

A revision of the Spanish species of *Tanacetum* L. Subsect. *Leucanthemopsis* Giroux

By

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This revision is concerned with those plants which Willkomm (Prodr. Fl. Hisp. II: 97-99: 1864) grouped together in the genus *Pyrethrum* Sect. *Eupyrethrum*, but which are here regarded as belonging to the genus *Tanacetum*. The reasons for this are discussed in detail below.

From the Iberian Peninsula Willkomm recorded four species of *Pyrethrum* Sect. *Eupyrethrum*, namely *P. alpinum*, *P. hispanicum*, *P. flaveolum* and *P. palmatifidum*. That this account is inaccurate and unsatisfactory is soon shown. Before the writing of volume two of the Prodr. Florae Hispanicae in 1864 many species and forms of *Pyrethrum* (*Chrysanthemum*) sect. *Eupyrethrum* had been described from Spain, several of which were synonymous. Among these were *Chrysanthemum aragonense* Asso, *Ch. pallidum* Mill., *Ch. alpinum* Asso, *Ch. minimum* Brot., *Ch. radicans* Cav., *Pyrethrum sulphureum* Bss. & Rt., *P. spathulaefolium* Gay and *P. flaveolum* Hffsgg. & Lk. Willkomm (l. c.) grouped several of these 'species' together under an entirely new name *Pyrethrum hispanicum* Wk.—a very apt one, but in contravention of the Code of Nomenclature, as in its many forms it covers most areas of Spain. However, apart from the invalidity of the epithet '*hispanicum*' this compound species was unsatisfactory because of its content and the treatment of the infraspecific variants. Since 1864 *Pyrethrum hispanicum* has undergone a very considerable amount of change in nomenclature and

circumscription and it is with the history of the vicissitudes of this species that this revision must largely be concerned.

Pyrethrum palmatifidum DC., a species doubtful in the time of Willkomm has not been definitely identified and is excluded from the list of species. It is most likely to have been an anomalous dwarfed form of *Tanacetum alpinum* (L.) Schultz. Bipont.

Carlos Pau made the next important contribution to the study of this group of plants in 1906. He justly revived the name *Chrysanthemum pallidum* Miller for *Pyrethrum hispanicum* and transferred it to *Pyrethrum*. Unfortunately the rest of his study did not come up to this standard and, although some of the synonymy was put in order, a greater confusion than existed before was created by many mistakes caused by the superficial treatment of the revision which was based on the thirty two specimens in Pau's private herbarium!

The latest development was the transference of *Pyrethrum pallidum* to *Tanacetum* by Maire in 1929. Only some of the transferences of the various forms of the species have been made. At the time of writing it is a matter of great difficulty to find the correct name and rank of many plants of the group without an intensive search through the relevant literature and even then one is often faced with the necessity of making some adjustment or new combination.

The purpose of this paper is to provide an easier means of classifying these species of *Tanacetum*; the treatment is as far as possible consistent and while particular attention has been paid to nomenclature and synonymy it is hoped that the classification of the infraspecific variations will add to our understanding of variation in the genus.

DISCUSSION OF THE STATUS OF THE GENUS *Pyrethrum*

Although the final arrangement of this difficult group of Composite genera—the *Chrysanthemideae*—must lie with the monographer (1), a short survey is necessary here to explain the assumption of the genus *Tanacetum* in this revision.

(1) Cf. Briquet, apud Briquet et Cavillier in Burnat, Fl. Alp. Marit. VI, 72, line 37: 1916.

The genus *Pyrethrum* was first established by Haller (Enum. Stirp. Helv., ii, 720: 1742) containing previous *Matricaria* and *Chrysanthemum* species. Linnaeus (Species Plantarum, ed. 1, 1753) quoted *Pyrethrum* species, but not in binominal form as synonymous with some of his *Chrysanthemum* species; he regarded *Leucanthemum* as a synonym of *Chrysanthemum* and treated *Tanacetum* as a genus apart. In his Genera Plantarum, ed. 5 (1754), *Tanacetum* and *Chrysanthemum* are included as distinct genera but while *Leucanthemum* is regarded as synonymous with *Chrysanthemum*, although separable from it, no mention is made of *Pyrethrum*.

In 1757, Zinn (Cat. Pl. Gott., 414) gave the first post-Linnaean citation of *Pyrethrum* as a genus, although the species were not given as binomials. This must however be accepted as the earliest valid publication of the genus (cf. Sprague in *Kew Bull.*, 219: 1934). The species given by Zinn were equivalent to *Chrysanthemum corymbosum* L. and *C. frutescens* L. but these species differ fundamentally and are referable to separate genera—the former to *Tanacetum* L. emend. Briquet (which includes *Pyrethrum* as a section) and the latter to *Chrysanthemum* L. emend. Briquet. If *Pyrethrum* is maintained as a separate genus in the sense chosen by subsequent authors the citation must be *Pyrethrum* Zinn *pro parte*, and the type species *Pyrethrum corymbosum*. The genus thus circumscribed differs only from *Tanacetum* L. *sensu stricto* in having capitula with ray and disc florets (and not composed entirely of disc florets).

In 1768, Haller (Hist. Stirp. Indig. Helv., 40) again included *Pyrethrum* in his Swiss Flora, referring the genus back to his Enumeratio l. c. of 1742; one of the species he included (which were still not binomial) was equal to *P. corymbosum*. The generic diagnosis was—«calyx hemisphaericus, foliis factus imbricatis. Semen corona dentata ornatum, quae flosculum excipit».

Four years later, Scopoli (Flor. Carniola, II: 148: 1772) accepted Haller's *Pyrethrum* (Hist. 720) an error for Enum. 720), mentioning only one species — *Pyrethrum corymbosum*.

It is not till 1791 that we find the generally accepted post-Linnaean citation of *Pyrethrum* as a genus, by Gaertner (Fruct. Sem., II: 430: 1791) which was taken up as a synonym for *Chrysanthemum* in the 1791 edition of Linnaeus Genera Plantarum.

Gaertner's genus was based on Haller's (1768, op. cit.) and included two species *P. corymbiferum* (i. e. *P. corymbosum*) and *P. frutescens*. He added this note «Huc porro quoque spectant *Chrys. inodorum, alpinum, atratum* β , *serotinum arcticum, Myconis, bipinnatum*; nec non *Matric. asteroides*; & *Achil. pubescens* Linn.» followed by the interesting comment «Est itaque nihil aliud quam *Tanacetum* radio larvatum».

The constant inclusion of *P. corymbosum* links these interpretations of the genus *Pyrethrum* together and, therefore, although Gaertner is generally accepted as the authority for *Pyrethrum*, his genus is based on the same two species as those of Zinn, the earliest, thus obviating any serious nomenclatural changes.

Smith (Fl. Brit. II, pp. 898, 900: 1800) was followed by Willdenow (Species Plant. III, 2150: 1803) in keeping *Chrysanthemum* and *Pyrethrum* separate thus: *Chrysanthemum*—pappus nullus; *Pyrethrum*—pappus marginatus. Gaudin (Flor. Helv. V, 1829) took a wider view of *Chrysanthemum*, making two sections: *Matricaria*—semina corona destituta (= *Chrysanthemum* sens. strict.) and *Pyrethrum*—semina margine scariosa coronata.

In the same year Cassini (Tableau Synoptique des Synanthérées in Ann. Sc. Nat., XVII, 403-404: 1829) in his summary of the Anthemideae-Chrysanthemeae classified *Tanacetum* in the «Tanacétées — Calathide non radiée. Fruits aigrettes» and *Pyrethrum* and *Chrysanthemum* in the «*Chrysanthémées vraies* — Calathide radiée».

De Candolle (Prodr. VI, 53: 1837) was the first author to accept *Pyrethrum* on a wide basis. His genus which can scarcely be separated from his concept of *Tanacetum* was characterised by heterogamous heads with female ligulate flowers, rarely absent, and hermaphrodite tubular disc flowers, with a flat or convex, naked or bracteolate receptacle, and unwinged angled conform achenes with a coroniform pappus, frequently toothed, occasionally auriculiform. It differed from *Leucanthemum* by all the achenes provided with a pappus (not those of the disc without, and those of the ray with or without), and from *Chrysanthemum* by its homomorphic achenes *inter alia*. The sections he recognised were: 1) *Leucoglossa* — ligulate flowers white or roseate; receptacle naked. 2) *Gymnoclines* — ligulate flowers white or yellow, few, short, rarely 0; receptacle naked. 3) *Xanthoglossa* — ligules

long, numerous, yellow; receptacle naked. 4) *Tridactylina* — *P. kirilowii* Turcz. ex DC. 5) *Dendranthema* — *P. indicum* Cass., *P. sinense* Sabin. 6) *Balsamitae* — heads homogamous, discoid or with female ligulate ray flowers; pappus very short, subdentate, equal — including *P. balsamita* Willd., *P. multifidum* DC., *P. tanacetum* DC.

This classification, while an advance on previous ones, did little to clarify the differences between *Tanacetum* and *Pyrethrum*.

The classification of this group of plants became by this time an exercise for any authors concerned with them until the publication by Schultz Bipontinus of his pioneer work *Ueber die Tanaceteen*, 1844 in which he made a drastic revision of the *Chrysanthemeae* according to carpological criteria. The pertinent points of his analysis are that no clear generic distinction could be shown between *Pyrethrum* and *Tanacetum*; that a series of transitions from heads with clearly ligulate ray florets through heads with scarcely ligulate ray florets to heads of entirely tubular florets could be traced in related species (cf. Gaertner quoted above); and carpologically the two groups show no basis for generic separation. Schultz distinguished *Leucanthemum* from *Tanacetum* by the absence of a corona (a character not regarded by Briquet, later, as having any considerable value) and by the foveolate (not punctate-granulate) receptacle. *Chrysanthemum* (as far as the German flora was concerned) was restricted to *Ch. Dioscoridis* and *Ch. coronarium* based on the difform winged achenes (cf. coniform of *Tanacetum*).

Thus while De Candolle created a large number of new combinations under *Pyrethrum*, Schultz Bipontinus did likewise under *Tanacetum*. Schultz at that time received little support in his new classification.

Syme in *English Botany* (Sowerby ed. 3, V, 39 & seq.: 1866) interpreted *Chrysanthemum* to include *Pyrethrum*, *Tanacetum*, *Matricaria* and *Chrysanthemum*. It is interesting to quote his subdivision of the genus.

Chrysanthemum L.Subgenus EUCHRYSANTHEMUM (*Chrysanthemum segetum*)

Subgenus TANACETUM

Sect. LEUCANTHEMUM (*Ch. Leucanthemum*)Sect. PYRETHRUM (*Ch. Parthenium*,
Ch. Tanacetum)Subgenus TRIPLEUROSPERMUM (*Ch. inodorum*)Subgenus MATRICARIA (*Ch. chamomilla*)

On the other hand Reichenbach fil. (Icon. Flor. Germ. XVI, 49: 1854) presented a modification of the system of Schultz Bipontinus and regarded *Pyrethrum* as a section of *Tanacetum* but containing only those species with corymbose inflorescences. *Tanacetum alpinum* is put in sect. *Leucanthemum* with, inter alia, *T. atratum* and *T. pallens*, «capitula in caulium elongatorum apicibus solitaria».

Bentham (in Bentham and Hooker f., Genera Plantarum II, 426) gave their classification in 1873. They agreed with Gaudin l. c. in regarding *Pyrethrum* as a section of *Chrysanthemum* stating that it had been separated or joined with *Tanacetum* and *Chrysanthemum* by numerous authors on various different criteria but they considered the presence or absence of an achaenial pappus (an important point in some previous classifications) as an inconstant and unreliable character; likewise achaenial winging and ribbing. *Leucanthemum* was also fused with *Chrysanthemum* but *Tanacetum* was kept as a distinct genus.

Shortly after Bentham and Hooker's work, Boissier faced the problem in his Flora Orientalis (Vol. III, 337: 1875). He recognised that no generic distinction was possible between *Pyrethrum* and *Tanacetum* but despite the priority of *Tanacetum* retained the name *Pyrethrum* to cover both groups because so many of the plants concerned had been better known for a long time by this designation. *Tanacetum* was relegated to sectional rank; and *Chrysanthemum* maintained as a separate small genus.

Meanwhile Willkomm had published his account of the *Compositae* in Volume II of the Prodrromus Floræ Hispanicæ. *Py-*

rethrum here was kept up with the comment «Genus habitu peculiari donatum, ceterum cum *Leucanthemo* et *Tanaceto* arctissime cohaerens». The section *Eupyrethrum* with which this revision is concerned was created for the species with a monocephalic type of inflorescence while those species with a corymbose type of inflorescence were grouped in section *Parthenium*.

Hoffmann (in Engler and Prantl, Nat. Pflanzenfam. IV: 5: 1897) agreed with Bentham and Hooker in regarding *Pyrethrum* as a section of a comprehensive *Chrysanthemum* genus but unlike Bentham and Hooker included as one of the sections, *Tanacetum*, which in the light of later work was an advance in the right direction in bringing it nearer the *Pyrethrum* group.

The position at the turn of the century was therefore very confusing but the majority opinion appeared to favour a large *Chrysanthemum* genus including *Pyrethrum* but varying by the inclusion or non-inclusion of *Tanacetum* and *Leucanthemum*. The situation was clearly provisional and unsatisfactory, awaiting a clarification from further research. This came from Briquet's intensive work on the carpology, floral morphology and anatomy of the *Chrysanthemideae* by modern techniques which was foreshadowed by the endeavours of Schultz Bipontinus l. c. The results were intended to form the basis of a monographic study but were first put into practice in the continuation of Burnat's *Flore des Alpes Maritimes* by Briquet and Cavillier — (Vol. VI: 1916).

It seems in a way unfortunate that Briquet's researches were made public in what is essentially a local flora, as it is not generally known by botanists who have not had occasion to work on the flora of this area, that this Flora contains one of the most, perhaps the most, important contributions to the systematics of the *Anthemideae-Chrysanthemideae*. The pertinent points of Briquet's work will be briefly mentioned. With regard to the Bentham and Hooker (Bentham) and Engler and Prantl (Hoffmann) wide-ranging *Chrysanthemum* genus he states: «if they had in their emendation of the genus arrived at a natural group clearly distinguished from its neighbours their work would have been justified but this was unfortunately not the case.» *The synthesis was often illogical for Bentham and Hooker generically separated Tanacetum from Chrysanthem-Pyrethrum, a quite impossible and artificial state of affairs* as Schultz Bipontinus had earlier demons-

trated. From an examination of the groups united by Bentham and Hooker and Hoffmann under the name of *Chrysanthemum* it is seen that they differ profoundly in their carpological characters. Briquet reaffirms that a critical study of the carpology, completed by anatomy, must become the basis of the systematics of the group, the rôle of fruit structure becoming analogous with its position in the *Umbelliferae*.

The diagnostic characters of 'Briquet's emended genera are as follows.

TANACETUM L. emend. Briquet.

Involucre concave with imbricated bracts. Receptacle convex naked. Flowers homogamous ♂ or heterogamous ♂ and ♀; those of the ray ♀ ligulate, in one row, sometimes tubular and zygomorphic; those of the disc ♂ with regular corolla, with tube bi-winged or not in the lower part. Achenes homomorphic, obconical, sessile, truncate at the summit, provided with an apical collar (corona) variable in shape, with 5-10 ribs projecting little, divest of myxogenic cells (2), with superficial hyaline valliculae divest of secretory canals. Embryo with transverse cotyledons.

LEUCANTHEMUM Adans emend. Briquet is distinguished from *Tanacetum* by homomorphic achenes with ten micropterous (3) ribs bearing on their back epicarpic myxogenic cells; with deep valliculae each enclosing a voluminous secretory canal; bearing a membranaceous collar of a pappus — complete, incomplete, or absent. Embryo with transverse cotyledons.

This concept of the genus contrasts with that of Schultz Bipontinus whose *Leucanthemum* contained only species divest of a pappus.

CHRYSANTHEMUM L. emend. Briquet differs carpologically by the *heteromorphic* achenes, divest of secretory vallicular canals and of myxogenic cells; those of the ray triquetrous often with

(2) Mucilaginous cells (célules myxogènes) are elements of the epicarp provided in their outer wall with a depression productive of mucilage capable of swelling enormously under the action of water.

(3) Micropterous - having short wings.

winged ribs, those of the disc cylindrical or cylindrical triquetrous with numerous equal or unequal ribs, the posterior often aliform. Embryo with cotyledons anterior — posterior.

Here then we have definite criteria for the delimitation of these genera; and although we may not follow every minutia of Briquet's classification, the general fabric proves to have afforded a more concrete and satisfactory basis than any other scheme up to his time and, it should be stressed, no attempt has been made since then to refute Briquet's work or provide proof of a better alternative (see below).

Briquet's doctrine was taken up in Hayek's *Prodromus Florae Peninsulae Balcanicae*, and, eventually, by Maire in his numerous publications on the North African flora. Recognition was also given by many continental botanists as shown by their distributed *exsiccata*; and in Spain by Font Quer and Rothmaler in their *Flora Iberica Selecta*.

However, many later writers would seem to have ignored Briquet's work and returned to the former unsatisfactory state — such as Lemée (*Dictionnaire des Genres Phanérogames*, 1935), where *Pyrethrum* and *Leucanthemum* are given as synonymous with *Chrysanthemum*, and *Tanacetum* kept separate. In the more recent floras of the Iberian Peninsula, Lázaro e Ibiza (*Compendio Flora Española*, 1921) more or less follows Willkomm and Lange, and Coutinho (*Flora de Portugal* ed. 2, 1939) includes *Pyrethrum* under *Chrysanthemum* but separates them in his key.

