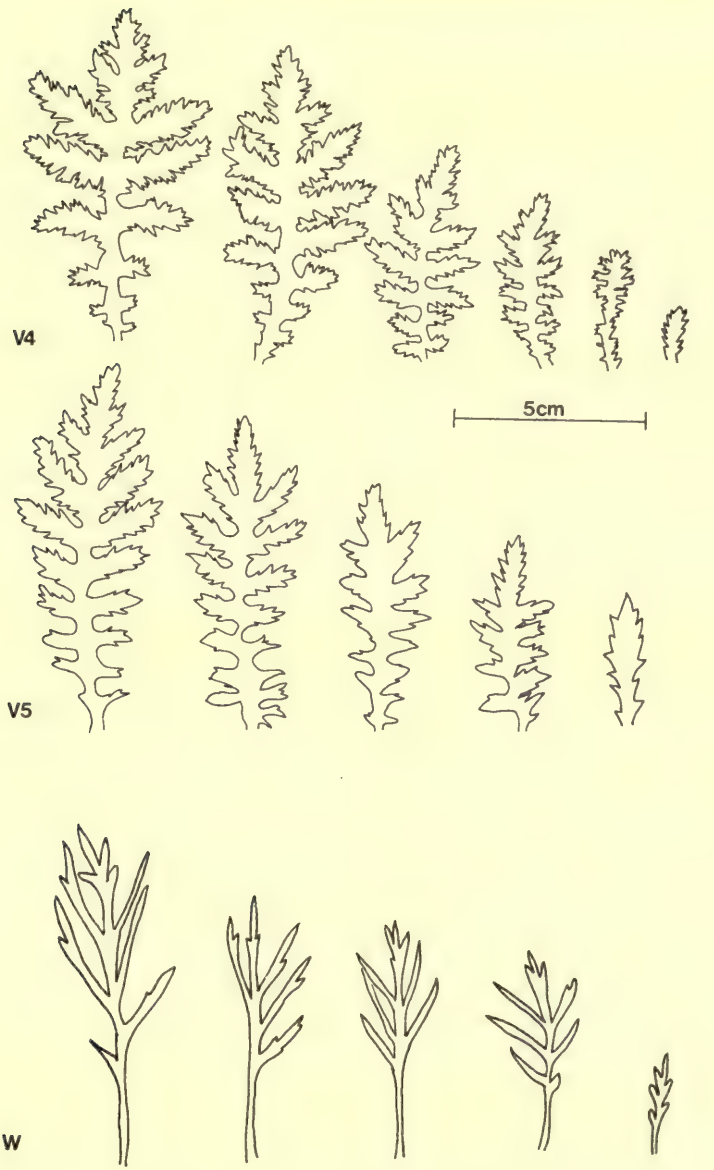

FIG. 2 (cont'd). Leaf morphology in *Argyranthemum* : V 4, *A. adauctum* subsp. *adauctum* ; V 5, *A. adauctum* subsp. *erythrocarpon* ; W, *A. sventenii*.

leaves of *A. filifolium* and *A. gracile* resemble other microphyllous plants common to the region. They are extremely dissected with a low number of leaf-lobes (Fig. 2E, R, S). Similarly coastal populations of *A. pinnatifidum* subsp. *succulentum*, *A. frutescens* subsp. *canariae* and subsp. *succulentum*, *A. thallassophilum* and *A.*

coronopifolium all show similar increased leaf succulence in response to the stringent conditions in the coastal communities in which they grow.

Indumentum

Most species of *Argyranthemum* are glabrous or sparsely pubescent on the stems and midrib. Conspicuously pubescent plants are only found in some populations of *A. adauctum*. The trichomes consist of two types. The most conspicuous are typically multicellular, unbranched hairs, with an enlarged terminal cell. The second type are small, rounded glandular hairs found predominantly on the lower leaf surface (Plate 28).

Inflorescence

The number of capitula in an inflorescence varies from one (as in some plants of *A. foeniculaceum*) to 30–50 (e.g. *A. hierrense* and *A. gracile*). A terminal capitulum develops first in the early stages of the inflorescence formation, followed by irregular alternate branching from lower bracts. The shape varies from a globose few-headed inflorescence with relatively short peduncles (e.g. *A. callichrysum*) to a lax open corymb with long peduncles (e.g. *A. gracile* and *A. filifolium*).

Capitulum

The shape of the capitulum is broadly to narrowly hemispherical and its size is extremely variable in species of wide ecological tolerance (e.g. *A. frutescens*, *A. pinnatifidum* and *A. broussonetii*). The size is normally quite uniform for any one population but frequently differs between them when they are completely separated. This suggests that it is controlled genetically, and the differences are apparently maintained by the lack of outcrossing between isolated populations (Humphries, 1973). Natural F_1 hybrids between the relatively small-headed *A. frutescens* and the large-headed *A. coronopifolium* have capitula of intermediate size while in the F_2 there is segregation to include sizes encountered in the species.

There is a wide range of variation in absolute capitulum size between different species, from the extremely narrow capitula in *A. filifolium* and Gomeran populations of *A. frutescens* to the broad capitula of *A. pinnatifidum*, *A. haemotomma* and *A. broussonetii*. Measurements are given in the descriptions.

Involucral Bracts

In all species the involucral bracts are imbricate and in 3–4 series. Bracts of the outer series typically have a triangular outline, with a thick fleshy midrib and thin scarious margins. The midrib of the outer bracts of *A. thallassophilum* is expanded into a broad fleshy keel. Bracts of the inner series vary from being linear-lanceolate to obovate or obspathulate in outline. The apex is usually expanded into a scarious lobe and is frequently laciniate or sinuate. Veins are conspicuously flabelliform at the apex in *A. thallassophilum* and easily observed in most species of section *Argyranthemum*. Bracts of *A. tenerifae* are distinctly narrow triangular in outline, with thin scarious margins, and expanded only slightly at the apex on the inner bracts.

In section *Preauxia* and in *A. tenerifae* (sect. *Argyranthemum*) the bracts are laxly imbricate in bud and can easily be removed, but in all other species they are tightly overlapping and difficult to remove.

Florets

All *Argyranthemum* species have conspicuously radiate capitula. Ray florets are female and the ligules are more or less linear-ovate in shape. The size and shape vary from the short, narrow ligules of *A. filifolium* to the long, broad ligules of *A. broussonetii* and *A. haouarytheum*. Measurements are given in the descriptions. The apex of the ligule can be entire, emarginate or 2- to 3-fid. They are normally white, but in *A. maderense* and *A. callichrysum* they are canary yellow, while in *A. haemotomma* they are white, pink or reddish-pink. The genetic basis of colour variation in *A. haemotomma* is unknown. The shade or colour tends to be constant for each population, but distinct between neighbouring populations, producing a wide range of colour variants within the species.

The disc florets are hermaphrodite and tubular-campanulate, the tube being terete or slightly compressed in transverse section. The five corolla lobes are initially involute, becoming revolute during anthesis. The tube is normally white and translucent, the corolla lobes being yellow, but in *A. haemotomma* the latter are deep reddish-purple.

Cypselas

The term 'cypsela' is used in preference to achene to describe the fruit of the Compositae, as it is derived from a bicarpellate syncarpous inferior ovary, fused with the pericarp, testa and hypanthium (after Fahn, 1967).

The cypselas are heteromorphic ; those of ray florets are morphologically quite distinct from those of the disc florets. The ray cypselas are trigonous (e.g. sect. *Argyranthemum* and sect. *Sphenismelia*, Fig. 3a, e), terete or semiterete (e.g. sect. *Preauxia*, Fig. 3s, t). They can be erect (e.g. *A. broussonetii*, Fig. 3j) or arcuate, with a convex dorsal surface and a concave ventral surface (e.g. sect. *Argyranthemum*, Fig. 3a–d). There are usually 1 to 4 wings, varying in shape from a large coriaceous expansion (Fig. 3a–d) to a thin hyaline cristate extension of the margin (Fig. 3j, k, p). Sects. *Monoptera* and *Preauxia* are typically wingless (Fig. 3s, t, w).

Disc cypselas are obconical-turbinate or clavate, and are strongly laterally compressed, irregularly 4-angled or terete in transverse section. They are 1-winged (e.g. sect. *Argyranthemum*, Fig. 3f, h), 2-winged (e.g. *A. broussonetii*, Fig. 3l, m) or wingless (e.g. *A. pinnatifidum*, *A. adauctum*, Fig. 3q, r, x, y). Wings vary in shape from a cuneiform coriaceous ventral keel (e.g. sect. *Argyranthemum*) to a cristate margin (e.g. sect. *Monoptera*, Fig. 3h, q).

In transverse or longitudinal section the individual compositional components of the fruit wall are impossible to identify anatomically. However, the cypsela wall can conveniently be divided into three distinct layers : the epicarp consisting of a single row of rectangular parenchymatous cells slightly thickened with sclerenchyma in the corners ; the mesocarp composed of numerous layers of irregularly

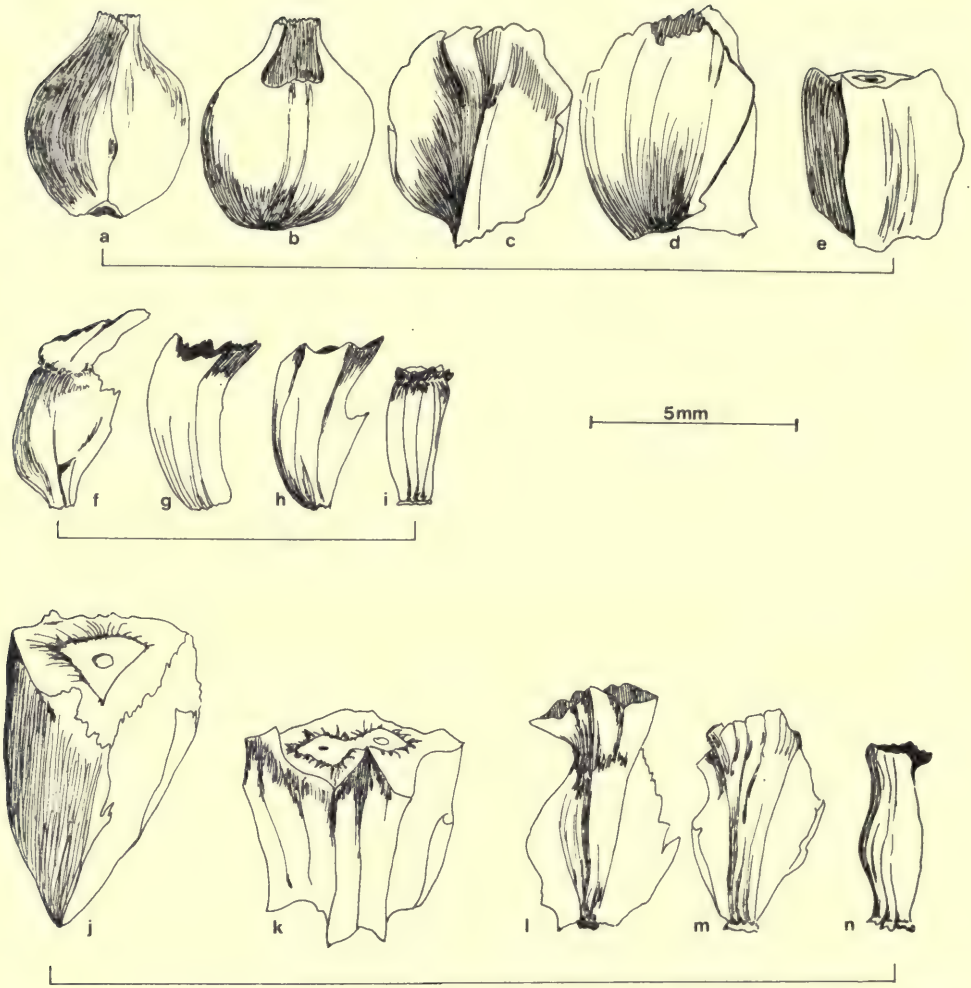

FIG. 3. Cypselas of *Argyranthemum* species grouped by taxonomic section: Section *Argyranthemum*: a, ventral surface, b, dorsal surface of ray cypsela of *A. gracile*; c, ventral surface, d, dorsal surface of ray cypsela of *A. winteri*; e, ventral surface of cypsela of *A. callichrysum*; f, lateral surface of disc cypsela of *A. dissectum*; g, h, i, lateral surface of disc cypselas of *A. frutescens* subsp. *frutescens*; Section *Sphenismelia*: j, ventral surface of ray cypsela of *A. broussonetii*; k, ventral surface of ray cypsela of *A. webbii*; l, lateral surface of disc cypsela of *A. broussonetii*; m, n, lateral surface of disc cypselas of *A. hierrense*.

shaped, tightly fitting, longitudinally arranged cells, variously thickened with sclerenchyma, vascular bundles, consisting entirely of lignified vessels and fibres, being found in this central layer; the endocarp consisting of a double row of regularly arranged rectangular cells lining the pericarp cavity between the mesocarp and the embryo. The cotyledons appear as two semi-terete lobes orientated in either anterior-posterior or transverse positions relative to the floral axis.

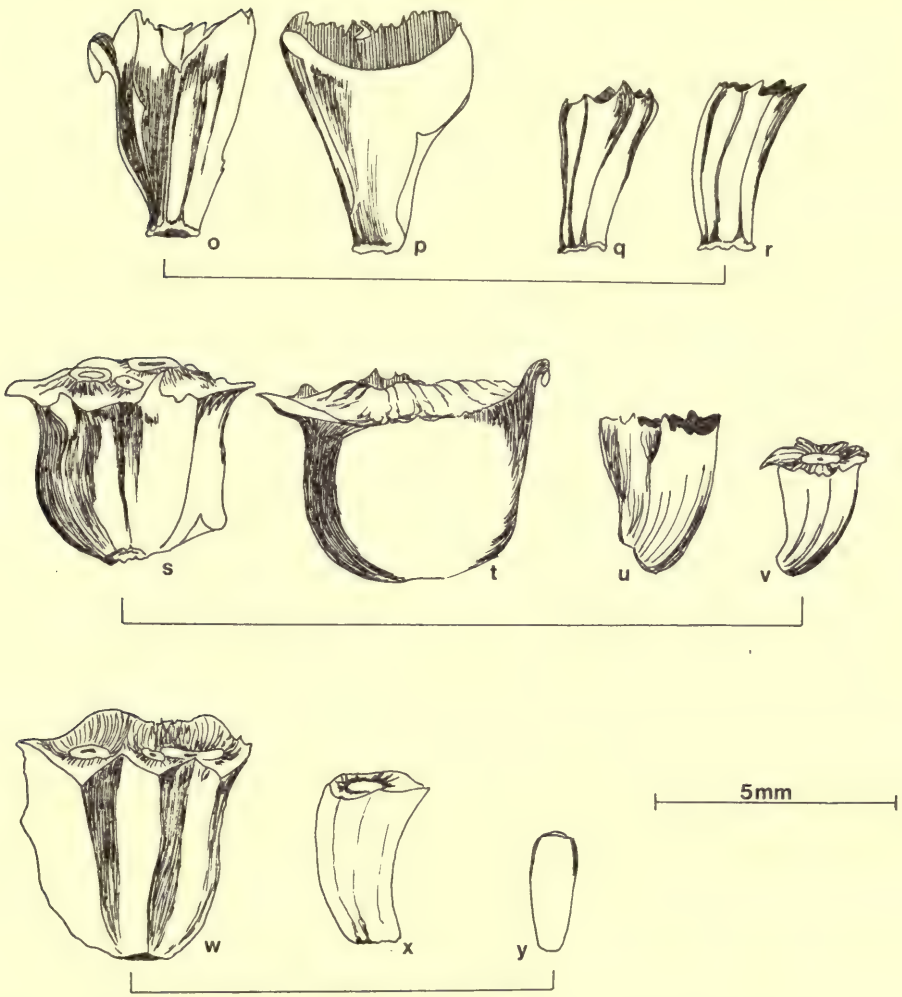

FIG. 3 (cont'd). Cypselas of *Argyranthemum* species grouped by taxonomic section: Section *Stigmatotheca*: o, ventral surface, p, dorsal surface of ray cypsela of *A. pinnatifidum*; q, ventral surface, r, lateral surface of disc cypsela of *A. pinnatifidum*; Section *Monoptera*: s, ventral surface, t, dorsal surface of ray cypsela of *A. filifolium*; u, v, lateral surface of disc cypselas of *A. filifolium*; Section *Preauxia*: w, ventral surface of ray cypsela of *A. adauctum*; x, y, lateral surface of disc cypselas of *A. adauctum*.

The epicarp of the cypsela is smooth and devoid of superficial structures, although the pericarp is irregularly folded or ridged in some species. The epicarp and mesocarp of adjacent ray cypselas are frequently coalesced (e.g. *A. hierrense*, *A. webbii*, *A. callichrysum* and *A. adauctum*, Fig. 3k, s, t, w), with occasional instances of fusion in both ray and disc cypselas (e.g. sect. *Monoptera*). Several specimens of *A. filifolium* have been observed with all of the cypselas in a capitulum completely coalesced to form a single dispersal unit.

In all species the cypselas have truncate bases encircled by a small ridge, which is presumably associated with abscission from the receptacle. At the distal end of the cypsela there is a small circular, semi-circular or triangular mark with a conspicuous central ring left by the abscission of the corolla and style (Fig. 3j, s, v, w). The colour ranges from white or yellow to chestnut brown, red-brown or black, the apex frequently being tinged with purple (e.g. sect. *Monoptera*).

Photographs of cypselas from several Canary Islands species are given in Borgen (1972).

Pappus

The variation in pappus morphology is generally greater than for other cypsela characters in *Argyranthemum*, particularly in sects. *Stigmatotheca*, *Argyranthemum* and *Sphenismelia*. The pappus consists of a scarious or coriaceous corona (Fig. 3a–d, f–h, l, m), a corneal or coriaceous ridge (Fig. 3e, w), or one or two corniculate spines (Fig. 3s, t). Margins are entire or sinuate-dentate. In sects. *Sphenismelia* and *Stigmatotheca*, the pappus often differs on ray and disc cypselas. In some species (e.g. *A. tenerifae*) the pappus may also vary in disc cypselas of the same capitulum. *A. adauctum* in sect. *Preauxia* sometimes has a rudimentary marginal ridge, but usually lacks a pappus completely (Fig. 3x, y).

In species with a coroniform pappus (e.g. *A. frutescens*, *A. gracile*, *A. foeniculaceum*, etc.) the pappus of the ray cypselas, and occasionally of the outer series of disc florets, is dimidiate and secund. The pappus projects centripetally from the ventral edge of the cypsela and is absent along the dorsal edge. This development is mainly influenced by the sloping position of the cypsela on the convex-conical receptacle and deflexion of the ray florets during anthesis.

CHROMOSOME NUMBERS

All species of *Argyranthemum* hitherto investigated from natural populations are diploid, with a basic number of $x = n = 9$ and a somatic chromosome number of $2n = 18$ (Tahara, 1915 ; Harling, 1951 ; Larsen, 1958, 1960 ; Borgen, 1969, 1970 ; Bramwell *et al.*, 1971). During the course of the work new counts have been made for six species, two subspecies of *A. frutescens* and two subspecies of *A. adauctum*, and previous counts have been confirmed at least once in all other taxa. In all of these cases the plants were found to be diploid, with 18 somatic chromosomes. The detailed results of these cytological studies are being reported elsewhere (Humphries, 1975).

Triploids ($2n = 27$) have only previously been reported in garden populations of *A. frutescens* (Tahara, 1915 ; Shimotomai, 1937 ; Harling, 1951 ; Dowrick, 1952). Similarly in this study, all meiotic preparations from pollen mother cells of buds fixed in the field have shown the diploid condition. However, in root tip mitoses and pollen mother cell preparations made from cultivated specimens of the only natural hybrid, *A. coronopifolium* × *frutescens* subsp. *frutescens*, plants with somatic numbers varying from $2n = 18$ to $2n = 36$ have been detected. It seems possible that genetic disturbances have occurred during meiosis giving rise to unbalanced

gametes in the hybrid plants and in turn resulting in the formation of aneuploids, triploids and tetraploids which are normally suppressed in natural conditions.

Since the Chrysanthemineae form a fairly clear-cut natural group, it is of interest to consider briefly the chromosome numbers of other genera related to *Argyranthemum*. Although the basic number of the subtribe is $x = 9$, a wide range of chromosome counts from $2n = 18$ to $2n = 198$ have been reported (Dowrick, 1952). Variation in chromosome numbers (of authentic material) are due almost entirely to the formation of polyploids which are largely distributed in two regional centres of Central and Southern Europe and Eastern China and Japan. A great deal of evidence has been assembled to show that polyploids of Europe, belonging mainly to the genus *Leucanthemum*, are neo-endemic allopolyploids predominantly occupying alpine regions in areas left by retreating glaciers after the Pleistocene period (Villard, 1970). Similarly, it has been suggested that the majority of the oriental polyploid species, which belong mainly to the genus *Dendranthema* Desmoul. (*Chrysanthemum* L. sensu lato), have been produced by successive waves of hybridization and allopolyploidy, but also in a few cases by autopolyploidy, as a response to local ecological conditions (Shimotomai *et al.*, 1956 ; Tanaka, 1959a, b, c ; Kaneko, 1961). In Macaronesia all taxa of the Chrysantheminae are diploid, apart from a single tetraploid population of *Tanacetum ptarmicaeflorum* Schultz Bip. (Larsen, 1960).

TAXONOMIC RELATIONSHIPS WITHIN *ARGYRANTHEMUM*

As pointed out above (p. 169) and originally indicated by Schultz Bipontinus (1844a) the cypselas are perhaps the most characteristic infra-generic morphological features in *Argyranthemum*. On the basis of variation in cypsela shape and size, wing form and pappus morphology, coupled with various vegetative characters, it is possible to recognize five distinct sections within the genus.

The geographical distribution of each section is influenced by a pronounced ecological preference closely correlated with the altitudinal distribution of vegetation zones in the Canary Islands and to a lesser known extent of water availability on Madeira and the Salvage Islands (Table 2). Individual details of climax components, habitat conditions and limits of vegetation zones in relation to the position, altitude and climate of the Macaronesian Islands, and the Canary Islands in particular, can be found in the works of Webb and Berthelot (1835–1850), Ceballos & Ortuño (1951), Cifferi (1962), Oberdorfer (1965), Bramwell (1971) and Sunding (1972).

Ecological adaptive radiation to different habitats within each of the vegetation zones of the Canary Islands accounts for about 80% of the species diversity in *Argyranthemum*. Species density and section distribution have a more or less direct correlation with habitat diversity and availability in the different vegetation zones on each of the islands (Table 2 ; Fig. 4). On Tenerife, with the greatest land surface area ($\simeq$ 1880 km^2), the maximum number (5) of different vegetation zones in the Canary Islands (Table 2), and a wide range of climatic conditions, one finds nine species from three sections representing some 40% of the total infra-generic variation in Macaronesia. Lanzarote, on the other hand, with its single lowland xerophytic zone, invariable, desert-like climatic conditions and a relatively small surface area, contains only one isolated species, *A. maderense* (Fig. 4).

TABLE 2

The principal vegetation zones of the Canary Islands

Vegetation zone	Altitude (m)	Distribution	Characteristics of the vegetation zones
Alpine violetum	2700–3500	Tenerife	Dominated by a single species; *Viola cheiranthifolia*
Sub-alpine leguminous scrub	1900–2700	Tenerife and La Palma	Dominant species include *Spartocytisus supranubius, Nepeta teydea, Echium wildpretii,* and *Argyranthemum frutescens*
Pine Savannah	200–2000	Hierro, La Palma Tenerife and Gran Canaria	Dominated by *Pinus canariensis,* but often broken down into sub-climax communities as a result of forestry activities. Predominant scrub species include *Chamaecytisus proliferus.* On the southern slopes of Tenerife, *Juniperus phoenicea* scrub is also present
Laurel forest	600–1500	La Gomera, La Palma and Tenerife	Dominant species include *Apollonias barbujano, Persea indica, Ocotea foetans* and *Laurus azorica.* Great destruction of the laurel forest in recent times has led to the development of secondary vegetation. The most widespread sub-climax communities include *Erica arborea, Myrica faya* and *Ilex canariensis* (Fayal-brezal)
Lowland xerophytic zone	0–600 (–800)	All islands	Many vegetation types and different communities. Dominant families include stem and leaf succulents of the *Euphorbiaceae* and the *Crassulaceae.* Other important families include the *Compositae, Caryophyllaceae* and the *Liliaceae.*

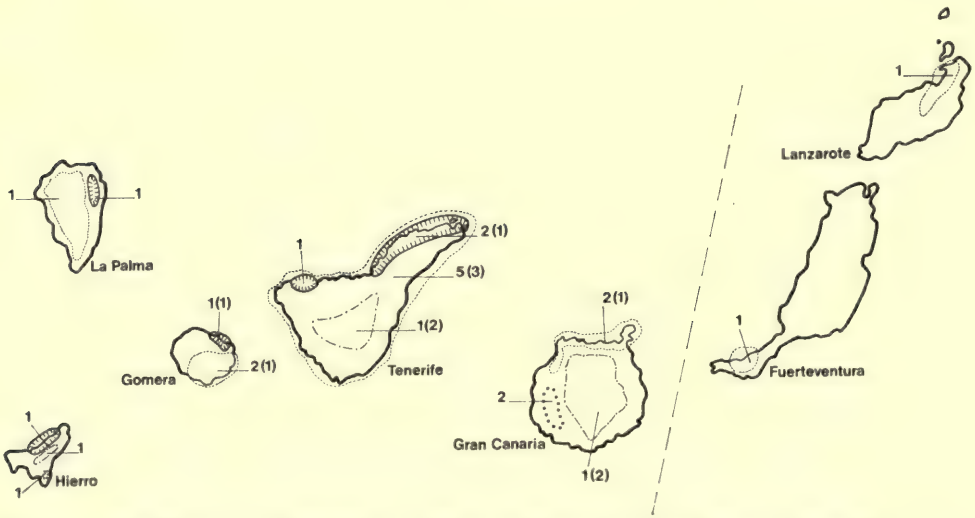

FIG. 4. Distribution of Sections of *Argyranthemum* in the Canary Islands. . . . . , Section *Argyranthemum*; ⌊⌊⌊⌊⌊, Section *Sphenismelia*; . . . . . , Section *Monoptera*; -·-·-, Section *Preauxia*. The figures are the numbers of species in each area, with the number of subspecies in parentheses.

Section *Argyranthemum*

Section *Argyranthemum* consisting of 13 widely different species is by far the largest and most complex group in the genus, occupying predominantly xerophytic habitats, but also montane and sub-alpine habitats in all of the Canary Islands (Fig. 4), the Salvage Islands and Madeira. Its greatest development is found in the western Canary Islands and especially on Tenerife, where five species (*A. frutescens*, *A. lemsii*, *A. gracile*, *A. foeniculaceum* and *A. tenerifae*) all occur. Two of these species (*A. frutescens* and *A. gracile*) dominate the lowland xerophytic zone around the island periphery (Figs 5, 6, 12) and, though basically similar morphologically, can readily be distinguished from one another and are allopatrically and ecologically isolated. *A. frutescens* is the most widespread species in the section and is divided into a number of subspecies occurring in a variety of localities on Tenerife, Gran Canaria, Gomera and La Palma. It is perhaps best considered as an actively evolving taxon at an early stage of fragmentation. As well as the seven subspecies there are a number of closely related vicariant taxa to *A. frutescens* including *A. thalassophilum* from the Salvage Islands, *A. dissectum* from Madeira and *A. sventenii* from Hierro.

A second species group (*A. winteri*, *A. lidii*, *A. haouarytheum* and *A. callichrysum*) represent the cliff-montane and forest vicariants of the Canary Islands within section *Argyranthemum*. The species are very similar morphologically but are separable on differences of leaf dissection, of flower colour, and of inflorescence structure. Two of the species, *A. winteri* and *A. lidii*, are very narrowly restricted endemics confined to single localities on the western mountains of Feurteventura and Gran Canaria respectively (Figs 14, 16). *A. callichrysum* is a little more widespread, being a dominant form of the xerophytic localities in the Gomeran mountains (Fig. 18). The last species of this group, *A. haouarytheum*, is the most distinctive and variable of montane taxa, widespread in western pine forest habitats on the island of La Palma (Fig. 11). It occupies a special ecological position in section *Argyranthemum* in so much as all other *Pinus canariensis* forests in the Canary Islands are dominated by the polymorphic *A. adauctum* of the monotypic section *Preauxia*.

The three remaining species in the section, *A. foeniculaceum*, *A. tenerifae* and *A. maderense*, are all morphologically very distinctive and do not have any immediately recognizable relatives within the genus. All three species are ecologically distinct and the habit and leaf morphology are closely correlated with habitat. *A. foeniculaceum* is an obligate chasmophyte on Tenerife, occurring as two disjunct population groups of inland sheltered cliffs on Miocene basalt substrata (Fig. 9). Between the two populations one finds more recent coverings of Pliocene basalts and volcanic lavas of the Quaternary epoch. The disjunction between the two populations is best explained by the prevention of reinvasion of the intermediate habitats by *A. foeniculaceum* because of the drastically changed ecology, and competition from more adaptable plants.

The sub-alpine species *A. tenerifae* grows on cinders and volcanic debris at about 2000 m in the geologically most recent area on Tenerife (Fig. 12), the Cañadas Caldera, where volcanic eruptions have been reported as late as the 20th century.

The morphological relationships of this distinctive nanophanerophyte with other species is rather obscure, suggesting that either it represents an adaptation to the extreme conditions of this barren region or it is an immigrant now extinct in its original source localities. An interesting phylogenetic point which stems from morphological observations on *A. tenerifae* is that morphological divergence is not necessarily indicative of species age. What is more likely in areas of rapidly changing environmental conditions such as those of the Cañadas region is that evolutionary rates are quite different from those in the old stable cliff (or forest) habitats, which might have remained unchanged for millions of years.

The geographically most isolated species of the Canaries group, *A. maderense*, occurs as a rare coastal chasmophyte on the rocks of Famara on Lanzarote (Fig. 13). The pale yellow ligules and the succulent, ± sessile, pinnatilobed leaves with wide internodes reflect also the taxonomically isolated position of this species.

Section *Sphenismelia*

The five broad-leaved species of this section (*A. coronopifolium*, *A. broussonetii*, *A. hierrense*, *A. webbii* and *A. haemotomma*) have an obligate ecological preference for the moist laurel forests and halophyte communities of the north-facing slopes and coastal areas of the western Canary Islands and Madeira. The two morphologically similar taxa *A. broussonetii* and *A. webbii* represent a vicariant species pair dominating the forest-covered northern slopes of Tenerife, Gomera and La Palma.

A. hierrense is a distinct third member of the section, also occurring in the laurel forests and the lower reaches of the pine forests on Hierro, but it is primarily a coastal chasmophyte of very low altitudes.

A. coronopifolium is perhaps the rarest of all species in the genus *Argyranthemum*, existing only as a single population of a few plants on the steep cliffs of Teno in N.W. Tenerife. It is in danger of becoming extinct in the near future in its pure form, as interspecific hybrids with *A. frutescens* are invading the stand and backcrossing with the parental plants (Humphries, 1973).

The exact affinities of *A. haemotomma* with other members of the section are somewhat obscure. The species is endemic to the small desert islands of Deserta Grande and Bugio, off Madeira. It is similar in habit to the Tenerife chasmophyte, *A. coronopifolium*, but differs in the smaller bipinnatifid leaves and distinctive deep red colour of the corollas. Plants with a similar flower colour in the Chrysanthemum complex are found only in the annual species, *Chrysanthemum carinatum* Schousb., from continental North Africa and the Salvage Islands (see p. 156).

Section *Stigmatotheca*

This section contains one polymorphic species, *A. pinnatifidum* from Madeira. It is distinguished from its nearest relatives of section *Sphenismelia* by the vestigial wings, lack of pappus and irregular ribbing of both ray and disc cypselas. The candelabra branching pattern and crowding of leaves around the base of the peduncles is shared by *A. foeniculaceum* in section *Argyranthemum*, but the unique development of large, ovate ± entire leaves represents an extreme development of the foliage repertoire in *Argyranthemum*. The distribution of this species is unusual

in that it occurs at all altitudes on the island of Madeira. A partial explanation for this phenomenon is that Madeira is much cooler and wetter than the Canary Islands and does not develop such distinctive vegetation zonation.

Section *Monoptera*

This section contains two species (*A. filifolium* and *A. escarrei*) both of which are very narrow endemics from the island of Gran Canaria. They are both adapted to extremely xerophytic habitats, having a reduced habit, thin pinnatisect leaves and diminutive floral parts. The distinctive clavate cypselas with a corniculate pappus are quite unlike any other species in the genus although their nearest relative on the basis of cypsela morphology is *A. adauctum* in section *Preauxia*.

The distribution and morphology of the two species never overlap and both taxa exist as a small number of populations. It is difficult to distinguish the subtle ecological differences of their individual habitats but *A. escarrei* tends to favour a slightly wetter climate and higher altitude than *A. filifolium* and probably represents a divergent upland ecotype.

Section *Preauxia*

This monotypic section containing *A. adauctum* is found primarily in the endemic montane *Pinus canariensis* forest and savannah of Gran Canaria, Tenerife and Hierro. *A. adauctum* subsp. *gracile*, however, occurs in more open situations and extends to the intensely arid lowland xerophytic scrub of southern Gran Canaria and subsp. *erythrocarpon* is found in the tree heath—broad-leaved evergreen forests of Hierro. The fruit morphology is unique amongst Macaronesian species in that the disc cypselas are quite wingless and not compressed. The species is extremely variable and a number of different subspecies can be recognized. As with *A. frutescens*, the component subspecies are groups of closely related ecologically adapted local populations, insufficiently diverged to be considered as separate species.

ARGYRANTHEMUM Webb ex Schultz Bip.

ARGYRANTHEMUM Webb ex Schultz Bip. in Webb & Berthel., Phyt. Canar. 2 : 245, 258 (1844).

Chrysanthemum L., Sp. Pl. 2 : 887 (1753) ; Gen. Pl., ed. 5 : 379 (1754), pro parte.
Pyrethrum Zinn, Cat. Pl. Gott. : 414 (1757), pro parte.
Argyranthemum Webb & Berthel., tom. cit. : t. 92 (Mar. 1839), *nom. nud.*
Chrysanthemum sect. *Argyranthemum* (Webb ex Schultz Bip.) Bentham in Bentham & Hooker, Gen. Pl. 2 (1) : 424 (1873).
Chrysanthemum subgen. *Argyranthemum* (Webb ex Schultz Bip.) Harling in Acta Hort. Berg. 16 : 50 (1951).

Suffruticose *perennials* 40–150 cm ; stems procumbent to ascending, sulcate. *Leaves* ± entire or variously dissected. *Inflorescence* lax, corymbose ; capitula pedunculate, (1–) 2–50 per branch ; peduncles erect, striate. *Involucre* hemispherical ; bracts imbricate, in 3–4 series, the veins thick, herbaceous, green, the margins scarious. *Receptacle* convex-conical ; scales absent. *Ray florets* 6–38 mm,

female, ligulate, yellow, white or pink ; *disc florets* 2–4 mm, hermaphrodite, tubular-campanulate, pentamerous, yellow or deep purple-red, usually with sparse glandular hairs on corolla-tube. *Anthers* 5, laterally connate with short tails and triangular apex. *Styles* bifid, the base swollen, the apices truncate-pencilliate. *Cypselas* heteromorphic, smooth or irregularly ribbed, without pericarpic secretory cells. *Ray cypselas* trigonous, with 1–3 wings, or wingless, turbinate, usually arcuate, sometimes coalesced into groups of 2–9 ; pappus completely or partially coroniform, or absent. *Disc cypselas* abconical, terete, 4-angled or laterally compressed, with 1–2 wings or wingless, sometimes coalesced with the ray cypselas ; pappus completely or partially coroniform, or absent. *Cotyledons* transversely orientated ; *embryo-sac* bisporic. $2n = 18$.

Type species : *A. frutescens* (L.) Schultz Bip., based on *Chrysanthemum frutescens* L.

Endemic to Macaronesia : Madeira, the Salvage Islands and the Canary Islands ; introduced in the Azores.

The question of whether the generic name *Argyranthemum* was validly published by Webb & Berthelot in March 1839 is debatable. It first appeared on Tab. 92 of the *Phytographia Canariensis*, which was part of livraison 37 of the work (Stearn, 1937). This plate gives illustrations of two plants : '*Argyranthemum frutescens* Nob. γ *grandiflorum*, δ *cuneiforme*'. Of the first, only a habit drawing is given, but the illustration of the second has both this and analyses of the flower. The analytical figures are numbered, but there is no key to the numbering on the plate. The problem is : can this plate be regarded as an illustration with analysis of a monotypic new genus based on a new species and as thus giving the generic name valid publication?

On the one hand, there is nothing to connect the name *Argyranthemum frutescens*, or either of the varietal epithets, with previously published species. Nevertheless the characters of the plant illustrated make it obvious that it is closely related to *Chrysanthemum*, and the names *C. frutescens* L., *C. grandiflorum* (Willd.) DC., and *C. grandiflorum* [var.] δ *cuneiforme* DC. all applied to plants from the Canaries.

The argument for rejecting the view that the plate gives valid publication to the generic name, on the other hand, is that, since the only illustration with analysis on it is of a non-typical variety, the pictures do not necessarily show the essential features of the species and genus. This view seems the more cogent, especially as the fact that Webb & Berthelot did not regard the species as new became apparent when the text of their work was issued, and it is adopted here.

When the name next appeared, on Tab. 94 of the *Phytographia Canariensis* in May 1839, it was on an illustration of '*Argyranthemum anethifolium* Nob.' As this adds a second species to the genus, it cannot give the name valid publication. Accordingly *Argyranthemum* is treated here as having been first validly published in 1844, in the text of the *Phytographia Canariensis*. This means that all the names on Plates 90–96 of the work are not validly published. This has the advantage that all those that were intended as new combinations can be treated as such, and do not have to be regarded as names of new species with Webb's specimens as their types.

Key to Species

Ray cypselas wingless ; pappus a coriaceous rim or absent :
  Stem and leaves hispid to tomentose . . . . . 22. *adauctum*
  Stem and leaves glabrous :
    Ray cypselas not coalesced into groups :
      Disc cypselas with one or two wings . . . . . 15. *broussonetii*
      Disc cypselas wingless . . . . . 19. *pinnatifidum*
    Ray cypselas coalesced into groups of 2–8 :
      Leaves sessile . . . . . 22. *adauctum*
      Leaves petiolate :
        Leaves oblong, pinnatisect, subulate-filiform, scarcely divided ; stems slender ; ray florets 6–12 mm . . . . . 20. *filifolium*
        Leaves obovate, pinnatisect to bipinnatisect ; stems robust ; ray florets 10–40 mm :
          Primary leaf-lobes obtriangular in outline, attenuate at the base . 21. *escarrei*
          Primary leaf-lobes ovate to obovate in outline, not attenuate at the base :
            Ray-florets 20–38 mm ; disc cypselas usually 2-winged . 15. *broussonetii*
            Ray-florets 12–22 mm ; disc cypselas usually 1-winged . . 17. *webbii*
Ray cypselas (1 –) 2–4-winged ; pappus usually coroniform :
  Leaves ± entire to pinnatilobed or bipinnatilobed :
    Ligules pale yellow . . . . . 7. *maderense*
    Ligules white :
      Disc cypselas without wings ; involucre 6–15 mm in diameter . 19. *pinnatifidum*
      Disc cypselas 1- to 2-winged ; involucre 12–22 mm in diameter . 14. *coronopifolium*
  Leaves bipinnatifid to bipinnatisect :
    Leaf-lobes 0·3–3·0 (–3·5) mm wide ; filiform to linear-lanceolate :
      Leaves 2–3 (–4)-fid ; stems slender . . . . . 5. *gracile*
      Leaves 4–6o-fid ; stems robust :
        Leaves glaucous, crowded around the base of the peduncles, the lower caducous 4. *foeniculaceum*
        Leaves green, on all parts of the stem, the lower persistent :
          Primary leaf-lobes 2–6 . . . . . 1. *frutescens*
          Primary leaf-lobes 6–14 (–20) :
            Involucre 11–15 mm in diameter . . . . . 3. *haouarytheum*
            Involucre 6–10 (–11) mm in diameter . . . . . 13. *sventenii*
    Leaf-lobes 2·0–8·0 mm wide ; ovate to obovate :
      Disc florets purple-red ; ligules usually pink to white ; disc cypselas 2-winged 18. *haemotomma*
      Disc florets yellow ; ligules white or yellow ; disc cypselas 1-winged or without wings :
        Ray cypselas coalesced in groups of 2–5 :
          Primary leaf-lobes 2–5 . . . . . 16. *hierrense*
          Primary leaf-lobes 6–14 . . . . . 12. *callichrysum*
        Ray cypselas not coalesced :
          Inner involucral bracts triangular-lanceolate . . . . . 6. *tenerifae*
          Inner involucral bracts obovate-spathulate with obtuse expanded apices :
            Leaves with 2–6 (–8) primary lobes :
              Outer involucral bracts with an extended fleshy keel along the midrib 11. *thalassophilum*
              Outer involucral bracts rounded (but not keeled) along the midrib :
                Peduncles villous towards the apex ; leaf-lobes cuspidate . . 2. *lemsii*
                Peduncles glabrous ; leaf-lobes acute to obtuse. . . 1. *frutescens*
            Leaves with 6–18 primary lobes :
              Involucre 12–20 mm in diameter :
                Leaves bipinnatifid . . . . . 8. *winteri*
                Leaves bipinnatisect-pectinate . . . . . 10. *dissectum*

Involucre 6–12 mm in diameter :
Leaf-lobes acute ; ray florets yellow or white . . . 12. *callichrysum*
Leaf-lobes obtuse, uncinate ; ray florets white . . . . 9. *lidii*

Section 1. *ARGYRANTHEMUM*

ARGYRANTHEMUM sect. ARGYRANTHEMUM, sect. typ. gen. (Text-fig. 4).

Chrysanthemum sect. *Magarsa* DC., Prodr. 6 : 65 (1838).
Stigmatotheca sect. *Otopappus* Schultz Bip. in Webb & Berthel., Phyt. Canar. 2 : 255 (1844).

Plants glabrous or hispidulous on the leaf midribs only. *Leaves* pinnatilobed to pinnatisect or bipinnatisect, petiolate. *Ray florets* white, yellow or pink. *Ray cypselas* trigonous, arcuate, 2-winged with 2 large coriaceous lateral wings and a small keel-like ventral wing ; pappus coroniform or absent. *Disc cypselas* obconical, laterally compressed, 1-winged ; pappus coroniform or absent.

1. ***Argyranthemum frutescens*** (L.) Schultz Bip. in Webb & Berthel., Phyt. Canar. 2 : 264 (1844). (Text-fig. 5–6.)

Chrysanthemum frutescens L., Sp. Pl. 2 : 887 (1753). – DC., Prodr. 6 : 65 (1838). – Masferer in An. Soc. esp. Hist. nat. 10 : 207 (1881) reimpr. ut Rec. Bot. Tenerife : 131 (1881). – Burchard in Biblthca bot. 98 : 199 (1929). – Ceballos & Ortuño, Veg. Fl. For. Canar. Occid. : 439 (1951).
Pyrethrum frutescens (L.) Gaertn., Fruct. Sem. Pl. 2 : 431 (1791). – Choisy in Buch, Phys. Beschreib. Canar. Ins. : 149 (1825).
Matricaria frutescens (L.) Desrouss. in Lam., Encycl. Méth., Bot. 3 : 730 (1792).
Chrysanthemum floridum Salisb., Prodr. Stirp. Hort. Chapel Allerton : 202 (1796), *nom. superfl.*
Chrysanthemum foliosum Brouss., Elench. Pl. Hort. Bot. Monsp. : 16 (1805), *nom. nud.*
Chrysanthemum grandiflorum Brouss., tom. cit. : 15 (1805), *nom. nud.*
Chrysanthemum speciosum Brouss. in Pers., Syn. Pl. 2 : 463 (1807), *nom. synon.*
Pyrethrum grandiflorum Willd., Enum. Pl. Hort. Berol. : 904 (1809). – Choisy in Buch, loc. cit.
Chrysanthemum grandiflorum (Willd.) DC, Cat. Pl. Hort. Bot. Monsp. : 96 (Mar. 1813)[1] ; Prodr. 6 : 66 (1838), excl. [var.] α *adauctum* et [var.] δ *cuneiforme*.
Pyrethrum speciosum Willd., Enum. Pl. Hort. Berol., Suppl. : 60 (1814).
Chrysanthemum fruticosum Buch in Abh. preuss. Akad. Wiss. 1816–17 : 375 (1819), *nom. nud.* (? sphalm. pro *C. frutescens*).
Pyrethrum crithmifolium sensu Link in Buch, Phys. Beschreib. Canar. Ins. : 149, 165 (1825), non Willd.
Chrysanthemum intermedium Hort. Monsp. ex DC., Prodr. 6 : 66 (1838), *nom. synon.*
Argyranthemum frutescens Webb in Webb & Berthel., Phyt. Canar. 2 : t. 91 (1840), *nom. invalid.*

Stems 20–80 cm, procumbent to erect, branches throughout or only at the base, glabrous to hispidulous. *Leaves* 1·5–8 × 0·5–6 cm, obovate to linear-lanceolate in outline, pinnatisect to bipinnatisect (rarely tripinnatisect), petiolate, glabrous to hispidulous, coriaceous, succulent ; primary lobes 2–10, opposite to alternate, 2–40 × 0·5–6 mm, lanceolate to linear-lanceolate ; secondary lobes 2–6, opposite

[1] *Chrysanthemum grandiflorum* Lapeyr., Hist. Abr. Pl. Pyrénées: 527 (May 1813), *nom. superfl.* was published about two months later than this name.

to alternate, 1–10 × 0·5–4 mm, linear-lanceolate to dentate, obtuse or acuminate. Leaf clusters common in the axils of cauline leaves. *Inflorescence* corymbose, with 4–30 capitula ; peduncles up to 16 cm ; bracts leaf-like or simply linear-lanceolate in outline. *Involucre* 6–22 mm in diameter ; bracts in 3 series, triangular to obspathulate or linear-lanceolate ; inner bracts scarious, with an expanded hyaline apex. *Ray florets* 7–15 × 2–5 mm, white, 1–3-fid at the apex ; *disc florets* 2–4 mm, corolla lobes yellow. *Ray cypselas* 3–5 × 2–4·5 mm, trigonous, arcuate, 3-winged ; 2 lateral wings, expanded, coriaceous, with convex dorsal surface ; ventral wing obtriangular ; pappus coroniform, dimidiate, the margin laciniate ; *disc cypselas* 2·5–4 × 1–2 mm, obconical, laterally compressed to sometimes ± terete, arcuate in outer series, 1-winged, irregularly ribbed ; pappus coroniform, dimidiate, with laciniate margins to sometimes vestigial or absent. *Flowering period* : throughout the year.

Tenerife, Gran Canaria and Gomera. Also reported from a single locality on Hierro.

Widespread in maritime and lowland areas from 5–700 m ; common on coastal cliffs, rocky shores and sand dunes ; grows on a variety of basal rocks, from Miocene basalts to recent lava flows.

The holotype of this species is in Hort. Cliff. (BM), Linnaeus having adopted unchanged in the *Species Plantarum* the phrase name he used for the species in the *Hortus Cliffortianus;* the specimen is labelled : 'Leucanthemii canariense sapore pyrethri H. C. Chrysanthemum frutescens'.

This species displays in the most extreme form the taxonomic problem of assessing allopatric differentiation of the kind encountered in *Argyranthemum.* At first sight a number of distinct morphological entities can be recognized, but attempts at their precise definition reveal that they overlap and intergrade to a considerable degree.

Most of the problem lies in the fact that the characters that most obviously distinguish the subspecies in the field (plant height and branching position) are difficult, if not impossible, to see in most herbarium specimens. Instead of relying on such characters, a conscious attempt has been made to select several quantitative morphological characters, including leaf-lobe width, number of leaf-lobes and capitulum diameter, to indicate the pattern of allopatric diversity which occurs below the species level and to give some criteria for herbarium identification. There are no immediate sharp discontinuities between populations but there is a continuum of variation, broken into nodal peaks in the distribution curves for each character corresponding with geographical distribution. It can be argued that such differences call for taxonomic lumping, a situation which readily proceeds to the recognition of a single taxonomic entity. Such a solution is unacceptable however, owing to the wide range of recognizable discontinuous variants the taxon would embrace relative to other less widespread species. Figures 5 and 6 provide data for variation of four such characters in samples of *A. frutescens,* selected from all parts of its distribution range.

In the absence of sharp breaks, the boundary between the infra-specific groups must necessarily be defined somewhat arbitrarily. The chosen rank of subspecies (Figs 5, 6A, B, C, etc.) at which to recognize these groupings is obviously open to

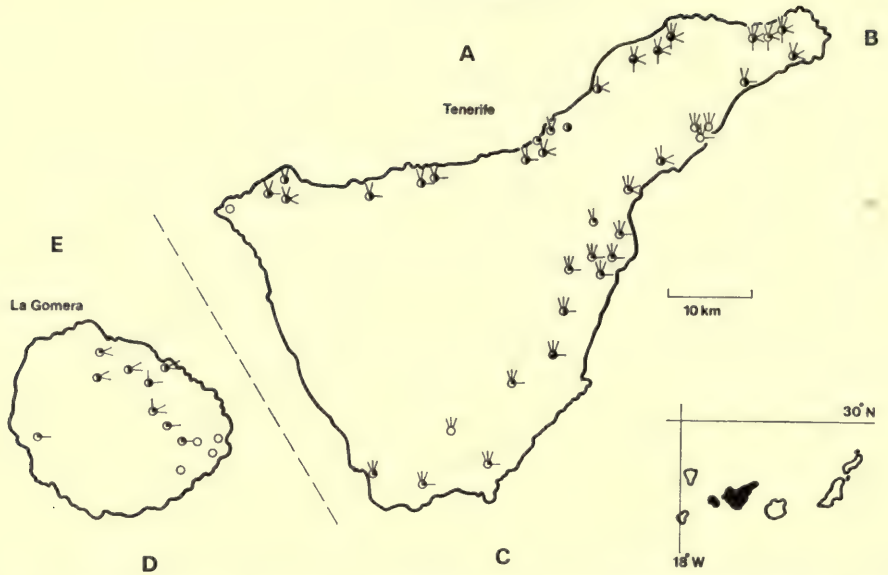

FIG. 5. Distribution and variation of subspecies of *Argyranthemum frutescens* on Tenerife and Gomera: A, subsp. *frutescens*; B, subsp. *succulentum*; C, subsp. *gracilescens*; D, subsp. *parviflorum*; E, subsp. *foeniculaceum*.

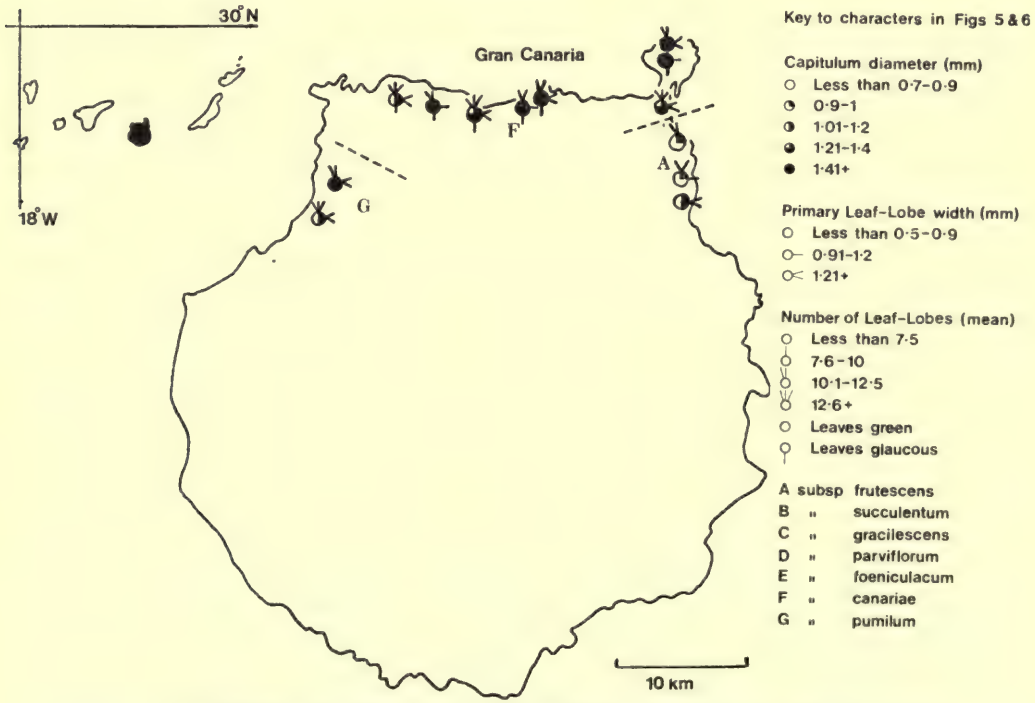

FIG. 6. Distribution of subspecies of *Argyranthemum frutescens* on Gran Canaria: A, subsp. *frutescens*; F, subsp. *canariae*; G, subsp. *pumilum*.

question, but populations are grouped into subspecies when there is a distinct morpho-geographical facies which can be distinguished by at least one character from other populations within the species. The concept normally applies to vicariant populations adapted to local ecological conditions, and in this way it is used in a sense similar to that of Du Rietz (1930) and present-day taxonomists (Hedberg, 1958 ; Heywood, 1958a ; Valentine & Löve, 1958).

Key to Subspecies

Ligules 4–7 mm :
  Leaf rachis 1–2 mm wide ; leaves glaucous . . . . . e. *foeniculaceum*
  Leaf rachis usually less than 1 mm wide ; leaves green . . . . d. *parviflorum*
Ligules 7–15 mm :
  Involucre 10–16 mm in diameter :
    Leaf-lobes 3–8 (–10) :
      Leaves 4–8 cm, glaucous, glabrous ; primary lobes 2–4 cm . e. *foeniculaceum*
      Leaves 1–4 cm, green, glabrous to scabridulous ; primary lobes 0·3–2·5 cm a. *frutescens*
    Leaf-lobes 7–20 :
      Leaf-lobes filiform, 0·5–1·2 mm wide . . . . . c. *gracilescens*
      Leaf-lobes broad, succulent, 1·2–5·0 mm wide :
        Leaf-lobes acute. . . . . g. *pumilum*
        Leaf-lobes obtuse to cuspidate . . . . . f. *canariae*
  Involucre 6–10 mm in diameter :
    Leaf-lobes 3–11 :
      Leaves 4–8 cm, glaucous, glabrous ; primary lobes 2–4 cm . . e. *foeniculaceum*
      Leaves 1–4 (–6) cm, green, glabrous to scabridulous ; primary lobes 0·3–2·5 cm a. *frutescens*
    Leaf-lobes 7–20 :
      Leaf-lobes linear-lanceolate, 0·5–2·0 mm wide . . . . . c. *gracilescens*
      Leaf-lobes ovate-lanceolate, 2·0–5·0 mm wide :
        Leaf-lobes acute . . . . . g. *pumilum*
        Leaf-lobes obtuse . . . . . b. *succulentum*

a. subsp. ***frutescens.*** (Text-fig. 2A 1, 3g, h, i.)

Pyrethrum frutescens α Choisy in Buch, Phys. Beschreib. Canar. Ins. : 149 (1825).
Argyranthemum frutescens [var.] γ *grandiflorum* Webb in Webb & Berthel., Phyt. Canar. 2 : t. 92, fig. dextr. (1839), *nom. nud.*
Argyranthemum frutescens [var.] α *linnaeanum* Webb in Webb & Berthel., tom. cit. : t. 91, fig. 1, 3–20 (1840), *nom. invalid.*
Argyranthemum frutescens forma *major* Schultz Bip. in Webb & Berthel., tom. cit. : 264 (1844).

Stems 30–70 cm erect, branched throughout, glabrous to hispidulous. *Leaves* 1·5–5 × 0·5–3 cm, glabrous to hispidulous ; primary lobes 2–6 (–8), subopposite to alternate 5–18 × 0·5–2 mm ; secondary lobes dentate, acute. *Involucre* 6–12 mm in diameter. *Ray florets* 12–15 × 2·5–3 mm.

Tenerife : Bco de Masca, 0–200 m, 13 Sept. 1966, *Lems 6282* (MICH). Casas de Teno Bajo, 5 Apr. 1971, *Bramwell & Humphries 3275* (BM ; RNG). El Fraile, 5 Apr. 1971, *Bramwell & Humphries 3282* (BM ; RNG). Buenavista, Mar. 1888, *Ball* (Z). Same locality, 19 June 1956, *Lems 2640* (L ; MICH). Same locality,

6 Sept. 1965, *Kaae* (C). Icod, 2 Jan. 1921, *Børgesen 307* (C). Same locality, 6 June 1890, *Murray* (RHS). San Juan de la Rambla, in *Cistus* scrub, Dec. 1968, *Bramwell 483* (RNG). Same locality, 3 Aug. 1954, *Lems 2093* (MICH). Bco. Cabezas near Orotava, 5 m, 25 Oct. 1968, *Bramwell 274* (RNG). Martinez, Orotava, 50 m, May 1922, *Burchard 84* (G ; Z). Same locality, 9 May 1884, *Ball* (Z). Puerto de la Cruz, 20 m, 8 May 1957, *Larsen* (C). Same locality, 10 Mar. 1855, *Perraudière* (P). Same locality, 15 Apr. 1855, *Perraudière* (P ; S). Same locality, *Webb* in herb. Schultz Bip. (P). Punta Brava, 13 Oct. 1969, *Kaae* (C). La Cuesta, 300 m, Sept. 1906, *Pitard* (G ; L ; P). Monte de Zafira, 3 June 1894, *Murray* (G ; K). Igueste de San Andrés, 200 m, 18 June 1971, *Bramwell & Humphries 3461* (BM ; RNG). San Andrés, 1954, *Wall 554* (S). Bco. de Bufadero, 21 Jan. 1905, *Pitard & Proust 198* (G ; L ; P ; S). Santa Cruz, Bco. de la Cruz, *c.* 180 m, 16 Mar. 1937, *Asplund 341* (G ; K). Same locality, 100 m, 27 May 1901, *Bornmüller 2472* (G ; P ; W ; Z). Same locality, 2 Mar. 1855, *Perraudière* (P ; W). Same locality, *Webb* in herb. Schultz Bip. (P). Playa de la Viuda, between Guimar and Candelaria, 18 Apr. 1971, *Bramwell & Humphries 3460* (BM ; RNG). *Broussonet* (C ; Z). *Broussonet* in herb. Willdenow (B). 1816, *Christian Smith* (G-DC). Ex herb. Daniel de la Roche (G-DC). *Webb* in herb. Schultz Bip. (K ; P).