Many practising Continental botanists show considerable uncertainty in classifying species in this group. They have not been consistent in adhering to one method; some have tried *Pyrethrum*, and others, *Tanacetum*, but they usually end by adopting *Chrysanthemum* in Hoffmann's sense. This is especially true of those working on the Eastern Mediterranean-Asia Minor flora; here the same problems exist as in Europe except that *Leucanthemum* is not represented. Boissier's classification of *Pyrethrum* (which is *Tanacetum* except in name) will have to be correlated with the European system and considerable changes made. Bornmüller says (in *Fedde Repert.*, XXXVI, 350 (366): 1934) «it is now generally accepted that *Pyrethrum* is linked with *Chrysanthemum*.» This was not correct, for at that time several authorities (e. g. Hayek, Maire, quoted above) were following Briquet; it was only true,

and still is, for a certain number of taxonomists who can be said to form the «Hoffmann — Chrysanthemum» school. What is almost universally accepted is that *Pyrethrum* must be reduced from generic rank, but it must be repeated that to relegate it to *Chrysanthemum* as a section, along with *Tanacetum*, is unnatural; to do so and keep *Tanacetum* a separate genus is even more so (4). *Chrysanthemum*, it should be emphasised is clearly separable from *Tanacetum* — *Pyrethrum* but the resulting genus is small (cf. Briquet, Boissier, Hayek, l. c.).

In one of the latest large floras to be published (Flora Aegaea; 1943) Rechinger fil. follows Briquet in relegating *Pyrethrum* to *Tanacetum*, leaving *Chrysanthemum* as a small genus, although the same author, in earlier and contemporary papers uses *Pyrethrum* and *Chrysanthemum* for what he here calls *Tanacetum*.

The present position is seen to represent two extremes — the «Briquet — *Tanacetum*» school in which *Pyrethrum* is a section of a large *Tanacetum* genus, whereas *Chrysanthemum* is a small separate genus; and the «Hoffmann — *Chrysanthemum*» school in which *Pyrethrum* is a section of a large *Chrysanthemum* genus, as is *Tanacetum*. In the former, *Chrysanthemum* is a very small more or less natural genus: in the latter it is a very large and unnatural one.

Recently Harling (Act. Hort. Berg. xvi: 1-56: 1951) in his embryological studies in the Compositae has made a valuable contribution towards the classification of the subtribe *Anthemideae-Chrysantheminae*. His evidence lends considerable support to Briquet's delimitation of the *Tanacetum-Chrysanthemum-Leucanthemum* group although he prefers to follow Hoffman in according the genus *Chrysanthemum* a wide circumscription. He remarks however that it is doubtless a matter of taste which is the most appropriate disposition but adverts that «the main thing is, of course, that the taxonomical units, whether given the rank of genera, subgenera or sections, be as homogeneous and as naturally delimited as possible» (l. c. p. 44). In another paper which it is hoped to publish shortly I shall give a detailed consideration of the taxonomy of this group in the light of Harland's researches. For the present it is sufficient to indicate here that I

(4) The same applies to E. Mediterranean-Asia Minor, as does to Europe.

maintain *Tanacetum* as a separate genus from *Chrysanthemum* but include in it *Leucanthemum* as a subgenus because of transitions between the two groups.

The question of recognising *Pyrethrum* as a section of *Tanacetum* remains to be considered. This as above mentioned was first done by Reichenbach fil. l. c. but his section contained only those species with corymbose inflorescences. Briquet however separated the section *Pyrethrum* (for the purposes of his flora) as follows: Flowers of the ray ligulate (rarely o) ♀; those of the disc 5-lobed ♂. Heads relatively large. Leaves divest of epidermal glands placed in small cavities — *Tanacetum alpinum*, *T. corymbosum* and *T. parthenium*. The former species is included by Willkomm in his section *Eupyrethrum* (of *Pyrethrum*) and the latter two species in section *Parthenium*.

Giroux (Bull. Soc. Hist. Nat. Afr. Nord. xxiv: 54: 1933) has shown that Briquet's section *Pyrethrum* of *Tanacetum* requires to be modified with regard to later research. In a study of the floral and carpological characters of *Chrysanthemum cinerariifolium* (Trev.) Vis. Giroux noted that this species has epidermal glands in the leaves (as in typical *Tanacetum*) and that the achenes are provided with «lacunes sécrétrices» (not «canaux sécréteurs» as in *Leucanthemum*); similarly in *Tanacetum alpinum* the achenes show «lacunes» resembling those of *C. cinerariifolium* although it has not been able to make certain that they are «sécrétrices». Moreover, both the typical form of *T. alpinum* and its f. *minor* G. G. and var. *pubescens* Duby (var. *minimum* (Vill.) Rchb.) have mucilaginous cells in the achenes (as in *Leucanthemum*).

As a result of these discoveries Giroux divided *Tanacetum* sect. *Pyrethrum* into subsect. *Eu-Pyrethrum* «Feuilles pourvues de glandes épidermiques placées dans des fossettes; akènes pourvus de lacunes sécrétrices mais dépourvus de cellules myxogènes» based on *T. cinerariifolium*, and subsect. *Leucanthemopsis* «Feuilles dépourvues de glandes épidermiques placées dans des fossettes; akènes pourvus de cellules myxogènes et de lacunes probablement sécrétrices» based on *T. alpinum*. The name «Eupyrethrum» cannot be adopted for the former subsection as it does not in this circumscription include the type of the «genus» *Pyrethrum*, viz. *P. corymbosum*; Willkomm's section *Eupyrethrum* of *Pyrethrum* which as already noted comprises species equivalent to *T. alpinum*,

T. pallidum, *T. flavicolum*, *T. pulverulentum* and *T. radicans* cannot be accepted for the same reason. A new name for Giroux's subsect. *Eupyrethrum* is given below (6).

Harling (l. c.) has shown that *T. alpinum* has a monosporic embryo sac development (as in his subgenus *Leucanthemum*) unlike subgenus *Tanacetum* where the development is tetrasporic, and supported by the presence of mucilaginous cells in the achenes noted by Giroux and the leaf form, assigns it to subg. *Leucanthemum*. In the other species with which this revision is concerned (*T. pallidum*, etc.) mucilaginous cells may be present in the achenes (although not constantly): Maire (Bull. Soc. Sc. Nat. Maroc xi: 101: 1931) points out «Par les côtes a cellules myxogènes cette plante [*T. pallidum*] fait transition entre les *Tanacetum* et les *Leucanthemum* mais elle reste bien cependant en *Tanacetum* par l'absence de canaux sécréteurs et le peu d'élevation des côtes». In my opinion these species (*T. alpinum*, *T. pallidum*, etc.) form a more or less natural group of *Tanacetum* sect. *Pyrethrum* linking with subg. *Leucanthemum* by the monocephalic inflorescences, occasional presence of mucilaginous cells in the achenes and general habit but separated by the lack of secretory canals (the «lacunes probablement sécrétrices» of *T. alpinum* being a further indication of the intermediate nature of the group), the slightly marked ribs of the achenes (showing a connection with sect. *Coleostephus* of subg. *Leucanthemum*) and the inconstant presence of mucilaginous cells. I have therefore maintained Giroux's subsect. *Leucanthemopsis* for them, a detailed description of which is given below. Its relationships are shown by the following partial key (cf. Giroux, l. c.):

Ray flowers ligulate, rarely O, white, yellow or purplish; disc flowers tubular, 5-lobed, hermafrodite; heads relatively large.

Sect. PYRETHRUM.

Leaves without epidermal glands in small pits; achenes without secretory canals or mucilaginous cells (*T. corymbosum*, *T. parthenium*) Subsect. *Pyrethrum* (5).

(5) *Tanacetum* subsect. *Pyrethrum* (Zinn.) Heywood (*Pyrethrum* Zinn., p. p., Gaertn. et auct. post., sensu stricto). Typus: *Tanacetum corymbosum* (L.) Sch. Bip.

Leaves with epidermal glands in small pits; achenes with secretory lacunae but without mucilaginous cells (*T. cinerariifolium*) Subsect. *Cinerariifolia* (6)

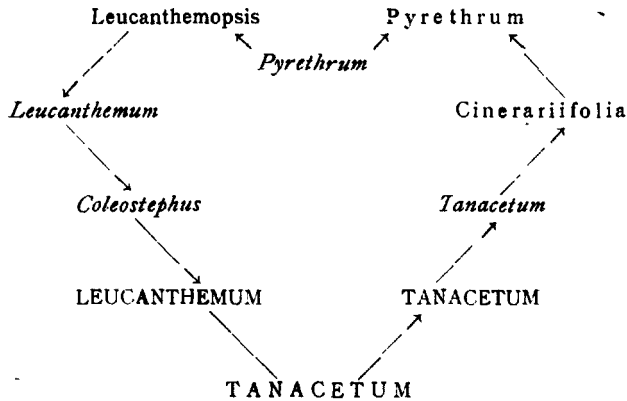
Leaves without epidermal glands in small pits; achenes sometimes with probably secretory lacunae, and frequently with mucilaginous cells (*T. alpinum*, *T. pallidum*, *T. pulverulentum*, etc.) Subsect. *Leucanthemopsis*

TANACETUM L., Subsect. **Leucanthemopsis** Giroux, ampl.

Plantae caespitosae, caulibus floriferis monocephalis, capitulis mediocribus vel magnis. Flores marginales ligulati, albi, lutei vel nunc rosei. Aquaenia cellulis mucilagiferis frequenter praedita atque lacunis secretoriis interdum obsita. Folia varie pinnatidivisa o subpinnatidentata, sine glandulis epidermicis.

Typus: *T. alpinum* (L.) Sch. Bip.

The section *Pyrethrum* as a whole affords a connection through subsect. *Leucanthemopsis* to subg. *Leucanthemum* on the one hand, and through subsects. *Pyrethrum* and *Cinerariifolia* to sect. *Tanacetum* on the other. This is shown graphically below.



(6) *Tanacetum* subsect. *Cinerariifolia* Heywood, nom. nov. (*Tanacetum* subsect. *Eu-Pyrethrum* Giroux non Zinn, pro gen.) Typus: *T. cinerariifolium* (Trev.) Giroux.

ABBREVIATIONS OF HERBARIA

- K* — Herbarium, Royal Botanic Gardens, Kew.
E — Herbarium, Royal Botanic Garden, Edinburgh.
BM — Herbarium, British Museum (Nat. Hist.) Dept. of Botany.
MA — Herbario del Jardín Botánico, Madrid.
MAF — Herbario del Laboratorio de Botánica de la Facultad de Farmacia, Ciudad Universitaria, Madrid.
MAFST — Herbarium, Instituto Forestal de Investigaciones y Experiencias, Madrid.
ĜDA — Herbario General de la Facultad de Farmacia, Granada.

GLAVIS SPECIERUM

- 1 { Folia lineari-spathulata, apice 3-5-7-fida nunc laciniis numerosis leniter dissecta vel orbiculato-spathulata. Plantae caespitosae, indumento cano vel argenteo vel virenti-sericeo. Ligulae citrinae sulphureae flavae vel albae **T pallidum** (Mill.) Maire. (p. 333).
 Folia pinnatisecto-partita vel pectinato-pinnatipartita 2
- 2 { Ligulae albae, basi flavescentes vel roseae 3
 Ligulae flavae vel luteae 4
- 3 { Ligulae albae, vel albae ad basin roseae praesertim post anthesin. Plantae nanae 4-8 cm. altae. Folia ovata 5-7-pinnatifida, glabrescentia vel pubescenti-tomentosa. Involucri phylla obtusa, late spadiceo-marginata, glabra vel molliter velutino-tomentosa, margine ciliata. Achaenia 5-costata **T. alpinum** (L.) Schultz-Bip. (p. 363).
 Ligulae albae ad basin flavae vel usque ad medium pallide flavescentes. Plantae c. 8-15 cm. altae. Folia lineari-oblonga 8-14 pinnatifida. Involucri phylla acuta, anguste fusco-marginata, tomentosa aut canescenti-tomentosa. Achaenia 7-10 costata. **T. pulverulentum** (Lag.) Schultz-Bip. (p. 328)
- 4 { Plantae dense caespitosae; rami rhizomatis lignosi *radicantes*. Folia pinnatisecta, pinnis oblongo-linearibus acutiusculis. Ligulae luteae, post anthesin rubro-aurantiacae. Involucri phylla ± glabra. Achaenia corona alba brevissima munita **T. radicans** (Cav.) Schultz-Bip. (p. 355).
 Plantae laxae caespitosae ramis rhizomatis radicanibus nullis. Folia pinnatisecta, pinnis remotiusculis mucronatis. Ligulae flavescentes, post anthesin colore eodem (nec rubro-aurantiaco). Involucri phylla pubescentia. Achaenia corona parva munita. **T. flaveolum** (Hoffsgg. et Lk.) (p. 361).

TANACETUM PULVERULENTUM (Lagasca) Schultz-Bipont., Über die Tanacetëen, 48: 1844.

Chrysanthemum pallidum minimis imisque foliis incisis superioribus integris et capillaribus, Barrelier, Plantae Gall. Hisp. Ita!. obs. 1903, icon. 421 (1714).

Pyrethrum pulverulentum Lag. in Variedades de Ciencias (40) (1805), non Willd.; Gen. et Sp.: 30 (1816); Cútanda. Flor. Comp. Madrid: 386 (1861); Rouy, Fl. de France, VIII: 264 (1903), *pro parte, quoad pl. hisp.*; Nyman, Conspect. Flor. Europ.: 373 (1879), *pro parte typica, subspeciebus et varietatibus exclusis*; Mariz, in Bol. Soc. Broter., IX: 213 (1891).

Chrysanthemum pulverulentum [Lagasca ex] Persoon, Synopsis II: 461 (1807), *excl. syn.* Lamarck; García in Bol. Soc. Broter., ser. 2, XX: 79 (1946).

Pyrethrum pectinatum Hoffsgg et Link, Fl. Port. II, t. 103 (1820), non *Chrysanthemum pectinatum* L.

Pyrethrum hispanicum Wk. var. *pinnatifidum* Wk. f. *pulverulentum* Wk. in Wk. et Lange, Prodr. Flor. Hisp. II: 98 (1864); Lázaro, Comp. Flor. Esp. ed. 3, III: 427 (1921), *ut var., pro parte*; Colmeiro, Enum. Pl. Hisp.-Lusit. III: 198 (1887).

Pyrethrum pallidum (Miller) Pau var. *genuinum* f. *leucoglossum* Pau, in Butl. Inst. Cat. Hist. Nat. VI: 89 (1906) *quoad typ. cit.*

Pyrethrum pallidum (Mill.) Pau subsp. *pulverulentum* (Lag.) C. Vicioso, in Anal. Jard. Bot. Madrid, VI (2): 83 (1946).

Matricaria minima Desr. β in Lamarck, Ency. méthod. III: 731 (1789), *pro parte? quoad tab. Barrelieri cit. et in suppl. pro syn. cit.*

Chrysanthemum minimum Brotero, Flor. Lusit.: 379 (1804), *quoad descript. et syn. cit.*, non Vill.

Prolongoa pectinata sensu Colmeiro, Enum. Pl. Hisp.-Lusit. III: 194 (1887), *pro parte quoad synonym. Broteri atque Hoffmannseggi et Linki et aliquot spec. citat.*

Leucanthemum pulverulentum (Lag.) Coste, Flor. France III: 721 (1913), *in add.*, *pro subsp. Leucanthemi alpini, quoad nomen tantum.*

Leucanthemum pulverulentum Sampaio, Herb. Portug.: 132 (1913).

Pyrethrum sulphureum var. *alpinum* sensu auct. plur.

Non Pyrethrum pulverulentum Willd. Enum. Hort. Berol.: 906 (1809).

Two subspecies are recognised:

subsp. **pulverulentum** (*Tanacetum pulverulentum* (Lag.) Sch. Bip., *sensu stricto*).

Specimens cited.

CASTILLA LA NUEVA: Madrid (Gay, 1846, *K.*); Madrid, el Pardo et Casa de Campo (Reuter, 1841, *K.*, *BM.*); *ibid.* (Dufour, 1818, *K.*); Madrid, Escorial (Herb. Gay, leg. Bourg., *K.*); Madrid, Pardo (Bourgeau, 1854, 2246, *K.*, *E.*, *BM.*); *ibid.* (Herb. Graells, *K.*); Madrid, Chamartín (leg. et det. Lagasca, adnotated as being the type but probably a later collection, *MA.*); Madrid, Chozas (Isern, *MA.*); Madrid, Batres (Vicioso et Beltrán, *MA.*); Madrid, Buitrago (Vicioso, *MA.*); Madrid, Chamartín de la Rosa (Cavanilles, *MA.*); Madrid, Escorial (Lagasca, *MA.*); Madrid, Chamartín (Jerónimo in Sennen Pl. d'Esp. 2910, *MA.*, *BM.*); Madrid, Chamartín de la Rosa (Vicioso, *MA.*); *ibid.* (Beltrán, *MA.*); Madrid, Braojos (Vicioso, *MA.*); Madrid, Cercedilla (Vicioso, *MA.*); Sierra Guadarrama (Gandoger, 1896, *K.*); *ibid.* (Atchley, 1935, *K.*); *ibid.* (Winkler, 1876, *K.*); Setiles, Pedrega (Benedict. Herb. Pau, *MA.*); (Madrid) — (leg. Lagasca, Herb. Roem., *MA.*).

CASTILLA LA VIEJA: Soria, Andaluz (Vicioso, *MA.*); Soria, Los Rábanos (Ceballos and Vicioso, *MA.*); Soria Santa María de las Hoyas (Ceballos, *MA.*); Soria, La Poveda (Ceballos and Vicioso, *MA.*); Avila (Barras, *MA.*); Avila (Pau, *MA.*); Segovia, Villacastín (Lagasca, *MA.*); Burgos, Aranda de Duero (Caballero López, *MA.*); Burgos, Castillo de la Reina (Losa in Sennen Pl. d'Esp., 7471, *MA.*); Valladolid (Sennen Pl. d'Esp. 78, *MA.*); Logroño, pr. Subia (Lacaita, Herb. Pau, *MA.*); Casalejo pres Talaveira de la Reina (Bourgeau 2535, *MA.*, *BM.*).

LEÓN: León, San Isidro (Bourgeau, 1864, *MA.*, *BM.*).

ARAGÓN: Pyrénées Aragonaises, Peña Montanera (Bellot 1856, *BM.*).

PORTUGAL: Tras-os-Montes, Beira Alta, Beira Baixa (Spec non vid. sed conf. García, 1946, l. c.).

HOLOTYPE: «Madrid, Chamartín, *P. pulverulentum* sp. n. N. é dedit. [det. Lagasca]» in Herb. Hort. Bot. Reg. Matrit.

ORIGINAL DESCRIPTION: *Pyrethrum pulverulentum*: tomentosò pulverulentum: caulibus unifloris: foliis linearibus inferioribus subpinnatis laciniis parallelis: summis indivisis angustissimis. Lagasca, in Variedades de Ciencias, litt. y art. tom IV, 40 (1805).

The early history of this species is confused. Lagasca l. c. created the species in 1805 based on collections from Chamartin de la Rosa, Madrid. He quotes «*Chrysanthemum pallidum minimis imisque foliis incisissimis superioribus integris et capillaribus*, Barrelier icon 421» as a synonym which was also given by Miller (Gard. Dict. ed. VIII, No. 18: 1768) for his *Chrysanthemum pallidum*. This latter species was described also as growing about Madrid; but Lagasca's plant agrees much more closely with Barrelier's figure especially with the leaves—pinnately divided—and with the name which probably refer to the pale whitish ligules (not sulphur-yellow as in *Ch. pallidum*), or even to the white pulverulent indumentum (not silky as in *Ch. pallidum*). Miller's error would be quite understandable as both species grow in the same area, Madrid, and Barrelier did not actually specify flower colour.

In 1804, Brotero l. c. described *Chrysanthemum minimum* which from the description and synonyms cited was clearly the same as *Pyrethrum pulverulentum* but, although an earlier name, it is invalidated by the previous homonym *Chrysanthemum minimum* Villars. An interesting point in the description is «radix annua» (see below). Persoon included Lagasca's species in his Synopsis (461: 1807 sub Chrysanthemo) but his synonym «*C. pallens* Lmk. enc. 3, 731» is untraceable. Lamarck (Ency. method. III, 731: 1789) referred «*Matricaria minima* β [= *T. alpinum* var. *minimum*] eadem, elatior, foliis inferioribus pinnatis» to Barrelier's Icon, 421. Desrier in the supplement to Lamarck's Dictionnaire notes that the plant is described by Lagasca (ex Persoon) as a new species. Earlier, Brotero l. c. had stated that his *Chrysanthemum minimum* was the variety of *Chrysanthemum alpi-*

num L. mentioned by Gouan (Illustr. 70: 1773) «... adeoque Iconi Barr. 421 simillimis (sic)». This linking with *Tanacetum alpinum* has been maintained by Pau who states of *Pyrethrum pallidum* sensu amplo (of which *T. pulverulentum* was in his opinion one of the types «in my opinion it cannot be considered as more than a subspecies of *Pyrethrum alpinum* (L.) Willd.»; and by Coste (Flore France III, 721: 1913). While it cannot be denied that these species are very closely related, the specific limits which are accepted in this group do not allow of a linkage into one huge comprehensive species. Specific distinctions are not easily made here by definite individual characters but rather are based on different combinations of characters.

The specific status of *Tanacetum pulverulentum* has been, and still is, a matter of doubt to many botanists. *Pyrethrum pulverulentum* was first linked with the related forms (*radicans* and *sulphureum* sens. ampl.) by Willkomm l. c. in his unfortunate *Pyrethrum hispanicum*. Pau in his revision retained this amalgamation in his *P. pallidum* and indeed would seem to have inferred unjustifiably that *P. pulverulentum* was the typical form of the species. This association with *T. pallidum* has been maintained throughout all its nomenclatural vicissitudes as shown by the synonymy quoted. It has been possible to see the types, and make an extensive examination of specimens of these two taxa and the conclusion is that *T. pulverulentum* is best treated as a separate species, and is quite distinct from *T. pallidum* sensu amplo. The evidence is examined below.

After the description of *Pyrethrum pulverulentum*, Lagasca gives the conventional sign for an annual plant, viz. ☉; moreover the synonymous *Chrysanthemum minimum* Brotero was definitely described as having «radix annua», and many plants in herbaria appear to be definitely *monocarpic*. However the type, as far as can be judged, is perennial, as are many other examples, and intermediate forms exist which, if not annual, flower at any rate in their first year of growth. This early flowering is quite common and it is not unusual to find a slender plant producing a dozen or more shoots each bearing a capitulum.

Tanacetum pulverulentum (typical), then, is variable in its life-span but it seldom attains the long-lived perennial habit as found

in *T. pallidum*. Generally it forms a slender single, more or less unbranched, taproot giving rise to numerous ascending flower shoots, with few, if any, sterile branches.

T. pallidum is a definite perennial, often long lived, usually straggling at the base and forming elongate branched rootstocks with numerous sterile shoots. It is, compared with *pulverulentum*, a stronger, more loosely growing plant.

The leaves of *T. pulverulentum* are more or less oblong-linear, pinnately divided with 18-14 lobes; those of *T. pallidum* are apically divided into 3-5 teeth (ssp. *pallidum*), or linear spathulate, scarcely divided (ssp. *virescens*) or ovate spathulate incised by numerous teeth (ssp. *spathulifolium*). (See Figs. 1 & 2).

The ligules of the ray florets of *T. pulverulentum* are white or palest yellow, always with a yellowish shading at the base; those of *T. pallidum* are entirely sulphur yellow (apart from white flowered varieties).

In indumentum the two species show differences: the arachnoid tomentose covering of *pulverulentum* gives it a powdery white appearance (hence the specific epithet?), unlike the more silky character of *pallidum*. Likewise the involucral bracts of the capitula differ in indumental characters, colour, covering and shape.

It is seen that some characters stated above as differential between the *typical* forms of both species, may be common to one or other of the component forms.

T. pulverulentum finds its nearest relationship with *T. radicans* in leaf shape although preeminently distinct in ligule colour and in habit; it also shows affinities with the *T. alpinum* complex, especially with the tomentose varieties.

subsp. **pseudopulverulentum** Heywood, *ssp. nova*.

Valde affine *T. pulverulento* ssp. *pulverulento* sed habitu densius caespitoso, laminis foliorum apice orbiculatis pinnatisectis, colore ligularum albo (haud basi flavescente) distinguitur.

Planta perennis, basi suffruticosa, dense caespitosa, tomentoso-pulverulenta. *Caules* indumento denso numerosi ascendentes vel erecti 5-13 cm. longi, 1 mm. lati, foliati, superne nudi. *Folia* (ramorum steriliu caulkumque) petiolata, apice suborbiculata pin-

natisecta, segmentis 5-9 ovatis submucronatis; caulina suprema linearia subintegra vel apice cuneata et 3-5-dentata; omnium limbus in petiolum longum sensim abiens.

Capitula 2-2.5 cm. diametro. *Flores* disci ♂ lutei, marginales ♀ ligulati albi breviter bilobati vel trilobati, omnes glandulis minutis muniti. *Phylla involucri* valde inaequalia, extima breviter acutiuscula, interiora lanceolata oblongave, apice acutiuscula obtusave, omnia dorso pulverulenta fusco-marginata.

Achaenia 7-8-costata cellulis mucilagiferis praedita, striis resiniferis nullis. Flores omnes pappo coronuliformi tertiam achaeni partem aequante.

Holotypus: Sierra de Javalambre, Prov. Teruel sur le calcaire, 2,000 metres. Rare. (Reverchon, Pl. d'Esp. 785: 1892, orig. det. *Pyrethrum hispanicum* Wk.) in *Herb. Kew.*

Specimens cited:

TERUEL: Sierra de Noguera (Reverchon, Pl. d'Esp. 785: 1900, *cotypus*, E); Sierra de Albarracín, Cerro de Sn. Tines (Vicioso & Pau MA).

JAÉN: Sierra de Cazorla (Reverchon, Pl. d'Esp. 785: 1901, E); *ibid.* (MA).

ALICANTE: Sierra de Átatea (?) poor specimen (Vicioso, MA.)

This new subspecies differs markedly in habit and appearance from the type but when the differences are analysed they appear surprisingly slight. As discussed above *T. pulverulentum* ssp. *pulverulentum* is at the most a short-lived perennial, but ssp. *pseudopulverulentum* is remarkable by its strong perennial character and extreme density of habit. The leaves are more or less orbiculate at the apex, unlike the typical form, and the ray ligules do not appear to have a yellowish base; but apart from these characters the two plants are comparable. A comparison of their respective distributions is more enlightening. The main area of distribution of subsp. *pulverulentum* is in Old and New Castille with outlying subareas in León and Portugal. A specimen in the British Museum Herbarium collected by Bellot, 1856 from «Pyrénées Aragonaises, Peña Montanera» seems to fit into *T. pulverulentum* subsp. *pulverulentum*. Its occurrence in this area is surprising but

the specimen is isolated and no great emphasis laid on it. Its discovery does not alter the statement given elsewhere that the supposed *T. pulverulentum* recorded from the Pyrénées is *Tanacetum alpinum* var. *minimum*. Subsp. *pseudopulverulentum* has a restricted and disjunct occurrence, in Teruel, Alicante (the specimen from here—Sierra de Altatea, Vicioso is small and very imperfect, and difficult to identify with certainty) and Jaén. It should be noted that whereas the typical subspecies is an apparent calciphobe occurring on noncalcareous terrain, the new subspecies is found on limestone ranges.

Thus, although the morphological distinctions are small, when they are considered with distributional data there is ample basis for separation with subspecific rank. The possibility of a genetic barrier suggests itself but no experimental evidence is available and it seems advisable to treat these plants as subspecies occupying as they do distinct areas whose margins meet. No particular relationship can be detected with any of the forms of *Tanacetum pallidum* unless it be with the dubious var. *Assoi* Pau (*Chrysanthemum alpinum* Asso non L.).

The subspecies *pseudopulverulentum* is poorly represented in herbaria. It was first recognised as a distinct unit by Pau as shown by a pencilled note in his handwriting «var. nova *squamum*» on a herbarium sheet (Reverchon, Pl. d'Esp. 785: 1901) in Madrid Herbarium. The varietal name was apparently inedited. Reverchon collected the plants in differing localities and distributed them as *Pyrethrum hispanicum* Wk. thus leaving their precise identity an open matter. Later collections were made by Vicioso and Pau, and named *P. pallidum* var. *genuinum* fa. *leucoglossum* (= *P. pulverulentum*).

In recent years the plant has not been collected and has escaped the attentions of the Spanish botanists.

TANACETUM PALLIDUM (Miller) Maire, ampl.

Syn:

Tanacetum pallidum (Miller) Maire in Emberger et Maire, Pl. Maroc. Nov. (*Arch. Sc. Maroc.*) fasc. 1: 4 (1929); Maire in Emberger et Maire in *Bull. Soc. Nat. Maroc.* 101 (1931).

Chrysanthemum pallidum Miller, Gard. Dict. ed 8, No. 12 (1768), *excl. syn. et tab. Barrelieri*.

Pyrethrum hispanicum Willk. in Willk. et Lange, Prodr. Fl. Hisp. II: 98 (1864), *pro parte, excl. syn. plur.*; Lázaro, Comp. Fl. Esp. III: 427 (1921), *pro parte*.

Pyrethrum pallidum (Mill.) Pau in Buttl. Inst. Cat. Hist. Nat. VI: 89 (1906), *pro parte typical, excl. form. et syn. plur.*

Chrysanthemum hispanicum (Willk.) Dörfler, Herb. Norm. No. 4122 (1891).

This species has undergone many taxonomic and nomenclatural vicissitudes before attaining its present form. Miller published the species in his Gardener's Dictionary, 1759 and later in ed. 8: 1768 as a binomial. His citation of Barrelier's Icon 421 and the reasons for the assumption of the epithet «pallidum» have already been explained under *Tanacetum pulverulentum*. In 1779, Asso (Synopsis, 123, Tab. IX, f.) described the synonymous *Chrysanthemum aragonense* with a brief diagnosis and poor figure. A third synonym *Pyrethrum sulphureum* was published by Boissier et Reuter (Diag. Plant. Nov. Hisp. 17: 1842). Thus the position was free from serious complications when Willkomm wrote his account for the Prodr. Hisp. but his treatment instead of clearly stating the synonymy made the situation considerably worse by the publication of *Pyrethrum hispanicum* Wk. This composite species was made up of *Pyrethrum pulverulentum* Lagasca, *Chrysanthemum radicans* Cavanilles, and *Pyrethrum sulphureum* Bss. et Reut. with its var. *alpinum* Bss. et Reut. It was divided into two varieties: *pinnatifidum* of which the former two species were forms, and var. *laciniatum* of which the latter two plants were forms. No type was indicated and the name of the earliest (or in fact of any) component species was not taken up as the specific epithet. Willkomm did, however, relegate *Chrysanthemum aragonense* to the synonymy of f. *sulphureum* (*Pyr. sulphureum* Bss. & Reut.). It was not till 1906 that Pau (l. c.) corrected Willkomm's error, in his 'Nota sobre el *Pyrethrum hispanicum* Willkomm', and reinstated the epithet «pallidum» based on *Chrysanthemum pallidum* Miller. Pau's revision which recognised eight varieties and numerous forms was based on the thirty two specimens of his

collection! As one might expect, a work based on such paucity of material added further complications to the already sufficiently involved taxonomy of the species. The subdivisions of Pau's species are discussed under the pertinent headings in this revision. It is sufficient to note here that *Chrysanthemum aragonense* (as var. *aragonense*) was kept distinct from *C. pallidum*, and *Pyrethrum sulphureum* was interpreted as including forms of *pulverulentum*, *versicolor* and *aragonense*. It is exceedingly difficult to follow Pau's paper due to numerous typographical and citational errors, the confused arguments and the incomplete and ambiguous statements of distribution and citation of species. *Pyrethrum pallidum* was accepted *sensu lato* for *Chrysanthemum hispanicum* by the Spanish botanists. A new variety, var. *marianum* Pau, was added by Pau (apud Lacaita in Cavanillesia I, 12: 1928), but examination of the type («In faucibus Despeñaperros, Sierra Morena, Lacaita», MA.) shows it to be *Prolongoa pectinata* (L.) Boiss. (= *Chrysanthemum pectinatum* L. non Hoffsgg. et Lk.). In 1929 Maire transferred *Chrysanthemum pallidum* to *Tanacetum* but did not attempt to revise the complex, concerning himself only with subsp. *radicans* (7) and subsp. *longipectinatum*. Other transferences of component forms of the species to *Tanacetum pallidum* were later made by Font Quer and Rothmaler.

In 1921 Lázaro e Ibiza (l. c.) retained the name *Pyrethrum hispanicum* and even at the time of writing the name is still in use by some Spanish botanists.

Tanacetum pallidum (Mill.) Maire, as it is understood here, is a polymorphic species comprising several geographical races which occupy a large area of the Iberian Peninsula. A key to the subspecies recognised is appended below.

	Folia lineari-spathulata 2
1	Folia cuneato-spathulata vel orbiculato-spathulata, inciso-dentata. Plantae indumento cano. Ligulae semper sulphureae; involucri phylla pilis longis munita subsp. spathulifolium (Gay) Font Quer et Rothmaler

(7) Here regarded as a distinct species—*T. radicans* (Cav.) Sch. Bip.

- 2 } Folia apice 3-5-fida. Plantae indumento argenteo vel virenti-sericeo. Ligulae citrinae vel sulphureae vel nunc albae. Involucri phylla dorso sericea subsp. **pallidum**
- 2 } Folia laciniis numerosis leniter incisa. Plantae indumento virenti-sericeo. Ligulae flavae vel albae. Involucri phylla dorso glabriuscula subsp. *virescens* (Pau) Heywood

subsp. **pallidum** (*T. pallidum* sensu stricto).

Syn:

Chrysanthemum aragonense Asso Synopsis: 123, tab. IX f (1779), *sensu amplo, excl. syn. Barrel.*

Pyrethrum sulphureum Boiss. et Reut., Diag. Plant. Nov. Hisp.: 17 (1842), *sensu amplo.*

Pyrethrum hispanicum Wk. var. *laciniatum* Wk., l. c.

This subspecies contains the typical form of the species (i. e. var. *sulphureum*). The treatment of *Chrysanthemum aragonense* by Pau (l. c.) as a variety (*P. pallidum* var. *aragonense* Pau) distinct from the typical form is difficult to understand. Pau's typical variety, var. *genuinum*, is divided into two forms—*leucoglossum* and *xanthoglossum*. The former plant (ligulae albae, basi vel ad medium propae (sic!) luteolae) is interpreted as representing *P. pulverulentum* Lag. which is quoted as a synonym of the species; the f. *xanthoglossum* (ligulae sulphureae, ad formam aragonensem (*P. sulphureum* (Bss. y R. p. p.))) is undoubtedly *Ch. pallidum* Miller. The localities given by Pau are «cercañas de Madrid (Miller)»—the locus classicus of *Ch. pallidum*, and «Charmartin (Lagasca)»—locus classicus of *Pyrethrum pulverulentum* Lag. It would seem that Pau regarded his *xanthoglossum* as a mere colour form of *P. pulverulentum*. This as already stated is not the case and one has therefore a choice of two distinct specimens which correspond to different species in the typical variety of Pau's species (8). Pau's var. *aragonense* (as distinct from his var. *genuinum*) has as a synonym *P. sulphureum* Bss. et Reut., but one has to infer from his discussions what the differentiating

(8) The typical form is, of course, the type specimen *Chrysanthemum pallidum* Miller, the earliest component species.

characters between these two varieties are. In this respect he states that the plant from the Sierra Mariola bears leaves of the type (which is presumably f. *xanthoglossum*) but the sulphur coloured ligules and glabrous scales of *aragonense*. Now I have seen the plants of the Sierra Mariola referred to, in Pau's Herbarium in Madrid, but the leaves are unlike either of his types (*Ch. pallidum*, *P. pulverulentum*) but are identical with those of his own var. *virescens*; then the bracts (scales)—I have seen the specimen of *Ch. aragonense* from the locus classicus referred to by Pau (Sierra de Villarroyo, leg. Vicioso) and the bracts (scales) are not glabrous but have a definite silky indumentum; as for the ligules, he has already described *genuinum* f. *xanthoglossum* as having sulphur coloured ligules! Thus the only distinctions he makes do not exist. Moreover I have seen the type of Miller's species and have made a detailed comparison of the specimens in herbaria identified as *P. sulphureum* with specimens of *Chrysanthemum aragonense* from the locus classicus and I can find no character or combination of characters to separate them. I have no hesitation then in regarding *Chrysanthemum aragonense* and *Pyrethrum sulphureum* as synonymous with the typical *Chrysanthemum pallidum*.