Gran Canaria : Catalina Park, Las Palmas, 16 Jan. 1965, *Kaae* (C). Agaete, 27 Dec. 1960, *Hummel* (S).

Cult., Hort. Cliff. (BM, holotypus).

North coast of Tenerife from Baranco de Masca and the cliffs of El Fraile to Puerto de la Cruz, and the south coast from Igueste on the Punta de Anaga to the Punta de Guimar. East coast of Gran Canaria from Las Palmas to La Estrella, and on the west coast around Agaete (Figs 5, 6).

Typically found on wet coastal cliffs and barrancos, but grows as a weed in disturbed areas and waste ground in towns ; 5–300 m. Several populations are also known from the xerophytic *Euphorbia canariense* and *E. balsamifera* scrub communities on the south slopes of the Anaga peninsula.

A reduction in size and leaf succulence is found along the south coast of Tenerife between Candelaria and Guimar, forming a gradual transition to *A. frutescens* subsp. *gracilescens*. Natural hybrids between *A. frutescens* subsp. *frutescens* and *A. coronopifolium* have been detected at Teno, on the west peninsula of Tenerife. Putative hybrids between this subspecies and *A. broussonetii* (*Chrysanthemum tanacetifolium* Desf., Cat. Pl. Hort. Reg. Paris ed. 3 : 447 (1829), *nom. nud.*) are also reported from the Barranco de Bufadero, near San Andrés on the south coast of the Anaga peninsula of Tenerife.

b. subsp. ***succulentum*** C. J. Humphries, subsp. nov. (Text-fig. 2A 2.)

Pyrethrum crithmifolium sensu Link in Buch, Phys. Beschreib. Canar. Ins. : 149, 165 (1825) non Willd., quoad specim. ex Tenerife.

Chrysanthemum coronopifolium Masferer in An. Soc. esp. Hist. nat. 10 : 208 (1881) reimpr. ut Rec. Bot. Tenerife : 132 (1881), pro parte, non *Pyrethrum coronopifolium* Willd. nec specim. a Teno.

Chrysanthemum crithmifolium Christ in Bot. Jb. 9 : 146 (1887), non *Chrysanthemum crithmifolium* (Willd.) Buch (1819).
Argyranthemum frutescens var. *crithmifolium* Pitard & Proust, Îles Canar., Fl. Archipel. : 230 (1908) pro parte, non *Pyrethrum crithmifolium* Willd. nec specim. a Gran Canaria.
Chrysanthemum frutescens var. *crithmifolium* Ceballos & Ortuño, Veg. Fl. For. Canar. Occid. : 439 (1951) pro parte, non *Pyrethrum crithmifolium* Willd.

Caules 30–50 cm procumbentes, omnino ramosi, glabri. *Folia* 2–7 × 2–4 cm, succulenta, glabra, glauca ; lobi primarii 2–6, 6–25 × 1–5 mm, oppositi vel subopositi ; lobi secundarii 2–4, 2–10 × 1–4 mm, alterni, obtusi. *Involucrum* 6–8 (–10) mm diametro. *Radiorum flosculi* 10–14 × 2·5–4 mm.

Stems 30–50 cm, procumbent, branched throughout, glabrous. *Leaves* 2–7 × 2–4 cm, succulent, glabrous, glaucous ; primary lobes 2–6, 6–25 × 1–5 mm, opposite to subopposite ; secondary lobes 2–4, 2–10 × 1–4 mm, alternate, obtuse. *Involucre* 6–8 (–10) mm in diameter. *Ray florets* 10–14 × 2·5–4 mm.

Tenerife: Taraconte, in regione maritima, 31 Jan. 1905, *Pitard & Proust 197* (G ; L ; P, holotypus). La Paz, Puerto de la Cruz, 1889, *Christ* (Z). Santa Ursula, Barranco de la Cruz, 150 m, 16 Mar. 1933, *Asplund 341* (G ; S). Bajamar, 21 Feb. 1969, *Asplund* (S). Bajamar, Punta Hidalgo, 7 Apr. 1967, *Kaae* (C). Playa del Roque, Taganana, 20 m, 9 Apr. 1971, *Bramwell & Humphries 3376* (BM ; RNG). Taganana, 5 June 1900, *Bornmüller 814* (G ; P ; W ; Z). Same locality, *Pitard* (P). Sierra Anaga, Roques de la Animas, 18 Apr. 1969, *Bramwell 1348* (RNG). East of Taganana, 50 m, 3 Apr. 1967, *Bally 12943* (G). *Simony 20 & 21* (W).

North coast of Tenerife from La Paz, north-east of Puerto de la Cruz, to Punta de Santiago, east of Taganana. Invariably found on wet coastal cliffs, commonly associated with halophyte communities ; 50–100 m. The cushion habit and succulent stems and leaves most resemble populations of subsp. *canariae*. The plants can easily be distinguished, however, by their smaller flowers and grey glaucous appearance.

Willdenow described *Pyrethrum crithmifolium* from specimens collected on Tenerife by Broussonet. I have examined photographs of these specimens and *P. crithmifolium* is clearly conspecific with *P. foeniculaceum* Willd. (= *A. foeniculaceum*). Specimens of succulent-leaved varieties of *A. frutescens* collected by L. von Buch. from the north coasts of Tenerife and of Gran Canaria were cited by Link (*loc. cit.*) under the name *Pyrethrum crithmifolium* Willd. The Gran Canarian populations were later considered by Christ (in Bot. Jb. 9 : 145 (1887)) to be a variety of *A. frutescens* (viz. *A. frutescens* var. *canariae*). Pitard later considered the plants from the north coast of Tenerife to be a distinct variety of *A. frutescens*, but followed Link's misapplication of the epithet *crithmifolium*, making a new combination based on *Pyrethrum crithmifolium* Willd. Since no validly published name has been applied to this subspecies it is described as new above.

c. subsp. ***gracilescens*** (Christ) C. J. Humphries, comb. et stat. nov. (Text-fig. 2A 3.)

Chrysanthemum frutescens [var.] *β hispidum* DC., Prodr. 6 : 66 (1838).
Chrysanthemum frutescens var. *gracilescens* Christ in Bot. Jb. 9 : 145 (1887).

Argyranthemum gracile sensu Pitard & Proust, Îles Canar., Fl. Archipel. : 230 (1908) ; non Webb ex Schultz Bip.

Chrysanthemum gracile sensu Burchard in Biblthca bot. 98 : 199 (1929) pro parte, excl. specim. a Arona, Adege et Guia, non Masferer. – Ceballos & Ortuño, Veg. Fl. For. Canar. Occid. : 439 (1951) pro parte, quoad specim. a ora meridionali-occidentali Tenerifae.

Stems 20–50 (–70) cm, branched towards the base, glabrous to hispidulous. *Leaves* 1·5–7 × 1–3·5 cm, hispidulous on the midrib ; primary lobes 4–10, subopposite, 6–25 × 0·5–2 mm ; secondary lobes 2–8, subopposite to alternate, 2–10 × 0·1–1 mm, acute. *Involucre* 9–12 mm in diameter. *Ray florets* 10–14 × 2–3·5 mm.

Tenerife: Between Sobradillo and Barranco Grande, 2 Apr. 1971, *Bramwell and Humphries 3178* (BM ; RNG). Between Barranco Hondo and Candelaria, 2 Apr. 1971, *Bramwell & Humphries 3179* (BM ; RNG). Guimar, 1882, *Hillebrand* in herb. Christ (Z, holotypus). Guimar, Monte de Los Guimes, 20 Mar. 1933, *Asplund 450* (G). Ladera de Guimar, 400 m, 2 Mar. 1969, *Bramwell 846* (RNG). Same locality, 2 Apr. 1971, *Bramwell & Humphries 3198* (BM ; RNG). Same locality, 550–650 m, 6 Jan. 1966, *Lems 6541* (MICH). Same locality, 20 Feb. 1855, *Perraudière* (P). Same locality, 24 Feb. 1855, *Perraudière* (P). Arajo, 580 m, 20 Oct. 1965, *Lems 6122* (MICH). Bco. de Escobonal, 400 m, 3 Apr. 1971, *Bramwell & Humphries 3203* (RNG). Playa de San Marcos, 50 m, 8 Aug. 1965, *Lems 5575* (MICH). Valle de Arico, Avesce, 1882, *Hillebrand* in herb. Christ (Z). Valley Seco, 10 Mar. 1884, in herb. Christ (Z). Bco. de Tamadaya, 600 m, 3 Apr. 1971, *Bramwell & Humphries 3208* (BM ; RNG). 1 km north of Medano, 100 m, 4 Apr. 1971, *Bramwell & Humphries 3256* (BM ; RNG). Same locality, 17 Oct. 1965, *Kaae* (C). Same locality, 16 Mar. 1967, *Kaae* (C). Between Granadilla and San Miguel, 20 Oct. 1965, *Kaae* (C). Guaza near Los Christianos, 21 Mar. 1967, *Kaae* (C). *Bolle 230* (P). Feb. 1845, *Bourgeau 16* (FI ; P ; TCD ; W ; Z). Dec. 1845, *Bourgeau 1237* (FI ; G ; P ; W). 1801, Broussonet (G-DC).

Widespread on the lower slopes and on the south coast of Tenerife from Sobradillo (near Santa Cruz) to Los Christianos on the southern peninsula of the island (Fig. 5).

Common in xerophytic communities of *Euphorbia canariensis, E. balsamifera, Launaea arborescens* and matorral on dry south-facing barrancos ; it grows in a variety of habitats such as cliffs, rocky slopes and sand dunes, and is frequently found as a weed in cultivated and urbanized areas ; 50–700 m.

d. subsp. ***parviflorum*** (Pitard & Proust) C. J. Humphries, stat. nov. (Text-fig. 2A 4.)

Argyranthemum frutescens var. *parviflorum* Pitard & Proust, Îles Canar., Fl. Archipel : 231 (1908).

Chrysanthemum frutescens var. *parviflorum* (Pitard & Proust) Ceballos & Ortuno, Veg. Fl. For. Canar. Occid. : 439 (1951).

Stems 30–60 cm, erect, branched from the base. *Leaves* 2–6 × 0·5–3 cm, glabrous; primary lobes 2–4, opposite to alternate, 2–25 × 0·5–2 mm ; secondary lobes 1–4 × 0·5–2 mm acute. *Involucre* 4–6 (–8) mm in diameter. *Ray florets* 4–7 × *c.* 1·5 mm.

La Gomera: Bco. de la Concepcion in aridis regionis maritimi, 8 Apr. 1905, *Pitard & Proust 196* (G ; L ; P, holotypus). Punta de San Cristobal, 5 m, 7 Apr. 1971, *Bramwell & Humphries 3363* (BM ; RNG). Same locality, 30 m, 27 May 1957, *Larsen* (C). San Sebastian, 14 Apr. 1901, *Bornmüller 2474* (G ; P ; W ; Z). Same locality, 27 May 1894, *Murray* (G). Same locality, 25 m, 1960, *Hummel* (S). Bco. de la Villa, 200 m, 3 Aug. 1969, *Bramwell 1943* (RNG). Same locality, 23 May 1894, *Murray* (W). Same locality, 200 m, 7 Apr. 1971, *Bramwell & Humphries 3360* (BM ; RNG). Same locality, 700 m, 3 July 1969, *Bramwell 1943 a* (RNG). Same locality, 7 km north of San Sebastian, 500 m, 6 Apr. 1971, *Bramwell & Humphries 3356* (BM ; RNG). La Carbonera, 22 July 1954, *Lems 2340* (L ; MICH). Valle Gran Rey, 400 m, 27 June 1969, *Bramwell 2271* (RNG).

Tenerife: Punta de Teno, 100 m, 4 May 1969, *Bramwell 1435* (RNG). Same locality, 50 m, 5 Apr. 1971, *Bramwell & Humphries 3274* (BM ; RNG). Buenavista, 27 Feb. 1845, *Bourgeau 823* (FI).

Widely distributed on Gomera along the south-eastern slopes and coastal areas around San Sebastian and along the mountains and north-west coast towards Hermigua. A single locality is also recorded for Valle Gran Rey, and on the Punta de Teno of Tenerife (Fig. 5).

Plants are usually found in xerophytic communities of *Euphorbia canariensis*, *E. regis-jubae* and *Kleinia neriifolia* between 5 and 500 m, but also in regenerative scrub communities of old *Laurus azorica* forest at higher altitudes near La Carbonera between 500 and 700 m.

This subspecies is similar to subsp. *gracilescens* in general appearance and foliage morphology. It differs by the diminutive floral parts, particularly in the size of the ray florets and cypselas. The habit is slightly more compact with branching from the base of the stem and with many peduncles in each inflorescence.

e. subsp. ***foeniculaceum*** (Pitard & Proust) C. J. Humphries, stat. nov. (Text-fig. 2A 5.)

Argyranthemum frutescens var. *foeniculaceum* Pitard & Proust, Îles Canar., Fl. Archipel. : 230 (1908).

Ismelia coronopifolia sensu Pitard & Proust, op. cit. : 232 (1908) quoad specim. a Gomera, non Schultz Bip.

Chrysanthemum coronopifolium sensu Ceballos & Ortuño, Veg. Fl. For. Canar. Occid. : 441 (1951) pro parte, quoad specim. a Gomera, non Masferer.

Stems 30–80 cm, branched throughout or only at the base, glabrous. *Leaves* 3–8 × 2–5 cm, glabrous, glaucous ; primary lobes 2–4, 8–40 × 1·5–2 mm, sub-opposite to opposite ; secondary lobes usually absent, rarely 1 or 2, 2–8 × *c.* 0·5 mm, acuminate. *Involucre* 6–12 mm in diameter. *Ray florets* 6–8 × 1·5–2·5 mm.

La Gomera: Agulo, in rupestribus, 300 m, 13 Apr. 1905, *Pitard 195* (G ; L ; Z, holotypus). Hermigua 200 m, 25 May 1957, *Larsen* (C). 3 km west of Agulo near Las Rosas, 500 m, 6 Apr. 1971, *Bramwell & Humphries 3352* (BM ; RNG). Agulo, 26 May 1894, *Murray* (K). Bco. de Vallehermoso near El Puerto, 25 m, 2 Jan. 1969, *Bramwell 463* (RNG). Same locality, 6 Apr. 1971, *Bramwell & Humphries 3348* (BM ; RNG). Same locality, 300 m, Apr. 1906, *Pitard* (G).

A subspecies of intermittent distribution along the north coast of La Gomera from Agulo to Vallehermoso (Fig. 5).

A locally common coastal subspecies in xerophytic communities of *Euphorbia canariensis* and *Kleinia neriifolia* between 25 and 200 m, and at higher altitudes in habitats dominated by *Adenocarpus foliolosus* scrub, between 200 and 500 m.

It is distinguished from all other subspecies by its deeply pinnatisect and sometimes trifid, glaucous leaves. The florets are similar to those in subsp. *parviflorum* but differ in having fewer peduncles and a taller, less compact habit, and by branching throughout the plant.

f. subsp. ***canariae*** (Christ) C. J. Humphries, stat. nov. (Text-fig. 2A 6.)

Pyrethrum crithmifolium sensu Link in Buch, Phys. Beschreib. Canar. Ins. : 149, 165 (1825) non Willd., quoad specim. a Gran Canaria.
Ismelia coronopifolia var. *angustifolia* Schultz Bip. in Webb & Berthel., Phyt. Canar. 2 : 272 (1844).
Chrysanthemum frutescens var. *canariae* Christ in Bot. Jb. 9 : 145 (1887).
Argyranthemum frutescens var. *canariae* (Christ) Pitard & Proust, Îles Canar., Fl. Archipel. : 230 (1908).
Argyranthemum frutescens var. *crithmifolium* Pitard & Proust, op. cit. : 230 (1908) pro parte, quoad specim. a Gran Canaria, non *Pyrethrum crithmifolium* Willd.
Ismelia coronopifolia sensu Pitard & Proust, op. cit. : 232 (1908), quoad specim. a Gran Canaria, non Schultz Bip.

Stems 20–50 cm, procumbent, branched throughout, glabrous. *Leaves* 3–8 × 2–4 cm, succulent, glabrous to sometimes glaucous; primary lobes 2–8, opposite to alternate, 6–18 × 2–5 mm ; secondary lobes 1–4, alternate, 2–10 × 2–3 mm, apiculate. *Involucre* 12–20 mm in diameter. *Ray florets* 15–30 × 3–5 mm.

Gran Canaria: En todas partes del norte de la Isla, 1882, *Hillebrand* in herb. Christ (Z, holotypus). La Isleta, Feb. 1905, *Pitard* (P). Confital, Feb. 1906, *Pitard* (P). Bañadero, 30 Apr. 1897, *Gelert* (C). Same locality, May 1892, *Murray* (G ; RHS ; W). San Felipé, 50 m, 17 Mar. 1971, *Bramwell & Humphries 3001* (BM ; RNG). Same locality, 200 m, 17 Mar. 1971, *Bramwell & Humphries 3002* (BM ; RNG). Moya, 60 m, *Bramwell 1226* (RNG). Same locality, 28 Oct. 1966, *Lems 6143* (MICH). La Cuesta de Silva, 100–200 m, Apr. 1924, *Burchard 238* (G ; S ; Z). Same locality, 2 May 1897, *Gelert* (C). Hermigua, 2 Feb. 1967, *Kunkel 10090* (G). Guia, Mar. 1896, *Collett* (K). Between Las Palmas and Telde, 29 Apr. 1890, *Murray* (K). Same locality, 30 Mar. 1901, *Bornmüller 2471* (G ; P ; W ; Z). Apr. 1846, *Bourgeau 489* (FI ; G ; K ; P ; TCD ; W ; Z). 1837, *Despreaux 196* (G).

Distributed in Gran Canaria from La Isleta on the north-east peninsula to Galdar on the north-west coast. Several collections have also been recorded on the east coast between Las Palmas and Telde (Fig. 6).

Occurs in halophyte communities along coastal rocks and cliffs and associated with *Astydamia latifolia* and *Euphorbia balsamifera* scrub communities at higher altitudes ; 25–200 m.

FIG. 7. *Argyranthemum frutescens* subsp. *pumilum* C. J. Humphries: A, whole plant; B, ventral view; C, dorsal view of ray cypsela; D, lateral view of disc cypsela of outer series; E, lateral view of disc cypsela of inner series.

g. subsp. ***pumilum*** C. J. Humphries, subsp. nov. (Text-fig. 2A 7, 7.)

Subsp. *foeniculaceo* affinis sed habitu magis compacto, floribus grandioribus, et foliis plus dissectis, imprimis differt.

Caules 30–50 cm, procumbentes, omnino ramosi, glabri. *Folia* 3·5–10·0 × 0·3–4·5 cm, bipinnatisecta, glabra; lobi primarii 2–8, oppositi vel alterni, 0·5–3·0 × 0·5–

3·5 cm ; lobi secundarii 1–2, 2·0–10·0 × *c.* 0·2 mm, acuminati. *Involucrum* 12–14 mm diametro. *Radiorum flosculi* 12–22 × 2–4 mm (Fig. 7).

Stems 30–50 cm, procumbent, with branches in all parts, glabrous. *Leaves* 3·5–10·0 × 0·3–4·5 cm, bipinnatisect, glabrous ; primary lobes 2–8, opposite to alternate, 0·5–3·0 × 0·5–3·5 cm ; secondary lobes 1–2, 2·0–10·0 × *c.* 0·2 mm, acuminate. *Involucre* 12–14 mm in diameter. *Ray florets* 12–22 × 2–4 mm.

Gran Canaria: Bco. Laya del Risco, 750 m, 23 Mar. 1971, *Bramwell & Humphries 3155* (BM ; RNG, holotypus). Same locality, 500 m, 23 Mar. 1971, *Bramwell & Humphries 3169* (BM ; RNG).

A chasmophyte of dry coastal cliffs at Laya del Risco in xerophytic scrub, dominated by *Euphorbia balsamifera* and *Launaea arborescens* ; 500–600 m.

2. ***Argyranthemum lemsii*** C. J. Humphries, sp. nov. (Text-fig. 2B, 8, 9.)

Ab *A. frutescens* subsp. *frutescens* foliorum lobis obspathulatis cuspidatis, pedunculis versus apicem villosis et bracteis externis involucri costis villosis differt.

Caules 50–60 cm, ascendentes, ramosi per tota planta, glabri. *Folia* 1–3·5 × 0·3–1·5 cm, ambitu obovata, pinnatifida vel bipinnatifida, petiolata, glabra vel hispidula, praecipue in costam ; lobi primarii 2–6, 0·3–1·2 × *c.* 1·0 cm, subopposite, ambitu spathulati ; lobi secundari subopposite, usque ad 3 mm longitudine, ad apicem cuspidati. *Inflorescentia* corymbosa, laxa, 2–10 capitulata ; pedunculi 3–10 cm longi ; bracteae foliiformae. *Involucrum* 8–11 mm diametro, bracteae series 3 continuas formantes, bracteae extimae parvae, triangularis, costis carnosis villosis, bracteae intimae obovatae vel oblongae, ad marginem et apicem expansae, hyalinae et scariosae. *Radiorum flosculi* 13–20 × 2·5–3·0 mm, albi, trifidi ad apicem ; *discorum flosculi c.* 3 mm longi, lobis corollae flavis et tubis albidis. *Radiorum cypselae* 3–4 × 2–3·5 mm, trigonae, aliquantum obconicae, arcuatae, alis 3 ; pappus coroniformis, dimidiatus vel plus minusve absens ad marginem dorsalem ; *discorum cypselae* 2–3 × 1–2 mm, turbinatae, a latere compressae vel plus minusve quadrangulares, ala 1 vel sine alam ; pappus coroniformis dimidiatus ad marginem dorsalem seriei extinarum. *Florescentia* ignotus.

Stems 50–60 cm, ascending, branched throughout the plant, glabrous. *Leaves* 1–3·5 × 0·3–1·5 cm, obovate in outline, pinnatifid to bipinnatifid, petiolate, glabrous to hispidulous, particularly on the midrib ; primary lobes 2–6, 0·3–1·2 × *c.* 1 cm, subopposite, obspathulate in outline ; secondary lobes up to 3 mm, subopposite, cuspidate at the apex. *Inflorescence* corymbose, lax, with 2 to 10 capitula, villous at the apex ; peduncles 3–10 cm long ; bracts leaf-like. *Involucre* 8–11 mm in diameter, bracts forming 3 continuous series, outer bracts small, triangular in outline, the midrib fleshy, villous, the margin scarious ; inner bracts obovate to oblong in outline, hyaline and scarious at the margins, expanded at the apex. *Ray florets* 13–20 × 2·5–3 mm, white, 3-fid at the apex ; *disc florets c.* 3 mm, with corolla lobes yellow and the tube white. *Ray cypselas* 3–4 × 2–3·5 mm, trigonous, somewhat obconical, arcuate, 3-winged ; pappus coroniform, reduced by half to ± absent on the dorsal edge ; *disc cypselas* 2–3 × 1–2 mm, turbinate, laterally compressed to ± quadrangular, usually 1-winged, occasionally wingless ; pappus coroniform, dimidiate on the dorsal edge of outer series. *Flowering period* unknown.

FIG. 8. *Argyranthemum lemsii* C. J. Humphries: A, whole plant; B, ventral view, C, dorsal view of ray cypsela; D, lateral view of disc cypsela of outer series; E, lateral view of disc cypsela of inner series.

Holotypus: Tenerifae, semita propre Chamorga 600 m.s.m., leg. *K. Lems.* In herb. Univ. Michiganum servatus (MICH)! Isotypus in herb. Novi Eboraci servatus (NY)!

This species is named in honour of the late Kornelius Lems, a distinguished contributor to the biological knowledge of the Canary Islands.

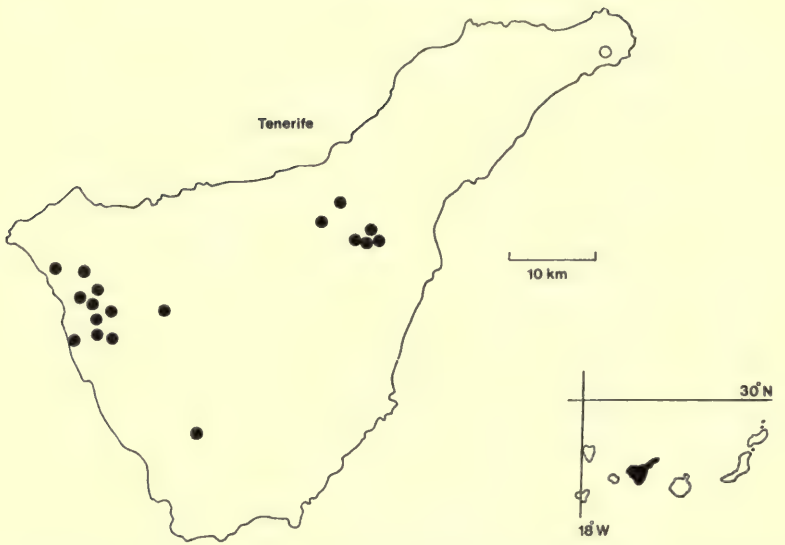

FIG. 9. Distribution of *Argyranthemum lemsii* (○) and *A. foeniculaceum* (●) on Tenerife.

A rare endemic of the Punta de Anaga from Tenerife (Fig. 9) ; known only from the single locality of Chamorga, and found in the Fayal-Brezal arboreal heath associated with *Myrica faya*, *Erica arborea* and *Ilex canariensis* between 500 and 700 m, on basal rocks consisting almost entirely of Miocene basalt.

The plants are low-growing shrubs with small hispidulous or glabrous leaves. They are readily distinguished from other species in the genus by the obspathulate cuspidate leaf-lobes (Fig. 2B) and the slight covering of villous hairs at the apex of the peduncles. There are no immediately discernible morphological affinities with any other taxa, except for a superficial resemblance of the habit to *A. frutescens* subsp. *frutescens*.

3. ***Argyranthemum haouarytheum*** Humphries & Bramwell, sp. nov. (Text-fig. 2C, 10, 11 ; Pl. 29b.)

Chrysanthemum coronopifolium var. *angustum* Christ in Bot. Jb. 9 : 146 (1887) *'angusta'*.
Argyranthemum webbii sensu Pitard & Proust, Îles Canar., Fl. Archipel : 231 (1908), non Schultz Bip.
Chrysanthemum webbii sensu Burchard in Biblthca bot. 98 : 200 (1929), non Masferer. – Ceballos & Ortuño, Veg. Fl. For. Canar. Occid. : 440 (1951).

A. callichryso Svent. similis, sed foliis minoribus cum lobis lineari-lanceolatis angustis, floribus majoribus et praeserti pappo coroniformi dentato irregulari, differt.

Caules 60–100 m, ascendentes, ramosi per tota planta, glabri. *Folia* 5–16 × 2–5 cm, obovata, bipinnatisecta, petiolata, glabra ; lobi primarii 4–12, 2–6 × 0·1–0·4 cm, subopposití, lanceolati ; lobi secundarii 0·5–2 × *c.* 0·1 cm, alterni vel subopposití, acuti. *Inflorescentia* corymbosa, laxa, 2–30 capitulata ; pedunculi

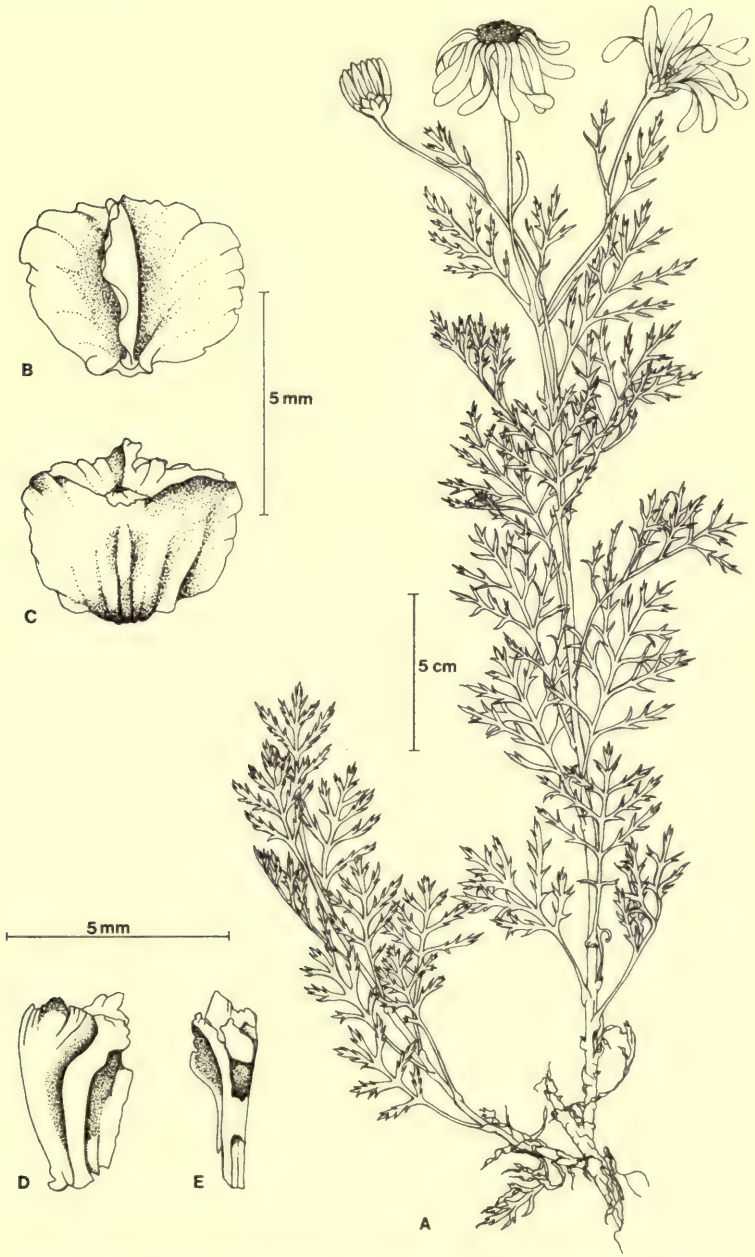

FIG. 10. *Argyranthemum haouarytheum* Humphries & Bramwell: A, whole plant; B, ventral view, C, dorsal view of ray cypsela; D, lateral view of disc cypsela of outer series; E, lateral view of disc cypsela of inner series.