The name *Tanacetum pallidum* (Mill.) Maire subsp. *pulverulentum* (Lag.) F. Q. & Rothm. (9) for this subspecies cannot obviously be accepted. It implies that *T. pulverulentum* and *T. pallidum* belong to the same subspecies (10) and are forms of it, a view that is not accepted here.

Subsp. *pallidum* contains two forms—var. *pallidum* and var. *alpinum*, given below.

Var. **pallidum** (*Chrysanthemum pallidum* Mill., *sensu stricto*).

Syn:

Pyrethrum Bocconi Willd., Sp. Pl. III (3): 2158 (1803).

Chrysanthemum Bocconi Pourret [in litt. ad Willd.] ex Willd., l. c. *pro syn.*

(9) Fl. Iber. Select. Cent. I 90 (1933).

(10) *T. pallidum* ssp. *pulverulentum* f. *sulphureum* (Boiss et. Rent) FQ et Rothmaler, l. c.

Tanacetum sulphureum Schultz Bipont., op. cit. p. 48.

Pyrethrum hispanicum var. *laciniatum* f. *sulphureum* Wk., l. c.; Suppl. Prodr. Fl. Hisp.: 85 (1893), *excl. specim. cit.*; Colmeiro, Enum. Pl. Hisp. Lusit. III: 198 (1887).

Pyrethrum pallidum var. *genuinum* Pau f. *xanthoglossum* Pau, l. c., *quoad typ. cit.*

Pyrethrum pallidum var. *aragonense* (Asso) Pau, l. c.

Pyrethrum aragonense (Asso) Pau [in Sennen, Plantes d'Esp.] ex G. Sampaio, in *Ann. Acad. Polyt. Porto*. XIV: 162 (1921) *in syn.*; Pau, in *Bol. Soc. Iber.*, XXIII, 102: 1925

Tanacetum pallidum ssp. *pulverulentum* f. *sulphurcum* (Bss. et Reut.) F. Q. et Rothm. *Flora Ibérica Selecta*, Cent. 1, 90 (1933).

Non *Pyrethrum hispanicum* var. *sulphureum* sensu Mariz, in *Bol. Soc. Brot.* VII: 53 (1889).

Specimens cited:

ARAGÓN: Villarroya de la Sierra (Vicioso, B.; in Sennen *Pl. d'Esp.* 1540: 1912, MA); *ibid.* (E); *ibid.* (Vicioso, B.: 1908, MA).

CASTILLA LA NUEVA: Madrid, Sierra Guadarrama, Cercedilla (Vicioso, C., MA); *ibid.* (Beltrán in *Herb. Pau*, MA); Madrid, S. Guadarrama (Reuter, MA); *ibid.* (Barras de Aragón in *Herb. Pau*, MA); Madrid, supra Monastr. S. Laurentii, Escorial (Lange *Pl. Europ. Austr.* 240, K); Madrid pr. Escorial (*Fl. Iber. Selecta*, No. 90, K, BM, GDA, MA); *ibid.* (Willkomm, 1844, BM); Madrid, S. Guadarrama, Cercedilla (Rodríguez, MAFST); *ibid.* (Lomax, MA); S. Guadarrama (Atchley, 231, K); *ibid.* (Atchley, 124, K); Cerro de Machatte pr. Escorial (Winkler, K); Montes de l'Escorial (Leresche, E); S. de Guadarrama (Bourgeau, 2217, K); *ibid.* (E); *ibid.* (Gandoger: 1896, K); Cerro de los Cervantes, Escorial (Ellman and Hubbard 985, K); Sierra de Guadarrama, Puerto de Navacerrada (Lomax, MA); *ibid.* El Ventorrillo (Cautrecasas, MA, MAF); *ibid.* (Cuatrecasas, MAF); S. Guadarrama, Escorial (Vicioso, MA); *ibid.* (Cagollaolo, MA); *ibid.* (Gros, MA); S. de Guadarrama, Carmencia (anon., MA); S. de Guadarrama, above Cercedilla (Wilmott, 1926, BM); Madrid, Pontien de Oliva (Vicioso, C., MA); Torrelaguna (Vicioso, C. et

Beltrán, *MA*); Madrid, Berzosa (C. Vicioso, *MA*); in reg. montan. carpetanorum (Graells Herb. Castell., *K*, *BM*); Toledo (Isern, *MA*).

CASTILLA LA VIEJA: Soria, Tojalnoso (Vicioso, *MA*); Soria, Sierra de Toranzo (Vicioso, *MA*); S. del Madero-Olvego (Vicioso, *MA*); Sierra de Moncayo (Ceballos, *MA*); *ibid.* (Heywood, *E*); Avila, Venta del Obispo (Caballero, orig. det. *Pyrethrum pulverulentum* Lag. *MA*); Avila, Mombeltrán, Puerto del Pico (Cogalludo, *MA*); Avila, Sierra de Gredos, Puerto del Arensil (Cogalludo, *MA*); Avila, S. de Gredos, Alto de Colgadizas (Willmott, Jul., 1927: *BM*); *ibid.* Hayo Casero *alias* Hoyo Quesero (Willmott, Jun. 1927: *BM*); Sierra de Mansillo, 1300 m. (Losa in Sennen, *MAF*).

EXTREMADURA: Plasencia, Majareina (Bourgeau, 2534, *MA*, *BM*); Cáceres, S. de las Villuercas, Guadalupe (Vicioso, *MA*); Cáceres, S. de Guadalupe, nr. Guadalupe above Cumbre de las Villuercas (Willmott, June, 1927, *BM*); Cáceres, S. de Montánchez (Vicioso, *MA*).

SIERRA MORENA: Valdeazores, 1941 (Rivas & Bellot, *MAF*), —*forma luxurians*.

HOLOTYPE: «*Chysanthemum pallidum* Mill. Gard. Dict.», in Herb. Miller apud Herb. Mus. Brit. (Nat. Hist.).

HABITAT: From the data available this plant is apparently a calciphobous form occurring in schists and rocks on siliceous soils. Its centre of distribution is in the mountains around Madrid and extends along the Sierra de Guadarrama in New Castille to Cáceres in Extremadura with an extension into Old Castille, occurring as far as the Sierra de Moncayo in the Iberian Mountains to Avila and in Aragón. There is a small subarea in Sierra Morena where the plants are somewhat intermediate in leaf shape to *T. radicans*.

In the Sierra de Moncayo, the plant occurs in the loose mobile slaty slopes in association with *Vioia moncaunica* Pau, *Saxifraga Willkommiana* Boiss., *Sedum micranthum*, *Digitalis purpurea* etc. in the subalpine zone. Here it shows modifications in accordance with its habitat—lower stature, very silvery indumentum, pale lemon ligules.

Pau (l. c.) mentions a variation from the Puerto de Guadarrama (Lomax, 1893) with smaller heads, darker edged bract scales and *apparently* whitish flowers. I have seen the specimen cited but do not consider it worth recognition as a separate taxon.

T. pallidum var. *sulphureum* was cultivated in the Royal Botanic Garden, Edinburgh from seed collected by T. Ashton Lofthouse in 1931. Plants flourished in the scree and retained their characteristics.

var. **alpinum** (Boiss. et Reut.) Heywood, *comb. et stat. nov.*

Syn:

Pyrethrum sulphureum var. *alpinum* Bss. et Reut. (l. c.)

Pyrethrum hispanicum var. *laciniatum* f. *versicolor* Wk l. c.; Colmeiro, Enum. Pl. Hisp.-Lusit. III: 198 (1887); Lofthouse, in New Flora & Silva, III: 210 (1931).

Pyrethrum pallidum var. *aragonense* f. *leucoglossum* Pau, l. c., *quoad descript.*

A typo (var. *pallido*) imprimis ligulis albis interdum ad basin rosellis differt. Etiam habitu variabili—laxe vel dense caespitoso—foliis longe vel breviter petiolatis, interdum petiolis contractis divergit.

Specimens cited:

CASTILLA LA NUEVA: Sierra de Guadarrama, Peñalara (Vicioso, C. et Beltrán, *MA*); *ibid.*, Pico de Peñalara (Lomax, 1892, *MA*); *ibid.*, Puerto de Navacerrada (C. Vicioso, *MA*); *ibid.*, Peñalara (Boissier et Reuter, *K*); *ibid.*, Pico de Peñalara (Ellman & Hubbard, 1091, *K*); *ibid.*, Puerto de Navacerrada (Cuatrecasas, *MA*); *ibid.*, cerca del Paular (Isern, *MA*); *ibid.*, Puerto de Reventón (Bourgeau, Pl. d'Esp. 2248a, *K, E*); *ibid.*, Canencia (Vicioso, *MA*); Madrid, Cerro de la Cebollera, Somosierra (C. Vicioso, *MA*); Madrid, Robregordo (C. Vicioso, *MA*); Madrid, S. de Guadarrama a Navacerrada (Sennen 1929, *BM*); Peñalara, Dos Hermanas, 2100 m., 1934 (Cuatrecasas, *MAF*); *ibid.*, Circo de la Laguna, 2200 m., 1934 (Cuatrecasas, *MAF*).

CASTILLA LA VIEJA: Avila, Sierra de Gredos (Ceballos, *MAFST*); *ibid.*, Cerro Escusa (Ceballos, *MA*); Sierra de Gredos (Lacaita, *MA*); *ibid.*, Puerto de Rico (Cuatrecasas, *MA*); Avila, Sierra de Gredos (Willmott, 1927, *BM*); *ibid.*, sides of Brco. de Escalerveas (Willmott, 1927, *BM*).

EXTREMADURA: Sierra de Majareina au dessus de Gerte pres Plasencia Bourgeau, Pl. d'Esp. 2537, *K, MA, BM*); *ibid.*, au Prisco de la Campana au dessus du Pto. Cornavacas (Bourgeau, Pl. d'Esp. 2536, *MA, BM*); Sierra de Béjar (Herb. Pau, *MA*)—*au forma depauperata*.

ORIGINAL DESCRIPTION (ex Boissier et Reuter): «minus sericea caules abbreviati, involucri squamae glabrescentes, ligulae albae».

Boissier & Reuter who first described this form said that it differed from the type only by the colour of the ligules and the shorter stems. In many specimens however the stems are as tall as in the typical form and occasionally taller. The designation *alpinum* is not entirely appropriate as this plant may occur with the typical form although variations which appear alpine in character occur, as will be seen later. It would be difficult and impracticable to separate the two classes of variants but although they are both accepted here as coming under var. *alpinum* Boissier's description must be amplified for their inclusion.

Willkomm described his f. *versicolor*: «ligulis albis, albis basi flavis aut basi purpurascensibus. Folia breviter petiolata, in forma purpurascens abbreviata minima».

Lange's (the co-author of the *Prodromus Florae Hispanicae*) conception of this group of species was confused and he regarded *Pyrethrum pulverulentum* as synonymous with *P. sulphureum* var. *alpinum*. He may have influenced Willkomm; thus the inclusion of white ligules yellow at the base (typical of *T. pulverulentum*) in the above description could be explained by the acceptance of specimens of *P. pulverulentum* as *P. sulphureum* var. *alpinum*.

The leaves of this form, far from being shortly petiolate, often have very elongate petioles. The form with purple-based ligules mentioned by Willkomm raises another problem. Bourgeau collected plants in the Sierra Majareina above Gerte, naming them

Pyrethrum sulphureum var. *alpinum* subvar. *radiis albis vel rosellis* (11). Presumably this is the «... forma purpurascens» of Willkomm (he includes Bourgeau's plants in the exsiccata he cites). Nyman mentions the same in his *Cönspectus Florae Europae* (373: 1879) and says «omnino *P. arundani* habitu sunt». It has not been traced from any other localities. For those who wish to regard it as a distinct unit it can be called *Tanacetum pallidum* var. *alpinum* sf. *purpurascens* Heywood (12). This should be compared with *Tanacetum alpinum* var. *minimum* where this ligule character is general after anthesis.

Pau recognised a f. *leucoglossum* of his var. *aragonense* «a rare form diverse from the type by its white ligules only» from Urquiza, Nieva de Cameros, Logroño; he also included f. *alpinum* based on *P. sulphureum* var. *alpinum* Bss. & Reut. The plant cited — Sierra de Béjar in the Pau Herbarium at Madrid — bears the inscription (of Pau) «fa. nova» but is in my opinion a depauperate specimen with small heads, slender rootstock and slender flower stems and narrow short leaves. It may be that Pau did not know the genuine var. *alpinum* of Boissier and Reuter and thought the plant of the Sierra Béjar, a true alpine variation in his opinion, to be this, whereas he thought the plant from Logroño to be a new unit — a white colour form of the typical variety and not an alpine form. I have not been able to trace the specimen from Urquiza but from the description I feel it best regarded as a synonym of var. *alpinum*:

In Pau's Herbarium there is a sheet from the Sierra de Gredos, 1907, bearing an extract of Nyman's quotation of *Pyrethrum sulphureum* var. *alpinum* subvar. *radiis albis* &c. It cannot however be included in this (= sf. *purpurascens*) but is more related to *Pyrethrum purpureum* Gay mentioned later.

HABITAT: Like variety *aragonense*, this plant is apparently calciphobous. It sometimes occurs with the yellow flowered form in some localities but generally grows at higher altitudes in the subalpine and alpine regions where microhabitats probably account for the 'alpine' modifications and anomalies mentioned above.

(11) Included in the same number 2587 are forms «ligulis pure albis».

(12) Forma ligulis basi purpurascens vel rosellis; foliis minoribus petiolo contracto.

The area of this variety is more circumscribed than that of the preceding one as is seen in the accompanying maps. Its lesser extension into Old Castille and non-occurrence in the provinces of Soria and Aragón are most noticeable.

ssp. *virescens* (Pau) Heywood, comb. et stat. nova.

Syn:

Pyrethrum pulverulentum var. *virescens* Pau [ad Assoc. Pyr: 1905-6], in Butll. Inst. Cat. Hist. Nat. XI: 90 (1906) in syn.

Pyrethrum pallidum (Mill.) Pau var. *virescens* Pau (1906), l. c.

Pyrethrum hispanicum var. *laciniatum* f. *sulphureum* (Bss. et Reut.) Wk., Suppl. Prod. Flor. Hisp.: 85 (1893), quoad specim. cit.

Chrysanthemum hispanicum var. *sulphureum* (Bss. et Reut) [«Wk.»] Dörfler, Herb. Norm. No. 4122 (1891) quoad specim. tantum.

For many years this form of *Tanacetum pallidum* remained undetected, usually being collected and regarded as typical *Pyrethrum sulphureum* Bss. et Reut. Willkomm included a specimen of it, as an addition to the area of *P. hispanicum* var. *sulphureum*, in the supplement of the Prodrömus. Hervier (Bull. Int. Géogr. Bot. XV, 100: 1905) indeed states «le *Pyrethrum sulphureum* Bss. Reut. se trouve à la Sierra Espadan (Segorbe)» — all plants from which area are in fact subsp. *virescens*. Pau (1906, l. c.) was the first to recognise this distinct taxonomic unit giving the brief diagnosis «virens, lamina foliorum spathulato-linearis elongata». It is easily distinguished from subsp. *aragonense* by the greenish indumentum, glabrous involucreal scales (and in the case of var. *bilbilitanum* by the white ligules also) but notably by the leaf shape — linear spathulate slightly dissected with numerous lobes, and not three to five toothed at the apex. The variation of this subspecies affords an interesting study. Pau (1906 l. c.) recognises his customary two forms — *xanthoglossum* and *leucoglossum* — and stated that the variety (our subsp. *virescens*) was confined to the Cordillera de Espadan. The forma *leucoglossum* (ligulae candidae) he considered localised on the mountain of Santa Bárbara de Pina, but called our attention to the phenomenon that when

the descent is made by the eastern slopes to La Tenencia, the forma *xanthoglossum* (ligulae aureolae) appears «sin transición perceptible, sin cambiar el terreno ni la selva.» Furthermore Pau described another white liguled form from Calatayud (Aragón) — forma *bilbilitana* which differed from his var. *virescens* forma *leucoglossum* by «the scales of the involucre more narrowly scariouly edged and black in colour». I have seen the type and other material of this form and can find no sufficient morphological character to warrant distinction from forma *leucoglossum* (but see later). Pau himself collected his forma *leucoglossum* again in 1919 from type locality but this time annotated the specimen in the Madrid Herbarium «es muy parecido al *bilbilitanum* Pau». Again we find that Pau collected a plant which he named var. *virescens* f. *leucoglossum*, from Orihuela del Tremedal, and I find the specimen to agree with this identification (though f. *bilbilitanum* to be precise) although the locality is the locus classicus of *Chrysanthemum alpinum* Asso non L. (*Pyrethrum pallidum* var. *Assoi* Pau); but the discussion of this problematical species is postponed till later.

If we now examine the distribution of subsp. *virescens* we find forma *xanthoglossum* occurs in the mountains around Valencia and the forma *bilbilitanum* further north in Aragón with the connecting forma *leucoglossum* occurring at Santa Bárbara, Valencia in the area of forma *xanthoglossum*.

Here then we appear to have an *intraspecific topocline* (13) (Gregor, Experimental Taxonomy IV, in New Phytol., XXXVIII: 1939) of ligule colour and the forms *xanthoglossum* and *bilbilitanum* may be regarded as topotypes forming the end points of the topoclinal variation. I use the terms topotype and topocline as there is no evidence available of an environmental gradient expressed on a physiologico-genetical basis to warrant the employment of Huxley's ecotype and ecocline categories. The forma *leucoglossum* affords a convenient reference point (= mid point) on the cline.

The problem of the correlation of this nomenclature with that of orthodox taxonomy inevitably arises. Three reference loci on

(13) I am indebted to Dr. Gregor for his advice on this point.

the cline have been given names but taxonomically two of them — the mid and one end point (i. e. *leucoglossum* and *bilbilitanum*), as stated, afford no sufficient basis for separation from each other and together they show phenotypically what is essentially a one character difference only — ligule colour — from the other end point (*xanthoglossum*). It seems best in this case to retain for orthodox taxonomic purposes the names of the two end references of the cline *xanthoglossum* and *bilbilitanum* and to include the mid point *leucoglossum* under *bilbilitanum*, as the retention of the three forms based on such minutiae would overburden the subspecies unnecessarily.

Of the two forms recognised I regard *xanthoglossum* as typical in consideration of the predominant ligule colour in the species as a whole.

The question remains of what rank to afford these forms. It is, of course, not known whether the ligule colour difference is based on one or several genes. Moreover we are not dealing here with variants occurring sporadically within the range of a uniform subspecific population but with a subspecies containing two areal populations, i. e. with populations and not variate classes. The rank of 'forma', in its customary usage, is not then satisfactory in this case and I propose to classify both plants as varieties of subspecies *virescens*. Morphologically, ssp. *virescens* represents a transitional stage in leaf shape variation between ssp. *pallidum* and ssp. *spathulifolium*.

The formal citation of the forms of ssp. *virescens* together with *exsiccata* is given below.

a) *Ligulae sulphureae*.

var. **virescens** (Pau) Heywood, comb. nov.

Syn:

Pyrethrum pallidum var. *virescens* f. *xanthoglossum* Pau, 1906, 1. c.

Specimens cited:

VALENCIA: Sierra de Espadan (Reverchon, 1891, E, K, BM); ibid. (Sennen, Pl. d'Esp. 688, E, MA); Sierra de Ayora (Porta

et Rigo, *E, K, BM*); *ibid.* (Herb. Pau, *MA*); *ibid.* Pico de Carroche (C. Vicioso, *MA*); Sierra Mariola (Cámara, *MA*); *ibid.* (Herb. Pau, *MA*); *ibid.* (Porta et Rigo, *Iter II, 1890, K, BM*); *ibid.* (Hegelmaier, *K*); *ibid.* (Rivas, Monasterio, Borja, *MAF*); *ibid.* (Verdei, *GDA*); Sierra de Pina ad 'la Tenencia' (Herb. Pau, *MA, holotypus*).

CASTILLA LA NUEVA: Cuenca (Beltrán, *MA*).

b) *Ligulac albac*.

var. **bilbilitanum** (Pau) Heywood, *comb. nova*.

Syn:

Pyrethrum pallidum var. *virescens* f. *bilbilitanum* Pau, et f. *leucoglossum* Pau, l. c.

Pyrethrum pallidum var. *bilbilitanum* [Pau *ex sched.* Sennen Plantes d'Espagne No. 1849: 1912] Lacaita in *Cavanillesia* I: 12 (1928).

Pyrethrum pallidum var. *Assoi* Pau, *pro parte quoad specim. cit. sed excl. syn.*

Specimens cited:

ARAGÓN: Orihueña del Tremedal (Herb. Pau, *MA*); Calatayud (C. Vicioso, in Sennen Pl. d'Esp. 1849, *MA, E, BM*); *ibid.*, Sierra de Vicort (C. Vicioso, 1907, *MA*); *ibid.* (C. Vicioso, 1912, *MA*); *ibid.* (C. Vicioso, 1930, *BM*); Calatayud, Sierra de Algairén entre Consuenda y Alpartir (Aguilar, 741, *MA = typus* var. *bilbilitanae*).

VALENCIA: Sierra de Pina Solum! in Monte Sta. Bárbara (Herb. Pau, 30 June, 1905, *MA*); *ibid.* (Herb. Pau, 1919, *MA*).

Subsp. **spathulifolium** (Gay) FQ. et Rothm., Flora Iberica Selecta, Cent. I, 91 (1933).

Syn:

Pyrethrum spathulaefolium Gay ap. Webb et Heldreich, Catalogus Plant. Hisp. ... ab Blanco lectarum, Paris, 1850 — *nomen nudum*; et *cum descriptione* in Webb et Heldreich, Appendix exhibens diagnoses spec. nov. quas in Hisp. prov. Giennensi (Reyno de Jaén) anno 1849 detexit Cl. Antonio Blanco, Paris, Jul. 1850 — manuscriptus in Herb. Gay. apud Herb. Hort. Bot. Reg. Kew., in Herb. Mus. Britannici (Hist. Nat.), et in Bibliotheca Herbarii Boissier, et in Cavanillesia, II, 9, 1929 — *editio manuscripti Webbii et Heldreichi anni 1850* — *synon. pro parte quoad descriptionem et specimina cotypica (partim), in Herb. Gay ap. Herb. Kew atque in Herb. Mus. Brit. necque specimina sub. num. cotyp. in Herb. Edin.*

Pyrethrum Bauhini Gay *ined.* var. *spathulifolium* Gay *ined. ex sched.* Bourgeau *exsicc.* Pl. d'Esp., 714: 1850

Pyrethrum leucanthemaeifolium Porta et Rigo, Att. Accad. Agiati, IX: 34 (1891); Willkomm, Suppl. Prod. Fl. Hisp.: 84 (1893).

Pyrethrum pallidum (Miller) Pau var. *spathulaefolium* (Gay) Pau, *op. cit.*, 1906, *quoad synonym. cit.*

Pyrethrum aragonense var. *spathulaefolium* Pau, Carta a un Botánico, 1904.

Pyrethrum leucanthemaeifolium Port. et Rig var. *cuartanense* Deb. et Rev. [*nomen in sched. pl. exsicc.* Reverchon Pl. d'Espagne, No. 1310: 1902] ex Hervier in *Bull. Acad. Intern. Géogr. Bot.*, XV: 100 (1905) («var. *cuartanense* Deb.»).

Pyrethrum quartanense Deb. et Rever. in *sched.* Reverchon Pl. d'Esp., No. 1310: 1902, 1905, *nomen.*

Pyrethrum Debauxianum Gandoger in *Bull. Soc. Bot. France.*, 455: 1905.

Pyrethrum leucanthemaeifolium Hut. Port. Rig. f. *cuartanense* Deg. Deb. ap. Hervier in *Bull. Acad. Inter. Géogr. Bot.*, XVI: 215 (1906) *nomen nudum.*

Pyrethrum leucanthemaeifolium var. *cuartanense* Deb. et Rev

ap Hervier in *Bull. Acad. Inter. Géogr. Bot.*, XVII: 45 (1907),
ubi descriptio adest a Gandoger reducta.

Pyrethrum leucanthemaeifolium Porta et Rigo f. *virescens*
 Lacaita, *nomen in sched.*

DESCRIPTION (from manuscript of Gay, 21st July, 1850 in Herb. Kew) (14): *Pyrethrum*-Perenne, humile caulibus ex una radice pluribus erectis, monocephalis, filiformibus, parce lanuginosis, usque ad medium laxe foliatis foliis sericeo utrinque villosis radicalibus inferioribus caulinis obovato-cuneatis, in petiolum filiformem basi attenuatis apice inciso 5-7-lobatis, lobis acute ovatis, caulinis subulatis, subintegerrimis in mucronem longiusculum subulatum et callosum coloratum desinentibus, involucri villosuli squamis — imbricatis, omnibus fusco-anguste marginatis exterioribus acute ovatis, interioribus oblongo-lanceolatis, obtusiusculis, etiam apice ciliatis, solis intimis passim glabris tumque obtusioribus atq (?) nonnumquam eroso-dentatis, radio flavo, ligulis involucri duplum longioribus, oblongo-linearibus obtusissime 3-dentatis; ovariis cum disci tum radii fertilibus omnibus cuneatis, ligula cum radii tum disci cyathiformi hyalino-membranacea receptaculo depresso hemispherico; achaeniis haud viscidis.

Pyrethrum spathulaefolium Gay.

Specimens cited:

MURCIA: Albacete, Sierra de Alcaraz (Porta et Rigo, 1890, *K*, *isotypus P. leucanthemifoliae*); *ibid.* (Porta et Rigo, 1891, *K*); *ibid.* (Porta et Rigo, 1892, *MA*); *ibid.* (Lacaita, in Herb. Pau, 1925, *MA*); S. de Alcaraz, mont. Padrón de Bienvenida (*Flor. Iber. Selecta*, Cent. I, No. 915: 1930, leg. Cuatrecasas, *K*, *BM*, *MA*); S. de Alcaraz (Lacaita, 1925 — *P. leucanthemifolium* f. *virescens* Lacaita — *BM*).

JAÉN: Sierra de Segura (Bourgeau, 1850, orig. det. *P. Bauhini* var. *spathulaefolium* Gay, *K*); *ibid.* (*E*); Sierra de la Cabrilla (Reverchon, *P. quartanense* Deb. et Rev. spec. nov., 1905, *E*, *BM*); Sierra de Segura (Reverchon, *Pl. d'Esp.* 1310: 1906, *MA*); Sierra de la Cabrilla (Reverchon, *Pl. d'Esp.* 1310: 1905, *MA*).

(14) This manuscript is imperfect but I have attempted to give here as clear a rendering as possible.

Barranco de Valentina (i. e. del Guadalentín) (Reverchon, Pl. d'Esp. 1310: 1904, *MA*); Sierra de Quarto [Cuarto] (Reverchon, Pl. d'Esp. 1310: 1902, *MA*, *BM*); Sierra de Castril, Cazorla (Reverchon, Pl. d'Esp. 1903, *E*); Sierra del Pinar, Cazorla (Reverchon, 656: 1900, *K*); S. de Cazorla (Lacaita, in Herb. Pau, 1927, *MA*); Barranco del Guadalentín, S. de Cazorla (Heywood & Davis); S. de Cazorla, al Punta de la Losilla (Lacaita, 1928, *BM*); S. de Cazorla in Barranco de Gínez, on S. de la Cabrilla (Lacaita, 1928, *BM*); S. de Cazorla near Rincontro de Avellana (Lacaita, 1927, *BM*); S. de Cazorla, above Cazorla, Rincontro de Avellana (Wilmott, 1927, *BM*); above Cazorla, Peñón Morondo (Wilmott, 1927, *BM*); S. de Cazorla, S. de la Cabrilla, all the way up the slopes of Las Empanadas (Heywood & Davis).

Lecto-type: Prov. Jaén. Correllana de Orcera (Blanco, 1850, No. 520, *K*).

The choice of a name for this subspecies presents considerable difficulties. Although the name '*spathulaefolium*' (based on *P. spathulaefolium* Gay) is used here it is not applied with complete confidence as will be seen from the following discussion.

In 1849 the Valencian botanist Blanco made a journey in the province of Jaén and the results of his work were brought together in a manuscript work by Webb and Heldreich (Catalogus plant. hisp. ... ab Blanco lectarum, Paris, 1850) containing the names of new entities identified by various botanists (including Gay) in Blanco's exsiccata. *Pyrethrum spathulaefolium* Gay was one of these names; and as the catalogue was placed on sale to the public (according to the International Rules of Botanical Nomenclature, ed. III, art. 36 q. v. which quotes this case as an example) the name was effectively published. Cuatrecasas (Estud. Fl. Mágina, 1929) says of this Catalogus «... que en 1850 publicaron 'los ingleses' (15) Webb y Heldreich ... del que sólo se hicieron tres ejemplares, siendo por lo tanto difícilmente asequible.» In view of this fact that only *three* copies were put out, I do not feel that the publication can be called effective despite the Rules.

The species was not, however, *validly* published as no description was given and this fact is important for purposes of priority

(15) My emphasis.

as it affects all the new species published in Webb and Heldreich's Catalogue — all of them being *nomina nuda*.

Only in Gay's own herbarium (incorporated at Kew) have I seen this Catalogue, at least, the portion of it attached to Blanco's exsiccata, 1850, No. 520, which reads as follows: — «*Pyrethrum spathulaefolium* Gay! n. sp.» (vide observ. in appendice). Peñiscas; Corellana de Orcera.

(Apparently the manuscript had been cut up and the parts attached to the corresponding sheets of Blanco's plants.) This Appendix referred to by Gay is without doubt the «Appendix exhib. diagn. spec. nov. ... detexit cl. Antonio Blanco, Paris» written by Webb and Heldreich (16) about which Cuatrecasas (1 c.) gives the following information: — «[the appendix] also very rare, which contains the original descriptions of the forms discovered by Blanco in 1849 and published in 1880, was at our disposal in the rich library of the 'Herbier Boissier' in Geneva, where we copied it entirely for our use.»

I have not seen the complete 'Appendix' but again the manuscript has been cut up and the relevant part is attached to Blanco's sheet No. 520 in the British Museum, and in Kew (Gay); the portion in Gay's herbarium is dated in his own handwriting 29 Jul. 1850; moreover amongst Gay's manuscripts is a description of *Pyrethrum spathulaefolium* dated 21 Jul. 1850.

Webb and Heldreich's manuscript 'Appendix' was published in type in its entirety (presumably from the copy made by Cuatrecasas) by Cavanillesia (II, 1: 1929) giving as the date and place of publication «Parisius, Jul. 1880».

The statement (of Cuatrecasas) «published in 1880» is the only definite information I can trace about the publication of this Appendix. Dr. Baehni of Geneva has kindly consulted the copy in the Boissier library and tells me that it bears the date 1850, like the Catalogus.

It seems probable that the manuscript Appendix may have been published by placing it on sale to the public in 1850 along with the Catalogus; there is however no proof.

On the other hand, neither of these works can be traced in books of reference; in the bibliography of Webb written by Gay

(16) Like the Catalogus, an indelible manuscript.

(Notice sur la vie et les travaux de Philip Barker Webb in Bull. Soc. Bot. Fr. III: 37: 1856) no mention is made of the Catalogus or of the Appendix, nor is there any notice about Webb's having co-operated with Heldreich. The appreciation of Webb given by Parlatore in the same year 1856 (Elogio de Philip Barker Webb, Firenze: 1856) gives little help: neither Catalogue nor Appendix is listed in Webb's bibliography but in the list of his herbaria, the collection «Blanco, Spagna, 1849» is recorded. This evidence however cannot be taken to prove that the Appendix was not published in 1850 for no mention is made in these bibliographies of the Catalogus which is accepted as having been published.

The important point as regards *this species* is not however to fix the date of publication at 1850 or 1880 but in fact to decide if the Appendix were ever effectively published at all: Even assuming that it were, in accordance with the rules, the publication surely cannot be called effective in fact: the first reference in print to *Pyrethrum spathulaefolium* is by Nyman (Conspect. Flor. Europ., 2, 373: 1879) who cites it as «*Pyrethrum spathulaefolium* Gay in Blanco exs. hisp. a. 1850, 520. Bourg. hisp. a. 1850. 714 (S. Segura)» etc. — quoted from a herbarium label and not necessarily Blanco's 520, for No. 714 of Bourgeau's Pl. d'Esp. bears the following label:

714. PYRETHRUM BAUHINI var. *spathulaefolium*, Gay octobr. 1850.

P. spathulaefolium, Gay in Blanc. Hisp. exsicc. n. 520 (jul. 4850) (17) cum observ. Bois sablonneux de la Sierra de Segura. (J. Gay.) 18 Mai.

Pau (Carta a un Botánico) appears to have taken the name from Nyman l. c. and changed it to *P. aragonense* var. *spathulaefolium* Gay, and later to *P. pallidum* var. *spathulaefolium*. In 1930 the Instituto Botánico Barcinonense distributed the Flora Iberica Selecta, Cent. 1, No. 91 of which was *Tanacetum pallidum* subsp. *spathulaefolium* (Gay) Font-Quer et Rothmaler.

But it was not till the late date of 1929 that there was any reference in literature to the Appendix (Cuatrecasas, l. c.) and the Catalogus was mentioned only in the International Rules l. c.

(17) Error for 1850.

Examination of Blanco's plants of *P. spathulaefolium* (Provincia de Jaén No. 520) adds further to the complications. These plants constitute the type number and gathering as indicated by the author himself, and in Gay's Herbarium (Kew), British Museum and Edinburgh bear his own determination thus:

Pyrethrum spathulaefolium

Gay! n.

sp.

1849.

The type number at Kew (Gay) is mixed — one specimen has ± orbicular-spathulate leaves as in *P. leucanthemifolium*; another has ovate-cuneate leaves less like *P. leucanthemifolium* (conf. infra); and a third has the leaves and other characteristics of *P. sulphureum* Bss. et Reut. sensu stricto. At Edinburgh, the «type» specimens are all *P. sulphureum* Bss. et Reut., whereas the material in the British Museum is uniform agreeing with *P. leucanthemifolium* Porta et Rigo.

In Gay's manuscript diagnosis of July 21st, 1850 (quoted in full above) the description of the leaves should be noted — «the radical, lower cauline obovate-cuneate ... 5-7 toothed at the apèx.» This agrees with one specimen of Gay's sheet of Blanco No. 520 (cf. supra) and I have selected this specimen as the provisional lecto-type of *P. spathulifolium* Gay.

The later collection by Bourgeau Pl. d'Esp. 1850, 714 det. Gay as «*P. Bauhini* var. *spathulifolium* Gay Oct. 1850, *P. spathulifolium* Gay in Blanco Hisp. exsicc. No. 520 Jul. 1850 cum observ.» diverges from the type as defined above and agrees well with *P. leucanthemifolium*. An important point is the «... cum observ.» suggesting that the «observ.» (i. e. the Appendix description) was circulated with Blanco's plants, but to whom or to what herbaria or institutions and how many?