FIG. 11. Distribution of *Argyranthemum haouarytheum* (●) and *A. webbii* (○) on La Palma.

12–15 cm ; bracteae lineo-lanceolate. *Involucrum* 11–15 mm diametro ; bracteae series 3 formantes ; bracteae extimae triangulares, scariosae, carnosae ad costam, bracteae intimae rectangulares vel obovatae, et ad apicem expansae, scariosae et hyalinae. *Radiorum flosculi* 15–21 × 2–5·2 mm, albi, trifidi ad apicem ; *discorum flosculi c.* 3 mm longi, lobis corollae flavis et tubis albis. *Radiorum cypselae* 3–5 × 2·6–4·5 mm, turbinatae, trigonae, trialatae, duae alae laterales expansae et coriaceae, ala ventralis parva, obtriangularis ; pappus coroniformis, irregulariter dentatus ; *discorum cypselae* 2–4·5 × 1·7–3 mm, obconicae, a latere compressae, unialatae ; pappus coroniformis irregulariter dentatus. *Florescentia* Mars ad Octavium.

Stems 60–100 cm, branched throughout, glabrous. *Leaves* 5–16 × 2–5 cm, obovate, bipinnatisect, petiolate, glabrous ; primary lobes 4–12, 2–6 × 0·1–0·4 cm, subopposite, lanceolate ; secondary lobes 0·5–2·0 × *c.* 0·1 cm, alternate to subopposite, acute. *Inflorescence* corymbose, lax with 2–30 capitula ; peduncles 12–15 cm ; bracts linear lanceolate. *Involucre* 11–15 mm in diameter ; bracts in 3 series ; outer bracts triangular, scarious, fleshy towards the midrib ; inner bracts rectangular to obovate, scarious and hyaline towards the expanded apex. *Ray florets* 15–21 × 2–5·2 mm, white, 3-fid at the apex ; *disc florets c.* 3 mm, with yellow corolla lobes and whitish tubes. *Ray cypselas* 3–5 × 2·6–4·5 mm, turbinate, trigonous, with 3 wings ; the 2 lateral wings expanded and coriaceous, the ventral wing, small, obtriangular ; pappus coroniform, irregularly dentate ; *disc cypselas* 2–4·5 × 1·7–3 mm, obconical, laterally compressed, 1-winged. *Flowering period:* March to October.

La Palma: Bco. de Candelaria, Tigarafe, 700 m, in pineto subumbroso, 12 June 1969, *Bramwell 1919* (RNG, holotypus ; LTR ; SEV). Santa Cruz, Caldereta, 6 June 1923, *Sprague & Hutchinson 1296* (K). Puerto de los Sauces, 30 Oct. 1845, *Bourgeau 1* (P). Roque de Teneguia, 150 m, 15 Apr. 1971, *Bramwell & Humphries 3417* (BM ; RNG). Same locality, 15 Apr. 1971, *Bramwell & Humphries 3410*

(BM ; RNG). Fuencaliente, 150 m, 8 July 1969, *Bramwell 1853* (RNG). Same locality, 9 June 1969, *Bramwell 1876* (LTR ; RNG). Volcan de San Antonio, 400–600 m, 28 May 1966, *Lems 7697* (MICH). Heliño, between Fuencaliente and Los Llanos, 15 Apr. 1971, *Bramwell & Humphries 3414* (RNG). Bco. de las Angustias, 800 m, 18 Apr. 1901, *Bornmüller 2475* (G ; K ; L ; P ; W ; Z). Same locality, *Hillebrand* in herb. Christ (Z). Same locality, 16 Apr. 1971, *Bramwell & Humphries 3442* (RNG). Same locality, Caldera de Taburiente, 1 Aug. 1956, *Lems 2941* (MICH). La Cumbrecita, 1500 m, 9 June 1969, *Bramwell 1878* (LTR ; RNG). Same locality, 15 Apr. 1971, *Bramwell & Humphries 3429* (RNG). Same locality, 1000 m, Mar. 1906, *Pitard & Proust 577* (G ; L ; W). Same locality *Hillebrand* in herb. Christ (Z). Same locality, cliffs above Terena, 13 June 1913, *Sprague & Hutchinson 462* (K). Same locality, north of Los Roques, 1900 m, 22 May 1966, *Lems 7745 b* (MICH). Same locality, rim of Caldera, 22 May 1966, *Lems 7746* (MICH). La Caldera, 1200 m, 25 Mar. 1905, *Pitard & Proust 199* (G ; L ; P ; Z). Garafia, 300 m, 5 June 1936, *Brookes 239* (BM).

Quite common on La Palma on the central, north west and south slopes of the island in La Caldera, La Cumbrecita, Barranco de Angustias, La Cumbre Nueva, Garafia and Pinar de Fuencaliente. Two localities have also been recorded on the east-facing slopes near Puerto de Los Sauces and the Caldereta above Santa Cruz de La Palma.

Most of the localities are in the *Pinus canariensis* forest regions at altitudes of 500–1600 m but recently coastal populations have been collected from open xerophytic *Euphorbia* communities on the dry southern slopes between 50 and 200 m. Geologically the pine forest region consists of an old basement block of syenite and diorite with more recent (Pliocene) coverings of basalt and phonolite. The open xerophytic communities in the south grow on a substratum with a very recent covering of phonolytic lava.

In his account of the Canary Islands Chrysantheminae, Schultz Bipontinus (1844a) described the broad-leaved laurel forest species *A. webbii* from the Island of La Palma, the 'locus classicus' being on one of the eastern-facing slopes of Barranco del Rio. Later collectors, such as Hillebrand (1882), Bornmüller (1901), Pitard (1906) and Sprague & Hutchinson (1923), used the name *A. webbii* on herbarium specimens to refer to a range of populations of another taxon found in the pine forests and lowland *Euphorbia* scrubs of the western, central and southern parts of the island at Las Angustias, La Cumbrecita, Tirajafe and Fuencaliente.

Recent collections by Bramwell in 1969 and Bramwell and Humphries in 1971 from many regions of the island and examination of other herbarium material do in fact show that, within the material thus referred to *A. webbii*, two species can be recognized, differing in habit, leaf shape and cypsela morphology. One of the species, that from the western laurel forest (at Los Tilos), closely agrees in morphology with the type material of *A. webbii* from the Schultz Bipontinus Herbarium at Paris and the Webb Herbarium at Firenze. A photograph of the lectotype is given in Plate 29a. The other more widespread species from the western, central and southern regions of La Palma was previously undescribed. A photograph of the holotype is given in Plate 29b.

A. haouarytheum is morphologically most similar to *A. callichrysum* Svent. from the island of La Gomera. The two species differ in leaf size and shape and cypsela morphology. Table 3 gives a summary of diagnostic characters used to separate them from one another, and from *A. webbii* Schultz Bip.

TABLE 3

Comparison of morphological characters of *A. webbii* Schultz Bip., *A. haouarytheum* Humphries & Bramwell, and *A. callichrysum* (Svent.) C. J. Humphries.

	A. webbii	*A. haouarytheum*	*A. callichrysum*
Leaf			
Shape	Pinnatifid to bipinnatifid	Bipinnatisect	Bipinnatisect
Length (cm)	4·0–14·0	5·0–16·0	10·0–15·0
Width (cm)	2·0– 7·0	2·0– 5·0	2·0– 6·0
Leaf lobes			
Primary (cm)	1·0–5·5 × 0·2–1·5, ovate-lanceolate	2·0–6·0 × 0·1–0·4, linear-lanceolate	0·5–5·0 × 0·2–0·6, linear-lanceolate
Secondary (cm)	Regular serrate teeth	0·5–2·0 × 0·1–0·15, linear-lanceolate	Irregular serrate teeth
Ray cypselas			
Size (mm)	5–6 × 3·5–8	3–5 × 2·5–4·5	4–5 × 4–8
Pappus	Marginal to slightly annular	Coroniform, margin dentate	Absent to annular, margin crispate
Disc cypselas			
Size (mm)	3–4 × 2–3	2–4·5 × 1·5–3	3–5 × 1–3
Pappus	Marginal to slightly annular	Coroniform, margin dentate	Coroniform, margin crispate

Both *A. callichrysum* and *A. haouarytheum* generally occupy similar altitudinal ranges (500–1600 m) although several lowland and coastal populations (50–200 m) of the new species have also been collected. The communities in which they occur are quite different. On La Gomera *A. callichrysum* grows in *Erica arborea* heath and in more humid *Laurus azorica* forest. On the more oceanic and higher island of La Palma, however, *A. haouarytheum* grows in predominantly *Pinus canariensis* forest, *Erica arborea* heath in the lower reaches of the forest zone and *Euphorbia balsamifera* communities in coastal areas.

4. ***Argyranthemum foeniculaceum*** (Willd.) Webb ex Schultz Bip. in Webb & Berthel., Phyt. Canar. 2 : 262 (1844). – Pitard & Proust, Îles Canar., Fl. Archipel : 230 (1908). (Text-fig. 2D, 9.)

Pyrethrum foeniculaceum Willd., Enum. Pl. Hort. Berol. : 903 (1809). – Choisy in Buch, Phys. Beschr. Canar. Ins. : 149 (1825), exc. [var.] δ *bipinnatifidum*.

Chrysanthemum foeniculaceum Brouss. ex Willd., loc. cit., *nom. synon.*
Pyrethrum crithmifolium Willd., loc. cit.
Chrysanthemum crithmifolium Brouss. ex Willd., op. cit. : 904 (1809), *nom. synon.*
Pyrethrum anethifolium Willd., op. cit. : 904 (1809).
Chrysanthemum anethifolium Brouss. ex Willd., op. cit. : 904 (1809), *nom. synon.*
Chrysanthemum crithmifolium (Willd.) Buch in Abh. preuss. Akad. Wiss. 1816–1817 : 364, 375 (1819).
Chrysanthemum anethifolium (Willd.) Buch, loc. cit.
Chrysanthemum foeniculaceum (Willd.) Desf., Cat. Pl. Hort. Reg. Paris ed. 3 : 169 (1829). – DC., Prodr. 6 : 66 (1838), excl. [var.] α *verum* quoad descr. et syn. 'Pyrethrum foeniculaceum δ Choisy . . . Pyrethrum foeniculaceum bot. reg. t. 272'. – Masferer in An. Soc. esp. Hist. nat. 10 : 207 (1881) reimpr. ut Rec. Bot. Tenerife : 131 (1881). – Hutch. in Curtis's Bot. Mag. 142 : t. 8644 (1916). – Burchard in Biblthca bot. 98 : 200 (1908). – Ceballos & Ortuño, Veg. Fl. For. Canar. Occid. : 439 (1951).
Argyranthemum foeniculaceum Webb in Webb & Berthel., tom. cit. : t. 93 (1840), *nom. invalid.*
Argyranthemum anethifolium (Willd.) Webb ex Schultz Bip. in Webb & Berthel., tom. cit. : 267 (1844), excl. descr. et tab. cit.
Argyranthemum frutescens var. *crithmifolium* (Willd.) Pitard & Proust, loc. cit., excl. specim. a Tenerife et Palma.

Stems 60–100 cm, procumbent to ascending, branched throughout the plant, glabrous. *Leaves* 3–10 × 1–6·5 cm, ± obovate in outline, bipinnatisect (–tripinnatisect), petiolate, glabrous, glaucous, crowded around the base of the peduncles, the internodes short ; primary lobes 2–8, 0·5–5 × *c.* 0·5 mm, subopposite, acuminate ; secondary lobes 2–10, alternate to subopposite, 2–15 × *c.* 2 mm, acute. *Inflorescence* monocephalic to laxly corymbose with 1–5 capitula ; peduncles up to 20 cm ; bracts 1 or 2, oblong to linear lanceolate, or absent. *Involucre* 10–18 mm in diameter ; bracts in 3 series, the outer ones triangular to obspathulate ; scarious with a fleshy midrib ; inner bracts with an expanded, scarious, hyaline apex. *Ray florets* 16–22 × 4–5 mm, white, the apex obtuse to 2–3-fid ; *disc florets* 3–3·5 mm, the corolla lobes yellow, the tube whitish. *Ray cypselas* (3–) 5–6 × 3–5 mm, trigonous, arcuate, 2–3-winged, with 2 wide lateral wings and 1 small cuneiform ventral wing ; pappus coroniform, dimidiate on the dorsal edges, dentate ; *disc cypselas* 2–3 × 1–2 mm, obconical, laterally compressed to ± quadrangular, usually with 1 small ventral wing, arcuate in outer series ; pappus coroniform, dentate. *Flowering period:* February to September.

Tenerife: Broussonet in herb. Willdenow 16200 (B, holotypus ; RNG, phototypus). Ladera de Santa Ursula, 600 m, 5 May 1933, *Asplund 1118* (C ; K). Madre del Aguamansa, Orotava valley, 16 July 1845, *Webb 818* (FI). Guimar, 600–700 m, 8 June 1901, *Bornmüller 2469* (G ; P ; W ; Z). Same locality, 1020 m, in lava flow, 9 July 1956, *Lems 2789* (MICH). Same locality, *Perraudière* (P ; S). Same locality 25 Apr. 1855, *Perraudière* (P). Anavigo, 26 May 1855, *Bourgeau 1403* (C ; FI ; G ; K ; P ; Z). Same locality, 6 May 1855, *Bourgeau* in herb. Willkomm (L). Bco. Badajoz, 600 m, 26 Apr. 1933, *Asplund 969* (G). Same locality, 6 July 1894, *Murray* in herb. Gelert (BM ; CGE ; G ; K). Same locality, *Murray* (K ; RHS). Taorem, La Florida, La Resbala, 200 m, Webb (FI). Tamaimo, Hoya de Malpais, 450 m, 5 Mar. 1969, *Bramwell 900* (RNG). Risco Blanco, 600 m, 12 Jan. 1969, *Bramwell 516* (CGE ; RNG). Between Tamaimo and Chio, 800 m, *Lems*

6468 (MICH). El Retamar, 4 Apr. 1971, *Bramwell & Humphries 3262* (BM ; RNG). Bco. and saddle between Santiago del Teide and Teno Alto, 23 July 1956, *Lems 2880* (MICH). Pico de Chierfe above Masca, 1100 m, 11 Feb. 1969, *Bramwell 665* (CGE ; RNG). Pico de Chierfe, 1000 m, 12 Jan. 1969, *Bramwell 514* (RNG). La Fortelaza de Masca, 1100 m, May 1923, *Burchard 107* (CGE ; G ; Z). Bco. de Masca, 19 Apr. 1971, *Bramwell & Humphries 3469* (BM ; RNG). Masca trail, 800–1000 m, 4 Apr. 1966, *Lems 7377* (MICH). Bco. de Masca, 26 Apr. 1969, *Bramwell 1400* (RNG). Mountains of Teno, Bco. de la Cueva, 200 m, 19 Feb. 1969, *Bramwell* 738 (RNG). May 1845, *Bourgeau 64* (BM ; CGE ; FI ; G ; P ; W ; Z). *Broussonet* (G-DC). *Christian Smith* (C). Herb. Willdenow 16201 (B ; RNG). El Pico, *Broussonet* in herb. Willdenow (B ; BM ; RNG). *Broussonet* in herb. Shuttleworth (BM).

Quite common locally on Tenerife with a disjunct distribution between two main areas : the high cliffs above Ladera de Guimar and Orotava ; the cliffs of the south-west facing barrancos of Teno, Masca, Tamaimo and Barranco del Infierno on the western coast (Fig. 9). It is found as a cliff chasmophyte of arid barrancos between 200 and 1100 m, and normally restricted to basal rocks of Miocene or plateau (Pliocene) basalts, although several populations have been collected from areas covered by recent phonolytic lavas.

This species is easily distinguished from other species in the field by the candelabra branching pattern (Fig. 1) and the deeply pinnatisect glaucous foliage. The internodes are extremely short on most specimens, giving new leaves a crowded appearance at the base of the peduncles. The lower leaves are caducous after one season's growth leaving the stem bases quite bare. There is considerable variation in height and habit with generally taller individuals with longer leaves and wider capitula found in the central cliff localities above Guimar and the Orotava valley. Populations from north-west Tenerife have smaller plants with shorter leaves and smaller capitula generally growing at lower altitudes and in a hotter drier climate. It is impossible to distinguish between the two major population groups on any statistical basis so infraspecific ranking is withheld in this treatment.

5. ***Argyranthemum gracile*** Schultz Bip. in Webb & Berthel., Phyt. Canar. 2 : 261 (1844). (Text-fig. 2E, 3a, b, 12.)

Pyrethrum foeniculaceum sensu S. Edwards, Bot. Reg. 4 : t. 272 (1818), non Willd.

Pyrethrum foeniculaceum [var.] δ *bipinnatifidum* Choisy in Buch, Phys. Beschr. Canar. Ins. : 149 (1825).

Chrysanthemum foeniculaceum [var.] α *verum* DC., Prodr. 6 : 66 (1838), quoad descr.

Chrysanthemum foeniculaceum [var.] γ *bipinnatifidum* (Choisy) DC., loc. cit., excl. descr. et syn. Willd.

Argyranthemum frutescens [var.] β *gracile* Webb in Webb & Berthel., tom. cit. : t. 91 (1840), *nom. invalid.*

Chrysanthemum gracile (Schultz Bip.) Masferer in An. Soc. esp. Hist. nat. 10 : 207 (1881) reimpr. ut Rec. Bot. Tenerife : 131 (1881). – Burchard in Biblthca bot. 98 : 199 (1929), quoad specim. a Arona, Adeje et Guia. – Ceballos & Ortuño, Veg. Fl. For. Canar. Occid. : 439 (1951), quoad specim. a Arona, San Juan et Adeje.

Stems up to 120 cm, ascending, slender, sparsely branched towards the apex to branched throughout, glabrous. *Leaves* 2–10 cm, usually trifid, pinnatisect,

petiolate, glabrous ; lobes 2, very rarely 4–6, alternate, 2–4·5 × *c.* 0·4 cm, acuminate ; frequently clusters of 3–4 young leaves are present in the axils of cauline leaves. *Inflorescence* laxly corymbose with up to 50 capitula ; peduncles 20 cm ; bracts leaf-like, trifid to linear lanceolate in outline. *Involucre* 6–12 mm in diameter ; bracts in 3 series ; outer bracts triangular, with narrow, scarious margin and fleshy midrib ; inner bracts obspathulate, with expanded, hyaline, scarious apices. *Ray florets* 10–14 × 3–4 mm, white, 1–3-fid at apex ; *disc florets c.* 3 mm, the corolla lobes yellow, the tube whitish. *Ray cypselas* (3·5–) 4–5 × 2–4 mm, trigonous, arcuate, 3-winged, with 2 broad lateral wings and 1 small cuneiform ventral wing ; pappus coroniform, dimidiate on the dorsal edge, secund on the ventral edge ; *disc cypselas* 2–4 × (1–) 2–3 mm, obconical, compressed, the outer series arcuate, usually with one ventral wing, pappus coroniform. *Flowering period:* February to September.

Tenerife: in rupestribus regionis inferioris insulae Tenerifae in convallis praesertim calioribus orae suae meridionalis las Bandas del Sud dictae, *Webb* in herb. Schultz Bip. (P, lectotype). Chio, Dec. 1968, *Bramwell 416* (RNG). Tamaimo, Riscos del Malpais, 23 Mar. 1969, *Bramwell & Humphries 3260* (BM ; RNG). Between Tamaimo and Chio, 4 Apr. 1971, *Bramwell 275* (RNG). Between Tamaimo and Santiago, 4 Apr. 1971, *Bramwell & Humphries 3268* (RNG). Western slope from Tamaimo to Chio, 800 m, 20 Sept. 1965, *Lems* (MICH). Santiago, 16 Mar. 1888, *Kunze* (K). Same locality, 1 June 1963, *Landbøhojsk 300* (C). Chigerque, north of Guia de Isora, 500 m, 3 May 1857, *Larsen* (C). Same locality, 600 m (Cult. No. 85),

FIG. 12. Distribution of *Argyranthemum gracile* (●), *A. tenerifae* (○) and *A. coronopifolium* (◎) on Tenerife.

27 July 1959, *Larsen* (C). Same locality, 700 m (Cult. No. 87), 27 July 1959, *Larsen* (C). Puerto de San Juan, *Lowe* (BM). 26 June 1855, *Bourgeau 1401* (C ; FI ; G ; K ; P ; W ; Z). Valle Seco, 600 m, 10 Mar. 1969, *Bramwell 948* (CGE ; RNG). Same locality, 4 Apr. 1971, *Bramwell & Humphries 3252* (RNG). Same locality, 200 m, Mar. 1925, *Burchard 205* (CGE ; G ; S ; Z). Bco. del Infierno, 25 Aug. 1965, *Lems 5739, 5759* (MICH). Valle de Barriques, 28 June 1855, *Perraudière* (P). Same locality, 6 June 1855, *Perraudière* (P). Same locality, 27 June 1855, *Perraudière* (P). 500 m, March 1855, *Perraudière* (G ; P). Same locality, *Webb 1025* (FI). Las Callictus, April 1906, *Pitard* (P). 1857, *Bolle 227* (P). *Broussonet* (C ; Z). *Broussonet* (G-DC). 1826, *Christian Smith* (CGE). *Scheele* in herb. Schultz Bip. (P). *Cult. hort. Paris.* 1835 in herb. Webb (FI). *Broussonet* in herb. Webb (FI).

Frequent on the south-west coast of Tenerife from Tamaimo in the north to Adeje in the south (Fig. 12).

Locally dominant component of the xerophytic zone between 100 and 550 m. It has also extended to the lower reaches of the pine forest zone in north-east populations. The basal rocks consist of young (Pliocene and later) phonolytic lavas and plateau basalt.

Morphologically this species most resembles *A. frutescens* subsp. *gracilescens*. There are, however, fewer vegetative branches, the habit is taller and the glabrous, trisect leaves are readily distinguished from the scabridulous pinnatisect leaves of that subspecies. A distinct geographical gap, without any overlap, occurs between these two taxa along the south-east coast of Tenerife near Los Christianos and they can rarely be confused in the field.

6. ***Argyranthemum tenerifae*** C. J. Humphries, sp. nov. (Text-fig. 2F, 12.)

Argyranthemum anethifolium Webb in Webb & Berthel., Phyt. Canar. 2 : t. 94 (1840), *nom. invalid.*

Argyranthemum anethifolium Webb ex Schultz Bip. in Webb & Berthel., tom. cit. : 267 (1844), pro parte, non *Pyrethrum anethifolium* Willd. – Pitard & Proust, Îles Canar., Fl. Archipel : 230 (1908).

Chrysanthemum anethifolium sensu Masferer in An. Soc. esp. Hist. nat. 10 : 207 (1881) reimpr. ut Rec. Bot. Tenerife : 131 (1881), non Buch. – Burchard in Biblthca bot. 98 : 200 (1929), excl. specim. a Cumbre de Bolico. – Ceballos & Ortuño, Veg. Fl. For. Canar. Occid. : 440 (1951).

Ab aliis speciebus sectionis *Argyranthemi* morphologia eius cypselorum et habitu nanophyto, petiolis latis et bracteis triangularis involucri differt.

Caules 30–50 cm, ascendentes, ramosi e basi, glabri vel scabri. *Folia* 2–6 × 0·3–1·6 cm, ovata vel oblonga, pinnatisecta vel bipinnatisecta, glabra vel scabra, petiolus expansus in rhachim longam lateribus parallelibus ; lobi primarii 4–10, 0·5–1·6 × 0·1–0·8 cm, oppositi, lobi secundarii 2–16, 2–6 × 0·5–0·8 mm, alterni vel sub-oppositi, acuminati. *Inflorescentia* corymbosus 1–12 capitulis ; pedunculi usque ad 30 cm longi ; bracteae foliiformes ad lineo-lanceolatae plerumque sessiles ad breviter petiolos. *Involucrum* 7–15 mm diametro, bracteae series 3, bracteae serierum extinarum triangulares, scariosae, costa carnosa, bracteae serierum intimarum lineo-lanceolatae ad lineo-triangulares, acutae, laciniatae,

marginibus angustis scariosis. *Radiorum flosculi* albi, ad apicem emarginati vel trifidi ; *discorum flosculi* 3–4 mm longi, lobis corollae flavis et tubis albidis. *Radiorum cypselae* 4–5 × 2·5–5 mm, trigonae, arcuatae, plerumque alis 3, alis duabus lateralibus latis et ala una ventrali cuneiformi, parva ; pappus coroniformis ad marginem dorsalem dimidiatus vel plerumque diminutus et ad instar marginis elevati peripheralis coriacei ; *discorum cypselae* 4–5 × 1·5–2·5 mm, obconicae, teres vel a latere compressae, ala una ventralis cuneiformis vel exalae, pappus coroniformis ad marginem dorsalem dimidiatus in serie externa. *Florescentia* Mars ad Octobrem.

Stems 30–50 cm, ascending, branched from the base, glabrous to scabrous. *Leaves* 2–6 × 0·3–1·6 cm, obovate to oblong in outline, pinnatisect to bipinnatisect, glabrous to scabrous ; the petiole expanded into a long parallel-sided rhachis ; primary lobes 4–10, 0·5–1·6 × 0·1–0·8 cm, opposite ; secondary lobes, 2–16, 2–6 × 0·5–0·8 mm, alternate to subopposite, acuminate. *Inflorescence* corymbose with (1–) 2–12 capitula ; peduncles up to 30 cm ; bracts leaf-like to linear-lanceolate in outline, usually sessile, occasionally shortly petiolate. *Involucre* 7–15 mm in diameter ; bracts in 3 series ; the outer ones triangular, scarious with a fleshy midrib ; the inner ones linear-lanceolate to linear-triangular, acute, laciniate, with narrow, scarious margins. *Ray florets* white, the apex emarginate to 3-fid ; *disc florets* 3–4 mm, the corolla lobes yellow. *Ray cypselas* 4–5 × 2·5–5 mm, trigonous, arcuate, usually 3-winged, with 2 broad lateral wings and 1 small cuneiform ventral wing ; pappus coroniform, dimidiate towards the dorsal edge, often reduced to a coriaceous marginal ridge ; *disc cypselas* 4–5 × 1·5–2·5 mm, obconical, terete to laterally compressed with 1 ventral cuneiform wing or wingless ; pappus coroniform, dimidiate towards the dorsal edge in outer series. *Flowering period* March to October.

Tenerife: below Pico de Teide, 2600 m, 1826, *Berthelot* in herb. Schultz Bip. (FI ; P, holotypus). El Portillo, 2000 m, 22 Oct. 1968, *Bramwell 265, 265(a)* (RNG). Between El Cabezon and El Portillo, 2000 m, 15 Apr. 1969, *Bramwell 1315* (RNG). El Sombrerito, 30 Apr. 1969, *Bramwell 1411* (RNG). Same locality, 10 Apr. 1971, *Bramwell & Humphries 3385* (RNG). Paso de Arenas negras, 30 May 1846, *Bourgeau 849* (BM ; FI ; G ; K ; P). Region de Pico de Teide, 6 July 1855, *Bourgeau* (P). Pico de Teide, 2000 m, 22 July 1963, *Brookes* (BM). 1847, ex herb. Webb (G-DC). Same locality, 6 July 1946, *Ceballos & Ortuño 14424* (MA). 2000 m, 25 Feb. 1935, *Chaytor* (K). Chazua, 5 June 1882, *Hillebrand* in herb. Christ (Z). Same locality, 22 Oct. 1969, *Hansen* (C). Same locality, *de Jussieu* (P). 2000 m, 14 Jan. 1965, *Kaae* (C). 1800 m, 11 May 1957, *Larsen* (C). Montana Blanca, 2900 m, 22 May 1963, *Landbohøjsk* (C). Same locality, 12 Nov. 1965, *Lems 6268* (MICH). Same locality, 11 June 1899, *Murray* (BM). 2200 m, 3 July 1855, *Perraudière* (C ; K ; P ; S). Same locality, 2300 m, 27 Aug. 1839, *Simoniz* (Z).

An obligate chamaephyte in the Cañadas region of Tenerife from El Portillo in the north-east through to Llana de Ucanca and Boca de Tauce in the south.

The sub-alpine scrub habitat is dominated by *Spartocytisus supranubius* and *A. tenerifae* is associated with such species as *Tolpis webbii* and *Descurainia borgaeanum* between 2000 and 2300 m (Fig. 12), on basal rocks which consist entirely of Recent phonolytic lava.

A. tenerifae is the one and only truly alpine species of the genus. The plants are well adapted to the harsh climate of the Cañadas region and die down during the winter for four or five months at a time when the ground is covered with snow. New shoots are produced from short woody ground stems in February and March as the snow clears. The aerial parts of the plants rarely attain a height of more than 50 cm and persist for about six months during the dry summer.