In 1892 Porta et Rigo described *P. leucanthemifolium* from the Sierra de Alcaraz (Albacete); from the description and co-types it is seen to be conspecific, although not identical, with *P. spathulifolium* Gay. However until more material of Gay's species is collected from the locus classicus I hesitate to differentiate these two species even at formal rank. Willkomm took up Porta et Ri-

go's species in the Supplement to the Prodrromus with the comment «vix specificè distincta» (i. e. from *P. sulphureum* Bss. et Reut.), making no reference to Gay's species.

Colmeiro (Pl. Hisp. Lusit., III, 198: 1887) quoted Bourgeau's collection under *P. hispanicum* Willk. var. *radicans* (Cav.) Wk. as «f. *spathulifolia* Gay».

The representatives of this subspecies from the Sierras de Ca-zorla, Segura, Cabrilla, Castril and neighbouring ranges have been variously named. In Reverchon's distributed exsiccata of 1902 (Plantes d'Espagne) some of No. 1310 from the Sierra de Cuarto were labelled *Pyrethrum leucanthemifolium* Porta et Rigo var. *cuartanense* Deb. et Rev., some as *P. quartanense* Deb. et Rever.; the name *cuartanense* was published again in 1905 in Hervier's notes on the botanical excursions of Reverchon. Hervier gave Sierras del Pinar, Cuarto and Castril as localities for *Pyrethrum leucanthemifolium* with the comment that the plant from these localities conformed very well with the text of Porta and Rigo and was perfectly identical with the specimens published by them, but that M. Debaux who had revised the collections from these three localities cited thought that they could perhaps constitute a variety *cuartanense* Deb. In the same year *P. Debauxianum* was described by Gandoger (Bull. Soc. Bot. France 455: 1905) who quoted as synonymous *Pyrethrum leucanthemifolium* var. *cuartanense* Deb. et Rev. (The specimens Gandoger cited from Aragón can be excluded—Albarracín, Teruel probably being referable to *T. pulverulentum* ssp. *pseudopulverulentum*, or even *T. pauidum* subsp. *virescens*, whereas Muela de San Juan is the locus classicus of *Chrysanthemum alpinum* Asso non L.—see discussion of this on p. 368.)

Two years later Hervier (op. cit. 45: 1907) accepted *P. leucanthemaefolium* var. *cuartanense* = *P. Debauxianum* Gandoger, explaining that a comparative study of more numerous specimens had permitted him to adopt the var. *cuartanense* as very distinct from the type, for the plant of the Sierra del Cuarto (cf. infra). It is further stated that Gandoger (in litt.) recognised the priority of this variety over his *P. Debauxianum* (apparently ignoring the fact that var. *cuartanense* was a *nomen nudum*). Hervier then appended Gandoger's description. By so doing, and by quoting Gandoger's species as a synonym the var. *cuartanense* was vali-

dated and extended, whether intentionally or not, to include the plants from Gandoger's localities; and moreover, Reverchon's exsiccata for 1905, No. 1310 from the Sierra de la Cabrilla were distributed, in part at least, under the name *Pyrethrum cuartanense* Deb. et Rev. No mention is made of this raising to specific level by Hervier. Later collections by Reverchon from various localities in Jaén were distributed under this epithet, as a variety or species, and the var. *cuartanense* had come to apply to all specimens from the Sierras de Cazorla, Cabrilla, Castril etc. and not to those of the S. del Cuarto only.

There is little in Gandoger's description that is of any significance in separating *P. Debauxianum* (i. e. var. *cuartanense*) from *P. leucanthemifolium* unless it be «foliis... multo brevius dentatis muticis nec mucronatis». There is in fact a slight difference in the depth of tothing of the leaves but in every case the teeth are mucronate. The distinctions given by Hervier *a typo differt capitulis paulo minoribus, foliis utrinque (subtus tamen densius); nitide argenteo sericeis* are quite valueless.

I have made a close study of all available material and can find no character warranting taxonomic separation within this subspecies, and as the differential characters given have proved valueless, I regard *P. Debauxianum* with all its nomenclatural variations as *synonymous with P. leucanthemifolium* which as explained above = *T. pallidum* subsp. *spathulifolium* (Gay) Font-Quer et Rothmaler.

Distribution: This subspecies represents the S. E. race of *T. pallidum*. It is confined to the provinces of Albacete and Jaén, where it extends over the calcareous mountain systems of the Sierra de Alcaraz, Massif de la Sagra, Sierra de Segura, Sierra de Cazorla and Sierra de la Cabrilla. It is not found in the Macizo de Mágina which parallels the S. de Cazorla floristically in many respects.

Habitat: The plant is calciphilous. In the Sierra de Cazorla a typical habitat is the loose chalky slopes of the Barranco del Guadalentín near Nava de San Pedro where it occurs with *Linaria*, *Echium*, *Silene*, *Plantago*, *Campanula*, *Scorzonera*, *Reseda*, *Salvia* spp. etc.

It forms a small plant with few rosettes of leaves, somewhat ungainly in appearance.

TANACETUM RADICANS (Cav.) Schultz Bipont., Über die Tanacetëen, 48 (1844).

Syn:

Pyrethrum radicans Cavanilles, Descripciones de las Plantas, que demostró en las lecciones públicas del año 1801, Madrid, 199, No. 490 (1802); Lagasca & Rodríguez in *An. Ci. Nat.* V: 286 (1802); Boissier, Voyage Botanique, II: 318 (1839); Caballero, in *ANAL. JARD. BOT. MADRID*, VI (2): 540 (1946); Nyman, *Consp. Flor. Europ.* 373 (1879) ut subsp. *P. pulverulenti*; Lofthouse, in *New Flora & Silva*, III: 209 (1931).

Chrysanthemum radicans (Cav.) Persoon, *Synops.* II: 462 (1807).

Pyrethrum hispanicum Wk. var. *pinnatifidum* f. *radicans* Wk., l. c.; *Suppl.*, l. c.; Colmeiro, *Enum. Pl. Hisp.-Lusit.* III: 198 (1887), *pro max. parte excl. specim. formae spathulaefoliae* Gay; Lofthouse, in *Journ. R. Hort. Soc.* LVIII: 313 (1933).

Pyrethrum pallidum var. *radicans* f. *genuinum* Pau, l. c.

Tanacetum pallidum subsp. *radicans* (Cav.) Maire in Emberger et Maire, *Plant. Maroc.*, Nov., 4 (1929).

Chrysanthemum radicans Willd. ex Colmeiro, *Pl. Hisp.-Lusit.* III: 188 (1887) *in syn.*

Pyrethrum Bauhini var. *radicans* Gay, *herb. ined.* in Bourgeau, *pl. exsicc.*: 1851.

Specimens cited:

GRANADA: Sierra Nevada (Funk, *E*, *BM*); *ibid.* (Willkomm, *BM*); *ibid.* (Boissier, *E*, *MA*); *ibid.* (Herb. Pau, *MA*); *ibid.* (Clemente, *MA*); *ibid.* (Lomax, 1891, *MA*, *BM*); *ibid.* (Herb. Pau, 3000 m.: 1908, *MA*); Veleta, (Beltrán, 1913, *MA*); *ibid.* (— 197-935, *GDA*); A Tajo al Veleta (Rivas y Bellot, *GDA*, *MAF*). Picacho de Veleta (Ball, 1851, *E*); Monachil ad Picacho (Hut. Port. Rig. 1879, *E*); Laguna de Vacares (Jiménez, *GDA*); Peñón de San Francisco (Porta et Rigo, 1891, 596, *MA*); Valle de Lanjarón (Ceballos y Vicioso, 1930, *MA*); Lanjarón, Peñón Colrao (Ceballos, *MAFST*); Lagunillas (Willkomm, *MA*); Capi-leira, Sierra de Mulhacén (Jahandiez, 1926, *E*); vall. suprema fl. Monachil ad Picacho &c. (Porta and Rigo, 926, 1879, *BM*);

ad Peñón de San Francisco et Picacho (Porta et Rigo, 1891, 596, *BM*); Picacho de Veleta (del Campo, *BM*); above Peñones de San Francisco towards Veleta (Wilmott, & Lofthouse, 1926, *BM*); Hotel Sierra Nevada, to Veleta (Wilmott, *BM*); screes stretching from Albergue Universitario towards Picacho de Veleta, 2,500-3,000 m. (Heywood & Davis).

ALMERÍA: Abrocena (Gros, 1929, *MA*); S. Nevada, above Minos de Beires towards Cerro de Rayo (Wilmott & Lofthouse, 1926, *BM*); between Minos de Beires and Col de Lobos (Lofthouse, 1924, *BM*); above Minos de Beires, Cerro de Rayo (Lofthouse, 1924, *BM*); above Minos de Beires towards Cerro de Rayo, towards source of Barranco de Ohanes (Lofthouse & Wilmott, 1926, *BM*); S. Nevada, 2300 m., 1925 (Jerónimo in Sennen, *MAF*).

Description (ex Boissier, l. c.).

Planta caespitosa perennis. Rhizoma basi suffruticosum. Caulis humiles prostrati breves parte inferiori saepe radicellas edentes. Pedunculi basi foliosi ascendentes parte superiori nudi monocephali, 3-6 pollices longi post anthesin elongati. Folia subradicalia pilis griseis adpressiusculis plus minusve hirto-canescencia, petiolata pinnatipartita, pinnis integerrimis abbreviatis oblongo-linearibus acutiusculis plus minusve inter se approximatis. Caulina ad laciniam linearem reducta. Capitula magnitudine fere *Pyrethri alpina*. Involucri squamae plus minusve dorso et margine pilis sparsis albidis hirtae, margine membranaceae rufescentes; exteriores breviores acutae, interiores obtusissimae, latius marginatae, sublaccerae. Flores radii ligulati lutei breviter tridentati striati post anthesin revoluti colore intensiori aurantiaco suffusi. Flosculi disci lutei et etiam post anthesin aurantiaci Receptaculum nudum convexum. Achaenia conformia teretia, obtuse sed evidenter 3-6 striato-costata, costis albidis, eis speciei praecedentis [*Pyrethrum arundanum*] plus dimidio breviora, apice umbonata coronata Corona alba brevissima subintegra.

Tanacetum radicans was one of the components of *Pyrethrum hispanicum* Willk. Although it was created by the great Spanish botanist Cavanilles, it is associated more with Boissier who gave an excellent account of it in his Voyage Botanique. Its synonymy is quite straightforward. Willkomm reduced it to a form of *P. hispanicum* and was followed by Pau who transferred it as a variety

to *P. pallidum* and divided the variety into two forms—*genuinum* (= *T. radicans sensu stricto*) and *flaveolum* (= *P. flaveolum* Hoffmanssegg & Link). This action of Pau was unwise as he admitted to not having seen a specimen of *flaveolum*. The relationship of *T. flaveolum* with *T. radicans* is discussed under the former species.

Maire in turn changed its rank to subspecific under *T. pallidum* (Mill.) Maire but in this revision it is decided to retain it at specific rank.

This species is separated from the other members of the subsection by its pronounced caespitose creeping prostrate habit (due mainly to the emergence of adventitious rootlets from the lower parts of the stem). Morphologically it is more closely related to *T. pulverulentum* than to *T. pallidum* by reason of its pinnately divided leaves. It differs from the former species most noticeably in having yellow ligules, glabrescent involucreal scales and a sericeous indumentum; and from the latter species, *sensu lato*, pre-eminently by its pinnately divided leaves—a character of prime importance in the taxonomy of these plants. Carpologically it is distinguished from both species by the very much abbreviated achaenial corona. An interesting phenomenon shown by *T. radicans* is that after anthesis the ligules turn a golden-orange-red colour. This may be due to some edaphic factor of the habitat correlated with high altitude (cf. *T. alpinum* var. *minimum*).

Plants raised from seed show a considerable variation in ligule colour (cf. Lofthouse, l. c.).

Considering the treatment of the section as a whole, it is more consistent to regard this plant, which is well defined morphologically and distinct in habit, as a separate species. It is the most differentiated of the *T. pallidum-pulverulentum* group.

Distribution: For a long time *T. radicans* was regarded as being endemic to the subalpine regions of the Sierra Nevada (18).

(18) Its distribution in the S. Nevada is wider than is usually realised, it occurs in parts of this range e. g. Cerro de Rayo, in the province of Almeria, as well as in the province of Granada. The occurrence in Morocco of the endemic *T. longipectinatum* (Font-Quer) Maire (= *T. pallidum* subsp. *longipectinatum* (Font-Quer) Maire = *Leucanthemum longipectinatum* Font-Quer = *Pyrethrum pallidum* var. *longipectinatum* Pau = *P. radicans* Cav. fa. *leucoglossum* Pau) which is closely related to *T. radicans*, should be noted.

but Willkomm in the supplement to the *Prodromus* records it also from the province of Cuenca (Diek, *Montes Universales*); in the Madrid Herbarium is a collection of *T. radicans* by Gros from Abrocena in the province of Almería. There is no doubt about the correct identification of Gros's plants but the quite unexpected jump in distribution to Cuenca, far north of its range calls for closer investigation. Caballero (*Anal. Jard. Bot. Madrid VI, 2 (1945) 540: 1946*) in a brief account of the flora of the Serranía de Cuenca states that «a form clearly intermediate between *Pyrethrum pulverulentum* Lag. and *P. radicans* Cav. is found on the path from Vadillos to Carrascosa (16-V-35): Achenes with 5-8 ribs; bracts of the involucre glabrous with the border wide and light brown; ligules white». In addition, Caballero collected plants named *P. radicans* and *Leucanthemum pulverulentum* fa. from the same Serranía. All these plants from Cuenca stand out by their intense silvery indumentum which is retained after several years in the herbarium; even the silvery mats of *Tanacetum radicans* from the Sierra Nevada fade a greenish grey colour after a short time in the press but the Cuenca populations are remarkable in their silvery appearance.

The specimens identified by Caballero as *Pyrethrum radicans* must be accepted as such as no morphological distinction is evident (unless it be that of indumentum). As in *T. pallidum* var. *sulphureum* the ligule colour is yellow but the *T. radicans* of Cuenca differs from this former species by its more slender, prostrate, creeping, radican habit, smaller capitula, glabrescent involucre scales which are ciliate at the margin, and by its 7-9 pectinate-pinnate leaves—precisely the differences used to separate the *radicans* of the Sierra Nevada. From the same localities (Vadillos-Carrascosa) there are other specimens, identical but for their whitish ligules.

On the other hand, the *Leucanthemum pulverulentum* fa. of Caballero from Cuenca (Hoyo de las Casas, 1933) are very silvery caespitose plants with whitish ligules and leaves rather broad at the apex, often 7-fid—quite atypical of any *T. pulverulentum*, *T. pallidum* or *T. radicans*. These are apparently the same as the form intermediate between *radicans* and *pulverulentum* mentioned by Caballero. The plants on still another Cuenca sheet (Pinares de El Tobar, 1942) are very similar but less caespitose. It is

interesting to note that Beltrán collected *T. pallidum* ssp. *virescens* var. *virescens* from Cuenca (orig. det. of Pau *P. pallidum* va. *genuinum* fa. *xanthoglossum*).

The Cuenca populations of these *Tanacetum* form an anomalous group which would repay further investigation and until a detailed examination in the field can be made I do not feel justified in making any definite statement about the true identity of these plants. It seems, however, inescapable that *T. radicans* and a white flowered form exist there but the remaining plants suggest a mixed population possibly due to hybridisation of two or more species.

Colmeiro's inclusion of Sierra Segura (f. *spathulaefolia* Gay) in the list of localities for this species is based on a misconception of *T. radicans*, as the representatives of the Sierra Segura form a separate well-distinguished entity—*T. pallidum* subsp. *spathulifolium*. In this connection, however, it is surprising to read in Boissier (Voyage, p. 319) when discussing *Pyrethrum radicans* «the plant of the Sierra Segura (from the Canon Muñoz de Córdoba) has all the characteristics of mine (i. e. *radicans*) except that the leaves are a little less divided». No *Tanacetum* of the *Leucanthemopsis* subsection has been recorded from the Segura other than *Pyrethrum leucanthemifolium*; moreover the Segura is a calcareous range unlike the Palaeozoic schistose-granitic areas of the Sierra Nevada where *Pyrethrum radicans* occurs; I am inclined therefore to think that Muñoz's collection was in fact *Tanacetum pallidum* subsp. *spathulifolium* (= *leucanthemifolium*) despite Boissier's statement.

To summarise the distribution of *T. radicans*, it is centred in the Sierra Nevada, a formation of the Baetic Cordillera localised in the Palaeozoic zone and follows this range in both Granada and Almería; and there is a possible disjunct subarea in Cuenca.

Habitat: In the Sierra Nevada, *T. radicans* grows at high elevations, representative altitudes being:

Peñones de San Francisco	2,579 m.
Laguna de Vacares	2,988 m.
Lagunillos	2,970 m.
Picacho de Veleta	3,100 m.

The Lanjaron localities are less elevated.

Its classical locality—Peñones de San Francisco to Picacho de Veleta—is in the upper alpine region of the Sierra, the *regione nivale* of Boissier. The residuary snowline is in fact located a short distance above the Peñones. According to Raunkaier's classification (The Life Forms of Plants, Oxford (1934), p. 302), this species occurs in an (Antarctic) chamaephyte climate; as he says (p. 302) the biological spectrum for the Sierra Nevada above 1,500 m. deviates from that of the Antarctic in very little besides its high Therophyte percentage. *T. radicans* is in the general sense chamaephytic (belonging to the *chamaephyta reptantia* of Braun Blanquet, Pflanzensoziologie, 1927). It grows in the vast micaeous schistose, slaty screes stretching from the Peñones de San Francisco to the slopes leading to the Laguna de las Yeguas, interrupted by borreguiles derived from the Laguna; the slaty terrain becomes more granitic and moist nearer to the Veleta summit at the Panderones de Veleta.