Morphologically it is superficially very similar and frequently confused with the upland montane and pine forest species, *A. adauctum* subsp. *dugourii*, but is easily distinguished, however, by its dwarf habit, the petiolate leaves, the 3-winged ray cypselas and the coroniform pappus.

Argyranthemum tenerifae is usually known as *Chrysanthemum anethifolium* Brouss. ex Willd. Willdenow's description of *Pyrethrum anethifolium* (Enum. Hort. Berol. : 904 (1809)) was based on specimens collected by Broussonet from Tenerife in 1801. These specimens are clearly conspecific with *Pyrethrum foeniculaceum* Willd., (*Argyranthemum foeniculaceum* (Willd.) Webb ex Schultz Bip.), a narrow-leaved chasmophyte from the lower cliffs of Tenerife that is a distinct species.

The plate and description of *A. anethifolium* Webb ex Schultz Bip. in the Phytographia Canariensis refer to *A. tenerifae* but the name is based on *Pyrethrum anethifolium* Willd., which is cited in the synonomy of Schultz Bipontinus's account. As no valid name has ever been applied to this species it is described here as new.

7. ***Argyranthemum maderense*** (D. Don) C. J. Humphries, comb. nov. (Text-fig. 2G, 13.)

Ismelia maderensis D. Don in Sweet, Brit. Flow. Garden. ser. 2, 4 : t. 342 (1836).
Argyranthemum ochroleucum Webb in Webb & Berthel., Phyt. Canar. 2 : t. 96 (1840), *nom. invalid.*
Argyranthemum ochroleucum Webb ex Schultz Bip. in Webb & Berthel., tom. cit. : 259 (1844). – Pitard & Proust, Îles Canar., Fl. Archipel. : 229 (1908).
Chrysanthemum ochroleucum (Webb ex Schultz Bip.) Masf. in An. Soc. esp. Hist. Nat. 10 : 208 (1881) reimpr. ut Rec. Bot. Tenerife : 132 (1881). – Turrill in Curtis's bot. Mag. 166 : t. 67 (1949).

Stems 40–70 cm, procumbent to ascending, slender, branched throughout, glabrous. *Leaves* 2·5–8 × 1–3 cm, obspathulate to obovate, pinnatilobed, ± sessile to shortly petiolate, cuneate at the base, glabrous, dark green, sometimes glaucous ; lobes 2–6, 0·5–3 × 0·4–0·8 cm, serrate, obtuse. *Inflorescence* subcorymbose ; peduncles 5–24 mm ; bracts resembling the leaves to oblong-lanceolate, entire. *Involucre* 11–15 mm ; bracts in 3 series, the outer ones triangular to obovate, scarious, fleshy towards the midrib, the inner ones obspathulate with an expanded, scarious, hyaline apex. *Ray florets* 18–25 × 4–5 mm, pale yellow, the apex emarginate to 3-fid ; *disc florets* 3–3·5 mm, the corolla lobes yellow, the tube white, hyaline. *Ray cypselas* 3–5 × 2–4·2 mm, trigonous, arcuate, 3-winged ; the lateral wings expanded, coriaceous, with a convex dorsal surface, the ventral wing obtriangular, smaller than the lateral wings ; pappus coroniform, dimidiate on the dorsal edge, laciniate ; *disc cypselas* 3–4 × 0·5–2 mm, obconical, laterally

compressed, arcuate in the outer series, wingless or 1-winged, irregularly ribbed ; pappus coroniform, laciniate. *Flowering period:* January to May.

Lanzarote: Yerva de Santa Maria, in rupibus apricis oppiduli Sancti Bartholomaea, *Webb* in herb. Schultz Bip. (P). Haria, 1845, *Bourgeau 303* (BM ; FI ; G ; K ; P ; TCD ; W ; Z). Same locality, 350 m, Apr. 1924, *Burchard 275* (CGE ; G ; Z). Same locality, Mar. 1922, *Burchard 377* (K ; W). Same locality, *Lowe 94* (K). Same locality, 5 Mar. 1905, *Pitard 194* (G ; L ; P ; Z). 'Ye', 14 May 1902, *Murray* (K). Same locality, 26 May 1892, *Murray* (BM ; K ; RHS). Riscos de Famara, 300 m, 15 May 1969, *Bramwell 1653a* (RNG). Same locality, 350 m, 14 Jan. 1969, *Lems 6601* (MICH). Roque de Famara, 600–625 m, *Lems 6678* (MICH). Same locality, 460 m, *Murray 1902* (K). Yerva de Santa Maria, 21 July 1958, *Murray* (BM). *Lowe* (BM ; P).

Endemic to Lanzarote on the north-western coast between Las Rositas and La Caleta above the Playa Famara. Inland localities at La Florida and Yerva de Santa Maria near San Bartholomé have also been recorded (Fig. 13).

It is usually found as an obligate chasmophyte on west-facing cliffs, associated with *Odontospermum* communities. It is restricted to basal rocks composed of Pliocene basalt between 50 and 650 m and on coastal sand dunes in the north-west peninsula.

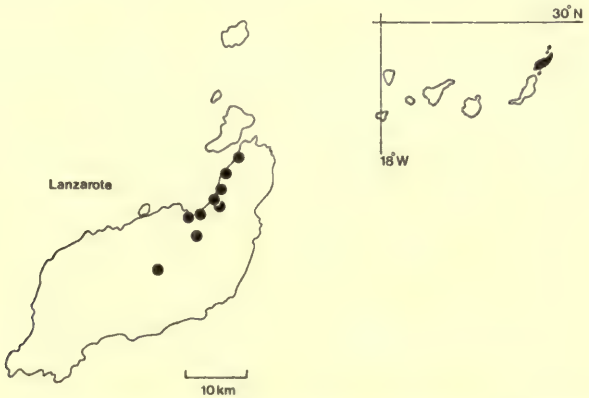

FIG. 13. Distribution of *Argyranthemum maderense* on Lanzarote.

This distinctive species of Lanzarote is usually known as *Argyranthemum ochroleucum* Webb ex Schultz Bip. or *Chrysanthemum ochroleucum* (Webb ex Schultz Bip.) Masf. an epithet coined by Webb to describe its unique yellow ligules for an illustration in the *Phytographia Canariensis*. However, the first description of this species was published under the name *Ismelia maderensis* in 1836 by D. Don in Sweet's *British Flower Garden* with an accompanying illustration drawn from material cultivated at the Chelsea Physic Garden, from seeds originally introduced into Britain by P. B. Webb, from the Canary Islands. D. Don applied the unfortunate epithet '*maderensis*' to the species as he based the diagnosis on a note in one of Webb's earlier manuscripts, '*I. maderensis*, suffruticosa, glauca ; foliis sessilibus cuneatis inciso-lobatis ; supremis subintegerrimus, capitulis corymbosis, rhachide

conica, pappo lobato. Pyrethrum maderense. *Webb MSS'*, which he also cites in the protologue. There is no doubt that, originally, Webb must have mixed up the Lanzarote collections with his Madeiran ones, as the only specimens he is known to have collected of the species are now in the Schultz Bipontinus herbarium in Paris, from gatherings at Yerva de Santa Maria on Lanzarote.

From the description and illustration there is no doubt that D. Don is referring to the Lanzarote endemic and in the absence of any authentic specimens and with the knowledge that the illustration in the protologue was based on live material, the plate is considered to be the holotype.

8. ***Argyranthemum winteri*** (Svent.) C. J. Humphries comb. nov. (Text-fig. 2H, 3c, d, 14.)

Chrysanthemum winteri Svent., Addit. Flor. Canar. 1 : 67, t. 26 (1960).
Chrysanthemum broussonetii sensu Burchard in Biblthca bot. 98 : 201 (1929) pro parte, quoad specim. ex Fuerteventura, non Pers.

Stems 60–80 cm, branched throughout the plant, glabrous. *Leaves* 2–8·5 × 0·6–2·5 cm, oblong ovate to ovate elliptical in outline, bipinnatifid, sessile, glabrous ; primary lobes 6–14, opposite to subopposite, 0·3–1·8 × 0·1–0·5 cm, linear-lanceolate, decurrent ; secondary lobes dentate, acuminate. *Inflorescence* tightly corymbose, 3–14 capitula ; peduncles 2–6 cm ; bracts pinnatifid. *Involucre* 14–20 mm ; bracts in 3 series, lanceolate to linear-lanceolate in outline ; those of the outer series with a fleshy midrib, margins scarious ; inner bracts scarious and expanded into a hyaline, laciniate apex. *Ray florets* 10–15 × *c.* 4 mm, white, the apex 2–3-fid ; *disc florets* 2–3 mm, the corolla lobes yellow, the tube white. *Ray cypselas* 3–7 × 3·5–7 mm, triquetrous, arcuate, irregularly ribbed, 3-winged ;

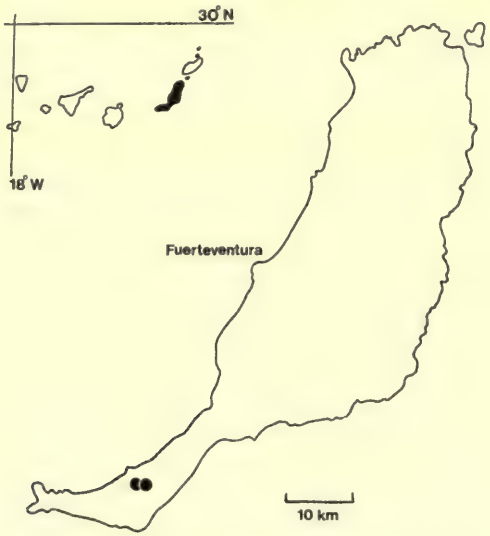

Fig. 14. Distribution of *Argyranthemum winteri* on Fuerteventura.

2 lateral wings prominent, coriaceous, with dentate margins ; the ventral wing diminutive, obtriangular ; pappus coroniform, dimidiate ; *disc cypselas* 5–6 × 1·9–3 mm, claviform, arcuate in the outer series, irregularly 8–10-ribbed, 1-winged, the margins crispate-denticulate ; pappus coroniform, lacerate. *Flowering period:* March to April.

Fuerteventura: Handia, Pico de la Zarza, *c.* 800 m, 21 Mar. 1946, *Sventenius* (TENE, holotypus). Same locality, *Sventenius* (TENE). Same locality, 800 m, Apr. 1912, *Burchard* 331 (G ; Z). Same locality, 30 Mar. 1971, *Bramwell & Humphries 3175* (BM ; RNG). Same locality, 11 Mar. 1967, *Kunkel 10665* (G). Same locality, 650 m, 1 May 1964, *Bramwell* (RNG).

A narrow endemic restricted to the montane regions of Handia (Pico de La Zarza) on Fuerteventura (Fig. 14). It occurs mainly as a chasmophyte in rock fissures of north-west-facing cliffs and occasionally associated with *Odontospermum sericeum* communities around 800 m, on basal rocks of Pliocene 'plateau' basalt.

9. ***Argyranthemum lidii*** C. J. Humphries sp. nov. (Text-fig. 2I, 15, 16.)

A. broussonetii primo adspectu maxime simile sed cypselis radii trialatis, cypselis disci unialatis, squama indurata versus basin petioli, lobis foliorum acuminatis vel uncinatis, differt.

Caules 50–60 cm, ascendentes, ramosi e basi, plerumque glabri vel aliquando scarbridiusculi. *Folia* 3–9 × 1–3·5 cm, ambitu ovato-elliptica, bipinnatifida, glabra vel scabridiuscula, breviter petiolata ; basis petioli tecta squama persistenti incrassata ; lobi primarii 6–14, 5–40 × 8–15 mm, subopposite vel opposite ; lobi secundarii 2–12 × 2–4 mm, dentati, acuminati vel uncinati. *Inflorescentia* corymbosa, 2–6 capitulata, pedunculi 6–10 (–12) cm, glabri vel scabridiusculi ; bracteae foliiformes vel pinnatifidae, sessiles plerumque scabridiusculae. *Involucrum* 8–16 mm diametro ; bracteae series 3–4 continuas formantibus ; bracteae extimae ambitu scariosae ad marginem et carnescentes ad costam ; bracteae intimae obspathulatae, ad apicem expansae, scariosae et hyalinae. *Radiorum flosculi* 10–15 × *c.* 4 mm, albi, emarginati vel trifidi ad apicem ; *discorum flosculi* 3–3·5 mm, lobis corollae flavis et tubis albidis. *Radiorum cypselae* 3·5–5 × 2–5 mm, trigonae, arcuatae, laeves, trialatae, pappus coroniformis secundus later ventralem cypselae dimidiatus vel absens ad marginem dorsalem ; *discorum cypselae* 2·5–4 × 1·3–2·5 mm obconicae a latere compressae vel plus minusve quadrangulares, erectae vel leviter arcuatae ad series extimas, unialatae ; pappus coroniformis, dimidiatus ad marginem dorsalem et secundus ad later ventralem seriei extimarum. *Florescentia* Mars ad Aprilem.

Stems 50–60 cm, ascending, branched from the base, usually glabrous, sometimes scabridulous. *Leaves* 3–9 × 1–3·5 cm, ovate-elliptical in outline, bipinnatifid, glabrous to scabridulous, shortly petiolate, the base of the petiole covered with a thick woody scale ; primary lobes 6–14, 5–40 × 8–15 mm, subopposite to opposite ; secondary lobes 2–12 × 2–4 mm, dentate, acuminate to uncinate. *Inflorescence* corymbose, with 2–6 capitula ; peduncles 6–10 (–12) cm glabrous to scabridulous ; bracts leaf-like to pinnatifid, sessile, usually scabridulous. *Involucre* 8–16 mm in

FIG. 15. *Argyranthemum lidii* C. J. Humphries: A, whole plant; B, ventral view, C, dorsal view of ray cypsela; D, lateral view of disc cypsela of outer series; E, lateral view of disc cypsela of inner series.

diameter; bracts in 3 or 4 series; outer bracts scarious at the margins becoming fleshy towards the midrib, scabridulous; inner bracts obspathulate, scarious, hyaline at the margins and apex. *Ray florets* 10–15 × *c.* 4 mm, white, the apex emarginate to 3-fid; *disc florets* 3–3·5 mm, the corolla lobes yellow, the basal tube white. *Ray cypselas* 3·6–5 × 2–5 mm, trigonous, smooth, 3-winged; pappus

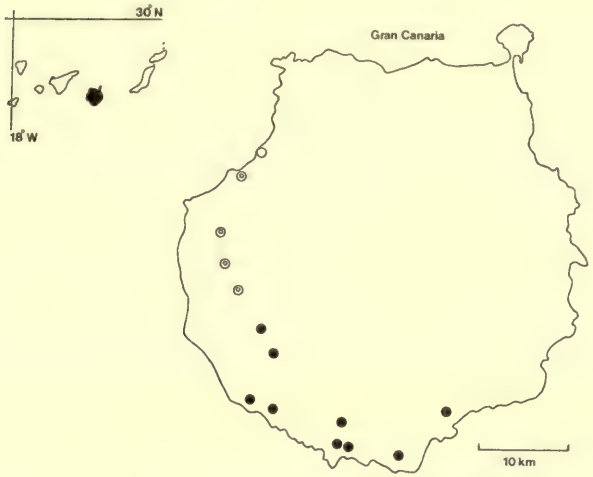

FIG. 16. Distribution of *Argyranthemum lidii* (○), *A. filifolium* (●) and *A. escarrei* (◎) on Gran Canaria.

coroniform, dimidiate, to more or less absent ; *disc cypselas* 2·5–4 × 1·3–2·5 mm, obconical, laterally compressed to more or less quadrangular, erect to slightly arcuate in outer series, 1-winged ; pappus coroniform, dimidiate on the dorsal margin and secund towards the ventral edge of the outer series. *Flowering period:* March to April.

Gran Canaria: Via prope Anden Verde inter Agaete et San Nicolas, 600 m.s.m. Leg. *Bramwell et Humphries 3152*. In herb. Univ. Radingensis servatus (isotypus BM).

This species is named in honour of the late Johannes Lid, for his contributions to the study of phanerogamic plants in the Canary Islands.

An extremely rare species known only from Gran Canaria on the slopes of Risco Faneque along the coast road between Agaete and San Nicolas. It occurs on a rocky substrata consisting of sakalavite and Miocene basalt (Fig. 16).

This species is referable to section *Argyranthemum* on the basis of cypsela morphology. The ray cypselas have large coriaceous lateral wings and a single ventral wing and the disc cypselas have a single cuneiform ventral wing. A coroniform pappus is usually found on both ray and disc cypselas.

The plants occur as low-growing shrubs, branched only from the base. The leaves are quite unlike any other species of this section and are superficially similar to those of *A. broussonetii* or *A. adauctum* subsp. *jacobaeifolium* (Fig. 2I, N, U). Other characteristics for the species are the hard abaxial scales found at the base of the petioles and the uncinate tips on some of the leaf lobes.

The only specimens of this species (*Bramwell & Humphries 3152*) were collected at the bottom of an inaccessible basalt cliff, and the population is suspected to have developed from seeds that have dropped from the top of the cliff – an apparently richly wooded area dominated by conifers.

10. ***Argyranthemum dissectum*** (Lowe) Lowe, Man. Fl. Madeira : 464 (1868). (Text-fig. 2J, 3f, 17.)

Matricaria pinnatifida [var.] β Desrouss. in Lam., Encycl. Méth. 3 : 729 (1792).
Chrysanthemum lacerum Desrouss., loc. cit., *nom. synon.*
Chrysanthemum dissectum Lowe in Trans. Camb. phil. Soc. 6 : 539 (1838).
Argyranthemum pinnatifidum Webb in Webb & Berthel., Phyt. Canar. 2 : t. 95 quoad fig. 2, 4 (1840), *nom. invalid.*
Stigmatotheca lacera Schultz Bip. in Webb & Berthel., tom. cit. : 257 (1844), *nom. superfl.*

Stems 60–120 cm, lax, branched throughout, glabrous. *Leaves* 2–9 × 0·2–3·5 cm, ovate-oblong to lanceolate in outline, bipinnatisect, pectinate, petiolate, glabrous ; primary lobes 10–16, 0·5–2 × *c.* 0·5 cm, subopposite, linear ligulate to narrowly lanceolate, acuminate ; secondary lobes dentate-acuminate. *Inflorescence* more

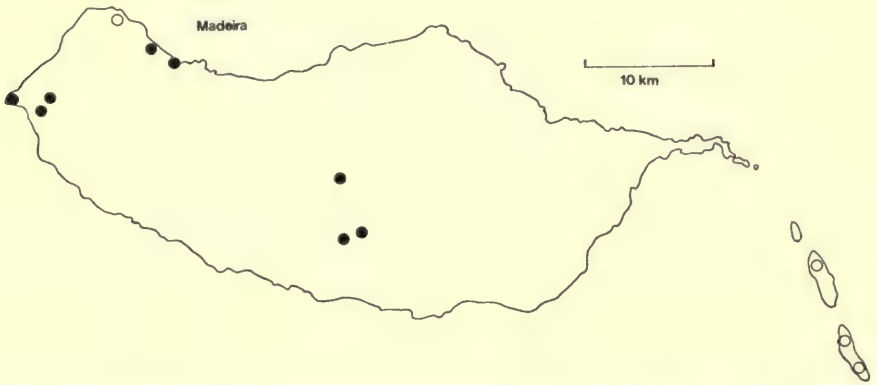

FIG. 17. Distribution of *Argyranthemum dissectum* (●) and *A. haemotomma* (○) on Madeira.

or less corymbose, with 1–5 capitula ; peduncles 10–25 cm, slender ; bracts 1–2, lanceolate, entire. *Involucre* 14–20 mm in diameter ; bracts in 3–4 series, triangular to spathulate in outline ; outer bracts fleshy, with a narrow, scarious margin ; inner bracts scarious, hyaline, expanded at the apex. *Ray florets* 15–22 × *c.* 0·5 mm, white, the apex emarginate to 3-fid ; *disc florets c.* 3 mm, the corolla lobes yellow. *Ray cypselas* 4–5 × 2–3 mm, turbinate, trigonous, unequally 3-winged ; the 2 lateral wings large, coriaceous, laciniate ; the ventral wing diminutive, carinate ; pappus coroniform, dimidiate on the dorsal edge, pointing towards the ventral edge ; *disc cypselas* 3–4 × 2–3 mm, obconical, slightly compressed to terete or ± quadrangular, 1-winged ; pappus coroniform, dimidiate, on the dorsal edge, in a dentate beak or apical aculus on the ventral edge. *Flowering period:* March to May.

Madeira: Punta Pargo, 15 Apr. 1860, *Lowe* (BM ; G ; K). Same locality, 5 May 1862, *Lowe* (BM). Same locality, 24 Apr. 1838, *Lowe* in herb. Tucker (BM). Same locality, 370 m, 7 June 1865, *Norman* (CGE). Pico Grande, 23 June 1855, *Moriz* (BM). Cabo Girao, at top of cliff, 24 Apr. 1838, *R. Lowe* in herb. Tucker

(BM, lectotype). Same locality, 11 May 1838, *Lowe* in herb. Leman (CGE). Malhada Velha, 1200 m, *Mandon 319* (C ; G ; K). Riberia Frio, *Vogel* (K). North coast between Seixal and Porto Moniz, 10–25 m, 1 May 1966, *Lems 7637* (MICH). Caninho, 3 Aug. 1902, *Vahl.* (C). 1837, *Leman* (CGE ; K). 1839, *Leman* (G). Det. *Webb* in herb. Schultz Bip. (P). 1856, *Mason 335* (CGE).

A rare endemic of moist cliffs, banks and hedges from the north-west peninsula of Madeira between Porto Moniz and Punta Pargo. The species has also been recorded from south-facing cliffs of the Curral das Freiras near Cabo Giram and west-facing cliffs of Pico Grande (Fig. 17).

11. ***Argyranthemum thalassophilum*** (Svent.) C. J. Humphries, comb. et stat. nov. (Text-fig. 2K.)

Chrysanthemum pinnatifidum var. *thalassophilum* Svent. in Indices Sem. Hort. Acclim. Pl. Arautapensi 1968 (4) : 59 (1968), reimpr. ut Pl. Macarones. nov. v. minus cogn. 1 : 17 (1968).

Stems up to 90 cm, ascending, branched throughout, glabrous. *Leaves* 2·4–6 × 0·7–3·5 cm, obovate-trapeziform, pinnatifid to bipinnatifid, petiolate, glabrous ; primary lobes 2–6, 0·3–2·5 × 0·2–0·8 cm, opposite to subopposite ; secondary lobes 1–7, 0·2–0·5 × *c.* 0·2 cm, alternate, obtuse, sometimes absent. *Inflorescence* corymbose, with 2–6 capitula ; peduncles 5–12 cm ; bracts pinnatifid to linear-lanceolate, sometimes subtending the capitula. *Involucre* 12–18 mm in diameter ; bracts in 3–4 series, triangular to obovate ; outer bracts fleshy along the midrib, invested with an obtuse fleshy keel towards the apex ; inner bracts scarious, with a flabelliform, rotund-crenulate, hyaline apex and distinct, divergent veins. *Ray florets* 16–20 × 5–8 mm, creamy white, the apex entire or emarginate ; *disc florets c.* 4 mm, the corolla lobes yellow, the tube pale yellow or whitish. *Ray cypselas* 4·5–6 × 4·5–8 mm, trigonous, 3-winged, the wings coriaceous ; pappus coroniform, dimidiate on dorsal edge and rising to a point on the ventral edge, irregularly dentate ; *disc cypselas* 4·2–5·5 × 1–3 mm, obconical, laterally compressed to terete, 1-winged ; pappus coroniform, dimidiate on dorsal edge or pointing towards the ventral edge in outer series, irregularly dentate. *Flowering period:* March to April.

Salvage Islands: Grand Piton, rocky places near the sea, 7 May 1953, *Sventenius* (TENE, holotype). Tafira Botanic Garden, ex locus classicus, *Bramwell & Humphries* (RNG).

A conspicuous endemic of coastal rocks between 5 and 10 m on Grand Piton Island.

The putative relationship of *A. thalassophilum* with *A. pinnatifidum* is questionable. *A. thalassophilum* is morphologically distinct as well as geographically isolated from all other taxa within the genus. It differs from *A. pinnatifidum* by the larger coroniform pappus of both the ray and disc cypselas and its distinctive leaf shape (Fig. 2). On the basis of sectional characters it is most like the Canary Islands taxa *A. frutescens* subsp. *succulentum* and subsp. *canariae*, but differs from them by the unique carinae of the outer involucral bracts.

12. ***Argyranthemum callichrysum*** (Svent.) C. J. Humphries, comb. nov. (Text-fig. 2L, 3e, 18.)

Chrysanthemum callichrysum Svent., Addit. Fl. Canar. 1 : 65, t. 25 (1960).

Stems 60–100 cm, erect, branched throughout the plant, glabrous. *Leaves* 10–15 × 2–6 cm, ovate-elliptical in outline, bipinnatisect, petiolate, glabrous, dark green on adaxial surface, pale green on abaxial surface; primary lobes 6–10, 0·5–5 × 0·2–0·6 cm, subopposite to opposite; secondary lobes 2–8, alternate, acuminate. *Inflorescence* corymbose, with 3–35 capitula; peduncles 5–15 cm; bracts pinnatifid to pinnatisect. *Involucre* 9–14 mm; bracts in 3 series, triangular-lanceolate to ovate or linear-lanceolate in outline, outer bracts scarious with a fleshy midrib, inner bracts scarious with an expanded apex. *Ray florets* 15–20 × 2–5 mm, yellow or creamy white, the apex entire or 1–3-fid; *disc florets* *c.* 3 mm, the corolla lobes yellow, *Ray cypselas* 4–5 × 4–8 mm, obconical, trigonous, solitary or with 2–6 coalesced together, with 2–3 diminutive wings with crispate margins; pappus a narrow marginal ridge to ± coroniform, dimidiate to absent on the dorsal edge; *disc cypselas* 3–5 × 1–3 mm, obconical to claviform, irregularly 4–5-angled, with a single obtriangular wing; pappus ± coroniform, crispate on the margins. *Flowering period:* March to June.

La Gomera: Iguelero, 1000 m, 18 May 1946, *Sventenius* (TENE, holotypus). Same locality, *Sventenius* (TENE). Tagamiche, 900 m, 18 Mar. 1966, *Lems 7296* (MICH). Bco. de Argaga, 10–250 m, 23 Mar. 1966, *Lems 7321* (MICH). Between Agando and Iguelero, 27 June 1969, *Bramwell & Humphries 3174* (RNG). Roque Agando, 1150 m, 19 Mar. 1966, *Lems 7240* (MICH).

Sparsely distributed from Barranco de Argaga on the south-west coast to the south and south-facing slopes of the central mountains of Igualero, Agando and Tagamiche. A single locality is also recorded from Vallehermoso on the north-west coast (Fig. 18).

A. callichrysum is associated with xerophytic scrub vegetation on rocky slopes. At lower altitudes it grows on cliffs in *Euphorbia regis-jubae* communities between 10 and 250 m and at higher altitudes it usually occurs as scattered individuals in

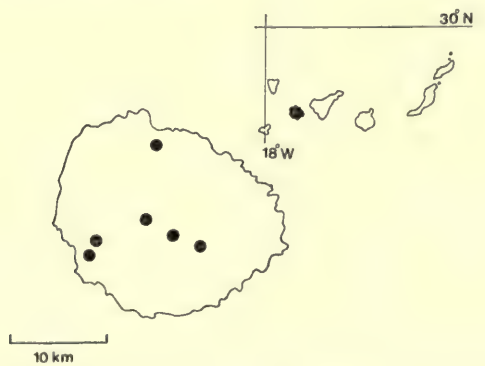

FIG. 18. Distribution of *Argyranthemum callichrysum* on La Gomera.

the *Juniperus phoenicea* scrub and *Erica arborea* communities between 900 and 1200 m. The basal rocks consist of trachyphonolytes and basalts.

The plants of Igualero have mostly yellow ligules but in all other populations they are creamy white. The montane populations are morphologically most similar to *A. haouarytheum* and occupy similar altitudinal ranges (p. 196). However, *A. callichrysum* consistently differs by its more numerous and wider leaf-lobes and the diminutive wings and pappus on the ray cypselas.

13. ***Argyranthemum sventenii*** Humphries & Aldridge, sp. nov. (Text-fig. 2W, 19, 23.)

Similis *A. callichryso* (Svent.) C. J. Humphries sed foliis parvis cum lobis angustis dissectis minoribus, involucris multo angustioribus et flosculis radiorum perpusillis differt.

Caules 30–60 cm, basi ramosi, glabri. *Folia* 3–10 × 1–6 cm, ambitu obovata, pinnatisecta vel bipinnatisecta, petiolata, glabra; lobi primarii 3–10, 0·5–3 × 0·05–0·3 cm, lineo-lanceolati, oppositi vel subopposite; lobi secundarii 1 vel 2, 0·1–0·5 × *c.* 0·05 cm, alterni, acuti. *Inflorescentia* corymbosa, 10–25 capitulata; pedunculi 5–9 cm, bracteae foliiformes vel lineo-lanceolateae. *Involucrum* 6–11 mm diametro; bracteae series 3 formantes, bracteae extimae ambitu anguste triangularis scariosae, bracteae intimae anguste obovatae vel lineo-lanceolati, hyalinae ad marginem et laciniatae ad apicem. *Radiorum flosculi* 6–10 × *c.* 2 mm, eburnei, integri vel emarginati ad apicem, *discorum flosculi c.* 4 mm longi, lobis corollae flavis et tubis albis. *Cypselae radiorum* 3–4 × 3–5·5 mm, turbinatae, trigonae, 3–4 alatae, binae vel ternae saepe coalescentes; pappus anguste coroniformis, irregulariter dentatus; *discorum cypselae* 2·5–4 × 1·5–2·8 mm, a latere compressae vel teretes, plerumque unialatae; pappus coroniformis, irregulariter dentatus. *Florescentia* Januarius usque Mars.

Stems 30–60 cm, branched at the base, glabrous. *Leaves* 3–10 × 1–6 cm, obovate pinnatisect or bipinnatisect, petiolate, glabrous; primary lobes 0·5–3 × 0·05–0·3 cm, linear-lanceolate; secondary lobes 1 or 2, 0·1–0·5 × *c.* 0·05 cm, alternate, acute. *Inflorescence* corymbose with 10–25 capitula; peduncles 5–9 cm; bracts leaf-like to linear-lanceolate. *Involucre* 6–11 mm in diameter; bracts in 3 series; outer bracts diminutive, narrowly triangular, scarious; inner bracts narrowly obovate to linear-lanceolate, scarious, hyaline towards the margin, laciniate at the apex. *Ray florets* 6–10 × *c.* 2 mm, creamy white, entire or emarginate at the apex; *disc florets c.* 4 mm with yellow corolla lobes and white tubes. *Ray cypselas* 3–4 × 3–5·5 mm, turbinate, trigonous, 3–4-winged, often coalesced into groups of 2 or 3; pappus narrowly coroniform, irregularly dentate; disc cypselas 2·5–4 × 1·5–2·8 mm, laterally compressed to terete, usually 1-winged; pappus coroniform, irregularly dentate. *Flowering period:* January to March.

Holotypus: Via ad meridiem e San Andrés prope Restigam, leg. 16 Mar. 1973, *Aldridge 1293*. In herb. Univ. Radingensis servatus (RNG).

A rare species occurring as a single population in the *Euphorbia balsamifera–Kleinia neriifolia* lowland xerophytic scrub near Restiga on the central slopes of the South Hierro peninsula.

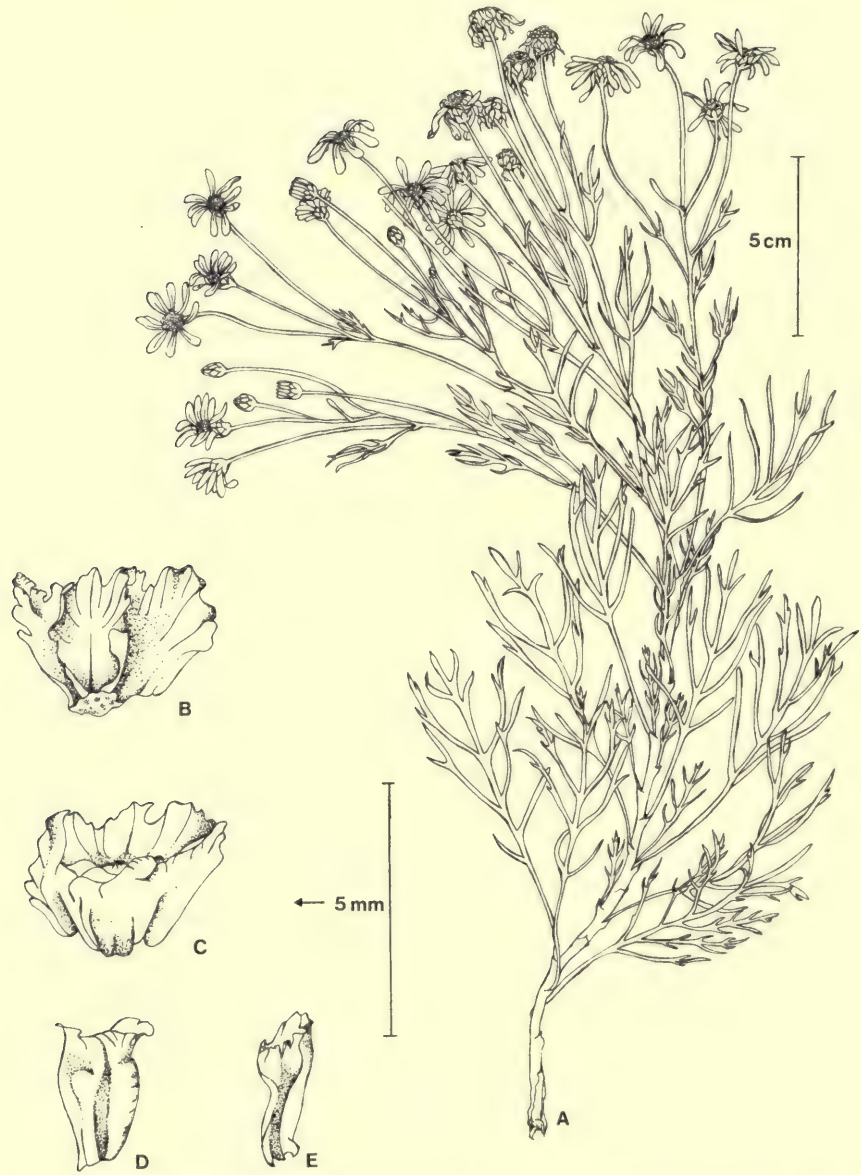

FIG. 19. *Argyranthemum sventenii* Humphries & Aldridge: A, whole plant; B, ventral view, C, dorsal view of ray cypsela; D, lateral view of disc cypsela of outer series; E, lateral view of disc cypsela of inner series.

Recent collections by Miss A. Aldridge (1973) from various regions of Hierro indicate that three species occur on the island. *A. hierrense* and *A. canariense* occur in the laurel forests on the northern slopes, but this is the first collection to be obtained in the south.

The ray-cypsela morphology of these plants most closely resembles that of *A. callichrysum*, in that the wings and pappus are very reduced and the pericarp is often coalesced to form groups of 2 or more cypselas. The plants can readily be distinguished from *A. callichrysum* by their small pinnatisect or bipinnatisect leaves, and tiny capitula. The species can also be distinguished from other members of section *Argyranthemum* occurring in the lowland xerophytic zones of the western Canary Islands (i.e. *A. frutescens* and *A. gracile*) by the leaf shape (Fig. 2).

Section 2. ***SPHENISMELIA*** (Schultz Bip.) C. J. Humphries

ARGYRANTHEMUM sect. SPHENISMELIA (Schultz Bip.) C. J. Humphries, comb. nov.

Ismelia sect. *Sphenismelia* Schultz Bip. in Webb & Berthel., Phyt. Canar., 2 : 272 (1844).
Ismelia sect. *Grammismelia* Schultz Bip. in Webb & Berthel., loc. cit.

Plants glabrous or hispid only on the leaf midribs. *Leaves* bipinnatifid to bipinnatisect, petiolate. *Ray florets* wingless to 1–2 (–3)-winged ; the wings narrow, scarious ; pappus coroniform. *Disc cypselas* obconical, laterally compressed with usually 2 or rarely 1 coriaceous wings ; pappus coroniform.

14. ***Argyranthemum coronopifolium*** (Willd.) C. J. Humphries, comb. nov. (Text-fig. 2M, 12.)

Pyrethrum coronopifolium Willd., Enum. Hort. Berol. : 904 (1809).
Chrysanthemum grandiflorum [var.] δ *cuneiforme* DC., Prodr. 6 : 66 (1838).
Chrysanthemum broussonetii [var.] β *parviflorum* DC., tom. cit. : 67 (1838).
Argyranthemum frutescens [var.] δ *cuneiforme* Webb & Berthel., Phyt. Canar. 2 : t. 92 fig. sinistr. (1839), *nom. invalid.*
Chrysanthemum grandiflorum [var.] γ [sphalm. pro δ] *coronopifolium* (Willd.) Steudel, Nomencl. Bot. ed. 2, 1 : 357 (1840).
Chrysanthemum coronopifolium (Willd.) Steudel, tom. cit. : 356 (1840), *nom. synon.*
Ismelia coronopifolia (Willd.) Schultz Bip. in Webb & Berthel., tom. cit. : 272 (1844). – Pitard & Proust, Îles Canar., Fl. Archipel. : 232 (1908) quoad specim. a Tenerife.
Argyranthemum coronopifolium (Willd.) Webb ex Schultz Bip. in Webb & Berthel. loc. cit., *nom. synon.*
Chrysanthemum coronopifolium (Willd.) Masf. in An. Soc. esp. Hist. nat. 10 : 208 (1881), reimpr. ut Rec. Bot. Tenerife : 132 (1881), excl. spec. a Orotava et Gran Canaria, non *C. coronopifolium* Vill. (1788). – Burchard in Biblthca bot. 98 : 201 (1929), excl. specim. a Ferro. – Ceballos & Ortuño, Veg. Fl. For. Canar. Occid. : 441 (1951), quoad specim. a Tenerife.

Stems 40–120 cm, prostrate, procumbent or ascending, branched throughout the plant, glabrous. *Leaves* 1·5–9 × 0·5–4·5 cm, obovate to obspathulate, 1–2-pinnatilobed, glabrous ; the petioles cuneate ; primary lobes 2–8, 0·5–3·5 × 0·3–1·5 cm, opposite to subopposite, secondary lobes 2–5, alternate, dentate, obtuse to acute. *Inflorescence* monocephalic to corymbose, with 1–8 capitula ; peduncles

up to 20 cm long ; bracts 1 or 2, or often absent, linear-lanceolate in outline. *Involucre* 12–22 mm ; bracts in 3 series ; outer bracts triangular in outline, scarious, with a thick fleshy midrib ; inner bracts obovate to oblong, scarious, with an expanded hyaline apex. *Ray florets* 11–24 × *c.* 6 mm, white, the apex emarginate to 3-fid ; *disc florets* 3–4 mm, the corolla lobes yellow, the tube pale yellow or white, hyaline. *Ray cypselas* 5–7 × 3–6 mm, trigonous, arcuate, 1–3 (–4)-winged ; pappus coroniform ; *disc cypselas* 3–4 × 1·5–3 mm, obconical, turbinate, arcuate in outer series, laterally compressed to ± quadrangular, usually with 2 wings, rarely 1 wing or wingless ; pappus coroniform dimidiate or absent on the dorsal margin. *Flowering period:* March to November.

Tenerife: In herb. bot. Berol., *Willdenow 16203* (B, holotype ; RNG, phototype). Roque del Fraile, Buenavista, Teno, 70 m, 3 Nov. 1968, *Bramwell 318* (RNG). Same locality, *Bramwell 553* (RNG). Same locality, 25 Jan. 1969, *Bramwell 556* (RNG). Same locality, 100 m, 13 July 1969, *Bramwell & Humphries 3271* (BM ; RNG). Same locality, 19 June 1855, *Bourgeau* (FI ; P). Same locality, 300 m, May 1923, *Burchard 174* (G ; Z). Same locality, 200 m, in scrub vegetation, 29 Mar. 1960, *Larsen* (C). Same locality, 19 June 1956, *Lems 2634* (MICH). Same locality, 220 m, 9 Oct. 1965, *Lems 6094* (MICH). Same locality, *Webb* (FI). Bajamar, in herb. Schultz Bip. (P). Same locality, in herb. Webb 196 (FI). Cultivar No. 13 (G-DC). In herb. de Jussieu (P). In herb. Webb (P).

A. frutescens (L) Webb ex Schultz Bip. × *A. coronopifolium* hybrids ; El Fraile, 3 Nov. 1968, *Bramwell 319* (RNG). Same locality, 13 Feb. 1969, *Bramwell 690* (RNG). Mirador Pompeii, 5 Apr. 1971, *Bramwell & Humphries 3280* (RNG). Same locality, 21 Oct. 1969, *Hansen* (C).

A rare endemic of Tenerife from the north-facing slopes of the Teno promontory at Buenavista. It is also recorded from localities around Bajamar on the north coast of the Anaga peninsula, from specimens in the herbarium of P. B. Webb, but it is likely that the species is extinct in this region today.

It is now a rare chasmophyte of wet, north-facing cliffs, commonly associated with stem succulents of the association *Aeonio–Euphorbetum canariense* Rivas & Esteve ; 50–300 m. The basal rock consists of plateau (Pliocene) basalts.

A large, complex hybrid swarm with many intermediates has developed between *A. coronopifolium* and *A. frutescens* subsp. *frutescens* on the scree slopes formed by the construction of a tunnel in 1965 through the cliffs at El Fraile connecting Buenavista with the Punta de Teno. Hybrid backcrosses to *A. coronopifolium* are rapidly being produced causing grave threats to the survival of the rare parental populations (Humphries, 1973).

15. ***Argyranthemum broussonetii*** (Pers.) C. J. Humphries, comb. nov. (Text-fig. 3j, l, 20.)

Chrysanthemum broussonetii Pers., Syn. Pl. 2 : 461 (1807). – Balbis, Cat. Hort. Taurin. : 20 (1810). – DC., Prodr. 6 : 66 (1838), excl. [var.] *β parviflorum*. – Masferer in An. Soc. esp. Hist. nat. 10 : 208 (1881), reimpr. ut Rec. Bot. Tenerife : 132 (1881). – Burchard in Biblthca bot. 98 : 201 (1929), quoad specim. a Tenerife. – Ceballos & Ortuño, Veg. Fl. For. Canar. Occid. : 441 (1951), excl. specim. a Hierro.

Pyrethrum broussonetii Choisy in Buch, Phys. Beschr. Canar. Ins. : 149 (1825).
Argyranthemum pinnatifidum Webb in Webb & Berthel., Phyt. Canar. 2 : t. 95, quoad fig. 3, 5–9 (1840), *nom. invalid.*
Ismelia broussonetii (Choisy) Schultz Bip. in Webb & Berthel., tom. cit. : 274 (1844). – Pitard & Proust, Îles Canar., Fl. Archipel : 232 (1908).

Stems up to 120 cm, procumbent to ascending, branched throughout the plant, glabrous. *Leaves* 3–16 × 0·5–8 cm, obovate-elliptical, bipinnatifid or rarely bipinnatisect, shortly petiolate to ± sessile, glabrous or sparsely hairy on the midrib ; primary lobes 2–18, 0·5–5 × 0·3–2 cm, ovate, opposite to subopposite ; secondary lobes dentate, acuminate. *Inflorescence* corymbose ; peduncles 4–12 cm, stout ; bracts leaf-like to narrowly oblong. *Involucre* 12–22 mm in diameter ; bracts in 3 series ; outer bracts triangular, fleshy ; inner bracts obovate, scarious with an expanded, hyaline apex. *Ray florets* 20–38 × 4–8 mm, white, 1–3-fid at the apex ; *disc florets c.* 4 mm, the corolla lobes yellow, the tubes pale yellow or white. *Ray cypselas* 4–6 × 3–5 mm, obconical, trigonous to ± terete, the wings 1–3 or rarely 4, often wingless ; pappus a large, coriaceous expansion of the pericarp to a marginal ridge, or a cuspate corona to sometimes absent ; *disc cypselas* 3–5 × 2–4 mm, obconical, laterally compressed to ± quadrangular with 2 or rarely 1 wings ; pappus coroniform, sometimes expanded laterally in outer series. *Flowering period:* February to October.

Two subspecies are recognized.

a. subsp. ***broussonetii*** (Text-fig. 2N 1.)

Argyranthemum pinnatifidum Webb & Berthel., Phyt. Canar. 2 : t. 95 fig. 3, 5–9 (1840), *nom. invalid.*

Stems up to 120 cm, ascending. *Leaves* 3–16 × 0·5–8 cm. *Involucre* 12–22 mm. *Ray cypselas* 5–6 mm. Endemic to Tenerife.

Tenerife: Broussonet in herb. Persoon (L, holotype). Montes de Anaga, Los Pajales, 900 m, 16 May 1933, *Asplund 1305* (G ; K). Same locality, 5 Oct. 1900, *Bornmüller 815* (G), Pico Inglés, 550 m, 2 Aug. 1968, *Bramwell 421* (RNG). Punta de Anaga, 600 m, May 1926, *Burchard 325* (G ; S ; Z). Cumbre de Anaga, 1957, *Lems 3081* (MICH). Same locality, 11 June 1894, *Murray* (G). Same locality, 1890 (BM ; K). Taganana, *Broussonet* in herb. Schultz Bip. (P). 600–800 m, 30 May 1901, *Bornmüller 2466* (P). Vueltas de Taganana, 7 Feb. 1969, *Bramwell 651* (RNG). Same locality, 21 May 1969, *Bramwell 1531* (RNG). Same locality, 1000 m, 3 Mar. 1961, *Hummel* (S). Cruz de Taganana, 900 m, 16 Aug. 1954, *Lems 2199* (MICH). Same locality, 1000 m, Mar. 1855, *Perraudière* (P ; S). 900 m, Feb. 1906, *Pitard & Proust 578* (G ; L ; P). Tegueste, 4 Feb. 1855, *Bourgeau 7405* (B ; C ; FI ; G ; K ; M ; P ; W ; Z). Same locality, 13 Feb. 1855, *Perraudière* (P). Same locality, 2 May 1846, *Webb* (FI). Roque de las Pasas, 934 m, 9 Apr. 1971, *Bramwell & Humphries 3382* (RNG). Valle de Chinamara, Apr. 1907, *Burchard 191* (Z). Tigaige, 7 May 1902, *Murray* (K). Monte Bajamar, 1842, *Webb 544* in herb. Schultz Bip. (P). Same locality, 1856, *Bourgeau 1409* (P). Same locality, Broussonet in herb. Ventenat (G). Same locality 1807, *Broussonet* (G-DC). Same

locality, 1820, *Courant* (G-DC). Same locality, 1796, *Ledru* in herb. de Jussieu (P). Same locality, *Mason 2463* (S). *Persoon* (L). Icod el Alto, on the road to Realejos, 650 m, 13 Apr. 1969, *Bramwell 1257* (RNG). Icod de los Vinos, 1 June 1895, *Keugler* (K). Icod el Alto to Tigaiga, 3 Dec. 1965, *Lems 6412* (MICH).

Locally common on the Punta de Anaga, the north-east peninsula of the island, along the central mountains from Las Mercedes to Tegueste on the north coast. Small populations also occur in the Orotava valley between Icod Alto and Realejo (Fig. 20). Predominantly, a subspecies of open clearings of *Laurus azorica* forest between 550 and 1000 m on basal rocks of Miocene and Pliocene plateau basalt.

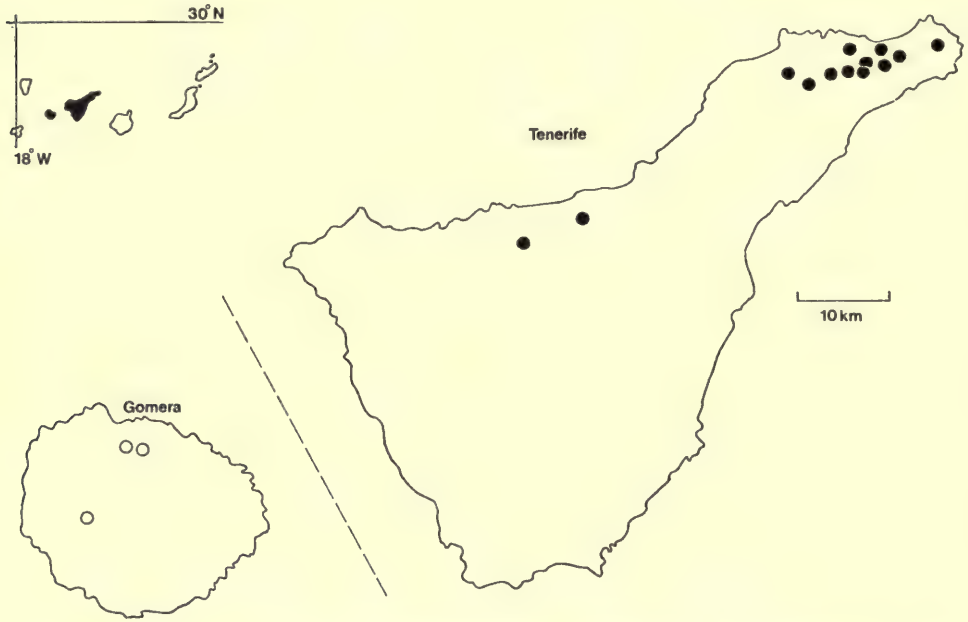

FIG. 20. Distribution of *Argyranthemum broussonetii* subsp. *broussonetii* (●) and subsp. *gomerensis* (○) on Tenerife and La Gomera.

This subspecies is variable throughout its range, particularly in foliage characters. Populations with almost pinnatisect leaves and smaller capitula are common in the Orotava valley. These plants differ from the plants of the Anaga peninsula with broader leaves and larger capitula but are not really worthy of taxonomic distinction as many intermediate forms exist.

b. subsp. ***gomerensis*** C. J. Humphries, subsp. nov. (Text-fig. 2N 2, 20, 21.)

A subspecie *broussonetii* habitu tenuior, floribus saepius parvis, cypselis parvioribus differt.

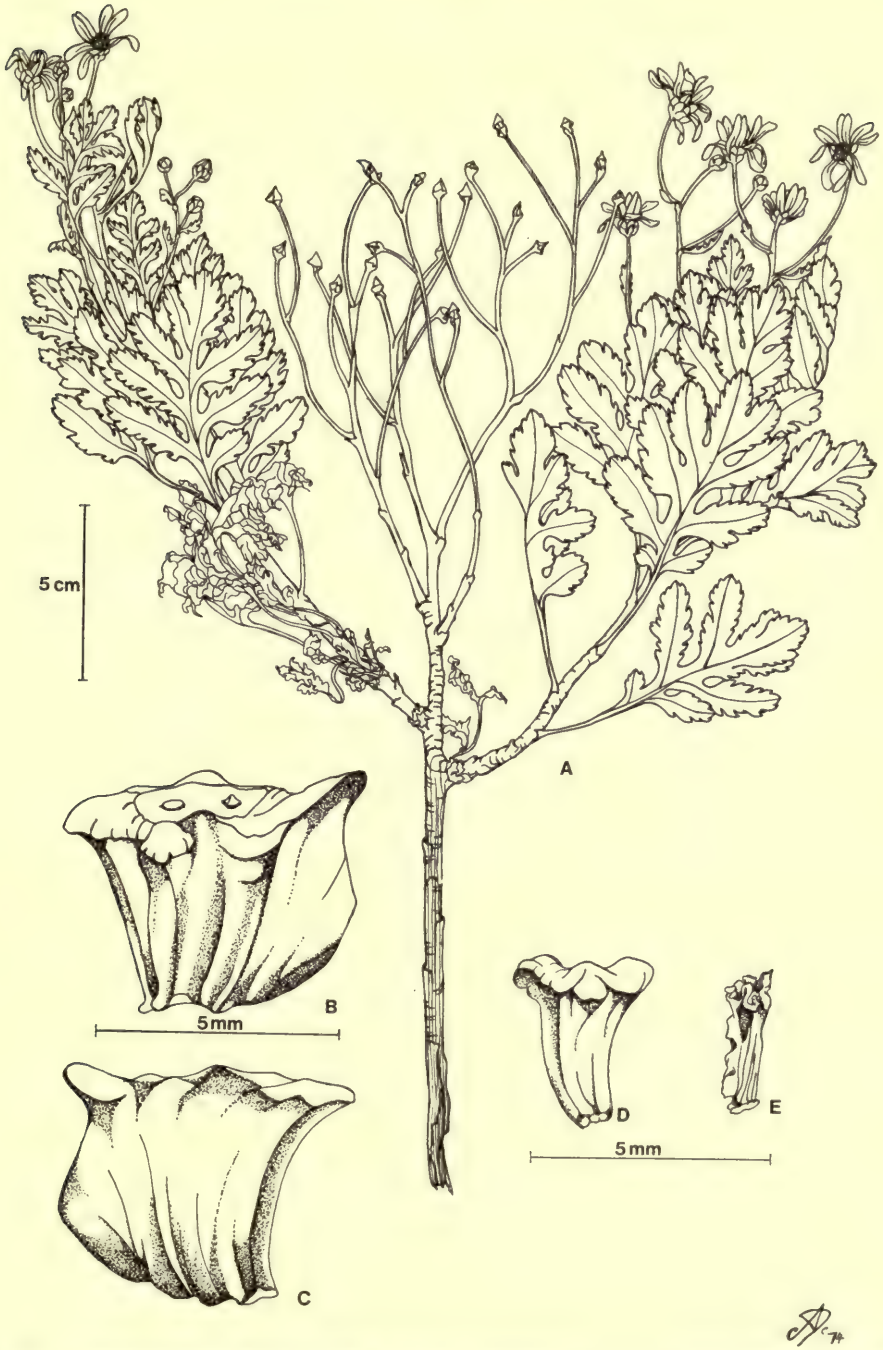

FIG. 21. *Argyranthemum broussonetii* subsp. *gomerensis* C. J. Humphries: A, whole plant; B, ventral view, C, dorsal view of ray cypsela; D, lateral view of disc cypsela of outer series; E, lateral view of disc cypsela of inner series.

Caules 70–80 cm, leviter procumbens vel ascendens. *Folia* 3–10 × 0·5–6 cm. *Involucrum* 13–16 (–19) mm diametro. *Radiorum cypselae* 4–5 mm longae. Plantae endemicae ad Gomeram.

Stems 70–80 cm, slightly procumbent to ascending. *Leaves* 3–10 × 0·5–6 cm. *Involucre* 13–16 (–19) mm diameter. *Ray cypselas* 4–5 mm. Endemic to Gomera.

La Gomera: inter Las Rosas et Agulo, 6 Apr. 1971, *Bramwell & Humphries 3355* (BM ; RNG, holotypus). Degollada de San Sebastian, 9 Apr. 1845, *Bourgeau 247* (BM ; C ; FI ; G ; P ; W ; Z). Riscos de Agulo, 400 m, Apr. 1905, *Pitard* (P).

Found as scattered populations on steep slopes of La Gomera between Las Rosas and Agulo on the north-west coast. A single locality in the Degollada de San Sebastian on south-facing slopes is also recorded (Fig. 20). The habitat is open places in *Laurus azorica* forest and *Adenocarpus foliolosus* scrub. The basal rocks consist of Pliocene basalts covered by more recent phonolytes.

Choisy cited *Chrysanthemum broussonetii* Balbis as the basionym of his *Pyrethrum broussonetii* ; whether this was meant to distinguish Balbis's plant from Persoon's cannot now be determined. De Candolle treated *Chrysanthemum broussonetii* Pers. as a synonym of *C. grandiflorum* var. *subnudum* whilst treating *C. broussonetii* Balbis as a separate species, but gave no reason for doing so. Schultz Bipontinus founded his *Ismelia broussonetii* on *Chrysanthemum broussonetii* Balbis, non Pers., i.e. on *Pyrethrum broussonetii* Choisy, and under *Stigmatotheca lacera* Schultz Bip. had as a synonym 'Chrysanthemum broussonetii. *Pers., Syn., Vol. 2, pag.* 461 (non Balb.), ex specimine in h. paris culto et in herb. Desf! asservato'. Persoon's type, however, is the species under consideration, and Choisy's, De Candolle's and Schultz's accounts of *Chrysanthemum* or *Ismelia broussonetii* also are based on it. One can only assume that the confusion arose because the name became attached in the Paris garden to another species of *Argyranthemum* and it was thought that Persoon's description was based on this. Broussonet sent seeds to Europe of a number of different species of *Argyranthemum*, so this is by no means improbable.

16. ***Argyranthemum hierrense*** C. J. Humphries, sp. nov. (Text-fig. 20, 3m, n, 22, 23.)

Ismelia coronopifolia sensu Pitard & Proust, Îles Canar., Fl. Archipel : 232 (1908) quoad specim. a Ferro, non Schultz Bip.

Chrysanthemum coronopifolium sensu Burchard in Biblthca bot. 98 : 201 (1929) pro parte, quoad specim. a Ferro, non Masferer. – Ceballos & Ortuño, Veg. Fl. For. Canar. Occid. : 441 (1951) pro parte, quoad specim. a Hierro.

Ab *A. coronopifolium* habitu elatior, inflorescentia multarum capitularum, capitulis parvis, foliis bipinnatifidis, petiolis lanceolatis et cypselis radiorum junctis differt.