In the scree extending from the Peñones, *T. radicans* occurs with the following species:

Juniperus sabina var. *humilis*

<i>Ptilotrichum spinosum</i>	<i>Dianthus brachyanthus</i>
<i>Arenaria armerina</i> vars.	<i>Plantago maritima</i> fa.
<i>Anthyllis webbiana</i>	<i>Jurinea amethystina</i>
<i>Ptilotrichum purpureum</i>	etc.

Higher in a wide level scree near the Rio Dilar it forms extensive colonies along with *Ptilotrichum purpureum*. Nearer the Laguna de las Yeguas in damper substrates it grows in isolated groups with *Plantago nivalis*, *Ranunculus acetosellifolius*, etc. It is not found in the massive granitic rocks forming the summit slopes.

Tanacetum radicans has been in cultivation in Great Britain and was mentioned by Farrer (The English Rock Garden, London: 1919). An indication of its behaviour in cultivation is given by Lofthouse (in New Flora & Silva, III, 209: 1931).

TANACETUM FLAVEOLUM (*Hoffmansegg et Link*) *Heywood, comb. nova.*

Syn:

Pyrethrum flaveolum Hoffsgg. & Lk., Fl. Portug. II: 341, t. 104 (1809-1840); Willk. in Willk. & Lange, l. c., p. 99; Colmeiro, l. c., p. 199; Nyman, Conspect. Flor. Europ. 373: 1879; Lázaro, Compend. Fl. Esp. III: 427 (1921); Mariz, in *Bol. Soc. Brot* IX: 213 (1892).

Pyrethrum pallidum var. *radicans* f. *flaveolum* (Hoffsgg. & Lk.) Pau, l. c., *quoad synon. cit. non descr. nec specim. cit.*

Leucanthemum flaveolum (Hoffsgg. & Lk.) Sampaio, Herb Portug. 132 (1913).

Chrysanthemum flaveolum (Hoffsgg. & Lk.) Coutinho, Flor. Port. 633 (1913); ed. 2. 748 (1939).

Tanacetum pallidum subsp. *flaveolum* (Hoffsgg. & Lk.) Rothm., in *Cavanillesia* VII: 121 (1936).

Leucanthemum pallidum Sampaio, Flora Portuguesa ed. 2: 577 (1946).

Pyrethrum hispanicum Wk. var. *sulphureum sensu* Mariz, in *Bol. Soc. Brot.* VII: 53 (1889), *non* (Bss. & Rt.) Wk.

Specimens cited:

LEÓN: Villafranca del Bierzo, Río Burbia pr. Villarde Acero (Rothmaler, 122, MA, MAF); Villafranca del Bierzo (Winkler, 1876, K).

Sierra de Berbodao (Ferreira, 1877, K).

Tanacetum flaveolum is restricted to the N. W. of the Iberian Peninsula and has a larger extension in Portugal than in Spain. Morphologically it is closer to *T. pulverulentum* and *T. radicans* than to *T. pallidum* in having pinnately-cut leaves; it is separated from *T. pulverulentum* by its flavescent ligules, pinnae of the leaves remote and mucronate, and silky indumentum, and from *T. radicans* by its much less caespitose ± erect habit and by the absence of adventitious creeping rootlets.

The Portuguese botanists consider it specifically distinct from

T. pulverulentum and *T. pallidum* and I am inclined to agree with them. Again, as with *T. radicans*, there is no doubt of the close relationship of *T. flaveolum* to the other members of the subsection and the most satisfactory treatment is to regard it as a specific population belonging to the *radicans-pallidum-pulverulentum* complex, and not as Rothmaler stated the special race representing *T. pallidum* in the N. W. of the Peninsula. Its reduction to subspecific rank by Rothmaler followed the general trend to regard all *Pyrethrum* species of this group as subspecies of *T. pallidum*—a treatment which, though in part satisfactory, is inaccurate when applied indiscriminately.

Pau (l. c., 1906) reduced *T. flaveolum* and *T. radicans* to forms of *Pyrethrum pallidum* var. *radicans*. This does emphasise the relationships of the two species but is not in my opinion tenable.

Distribution: The only area of *T. flaveolum* in Spain is in the province of León; its distribution in Portugal is Alemdouro transmontano, Beira meridional, Algarve, Tras-os-Montes.

f. alpestre (*Mariz*), *Heywood*, *comb. nov.*

Syn:

Pyrethrum flaveolum Hoffsgg. & Lk. f. *alpestre* Mariz, l. c., 214 (1892).

Pyrethrum pectinatum Hoffsgg. & Lk. var. *flavum* Hoffsgg. & Lk., l. c., 340.

Chrysanthemum flaveolum Coutinho f. *flavum* (Hoffsgg. & Lk.) Coutinho, l. c.

Leucanthemum pallidum Sampaio raç. *flavum* Sampaio, *Flora Portuguesa*, ed. 2, 577 (1946).

Prolongoa pectinata var. *flava* (Hoffsgg. & Lk.) Colmeiro, l. c., 194.

Pyrethrum hispanicum Willk. f. *sulphureum sensu* Henriq. *Sc. S. da Estrella*, 60, No. 291, pro parte.

Specimen cited:

Peña Rubia (Merino, MA).

It has not been possible to study this variety in detail due to lack of material. It is recorded from Galicia in Spain by Pau

(based on a specimen of Merino) and I have seen the specimen in Madrid Herbarium but I have not been able to compare it with typical Portuguese specimens. It agrees however with Mariz's description.

This variation of *T. flaveolum* was described by Link as a variety of his *Pyrethrum pectinatum* (= *P. pulverulentum* Lag.) because of its small somewhat rounded leaf lobes. Mariz (1892, l. c.) stated that these characters are inconstant and that the leaves of the plants from the localities given by Hoffmensegg are comparable to those of *P. flaveolum*. Mariz then redescribed the variety under the name *P. flaveolum* f. *alpestre*.

Colmeiro's synonym *Prolongoa pectinata* var. *flava* is explained by his erroneous assumption that *Pyrethrum pectinatum* Hoffsgg. & Lk. and *Prolongoa pectinata* (L.) Boiss. were synonymous but *Pyrethrum pectinatum* Hoffsgg. & Link is a later synonym of *P. pulverulentum* Lag. whereas *Prolongoa pectinata* Bss. is based on *Chrysanthemum pectinatum* L.

Mariz regarded f. *alpestre* as a transitional form linking *T. pulverulentum* and *T. radicans* with *T. flaveolum*. The link is more apparent between *T. radicans* and *T. flaveolum*.

Distribution: Spain, Galicia.

Portugal, Beira Central—Serra Estrella (spec. non vid.).

TANACETUM ALPINUM (L.) Schultz Bipont.

Syn:

Tanacetum alpinum (L.) Schultz. Bip., Über die Tanacetëen 61 (1844); Reichb. fil., Icon. Flor. Germ. et Helv. XVI 51 (1854); Briquet ap. Briquet et Cavillier in Burnat, Flores des Alpes Marit. VI (1): 119 (1916); Hayek, Prodr. Fl. Penins. Balc. II: 650 (1921).

Chrysanthemum alpinum L., Sp. Pl., ed. 1, 889 (1753); Villars, Hist. Dauph. III: 203 (1789); Gaudin, Fl. Helv. V: 346 (1829); Duby, Bot. Gall. ed. 2, I, 272 (1828); Loiseleur, Fl. Gall. II: 580 (1807); ed. 2, 253 (1828); Schinz & Keller, Flor. Schw. 532 (1900); Schröter, Pflanzenlieben Alp. 510-11 et loc. var.; Hegi, Ill. Flor. Mittel-Eur. VI (2): 604 et seq. et loc. plur. (1927); Vierhapper, in Mag. Bot. Lap. XIII: 17 et seq. (1914); Fiori & Paoletti, Flor. Anal. Ital. III: 242 (1903-4) excl. f. *rollensis* Briquet.

Leucanthemum alpinum Lamk. Flor. Franç. II: 138 (1778); Philippe, Flore des Pyrénées I, 477 (1859); Gremlí, Exscursionsfl Schweiz. 233 (1893); Bouvier, Fl. Alp. 355 (1878); Gillet & Magne, Nouv. Fl. Franç. 226 (1863); Grenier & Godron, Fl. France 2, 144 (1850); Coste, Fl. France II: 339 (1903).

Pyrethrum alpinum Schrank, Prim. Flor. Salisb. 215 (1792); Willdenow, Sp. Pl. III (3): 2153 (1803); Rouy, Flore France VIII: 263 (1903); Willk. in Willk. & Lange, Prodr. Flor. Hisp. II: 97 (1864); Colmeiro, Enum. Plant. Hisp.-Lusit. III: 188 (1887); DC., Prodr. VI: 54 (1837).

Matricaria alpina Desrier in Lam. Ency. méth III: 730 (1792).

Pontia alpina «(Gesneri)» Bubani Flor. Pyr. II: 219 (1900).

? *Pyrethrum versicolor* Pourret in Herb. Matrit. teste Bubani.

Non *Tanacetum alpinum* Simonk, Enum. Fl. Transsilyv.: 313 (1886).

nec *Chrysanthemum alpinum* Baumg., Enum. Stirp Trans III: 108 (1816-1846).

Chrysanthemum alpinum Bieb., Casp. 211 (1800).

Chrysanthemum alpinum Asso. Synopsis 123 (1779).

Tanacetum alpinum belongs to Spain only by the borders of its range. It has a restricted occurrence in the Spanish Pyrenees, and although it has been recorded from other Spanish localities there is no satisfactory evidence of this.

The species *sensu lato* comprises a complex polymorphy of forms with or without geographical areas stretching across the alpine mountain systems of Europe from the Pyrenees to the Carpathian ranges. The most recent revision, that of Vierhapper (Mag. Bot. Lap. XIII, 17: 1914) recognises six forms of which three, by the ranges cited, could occur in Spain, viz. f. *hutchinsiiifolium*, f. *minimum* and f. *pyrenaicum*. Of these Vierhapper himself gives only f. *pyrenaicum* and f. *hutchinsiiifolium* > *pyrenaicum*, from the Spanish Pyrénées.

Willkomm and Lange (Prodr., 97) describe *Pyrethrum alpinum* so as to include var. *pubescens* Dub. (= f. *minimum* (Vill.)) and in Willkomm's supplement f. *minimum* Vill is added.

Vierhapper could not have been aware of Ducomm's *Leucanthemum alpinum* f. *geninum* (Tasch. Schw. Bot. 384: 1869) for

no mention is made of this. As indicated elsewhere (19) this form apparently includes Vierhapper's f. *pyrenaicum* and part of his f. *minimum*. Briquet (in Burnat, Flor. Alp. Marit. VI, 1, 119: 1916) transferred Ducomm's form to *Tanacetum alpinum*, and extended f. *minimum* to include a wider variation of indumentum. The material of *T. alpinum* from Spain is poorly represented in herbaria and it is not therefore possible to quote a comprehensive list of specimens examined for this species. It is evident that the typical form var. *alpinum* (= f. *pyrenaicum* Vierh. p. p.) and var. *minimum*, occur in the Spanish Pyrenees. I have not been able to identify f. *hutchinsiiifolium* from Spanish material, but as Vierhapper records *hutchinsiiifolium* > *pyrenaicum*, it is not unreasonable to assume that f. *hutchinsiiifolium* itself may occur. Accordingly the corresponding synonymies and specimens (where known) are listed below:

var. **alpinum**

Syn:

Tanacetum alpinum var. *genuinum* (Ducomm) Briquet in Burnat Fl. Alpes Marit., VI (1): 120 (1916).

Leucanthemum alpinum f. *genuinum* Ducomm, Taschenb. Schw. Bot.: 384 (1869).

Chrysanthemum alpinum L. f. *pyrenaicum* Vierhapper l. c. *pro parte quoad plant. paulum pubescent.*

Chrysanthemum alpinum subsp. *eu-alpinum* P. Fournier, Quatre Fl. Fr. 973 (1939).

Description (ex Briquet op. cit. p. 20).

Feuilles vertes, glabres, ou à poils disseminées peu nombreux. Bractées involucrales glabres, ou à poils peu nombreux et disseminés sur le champ median, parfois a marges ciliées. Liguës restant blanche à la fin de l'anthèse.

(19) On the Identity of *Pyrethrum alpinum* var. *Hispanicum* Gautier.

Specimens cited:

PIRINEOS DE ARAGÓN: Puerto de Benasque (Timbal, *E!*); Col de L'Hopital de Viella (Bourgeau, 96, 1847 — var. *genuinum* > *hutchinsiiifolium* — *MA*); Camprodón Plans de Morens (Ull de Ter), 2,400-2,800 m., 1921 (Cuatrecasas, *MAF*).

Discussion: The specimen of Timbal quoted above was that given by Willkomm in the Supplement as *Pyrethrum alpinum* (*typicum*); it is however also quoted by Vierhapper as *Chrysanthemum alpinum* f. *pyrenaicum*. There is no reason to regard this plant as separate from the typical form and it is therefore classified in var. *alpinum*. The Bourgeau specimen is that termed f *hutchinsiiifolium* > *pyrenaicum* by Vierhapper.

Other localities are given by Willkomm and by Colmeiro. Those of Navarra, Santander and Valencia should be excluded.

var. **minimum** (*Vill.*) *Reichenb.* fil., op. cit. p. 52; Briquet and Cavillier in Burnat, op. cit. p. 121.

Syn:

Leucanthemum minimum Vill., Prosp.: 32 (1779).

Chrysanthemum minimum Vill., Hist. Pl. Dauph. III: 202 (1789).

Matricaria minima Desr. in Lamk. Ency. méthod. III: 731 (1792).

Pyrethrum alpinum (L.) Willd. β Willd., l. c. (1803).

Pyrethrum minimum DC., Fl. Fr. IV, 924: 1805, *pro min. parte* (*excl. pl. Cors.*).

Chrysanthemum alpinum L. var. *minimum* (Vill.) Persoon. Syn. II: 461 (1807); Gaudin, Flor. Helv. V: 346 (1829); Fiori & Paol, Fl. Anal. It. III: 242 (1903-1904); Hegi, Ill. Flor. Mittel-Eur. VI (2): 604 (1927); Vierhapper, in Mag. Bot. Lapok, XIII: 25 (1914).

Chrysanthemum alpinum L. β Wahlenberg., Flor. Carp. Princ., 275 (1814).

Chrysanthemum alpinum L. var. *pubescens* Duby., Bot. Gall I: 272 (1828).

Pyrethrum alpinum (L.) Willd. var. *pubescens* (Duby.) DC., Prodr. VI: 55 (1837).

Leucanthemum alpinum (L.) Lamk. var. *minimum* (Vill.) Bouvier, l. c.; Gremli, Exkursionfl. Schw. ed. 3: 227 (1878).

Pyrethrum alpinum (L.) Willd. var. *minimum* (Vill.) Wk. Suppl. Prodr. Flor. Hisp.: 84 (1893).

Chrysanthemum alpinum L. f. *pyrenaicum* Vierhapper l. c. *pro parte quoad plant. manifeste pubescent.*

Pyrethrum tomentosum Clairv. Man. 247 (1811), *non* DC.

Chrysanthemum alpinum subsp. *tomentosum* (Lois.) P. Fournier, Quatre Fl. Fr. 973 (1939), *pro parte, quoad descr*

Specimens cited:

PIRINEOS DE CATALUÑA: Haute vallée de Nouffonts (Sennen, BM); ? Cerc. de Morens (Pyr. Or.) 2400 m., 1922 (Cuatrecasas, K); Montañas de Nuria, 2400 m., 1922 (Cuatrecasas, MAF); Ull de Ter, 2400 m., 1922 (Cuatrecasas, MAF).

Description (ex Briquet).

Feuilles grisâtres ou blanchâtres, entièrement couvertes de poils serrés ± tomenteuses. Bractées involucreales à champ median généralement mollement velu ou tomenteux, à marges souvent densément ciliées. Ligules devenant généralement roses, ou moins à la fin de l'anthèse; fleurs périphériques du disque parfois roses -- varie exceptionnellement à tiges florifères caulescentes portant plusieurs feuilles développées et semblables à celles basilaires (f. *caulescens* Briquet (20)).

Discussion:

Several examples of this variation have been recorded from the Spanish Pyrenees; it occurs, in fact, throughout most of the range of *Tanacetum alpinum*.

Fr. Sennen (Flore de Catalogne, Inst. Cat. Hist. Nat., 143: 1917) makes a remarkable statement which will be quoted in full. «Le *P. pulverulentum* Lag. type et la var. *versicolor* (Wk.) Rouy, ne sont pas rares dans la haute vallée de Nouffonts = *P. pallidum* (Mill.) Pau var. *Assoi* Pau = *P. alpinum* Asso non Wk.»

Pyrethrum pulverulentum Lag. var. *versicolor* (Wk.) Rouy

(20) *Caulescens, foliis caulinaribus summis exceptis pinnatifidis.*

(= *Pyrethrum alpinum* (L.) Willd. var. *Hispanicum* Gautier) has been shown to be *Tanacetum alpinum* var. *minimum* (21) and the specimens distributed by Sennen from Nouffons are in fact this.

The synonym quoted — *P. alpinum* Asso, which is the *Chrysanthemum alpinum* Asso non Wk. — is difficult to explain, and it will be convenient to discuss the identity of this plant here.

Asso published his species in 1779 (Synopsis, 123) with a brief description — «*Chrysanthemum alpinum*. *Leucanthemum alpinum*, *tenuifolium* Barrel, l. c. 458, n. 3. Oritur in montosis circa Orihueña, in la Muela de San Juan prope Griegos.

Planta pollicaris. Folia cuneiforma, dentata. Calyx squamis oris sphacelatis».