Caules 50–80 cm, ascendentes, ramosi per tota planta, glabri. *Folia* 3–9 × 0·6–6 cm, ovata usque deltiodea, bipinnatisecta vel raro tripinnatisecta, glabra, plane petiolata, lobi primarii 2–12, 3–35 × 4–13 mm, oppositi vel suboppositi, lobi secundarii 3–12 × 3–4 mm acuti. *Inflorescentia* corymbosa, 6–50 capitulis, pedunculi 8–10 cm, bracteae foliiformae vel lineo-lanceolatae. *Capitula* subtilia et parva, *involucrum* 5–11 (–16) mm diametro, bracteae series 3 formantes, bracteae extimae triangulares, scariosae, costis carnosis, bracteae intimae obovatae,

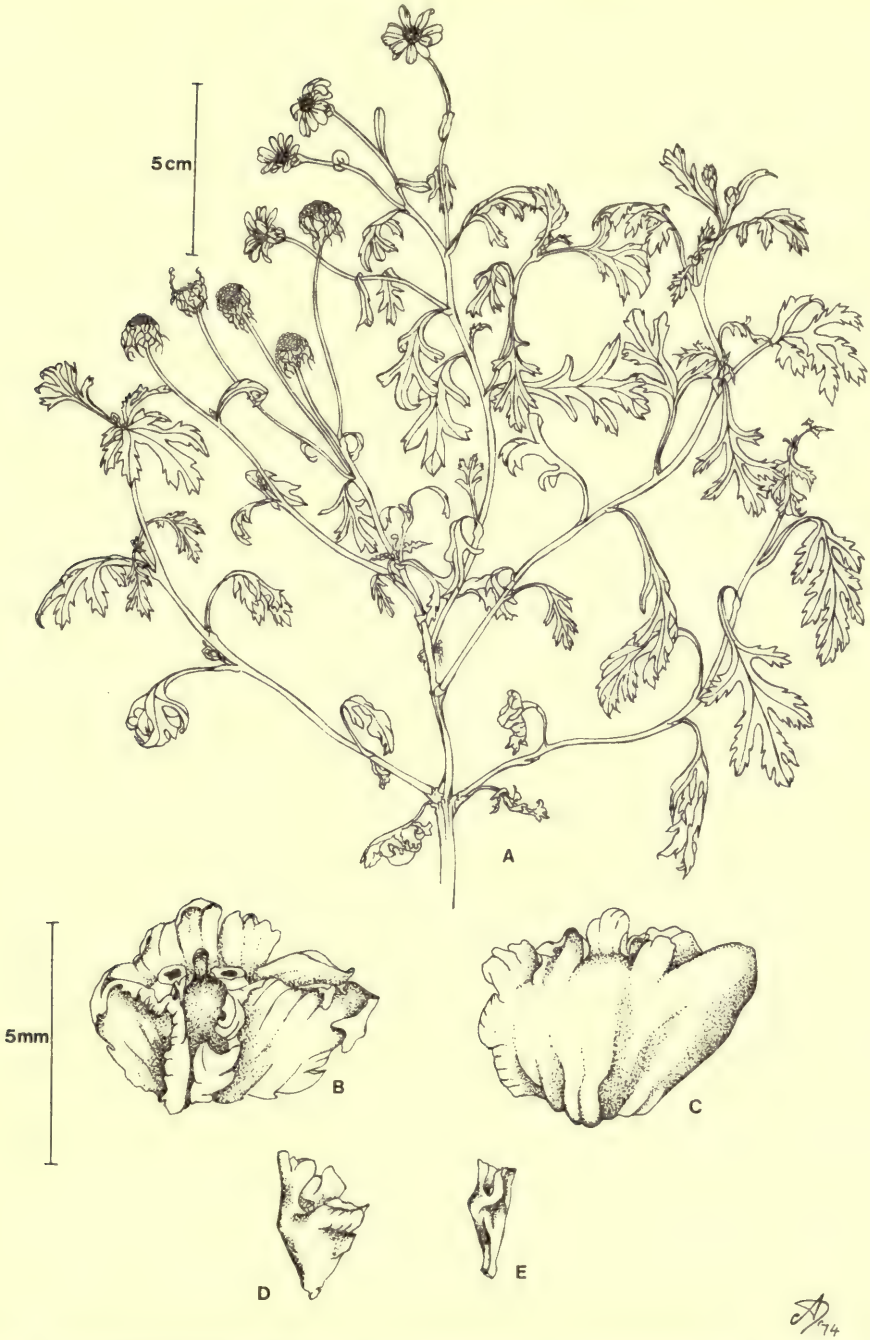

FIG. 22. *Argyranthemum hierrense* C. J. Humphries : A, whole plant ; B, ventral view, C, dorsal view of ray cypsela ; D, lateral view of disc cypsela of outer series ; E, lateral view of disc cypsela of inner series.

scariosae, ad apicem expansae hyalinae. *Radiorum flosculi* 8–17 × *c.* 3·5 mm plus minusve spathulati, albi vel cremei, *discorum flosculi* 2·5–3 mm, lobis corollae flavis et tubis ochroleucis vel albis. *Radiorum cypselae* 3·5–6 × 1·8–9 mm, obconicae, trigonae, arcuatae, 2–4-alatae, dua usque ad quinque saepe coalescentes, pappus coroniformis, dimidiatus vel plus minusve absens ad marginem dorsalem ; *discorum cypselae* 2·5–4 × 1–2·8 mm, obconicae, a latere compressae, in series externas arcuatae, pappus coroniformis, dimidiatus vel absens ad marginem dorsalem seriei extimarum. *Florescentia* Mars usque ad September.

Stems 50–80 cm, ascending, branched throughout the plant, glabrous. *Leaves* 3–9 × 0·6–6 cm, ovate to slightly deltoid, bi-, rarely tri-pinnatisect, glabrous, distinctly petiolate ; primary lobes 2–12, 3–35 × 4–13 mm, opposite to sub-opposite ; secondary lobes 3–12 × 3–4 mm, acute. *Inflorescence* ± corymbose, with 6–50 capitula ; peduncles 8–10 cm ; bracts leaf-like to linear-lanceolate. *Capitula* delicate and small ; *involucre* 5–11 (–16) mm in diameter ; bracts formed of 3 series, outer bracts triangular, scarious with a fleshy midrib, inner bracts obovate with an expanded, scarious, hyaline apex. *Ray florets* 8–17 × *c.* 3·5 mm, ± spathulate to obovate, obtuse, seldom divided at the apex, white to creamy yellow ; disc florets 2·5–3 mm, the corolla lobes yellow, the tube pale yellow or whitish. *Ray cypselas* 3·5–6 × 1·8–9 mm, obconical, trigonous, arcuate, 2–4-winged, often coalesced into groups of 2–5 ; pappus coroniform, dimidiate on the dorsal edge, or absent ; *disc cypselas* 2·5–4 × 1–2·8 mm, obconical, laterally compressed, arcuate in outer series ; pappus coroniform, dimidiate on the dorsal edge in outer series or absent. *Flowering period:* March to September.

Hierro: Scopuli orarum versus Sabinosam, 150 m, 8 June 1971, *Bramwell & Humphries 3317* (RNG, holotypus ; BM, isotypus). Golfo near Roques de Salmar, 9 Apr. 1971, *Bramwell & Humphries 3340* (RNG). Sabinosa, in montane rocks, *Bourgeau 1402* (B ; C ; FI ; G ; K ; P ; W ; Z). North-west of Sabinosa, 150 m, 8 Apr. 1971, *Bramwell & Humphries 3323* (RNG). Same locality, 100 m, *Burchard 174* (K). Same locality, 50 m, May 1924, *Burchard 388* (G ; S ; Z). Sabinosa, 10–350 m, 25 Sept. 1966, *Lems 5982* (MICH). El Bozo de Sabinosa, Apr. 1905, *Pitard & Proust 191* (G ; L ; P). Riscos de Sabinosa, 400 m, Apr. 1906, *Pitard* (G ; P). Valle de Sabinosa, 29 Mar. 1855, *Perraudière* (P). Same locality, 1 May 1855, *Perraudière* in herb. Schultz Bip. (P). Same locality, 500 m, Mar. 1855, *Perraudière* (P ; S).

A locally common endemic on the north-west-facing slopes of the Ensonada de Golfo between Sabinosa and Roques del Salmar.

At lower altitudes between 10 and 350 m it forms the dominant species of the xerophytic zone and is associated with *Euphorbia balsamifera* and *Kleinia neriifolia* communities ; but it also extends at higher altitudes between 200 and 500 m in more widely dispersed populations, to the lower reaches of the *Laurus azorica* forest and the *Erica arborea* zone. The basal rocks consist of Pliocene basalts and Quaternary phonolytes (Fig. 23).

Coastal populations tend to have the caespitose habit of *A. coronopifolium* with fewer and larger capitula than plants from higher altitudes, and in fact have been considered by Burchard (in herbarium material) to represent a form of it with smaller

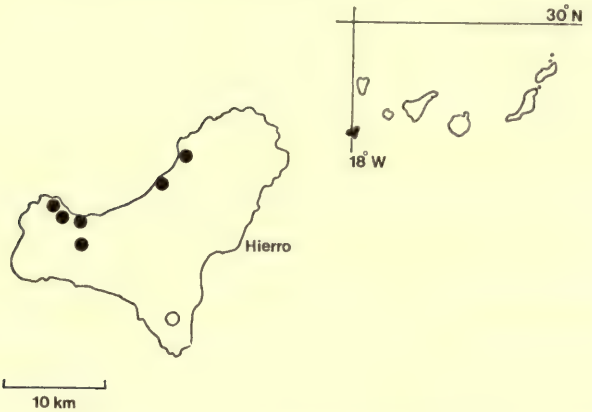

FIG. 23. Distribution of *Argyranthemum hierrense* (●) and *A. sventenii* (○) on Hierro.

flowers and dissected leaves. It differs generally in a number of characters, but notably by its erect habit, the narrowly petiolate, dissected leaves, the proliferous inflorescences, the smaller ligules and involucre, and the coalescent ray cypselas.

17. ***Argyranthemum webbii*** Schultz Bip. in Webb & Berthel., Phyt. Canar. 2 : 269 (1844). (Text-fig. 2P, 3k, 11 ; Pl. 29a.)

Argyranthemum pinnatifidum Webb in Webb & Berthel., tom. cit. : t. 95, quoad fig. 1 (1840), *nom. invalid.*

Chrysanthemum webbii (Schultz Bip.) Masferer in An. Soc. esp. Hist. nat. 10 : 207 (1881), reimpr. ut Rec. Bot. Tenerife : 131 (1881).

Stems 40–85 cm, erect, branched towards the base, or unbranched, glabrous. *Leaves* 4–14 × 2–7 cm, obovate-elliptical in outline, bipinnatifid, narrowly petiolate, glabrous ; primary lobes 4–8, 1–5·2 × 0·2–1·5 cm, opposite to subopposite, dentate ; secondary lobes acuminate. *Inflorescence* corymbose with 2–8 capitula ; peduncles 3–12 cm ; bracts leaf-like to narrowly oblong, dentate. *Involucre* 8–14 mm in diameter ; bracts in 3 series ; outer series triangular, scarious with fleshy midribs ; inner bracts obspathulate or linear-lanceolate, scarious, with an expanded hyaline apex. *Ray florets* 12–22 × 2·5–4 mm, white, the apex emarginate to 3-fid ; *disc florets c.* 3 mm, the corolla lobes yellow, the tube whitish. *Ray cypselas* 5–6·2 × 3·5–8 mm, obconical, ± trigonous, solitary or coalesced into groups of 2 or 3, the wings 2–3, coriaceous, diminutive ; the pappus a marginal coriaceous ridge ; *disc cypselas* 3–4 × 1·9–3·2 mm, obconical, laterally compressed to ± terete, 1-winged ; pappus ± coroniform or a marginal coriaceous ridge. *Flowering period:* February to June.

La Palma: In convalle del Rio, in herb. Schultz Bip. (P, holotypus ; RNG, phototypus). Same locality, in herb. Webb (FI, isotypus). Los Tilos, 6 Sept. 1969, *Bramwell 1831* (RNG). Same locality, Bco. del Agua, 14 Apr. 1971, *Bramwell & Humphries 3409* (BM ; RNG).

A rare endemic of La Palma, confined to the north-east slopes of the Caldera de la Palma, above Los Tilos in the Barranco del Agua and above Santa Cruz de la Palma in the Barranco del Rio. It is intimately associated with the laurel forest, between 500 and 900 m. The basal rocks consist almost entirely of Miocene phonolytic lavas (Fig. 11).

18. ***Argyranthemum haemotomma*** (Lowe) Lowe, Man. Fl. Madeira : 463 (1868). (Text-fig. 2Q, 17.)

Chrysanthemum haemotomma Lowe in Hooker's J. Bot. 8 : 296 (1856).
C. barretti Costa in Broteria 23 : 123 (1927).

Stems 60–120 cm, somewhat decumbent to ascending, ± branched from the base, glabrous. *Leaves* 2–7 × 1–3 cm, obovate or ovate, pinnatisect to bipinnatisect, petiolate, glabrous, rigid, fleshy with sphacelate margins ; primary lobes 2–6, 0·5–2·5 × 0·2–0·8 cm opposite ; secondary lobes dentate, alternate, acute. *Inflorescence* monocephalic or with 3–4 capitula ; peduncles up to 20 cm ; bracts 1–2, leaf-like to oblong lanceolate, or absent. *Involucre* 15–20 mm in diameter ; bracts in 3 series, outer bracts triangular, scarious, with fleshy midribs, sometimes slightly carinate towards the base, inner bracts obovate with an expanded, scarious, hyaline apex. *Ray florets* 12–15 × *c.* 3·5 mm, pink, rose or white, the apex obtuse to emarginate ; *disc florets* 2–3 mm, the corolla-lobes deep purple, the tubes pale pink or whitish. *Ray cypselas* 4–6 × 3–6 mm, unequally triquetrous, arcuate, 3–4-winged ; lateral wings carinate, diminutive, the ventral wings 1–2, wider than the laterals, with sinuate margins ; pappus coroniform, dimidiate or reduced completely on the dorsal edge, often pointing forwards on the ventral edge ; *disc cypselas* 3–5 × 2–3 mm, obconical, laterally compressed to ± quadrangular, 2-winged in the outer series, to 1-winged near the centre of the disc ; pappus coroniform, dimidiate, or absent on dorsal margin, sometimes absent completely in the centre series of the disc. *Flowering period:* June to July.

Madeira: Deserta Grande, 2 June 1849, *Lowe* (BM, lectotypus). Same locality, 18 June 1855, *Lowe 832* (BM ; G). Madeira 1856, *Mason 334* (CGE). Bugio, 400 m, 1865–66, *Mandon* (G). Same locality, *Lowe* in herb. Moriz (BM). Porto Moniz, 1926, *Costa* (MADM).

An extremely rare species from Deserta Grande and Bugio, Las Desertas islands, south-east of Madeira, occurring as an obligate chasmophyte of wet coastal cliffs between 50 and 450 m. The basal rocks consist of basalts and trachytes of probable Miocene origin. Tentative records from the north-west of Madeira near Porto Moniz are also indicated, but this is based on two very mature specimens only, completely lacking floral parts.

Section 3. ***STIGMATOTHECA*** (Schultz Bip.) C. J. Humphries

ARGYRANTHEMUM sect. STIGMATOTHECA (Schultz Bip.) C. J. Humphries, comb. et stat. nov.

Stigmatotheca Schultz Bip. in Webb & Berthel., Phyt. Canar., 2 : 245, 255 (1844), excl. sect. *Otopappus*.

Plants glabrous. *Leaves* ± entire to pinnatilobed, shortly petiolate to ± sessile. *Ray florets* white. *Ray cypselas* turbinate, trigonous, irregularly ribbed, with 1–3 vestigial wings or wingless ; pappus absent, or with a crispate margin ; *disc cypselas* obconical, terete to quadrangular, rarely compressed, with 1–2 vestigial wings or wingless ; pappus marginal, crispate.

19. ***Argyranthemum pinnatifidum*** (L. f.) Lowe, Man. Fl. Madeira : 460 (1868). (Text-fig. 30, p, q, r, 24.)

Chrysanthemum pinnatifidum L. f., Suppl. Pl. : 377 (1781). – DC., Prodr. 6 : 66 (1838), excl. syn. D. Don.
Matricaria pinnatifida (L. f.) Desrouss. in Lam., Encycl. Meth., Bot. 3 : 729 (1792), excl. [var.] β.
Pyrethrum pinnatifidum (L. f.) Choisy in Buch., Phys. Beschreib. Canar. Ins. : 149 (1825), non *P. pinnatifidum* Willd. (1803).
Pyrethrum grandiflorum sensu Holl in Flora, Jena 13 : 382 (1830), non Willd.
Stigmatotheca pinnatifida (L. f.) Schultz Bip. in Webb & Berthel., Phyt. Canar. 2 : 255 (1844).
Chrysanthemum lacerum Buch. ex Lowe, op. cit. : 461 (1868), *nom. synon.*

Stems 30–150 cm, decumbent or ascending, with several stems of equal length to give a candelabra-like habit, glabrous, leafy on upper parts only. *Leaves* 4–20 × 0·5–7·5 cm, obovate or oblong-lanceolate, gradually cuneate at the base, ± entire to pinnatilobed, shortly petiolate to sessile, glabrous, crowded at the base of the peduncles with short internodes, and readily caducous below ; lobes 3–9, 1–6 × 0·1–1·5 cm, subopposite, dentate, the teeth obtuse to acuminate. *Inflorescence* corymbose, with 2–30 capitula, peduncles stout, up to 30 cm ; bracts leaf-like to spathulate-oblong, serrate or sub-entire. *Involucre* 6–15 mm in diameter ; bracts in 3 series, the outer ones triangular, with scarious margins and fleshy midribs, the inner ones scarious with a hyaline, expanded, laciniate apex. *Ray florets* 10–20 × 3–6 mm, white, 1–3-fid at apex ; *disc florets* 3–4 mm, the corolla lobes yellow, the tube white, hyaline. *Ray cypselas* 3–4 × 3–4 mm, ± obconical, unequally trigonous, arcuate, the wings occasionally 1–3, diminutive, but usually absent ; pappus absent or present as a 2–4-toothed coriaceous ridge ; *disc cypselas* 2–3 × 1·5–2 mm, obconical, laterally compressed to quadrangular, irregularly ribbed, wingless ; pappus a coriaceous ridge or sometimes ± coroniform. *Flowering period:* April to July.

Two subspecies are recognized :

a. subsp. ***pinnatifidum*** (Text-fig. 2R 1.)

Argyranthemum pinnatifidum [var.] α *flaccida* Lowe, Man. Fl. Madeira : 461 (1868) *nom. illeg.*

Stems 50–150 cm. *Leaves* 7–20 × 2·5–5 cm, pinnatilobed, the lobes usually serrate. *Inflorescence* with (2–) 10–30 capitula.

Madeira: Masson, in herb. L. f. 1332.14 apud herb. Smith (LINN, holotypus). Between Seixal and Porto Moniz, 10–25 m, 1 May 1966, *Lems 7632* (MICH). Rabacal, 1000 m, 14 Apr. 1966, *Lems 7444* (MICH). Saõ Vicente, 650 m, 28 Aug.

1954, *Moore* (BM). Pico de Arrieiro, 1500 m, 24 July 1968, *Hansen* (C). Same locality, 24 July 1968, *Kaae* (C). Same locality, 7 May 1952, *Een 116* (S). Ribeira Frio, 1 May 1952, *Een* (S). Same locality, 4 May 1828, *Gay* (K). Same locality, 800 m, *Lems 7543* (MICH). Same locality, *Neer 1853* (S). Same locality, 2 Aug. 1901, *Vahl* (C). Camacha, 15 July 1846, *Lowe 225* (BM). Sera de San Roque, Poco de Neve, Malhada Velha, 1000–1300 m, July 1865, *Mandon 318* (BM ; C ; G ; K ; S). Funchal, Ribeira do Santa Lizia, 1100 m, 2 July 1900, *Bornmüller 818 b* (G). Camara dos Lobos, Aug. 1853, *Welwitsch* (BM). Cabo Girao, 14 Apr. 1966, *Lems* (MICH). Ribeira do Joao Fernandes, 30 June 1952, *Persson* (S). Same locality, 1832, *Lowe* (G-DC). Same locality, 25 Apr. 1827, *Lowe* (K). Same locality, 1828, *Webb* (G-DC).

Azores: San Miguel, Furnao, May 1838, *Holhort 99* (G ; W).

A common plant of Madeira in the central mountains around Curral das Freiras, the principal ravines on the north side of the island, the lower valleys above Funchal on the south coast and Sao Vicente on the north coast (Fig. 24). Introduced at Furnao in the Azores. It is usually found amongst rocks and open clearings of wet ravines and sea cliffs in most parts of the island between 5 and 1500 m.

FIG. 24. Distribution of *Argyranthemum pinnatifidum* subsp. *pinnatifidum* (●) and subsp. *succulentum* (○) on Madeira.

b. subsp. ***succulentum*** (Lowe) C. J. Humphries, stat. nov. (Text-fig. 2R 2.)

Argyranthemum pinnatifidum var. *succulentum* Lowe, Man. Fl. Madeira : 462 (1868).
Chrysanthemum mandonianum Cosson in Bull. Soc. bot. Fr. 15 : 100 (1868), *nom. nud.*

Stems 30–45 cm. *Leaves* 4–8 × 0·5–2 cm, fleshy, ± entire with serrate margins. *Inflorescence* with 1–2 (–5) capitula.

Madeira: Punta do San Lorenzo, 6 Mar. 1861, *Lowe 225* (BM ; K, holotypus). Between Seixal and Saõ Vicente, 6 Apr. 1846, *Lowe 936* (BM ; G ; K). Pindo do Saco, 13 Mar. 1860, *Lowe* (BM). Ilheos dos Embarcadores, May 1865, *Mandon 314* (BM ; C ; G ; K ; P ; S ; W). July 1862, *Clarke* (K).

A coastal ecotype of *A. pinnatifidum*, with a very reduced habit and small fleshy leaves, found between Seixal and Saõ Vicente on the central north coast, and

Ponta do Saõ Lourenço on the eastern tip of Madeira. It is also known from the Ilheos dos Embarcardores.

Webb and Bethelot's illustration to which they attached the name *Argyranthemum pinnatifidum* (Phyt. Canar. 2 : t. 95 (1840)) depicts three different plants belonging to separate species, *A. webbii*, *A. broussonetii* and *A. dissectum*. It would seem that Webb and Berthelot regarded the plants from the Canary Islands with broad bipinnatifid leaves as all belonging to the same species as the Madeiran plants originally described as *Chrysanthemum pinnatifidum* by the younger Linnaeus. As is pointed out above (p. 178), none of the names on Webb and Berthelot's plates were validly published.

Section 4. ***MONOPTERA*** (Schultz Bip.) C. J. Humphries

ARGYRANTHEMUM sect. MONOPTERA (Schultz Bip.) C. J. Humphries, comb. et stat. nov.

Monoptera Schultz Bip. in Webb & Berthel., Phyt. Canar. 2 : 244, 253 (1844).

Plants glabrous. *Leaves* bipinnatisect, distinctly petiolate. *Ray florets* white. *Ray cypselas* clavate to turbinate, arcuate, wingless, usually coalesced into groups of 2–8 ; pappus corniculate when present ; *disc cypselas* obconical, terete, usually wingless ; pappus corniculate when present ; outer series often coalesced with ray cypselas.

20. ***Argyranthemum filifolium*** (Schultz Bip.) C. J. Humphries, comb. nov. (Text-fig. 2S, 3s, t, u, v, 16.)

Monoptera filifolia Schultz Bip. in Webb & Berthel., Phyt. Canar. 2 : 253 (1844). – Pitard & Proust, Îles Canar., Fl. Archipel : 231 (1908).

Chrysanthemum filifolium (Schultz Bip.) Christ in Bot. Jb. 9 : 168 (1887). – Burchard in Biblthca bot. 98 : 201 (1929).

Stems up to 80 cm, ascending, branched towards the base, filiform, glabrous. *Leaves* 1–11 × 2–7, pinnatisect to bipinnatisect, glabrous, with clusters of 2–4 smaller leaves in the axils ; rachis and leaf-lobes filiform, 1–4 mm wide ; primary lobes 1–8, 0·5–6 cm long. *Inflorescence* corymbose ; peduncles 3–25 cm. *Involucre* 6–12 mm in diameter ; bracts in 3 series ; those of outer series triangular with a narrow scarious margin and fleshy midrib ; inner bracts obovate, scarious, with an expanded hyaline apex. *Ray florets* 6–12 × 1·5–2·5 mm, filiform, white, the apex entire or emarginate ; *disc florets c.* 3 mm, the corolla lobes yellow, the tubes hyaline, white. *Ray cypselas* 3–4 × 3·2–6 (–10) mm, arcuate, trigonous, rarely solitary, coalesced in pairs and sometimes in groups of 3–8, the wings 2–4, very small, coriaceous, with irregular margins, or absent ; pappus irregularly cornate, or very rarely a marginal coriaceous ridge ; *disc cypselas* 2–4 × (1·6–) 2–3 mm, obconical-turbinate, usually terete to slightly compressed, coalesced to ray cypselas in outer series, wings usually absent or sometimes 1 ; pappus usually

absent but sometimes a corniculate, marginal ridge. *Flowering period:* February to May.

Gran Canaria: J. Despreaux in herb. Webb 198 (FI, holotypus). Between Maspalomas and Tirajana, 9 May 1894, *Murray* (BM ; G ; K). Maspalomas, May 1918, *Burchard 285* (Z). Arguiniguin, 1856, *Bolle* (FI ; W). Same locality, 250 m, 20 Mar. 1969, *Bramwell* (RNG). Same locality, 100 m, 21 Mar. 1971, *Bramwell & Humphries 3060* (BM ; RNG). Same locality, 150 m, 8 Feb. 1969, *Kunkel 12674* (BM). 6 km north-west of Arguiniguin, 2 Nov. 1965, *Lems 6255* (MICH). Puerto de Mogan, 100 m, 21 Mar. 1971, *Bramwell & Humphries 3069* (RNG). 8 km north of Mogan, 21 Mar. 1969, *Bramwell & Humphries 3081* (RNG). Same locality, 11 May 1894, *Murray* (BM ; C ; RHS).

Common along the south coast of Gran Canaria around San Agustin, Maspalomas, Arguiniguin and Puerto de Mogan. Small populations also occur at higher altitudes along the Barranco de Mogan (Fig. 16).

It occurs in the xerophytic vegetation dominated by *Euphorbia obtusifolia* between 50 and 300 m on basal rocks consisting of Miocene phonolytes.

21. ***Argyranthemum escarrei*** (Svent.) C. J. Humphries comb. nov. (Text-fig. 2T, 16.)

Chrysanthemum escarrei Svent. in Boln. Inst. nac. Invest. agron., Madr. 13 : 69 (1953).

Stems 30–50 cm, erect, branched towards the base, glabrous. *Leaves* 1–8 × 0·5–5 cm, bipinnatisect, petiolate, glabrous ; primary lobes 4–10, 2·5–4·2 × 0·2–0·6 mm, subopposite, linear to linear-lanceolate, acuminate ; secondary lobes linear-lanceolate or dentate. *Inflorescence* corymbose, lax, with 2–8 capitula ; peduncles 2–16 cm ; bracts pinnatisect to linear-lanceolate. *Involucre* 8–14 mm in diameter ; outer bracts triangular, scarious, with a fleshy midrib ; the inner bracts laciniate, hyaline at the apex, linear-oblong, scarious. *Ray florets* 10–14 × 4–6·5 mm, white, the apex obtuse to 3-fid ; *disc florets* 3–5 mm, the corolla lobes yellow, the tubes white. *Ray cypselas* 3·5–4·8 × 2·2–5 mm, obconical, arcuate, trigonous, rarely solitary, usually coalesced in pairs or groups of 3–5, wings 1–2, small, coriaceous or absent ; pappus irregularly cornate ; *disc cypselas* 3–4·5 × 1·6–2·5 mm, obconical, turbinate, terete or 4-angled to laterally compressed, coalesced with ray cypselas in outer series ; pappus irregularly coroniform. *Flowering period:* February to May.

Gran Canaria: Dry rocky cliffs near San Nicolas between 200 and 400 m, 11 Mar. 1950, *Sventenius* (TENE, holotypus). Degollada de Tasartico, 550 m, 21 Mar. 1971, *Bramwell & Humphries 3072* (RNG). Barranco de Tasarte, 600 m, 21 Mar. 1971, *Bramwell & Humphries 3077* (RNG). Tirma, 100 m, coastal cliffs, 28 Mar. 1971, *Bramwell & Humphries 3153* (RNG).

Mountain cliffs of Gran Canaria south of San Nicolas and coastal cliffs north-west of Tirma on the west coast of the island (Fig. 16). The species is found amongst xerophytic *Euphorbia obtusifolia* communities on basal rocks of rhyolite and phonolyte between 200 and 700 m.

Section 5. ***PREAUXIA*** (Schultz Bip.) C. J. Humphries

ARGYRANTHEMUM sect. PREAUXIA (Schultz Bip.) C. J. Humphries, comb. nov.

Preauxia Schultz Bip. in Webb & Berthel., Phyt. Canar. 2 : 244, 250 (1844).
Chrysanthemum sect. *Preauxia* (Schultz Bip.) Christ in Bot. Jb. 9 : 146 (1887).

Plants tomentose to glabrous. *Leaves* bipinnatifid to bipinnatisect, sessile. *Ray florets* white. *Ray cypselas* turbinate, erect, trigonous when single, wingless, and fused together in groups of 2–5 ; pappus a small marginal ridge or absent ; *disc cypselas* obconical, terete, wingless ; pappus absent.

22. ***Argyranthemum adauctum*** (Link) C. J. Humphries, comb. nov. (Text-fig. 3w, x, y, 25, 26.)

Pyrethrum adauctum Link in Buch, Phys. Beschr. Canar. Ins. : 149, 181 (1825).

Stems 70–90 cm, erect, branched throughout the plant or only from the base, densely tomentose to glabrous. *Leaves* 2–8 (–10) × 0·5–4 (–5) cm, obovate, bi- to tripinnatifid (or pinnatisect), sessile ; primary lobes 4–24, 2–30 × 0·5–15 mm, acute. *Inflorescence* corymbose with 5–20 capitula ; bracts leaf-like to linear-oblong ; peduncles 1–8 (–15) cm. *Involucre* 4–12 mm in diameter ; bracts in 3 series ; triangular to obovate-oblong in outline ; outer bracts fleshy with a narrow scarious border ; inner bracts scarious, usually with an expanded, hyaline apex.

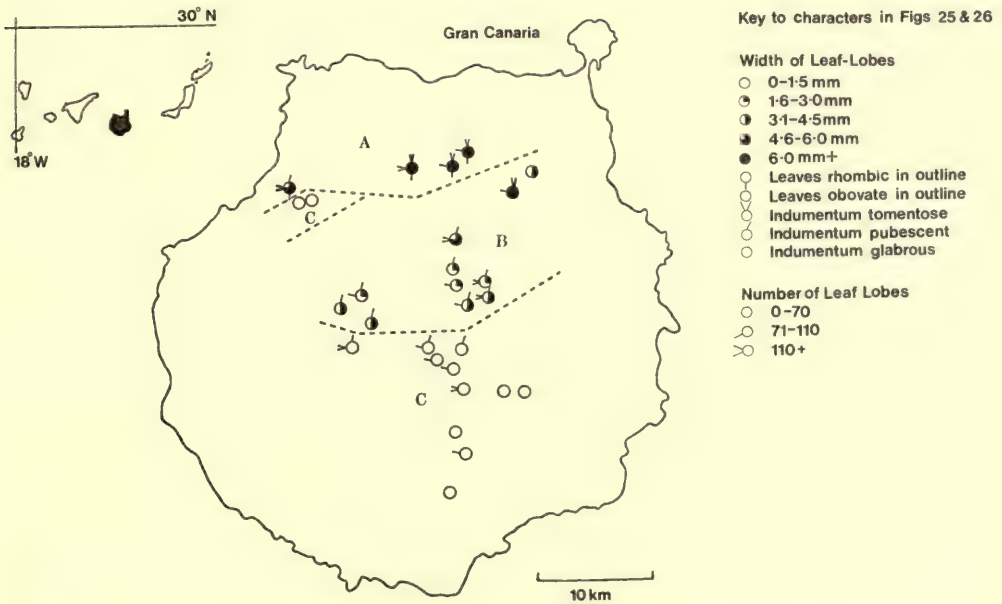

FIG. 25. Distribution and variation of subspecies of *Argyranthemum adauctum* on Gran Canaria : A, subsp. *jacobaeifolium* ; B, subsp. *canariense* ; C, subsp. *gracile*.

FIG. 26. Distribution and variation of subspecies of *Argyranthemum adauctum* on Tenerife and Hierro : D, subsp. *dugourii* ; E, subsp. *adauctum* ; F. subsp. *erythrocarpon*.

Ray florets 10–15 × 2–3·5 mm, white, the apex 1–3-fid ; *disc florets* 3–4 mm, the corolla lobes yellow, the tubes white. *Ray cypselas* 2·5–4·5 × 1·3–6·5 mm, turbinate, ± trigonous to semi-terete in transverse section, the dorsal surface arcuate, the ventral surface slightly concave or flat, wingless, coalesced together in groups of 2–5 ; pappus absent or present as a narrow marginal ridge with a convex-conical floret abscission scar at the apex ; *disc cypselas* 1·6–2·2 × 0·5–1 mm, obconical, terete, wingless, usually sterile ; pappus nil. *Flowering period:* February to September.

A. adauctum is a relatively widespread species of the western Canary Islands of Gran Canaria, Tenerife and Hierro, in montane scrub, broad-leaved forest and *Pinus canariensis* forest habitats between 350 and 1950 m. Widely dispersed populations are often morphologically distinct and can be grouped into morpho-geographical entities on the basis of vegetative characters. The pictorialized dot maps (Figs 25, 26) indicate the range of distribution and variation in the species with respect to width and number of leaf-lobes, leaf shape and indumentum density. By using these characters, six subspecies can be recognized.

KEY TO SUBSPECIES

Ray cypselas dark brown, the apex becoming black ; inner involucral bracts only slightly expanded at the apex, the margins dark brown, scarious . . f. *erythrocarpon*

Ray cypselas yellow to chestnut brown ; inner involucral bracts with an expanded, scarious, hyaline apex, the margins light brown to translucent :

Primary leaf lobes 2–12 mm wide :

Mature leaves rhombic in outline . . . . . c. *jacobaeifolium*

Mature leaves obovate in outline :
Indumentum subglabrous to glabrous ; basal lobes of leaves usually undivided a. *adauctum*
Indumentum scabridulous, sometimes tomentose ; basal lobes of leaves divided at least once . . . . . b. *canariense*
Primary leaf-lobes up to 2 mm wide :
Indumentum subglabrous to glabrous . . . . . c. *gracile*
Indumentum scabrid to tomentose . . . . . e. *dugourii*

a. subsp. ***adauctum***. (Text-fig. 2V 4.)

Chrysanthemum grandiflorum [var.] α *adauctum* (Link) DC., Prodr. 6 : 66 (1838).
Preauxia peralderii Schultz Bip. ex Sauer, Cat. Pl. Canar. Ins. : 24 (1880), *nom. nud.* – Pitard & Proust, Îles Canar., Fl. Archipel : 231 (1908), *nom. nud. 'Perraudieri'*.
Chrysanthemum perralderii Christ in Bot. Jb. 9 : 168 (1887) *nom. nud.*
Chrysanthemum anethifolium sensu Burchard in Biblthca bot. 98 : 200 (1929), quoad specim. a Cumbre de Bolico ; non Buch.

Stems 80–120 cm, ascending, branched throughout, subglabrous to glabrous. *Leaves* 4–9 × 2–4 cm, bipinnatifid to bipinnatisect, subglabrous to glabrous ; primary lobes 4–14, opposite to subopposite, dentate, acuminate. *Inner involucral bracts* expanded at the apex. *Ray cypselas* 2·5–4·4 mm ; *disc cypselas* 1·5–2·2 mm, light brown to chestnut in colour.

Tenerife: Moro de Gaitero, 1700 m, 14 Apr. 1969, *Bramwell 1316* (RNG, neotypus). Los Raices, Monte de Esperanza, 2 Apr. 1971, *Bramwell & Humphries 3190* (BM ; RNG). Mirador Ortuño, 2 Apr. 1971, *Bramwell & Humphries 3186* (BM ; RNG). Ladera de S. Ursula, *Laurus* wood, 800 m, *Larsen 1315* (C). Aguamansa, Los Organos, 1200 m, 3 May 1933, *Asplund 1070* (S). Same locality, 1400 m, 8 May 1969, *Bramwell 1482* (RNG). Same locality, 1000–1200 m, 28 Jan. 1933, *Lems 6850, 6893, 6902, 7175* (MICH). Guimar, Bco. del Rio, 700 m, 1933, *Asplund 939* (G ; S). Bco. del Agua, May 1855, *Bourgeau 1387* (C ; FI ; G ; K ; P ; W ; Z). Same locality, 1000 m, 27 Feb. 1855 and 11 Oct. 1855, *Perraudière* (P). Bco. de Valle, 23 May 1879, *Hillebrand* in herb. Christ (Z). La Orotava, 400 m, 27 Sept. 1965, *Lems 6384* (MICH). Cumbre de Bolico, by streams in laurel forest, 1100 m, May 1923, *Burchard 123* (G ; S ; Z). *Broussonet* (BM).

An endemic locally abundant as isolated populations growing along the central Pinar range of Tenerife from Los Raices on the Bosque de la Esperanza to the cliffs at Ladera de Guimar. A single collection is known from the Cumbre de Bolico above the Teno promontory (Fig. 26).

It is usually found growing between 400 and 900 m in *Pinus canariensis* forest, but several collections have been made from *Laurus azorica* forest at lower altitudes. It is also found on rare occasions in the leguminous scrub surrounding the pine forests on the north-west-facing slopes. The basal rocks consist of various types of volcanic lava from the Miocene and later periods.

No particular specimens are indicated in Link's protologue for *Pyrethrum adauctum* which can be traced to the original basic collections of the L. von Buch herbarium at Berlin. As with Bolle's specimens it is likely that all of Link's and indeed Choisy's 'types' for new taxa of Macaronesian Chrysantheminae were destroyed in

the great fire of 1943. Link does, however, give the 'locus classicus' as 'Realexo (Realejo) 3300 ft [1000 m]', a locality on the north-facing slopes of Tenerife. This locality must be near the 'Moro de Gaitero' on the Pinar range and in the absence of any possible authentic material I propose to designate a specimen collected by D. Bramwell as the neotype : 'Moro de Gaitero, 1700 m., 14 April 1969, no. *1316*'. The specimen is conserved at RNG.

The habit is characteristic for this subspecies. The plants are very diffuse, with straggling, divaricate branches to form large sub-shrubs with relatively few capitula. It is similar to subsp. *canariense* but differs in the larger, glabrous leaves.

Transitions to subsp. *dugourii* are found above the Ladera de Guimar as the pine forests are replaced by leguminous sub-alpine scrub and the habitats become much more exposed and arid.

b. subsp. ***canariense*** (Schultz Bip.) C. J. Humphries, comb. et stat. nov. (Text-fig. 2V 1.)

Preauxia canariensis Schultz Bip. ex Webb & Berthel., Phyt. Canar. 2 : 252 (1844), excl. forma *gracilis*.

Chrysanthemum canariense (Schultz Bip.) Christ in Bot. Jb. 9 : 146 (1887), excl. var. *tenuisectum*.

Preauxia jacobaeifolia sensu Pitard & Proust, Îles Canar., Fl. Archipel : 231 (1908), non Schultz Bip.

Chrysanthemum canariense var. *jacobaeifolium* Bornm. ex Burchard in Biblthca bot. 98 : 201 (1929) pro parte, non *Preauxia jacobaeifolia* Schultz Bip.

Stems up to 60 cm, ascending, usually branched throughout the plant, pubescent to scabridulous. *Leaves* 1·5–9 × 0·6–4 cm, bipinnatifid to bipinnatisect, pubescent to tomentose ; primary lobes 4–20, 2–25 × 2–12 mm, opposite or almost so ; secondary lobes 2–6, 1–9 × 3 mm, opposite to alternate, tomentose to pubescent, acute. *Inner involucral bracts* expanded at the apex. *Ray cypselas* 2·5–4·2 mm ; *disc cypselas* 1·6–2 mm, light brown to chestnut in colour.

Gran Canaria: in summis Canariae montibus la Cumbre propre montem Saucillo, *Despreaux* in herb. Schultz Bip. (P, holotypus). Bco. Guiniguada, 400 m, amongst rocks, 27 Mar. 1901, *Bornmüller 2461* (G ; L ; Z). Monte Lentiscal, 450 m, 20 Mar. 1966, *Kunkel 8857* (BM ; G). Same locality, *Lowe* (BM ; K). San Mateo, 1700 m, 20 May 1900, *Bornmüller 811* (G ; P ; V ; Z). Same locality, 1100 m, pine forest, 15 Feb. 1905, *Pitard 192* (FI ; G ; L ; Z). Same locality, 18 May 1894, *Murray* (BM ; RHS). 2 km south of San Mateo, 650 m, 17 Mar. 1971, *Bramwell & Humphries 3008* (RNG). Lagunetas, 24 May 1897, *Gelert* (C). Rincon de Tenteniguada, 600 m, 19 Mar. 1971, *Bramwell & Humphries 3009* (RNG). Same locality, 900–1000 m, Apr. 1924, *Burchard 246* (G ; S ; Z). Same locality, 1200–1500 m, 30 Oct. 1965, *Lems 6201* (MICH). Cueva Corcho, 9 km south of Valleseco, 700 m, 17 Mar. 1971, *Bramwell & Humphries 3005* (RNG). Saucillo, 28 Apr. 1855, *Bourgeau* (L). Same locality, 2 May 1894, *Murray* (G). Summit of the Cumbre, Apr. 1839, *Despreaux* in herb. Webb 21 (FI). Cruz de Tejeda, 27 Mar. 1969, *Bramwell 1082* (RNG). Artenara, 17 Feb. 1966, *Hulten* (S). Tirajana, Paso de la Plata, Apr. 1846, *Bourgeau 536* (BM ; FI ; G ; K ; P ; W ; Z). June 1912,

Pitard in herb. Alleizette (L). Lomo Mangrera, 1350 m, 17 Mar. 1967, *Kunkel 10692* (G). 1860, *Despreaux 72* (G). *Christian Smith* (C).

A common plant on the northern slopes of Gran Canaria, extending from Monte Lentiscal in the north-eastern part of the island to Cruz de Tejeda in the west central slopes (Fig. 25). Usual habitats are *Pinus canariensis* savanna at higher altitudes and xerophytic scrubland dominated by *Cytisus canariensis* and *Euphorbia obtusifolia* on lower slopes; 400–1200 m. The basal rocks consist mainly of Miocene basalts, tufts and pouzzolane.

Populations of subsp. *canariense* in the xerophytic scrub of Paso de la Plata, in central Gran Canaria, intergrade with populations of subsp. *gracile*. The transition from one to the other in respect of the habit, and the tomentose, wide, leaf-lobes to glabrous or glabrescent narrow leaf-lobes is very abrupt and instantly recognizable. The vegetative characters are variable between isolated populations throughout the ranges of the recognized subspecies, but generally fall naturally into the two major groups.

c. subsp. ***gracile*** (Schultz Bip.) C. J. Humphries, comb. et stat. nov. (Text-fig. 2V 2.)

Preauxia canariensis forma *gracilis* Schultz Bip. in Webb & Berthel., Phyt. Canar. 2 : 252 (1844).

Preauxia canariensis sensu Pitard & Proust, Îles Canar., Fl. Archipel : 231 (1908), non Schultz Bip.

Chrysanthemum canariense sensu Burchard in Biblthca bot. 98 : 201 (1908), excl. var. *jacobaeifolium*; non Christ.

Stems 50–60 cm, branched from base, subglabrous to glabrous. *Leaves* 0·5–5 × 0·2–3 cm, bipinnatisect, usually glabrous; primary lobes 4–18, opposite to alternate, 0·2–1·8 × *c.* 0·2 cm; secondary lobes 2–12, 0·1–1·8 × 0·1–0·2 cm, subopposite to alternate. *Bracts* and *cypselas* as in subsp. *canariense*.

Gran Canaria: in altibus montibus, *Despreaux* in herb. Schultz Bip. (P, holotypus). Near Tejeda, eastern slopes of Roque Ventaige, 22 Mar. 1966, *Hulten* (S). Los Ardennes de la Mina, 1800 m, May 1914, *Burchard 396* (K ; W). Pasa de la Plata, 2 km north of Paso de la Plata, 20 Mar. 1971, *Bramwell & Humphries 3039* (RNG). Same locality, 3 km north, 20 Mar. 1971, *Bramwell & Humphries 3034* (RNG). Artenara, Mna. de Brezo, 1200 m, 28 Mar. 1969, *Bramwell 1121* (RNG). Caldera de Tirajana, below Roque Nublo, 1400 m, 27 Feb. 1969, *Bramwell 1027* (RNG). Same locality, 1000 m, 19 Apr. 1936, *Brookes 116* (BM). San Bartolomé, 3 km north, 780–800 m, 19 Mar. 1971, *Bramwell & Humphries 3014* (RNG). Same locality, 800 m, 18 May 1957, *Larsen* (C). Same locality, 950 m, 16 Feb. 1905, *Pitard 193* (G ; L ; P ; Z). Santa Lucia de Tirajana, 2 km north, on cliffs, *Lems 6230* (MICH). Same locality, 1 km south, 19 Mar. 1971, *Bramwell & Humphries 3013* (RNG). Bco. de Tirajana, *Kunkel 12442* (BM). Temisas, 6 km west, 900 m, 19 Mar. 1971, *Bramwell & Humphries 3010* (RNG). Hoya de la Vieja, 1854, *Bolle* (Z). Bco. de Fataga, 200 m, 30 Aug. 1969, *Bramwell 1184* (RNG). Below Fataga, 200 m, 21 Mar. 1971, *Bramwell & Humphries 3046* (RNG). Near Maspalomas, 9 May 1894, *Murray* (BM ; RHS). Pinos de Tamadaba, 25 Mar. 1971, *Bramwell &*

Humphries 3110 (RNG). Above Mogan, *Lowe* (BM). Same locality, 1250 m, 10 May 1967, *Kunkel 11056* (G) June 1839, *Despreaux* in herb. Webb 12 (FI).

A locally common subspecies from the central south-east and southern slopes of Gran Canaria from Artenara and Paso de la Plata, particularly along the barrancos of Tirajana and Fataga. Two distinctive populations have also been collected from the high pine forests at Pinar de Tamadaba (Fig. 25). It is usually found in *Euphorbia obtusifolia* and *Cytisus proliferus* scrub on central and southern slopes but also in open *Pinus canariensis* savannah in the central mountains ; 400–1400 m. The basal rocks consist mainly of Pliocene and more recent phonolytes and trachytes.

d. subsp. ***jacobaeifolium*** (Schultz Bip.) C. J. Humphries, comb. nov. (Text-fig. 2U ; Pl. 28.)

Argyranthemum jacobaeifolium Webb in Webb & Berthel., Phyt. Canar. 2 : t. 90 (1839), *nom. invalid.*

Preauxia jacobaeifolia Schultz Bip. in Webb & Berthel., tom. cit. : 251 (1844).

Chrysanthemum jacobaeifolium (Schultz Bip.) Christ in Bot. Jb. 9 : 168 (1887).

Preauxia canariensis subsp. *jacobaeifolium* (Schultz Bip.) Bornm. in Bot. Jb. 33 : 484 (1903), *nom. provis.*

Chrysanthemum canariense var. *jacobaeifolium* Bornm. ex Burchard in Biblthca Bot. 98 : 201 (1929), excl. descr.

Stems 70–120 cm, ascending, branched throughout the plant, densely tomentose when young, becoming glabrous when mature. *Leaves* 2–14 × 0·5–6·5 cm, rhombic, bipinnatifid, dark green, pubescent to tomentose ; primary lobes 8–32, 0·5–3·5 × *c.* 1·5 cm ; opposite or almost so ; secondary lobes dentate, acute ; apex of *inner involucral bracts* expanded, scarious, hyaline. *Ray cypselas* 2·5–4 mm ; *disc cypselas* 1·5–2 mm.

Gran Canaria: 1837, *Despreaux 188*, in herb. Webb (FI, holotypus). Pinos de Tamadaba, 1300 m, pine forests, 23 June 1969, *Bramwell 2226* (RNG). Same locality, 1350 m, pine forest cliffs, 25 Mar. 1971, *Bramwell & Humphries 3111* (BM ; RNG). Firgas, 13 May 1891, *Murray* (K ; RHS ; S). Monte Doromas, high rocky regions, 5 May 1855, *Bourgeau 1389* (C ; FI ; G ; K ; Z). Casa Doromas, 26 May 1882, *Hillebrand* (Z). Teror, 20 May 1894, *Murray* (K). Bco. de la Vingua, 13 May 1892, *Murray* (K ; S). 'S.S. Virginis', 30 Mar. 1846, *Bourgeau 537* (BM ; FI ; G ; K). *Broussonet* (G). 4 May 1894, *Murray* (K). *Lowe* (K). *Webb* (K).

A rare endemic of north and north-west-facing slopes of Gran Canaria at Firgas, San Matheo, Monte Dormas and steep cliffs at Pinar de Tamadaba (Fig. 25). A tall straggling shrub usually found in shaded *Pinus canariensis* forest and rarely in open scrub of rocky, mountain slopes ; 450–1400 m.

Schultz Bipontinus (1844a) considered subsp. *jacobaeifolium* to be a distinct species, *Preauxia jacobaeifolia*. On the basis of the diagnosis, 'Planta herbacea, hirta, receptaculo elongato-conico, foliorum pinnatifidorum lobis oblongis, obtusis dentatis', he separated it from *Preauxia canariensis* (*Argyranthemum adauctum* (Link) C. J. Humphries), 'Planta fruticulosa, hirta, receptaculo depresso-conico, foliorum pinnatipartorum lobis linearibus, acutis, subdentatis'. The separation

has its shortcomings as all species of *Argyranthemum* are perennial and have convex-conical receptacles. Also, in sect. *Preauxia*, variation follows more or less a continuum throughout its distribution range in habit, foliage, and fruit characters. From Figs 25 and 26, it is possible to see that there is a parallel north–south cline in reduction of indumentum and leaf area from different localities on Gran Canaria and Tenerife and considerable overlap of variation in most characters in similar habitats from Gran Canaria, Tenerife and Hierro. Thus, populations from north Gran Canaria referable to *'jacobaeifolium'* can only effectively be separated from all other populations in section *Preauxia* by their rhombic-shaped leaves. In general facies, subsp. *jacobaeifolium* is more like its Teneriffean and Hierrean counterparts, referable to subsp. *adauctum* and subsp. *erythrocarpon*.

e. subsp. ***dugourii*** (Bolle) C. J. Humphries, comb. et stat. nov. (Text-fig. 2V 3.)

Preauxia dugourii Bolle in Bonplandia, Hannover 7 : 297 (1859). – Pitard & Proust, Îles Canar., Fl. Archipel : 231 (1908).
Chrysanthemum dugourii (Bolle) Christ in Bot. Jb. 9 : 146 (1887).
Chrysanthemum canariense var. *tenuisectum* Christ, loc. cit. *'tenuisecta'*.

Stems 60–80 cm, branched from the base, scabridulous to tomentose. *Leaves* 2–6 × 0·3–2 cm, bipinnatisect, scabridulous to tomentose ; primary lobes 6–22, 0·5–2 × *c.* 0·2 cm, opposite or almost so ; secondary lobes 2–10, 0·2–0·6 × *c.* 0·15 cm, opposite to alternate, acute. *Bracts* and *cypselas* as in subsp. *canariense*.

Tenerife: Las Cañadas, El Portillo, between El Cabezon and El Portillo, 2000 m, 14 Apr. 1969, *Bramwell 1315* (RNG). El Sombrerito, 2000 m, 30 Apr. 1969, *Bramwell 1411* (RNG). 2000 m, 11 May 1957, *Larsen* (C). Same locality, 1700 m (Cult. No. 83), *Larsen* (C). Same locality, 1882, *Askenasy* in herb. Christ (Z). Fasnea, 17 June 1855, *Perraudière* (P). Peñones, 6 May 1956, *Lems 2611* (MICH). Llano de Ucanca, 2100 m, 22 May 1957, *Larsen* (C). El Retamar, 2300 m, 10 Apr. 1971, *Bramwell & Humphries 3386* (RNG). Vilaflor, 2 km north-west, 10 Apr. 1971, *Bramwell & Humphries* (RNG). Granadilla, 1954, *Wall 554* (S). Tamadaya, near Arico, 1 Mar. 1855, *Bourgeau 1388* (C ; FI ; G ; K ; P ; W). Near Arico, 700 m, 1926, *Burchard 312* (G ; S ; Z). In Pinetis convallis Tamadaya, *Bourgeau 1388* (C ; FI ; G ; K ; P, neotypus ; W). Same locality, 17 July 1855, *Perraudière* (P). Same locality, 1200 m, 18 June 1855, *Perraudière* (P).

The distribution extends from El Portillo in the north-east region of the Cañadas on Tenerife to the south-facing slopes of Barranco de Pasa Jiron, Lomo de Retama and Vilaflor (Fig. 26). It is a dominant plant of the *Pinus canariensis* forests and also occurs in the sub-alpine, *Spartocytisus supranubius* scrub : 800–2100 m. The basal rocks consist entirely of Quaternary phonolytes.

Subsp. *dugourii* is rather variable in foliage and indumentum characters. It resembles and is often confused with *A. tenerifae* in its chamaephytic habit and erect pinnatisect foliage. It differs, however, by the sectional characters, i.e. the epappose and wingless ray and disc cypselas, the sessile leaves and the obspathulate, inner involucral bracts.

Morphologically it is most similar to subsp. *gracile*, but the leaves are usually larger, more dissected and tomentose.

Bolle's specimens on which he based the description of *Preauxia dugourii* (= *A. canariensis* subsp. *dugourii*) were originally deposited at the Berlin (Dahlem) herbarium. However, there is no material there on which Bolle can be assumed to have based his descriptions, and it seems likely that the specimens were in the herbarium fire of 1943, in the bombing of Berlin, which destroyed them. There are no duplicates at C, FI, W, or Z, where more of Bolle's collections and duplicates are kept.

In the absence of suitable material from the 'locus classicus' (Bco. de Pasa Jiron) cited in Bolle's protologue a neotype has been selected from Bourgeau's well-distributed collections. The label reads '*Tenerife:* Arico in Pinetis Convallis Tamadaya, *Bourgeau 1388*'. Conserved at P ; isotypes C, FI, G, K and W.

f. subsp. ***erythrocarpon*** (Svent.) C. J. Humphries, comb. nov. (Text-fig. 2V 5.)

Chrysanthemum dugourii subsp. *erythrocarpon* Svent. in Index Sem. Hort. Acclim. Pl, Arautapensi 1968 : 52 (1968), reimpr. ut Pl. Macarones. nov. v. minus cogn. 1 : 10 (1968).
Chrysanthemum broussonetii sensu Burchard in Biblthca bot. 98 : 231 (1929), pro parte quoad specim. a Ferro ; non Pers.

Stems 80–100 cm, branched throughout the plant, subglabrous. *Leaves* 3–10 × 0·8–4 cm, bipinnatifid, subglabrous, to glabrous ; primary lobes 6–24, 2–25 × *c.* 8 mm, opposite to subopposite, the lower lobes undissected ; secondary lobes dentate, cuspidate. *Inner involucral bracts* slightly expanded at the apex. *Ray cypselas* 3·5–4·5 mm, dark brown to black, becoming succose at maturity ; *disc cypselas* 1·8–2·2 mm.

Hierro: In the northern pine forests above La Frontera, 10 May 1959, *Sventenius* (TENE, holotypus). La Frontera, 850 m, 7 Mar. 1971, *Bramwell & Humphries 3309* (RNG). Cumbre de Golfo, 800 m, 2 May 1855, *Perraudière* (P).

Found only in *Myrica faya* and *Erica arborea* forest between 600 and 850 m on Hierro. Central mountains of north-west-facing slopes above La Frontera (Fig. 26).

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TAXONOMIC INDEX

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PLATE 28

Photomicrograph of abaxial leaf surface of *Argyranthemum adauctum* subsp. *jacobaeifolium* to show multicellular glandular hairs and elongated trichomes.

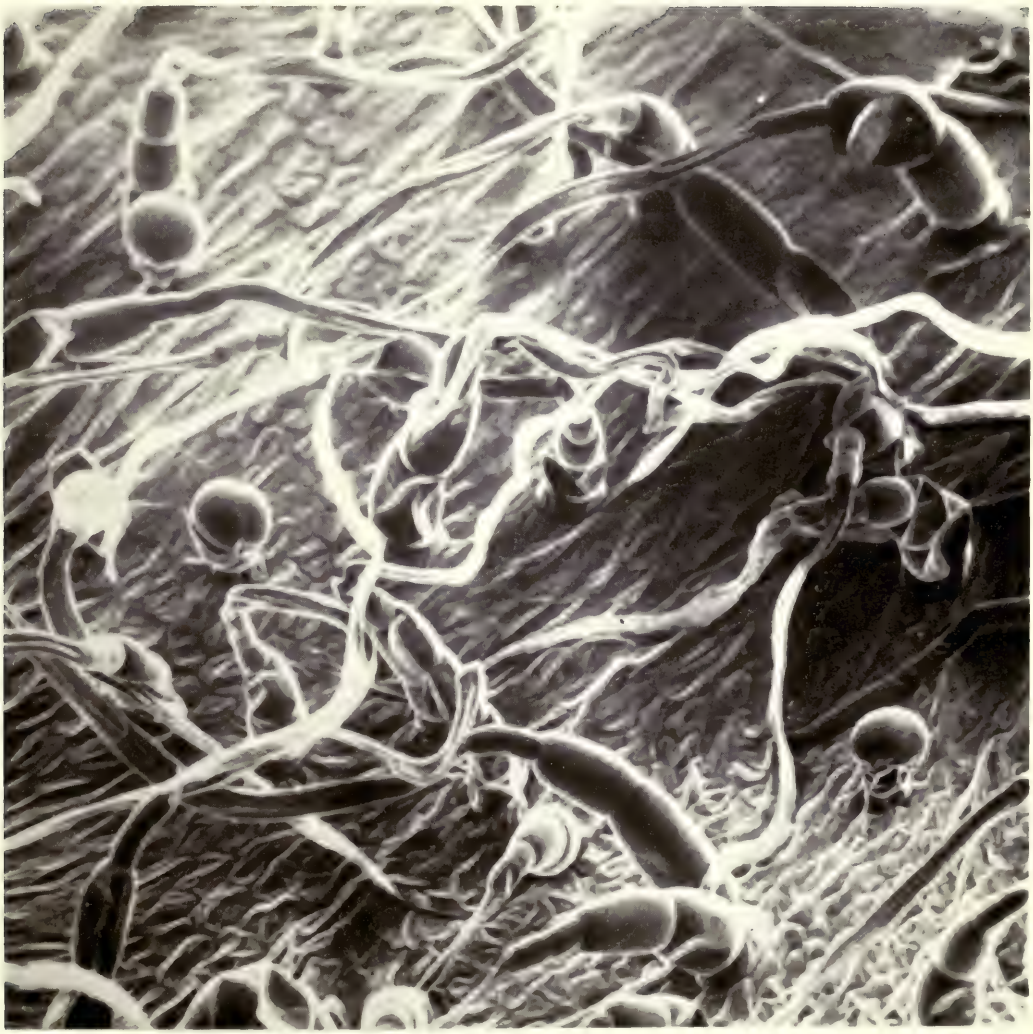

PLATE 29

(a) *Argyranthemum webbii* Schultz Bip. : lectotype from the herbarium of Schultz Bipontinus, Muséum National d'Histoire Naturelle, Paris.

(b) *Argyranthemum haouarytheum* Humphries & Bramwell : holotype, Reading University herbarium.

b

a