The name *Chrysanthemum alpinum* is invalidated by the earlier Linnaean homonym but apart from this it is difficult to come to a conclusion about the character of the plant. Barreliers's fig 458, no. 3 cited by Asso depicts a plant with leaves somewhat intermediate between ssp. *virescens* and ssp. *spathulifolium*, but not quite typical of either. The latter subspecies has a much more southern range whereas the former has been recorded from Aragón. Indeed it is likely that *Chrysanthemum alpinum* Asso refers to broad-leaved forms of *Tanacetum pallidum* ssp. *virescens* (cf *infra*).

Willkomm and Lange l. c. quoted the locality given by Asso «Orihueña del Tremedal, Muela de San Juan, cerca de Griegos (Aragón)» with the comment that the plant, by its cuneiform leaves, might better be placed in *Pyrethrum hispanicum*. Pau l. c. reduced *C. alpinum* Asso to a form of his *P. pallidum* — var. *Assoi* Pau (thereby validating it) — indicating that he had collected it from the type locality. I have seen his specimen in Madrid and it is interesting to note the identification it bears — *P. pallidum* var. *virescens* f. *leucoglossum*, and I am quite inclined to accept this determination (qua *Tanacetum pallidum* subsp. *virescens* var. *bilbilitanum*).

As the whereabouts of Asso's type, if there is one, are not known, there is no certainty that Pau saw it and the equation of the specimen collected by him from the *locus classicus* with *C. alpinum* Asso cannot be made with any certainty.

(21) On the Identity of *Pyrethrum alpidum* (L.) Schrank var. *Hispanicum* Gautier.

In the Madrid Herbarium are two sheets identified as *Chrysanthemum alpinum* Asso, both collected by Pau — one from the Sierra de Albarracín and the other from the «summo de Javalambre». The former sheet bears two small specimens which are difficult to identify but appear related to *Tanacetum alpinum* but once again there is no evidence for the application of the name *Chrysanthemum alpinum* Asso to them. The other sheet from the Sierra de Javalambre bears one plant and is the cotype of the «varatio longicaulis squamis anguste fusco-marginatis» given by Pau in his discussion of var. *Assoi* Pau, l. c. I find it best to include this plant under *Tanacetum pallidum* subsp. *virscens* var. *bilibitanum* — it differs but slightly in that the leaves are rather more broadly spatulate, but the bracts, flowers and indumental characters are the same.

Sennen, as quoted above, gives *Chrysanthemum alpinum* Asso as a synonym of opinion for *Pyrethrum pulverulentum* var. *versicolor* but offers no explanation for this assumption. However, it gives a second possibility for the identity of Asso's plant viz. *Tanacetum alpinum* var. *minimum*.

Gandoger (Bull. Soc. Bot. France, LII, 455: 1905) states under *Pyrethrum Debauxianum* Gdgr. «eadem speciem ex Aragonia multoties quoque accepi nempe: Muela de San Juan, Griegos.» This, as already stated, is the type locality of *Ch. alpinum* Asso but the possibility that Asso's plant is *P. Debauxianum* (i. e. *T. pallidum* ssp. *spatulifolium*) need not be considered seriously.

The mystery that surrounds *Chrysanthemum alpinum* is analogous to the position in the genus *Digitalis* pertaining to *D. minor* L. While this uncertainty and confusion exists I do not propose to make any nomenclatural changes but leave *Ch. alpinum* Asso as a *forma non satis notata*.

subsp. **cuneatum** (Pau) Heywood, *comb. et stat. nov.*

Syn:

Pyrethrum cuneatum Pau *pl. exs. et ad Societ. Assoc. Pyr.* 1905-6.

Pyrethrum pallidum (Mill.) Pau var. *cuneatum* (Pau) Pau l. c., 93.

Pyrethrum cuneifolium Pau, in herb. *ined.*

Original Description (ex Pau l. c.).

«Robustior, pollicaris, folia spathulata latiora, apice 5-crenata, sericea, anthodia glabra: ligulis albis.»

Specimens cited:

SORIA: Montenegro de Cameros (Caballero, MA); Sierra de Urbión (Ceballos & Vicioso, MA); Pico de Urbión (Pau 9, VIII, 1905, MA); Pico de Urbión (Heywood, E).

Type: «Pico de Urbión (Soria) 9, VII: 1905, *Pyrethrum cuneifolium* Pau» in Herb. Pau apud Herb. Matrit.

This well defined subspecies was collected by Pau from the Sierra de Urbión, in the Iberian Mountain range and further gatherings have shown it to be endemic to this locality. I do not agree with its author Pau in referring it to *Pyrethrum pallidum* as a variety; it is better placed with *Tanacetum alpinum* by reason of its shortly petiolate pinnatifid, spathulate-cuneate leaves, white ligules and dwarf habit — characters which link with the other variations seen in this species. Because of its definite restricted geographical area I treat it as a subspecies forming an isolated race of the wide ranging species *T. alpinum*.

The type as indicated above was originally named *Pyrethrum cuneifolium* but Pau changed the name to *cuneatum* on publication.

Subspecies *cuneatum* is an alpine plant occurring in loose rocks and screes at an altitude of about 2,000 metres.

SPECIES DUBIAE

Pyrethrum Debauxii Degen, Herv. et Reverch. ap. Hervier in *Bull. Acad. Intern. Géogr. Bot.*, XV: 99 (1905).

This interesting species was collected by Reverchon in the Sierra de Castril (Jaén) in 1903 and labelled *P. hispanicum* Willk. When described as a new species the authors said of it «*Planta nana, certe annua (...) facie Anthemidis cujusdam, a congeneribus acheniis ecoronulatis valde diversa et in genere paradoxa.*»

I have only been able to see one collection of this plant but examination of it has shown that it differs from *Pyrethrum* (i. e. *Tanacetum* sect. *Pyrethrum*) by its annual habit, Anthemid-appearance, absence of an achenial corona, and \pm winged achenial ribs which bear numerous myxogenic cells. Although it resembles an *Anthemis*, it is removed from that genus by its epaleaceous receptacle, fertile marginal florets, and different achenes.

It is therefore difficult to place this plant: the abundant myxogenic cells place it near subg. *Leucanthemum* (cf. Briquet) but in the material available I have not been able to see resiniferous canals in the achenes. I would therefore suggest that *P. Debauxii* probably constitutes an anomalous section of *Leucanthemum* but until it is possible to make further investigation of the plant I do not feel justified in making any nomenclatural changes.

Pyrethrum palmatifidum DC., Prodr., VI: 54 (1837).

Little is known of this plant beyond the original diagnosis: «Totum hirsuto-tomentosum adscendens basi suffruticulosum, foliis confertis petiolatis suborbiculatis palmatifidis, lobis 7-9 oblongis subobtusis, pedunculo foliis triplo longiore erecto 1-cephalo, invol. squamis hirsutis oblongis vix margine rufis.»

Its origin is obscure: De Candolle gives it «In Hispania (verisim. in montosis) sed locus proprius ignotus» and says that it is easily confused with *P. tomentosum*, but differs in its 20-25 ligules, and pappus longer than half the tube. I have not been able to see the type (in the Prodr. Herb., Conservatoire Botanique, Geneva).

Willkomm & Lange (Prodr. 1. c.) record the plant but add no further information.

Boissier saw the plant, for in his discussion of *P. arundanum* (Voyage Bot., II, 318: 1845) he says that *P. palmatifidum* is remarkable by its tomentose orbicular leaves with very short divisions, resembling those of a Lupin.

In the Kew Herbarium there is a collection of Graells, No. 13 labelled *P. purpureum* Graells! with a manuscript note of Gay which reads: «Mihi est forma nova Pyrethri Bauhini Gay ined quod pulverulentum, radicans, sulphureum, et spathulaefolium complectitur. Nescio cui formarum primarium magis affinem di-

cam. Recedit ab quinis mihi cognitis (pulverulento, alpino, quod sulphureum β alpinum B. et R., γ radicante, δ sulphureo et ϵ spathulaefolio nob. olim ex prov. giennense) statura humillima et habitu caespitoso valde contracto. Variat ut radicans, ligulis saepe purpurascens. » No indication of a precise locality, other than Spain, is given.

It seems very probable that this is the same as *P. palmatifidum* DC., and it is very likely that these plants represent anomalous dwarfed tomentose forms of *Tanacetum alpinum* var. *minimum* which shows such a diversity of habit. Their habitat would therefore be in the Pyrenees.

SYNOPSIS OF THE SPECIES ACCEPTED IN THIS REVISION

Tanacetum alpinum (L.) Schultz Bip.

var. *alpinum*.

var. *minimum* (Vill.) Reichb. fil.

var. *hutchinsiiifolium* (Mur.) Hayek.

subsp. *cuneatum* (Pau) Heywood.

Tanacetum pallidum (Mill.) Maire.

subsp. *pallidum*.

var. *pallidum*.

var. *alpinum* (Boiss. & Reut.) Heywood.

subsp. *virescens* (Pau) Heywood.

var. *virescens* (Pau) Heywood.

var. *bilbilitanum* (Pau) Heywood.

subsp. *spathulifolium* (Gay) F. Q. et Rothmaler.

Tanacetum radicans (Cav.) Schultz Bip.

Tanacetum flaveolum (Hoffsgg. & Lk.) Heywood.

f. *alpestre* (Mariz) Heywood.

Tanacetum pulverulentum (Lab.) Schultz Bipont.

subsp. *pulverulentum*.

subsp. *pseudopulverulentum* Heywood.

SUMMARY

As a result of this study the five species, six subspecies, and eight varieties given in the above synopsis are admitted to the Spanish flora representing the genus *Tanacetum* subsect. *Leucanthemopsis*.

These species constitute a natural group, confined with the exception of *T. alpinum* to the Iberian Peninsula.

Two leaf-shape types are shown by the endemic Spanish species: pinnately divided — *T. pulverulentum*, *T. flaveolum*, *T. radicans*, and lobed-dentate — *T. pallidum*.

The species of the first type show relatively little variation in leaf shape.

In the second type a study of the variation in leaf shape correlated with distribution has led to the treatment of *T. pallidum* as consisting of three subspecies each with a geographical area and a characteristic leaf pattern. The trend of leaf variation traced from the centre eastwards is from the linear apically tridentate form of subsp. *pallidum* to the linear spathulate slightly dissected form of subsp. *virescens*; the southward trend produces the rosulate-spathulate leaf of subsp. *spathulifolium*. The two lines of variation taken as a whole do not fit into a clinal pattern, i. e. the two trends are distinct and the rosulate-spathulate leaf cannot be derived from the linear directly through the linear-spathulate leaf.

Specimens have been seen of subsp. *pallidum* (collected from the Sierra Morena) south of its general distribution, in which the leaves are transitional to *T. radicans* but as this variation is poorly represented no emphasis is laid upon it.

It has been found that leaf shape and general habit afford the most valuable criteria in the taxonomy of this section. The nature but not the density of the indumentum is also important. Carpologically the species can be separated but in the infraspecific forms achenial characters are of little value.

* * *

Tanacetum pallidum is emended to include three subspecies *pallidum* (typical), *virescens* and *spathulifolium*.

Pyrethrum pallidum var. *virescens* has been raised to the rank of subspecies, and the f. *leucoglossum* abandoned in favour of f. *bilbilitanum* (as var.).

Tanacetum radicans is retained as a distinct species on morphological, ecological, and geographical grounds.

Pyrethrum flaveolum is also retained as a species (qua *Tanacetum* f.).

Tanacetum pulverulentum has been separated from *T. pallidum* on morphological and distributional evidence; a new subspecies of it is described from the east of Spain.

It is believed that *Pyrethrum purpureum* Graells herb. *incd.* seen in the Kew Herbarium is the *P. pamatifidum* DC. and their identity is discussed.

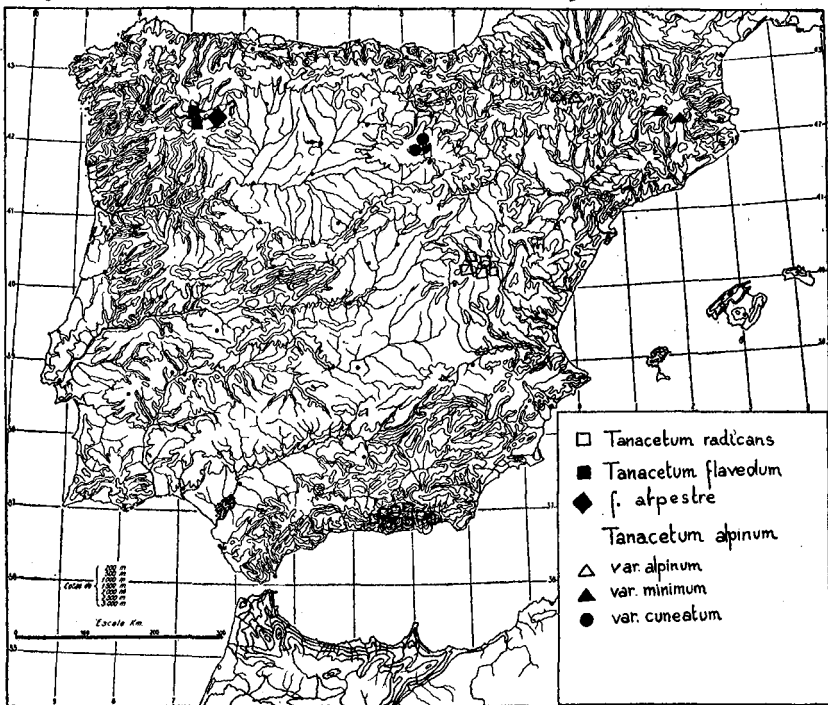
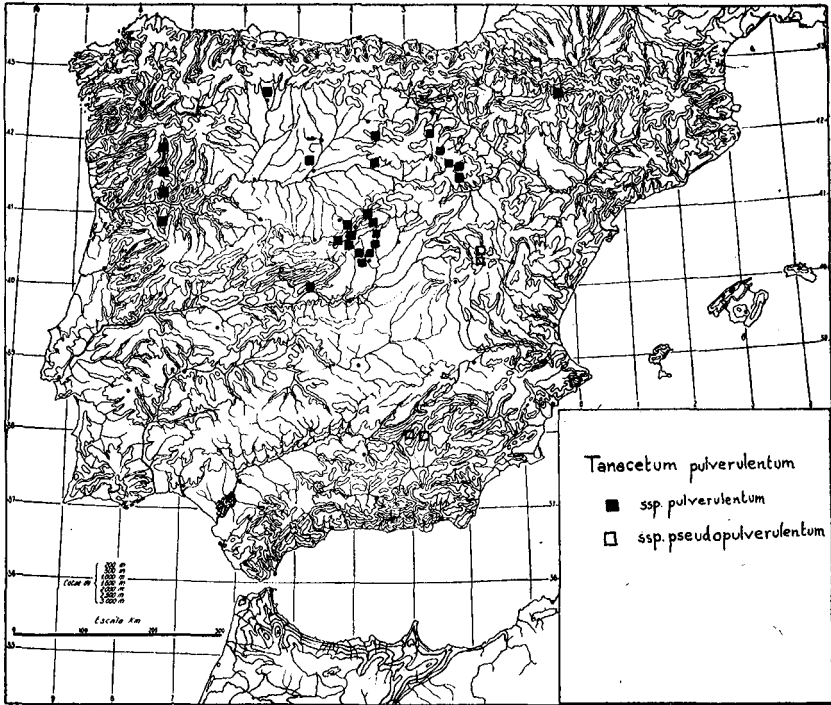
Pyrethrum pallidum var. *cuneatum* is transferred to *T. alpinum* as a subspecies.

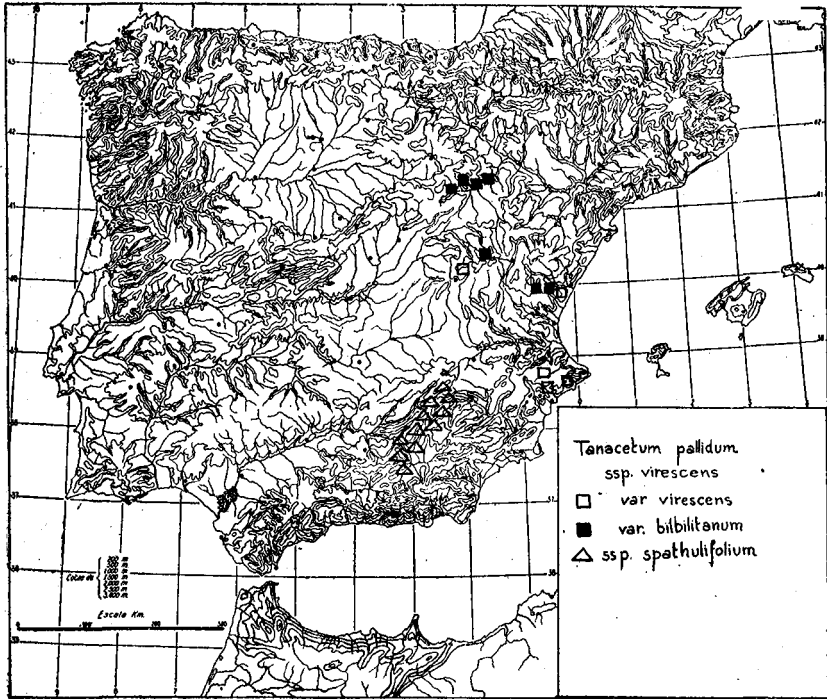
It has not been possible to establish definitely the identity of *Chrysanthemum alpinum* Asso non L.

Pyrethrum pallidum var. *marianum* Pau has been shown to be *Prolongoa pectinata* (L.) Boiss. (= *Chrysanthemum p.* L.).

Examination of *Pyrethrum Debauxii* Deg. Herv. et Reverch. has shown that it should be excluded from *Pyrethrum* (i. e. *Tanacetum*) sect. *Pyrethrum*, and that it probably constitutes a distinct section of the subgenus *Leucanthemum*.

My thanks are due to Mr. N. Y. Sandwith (Kew) who has kindly read the manuscript and for many helpful suggestions.





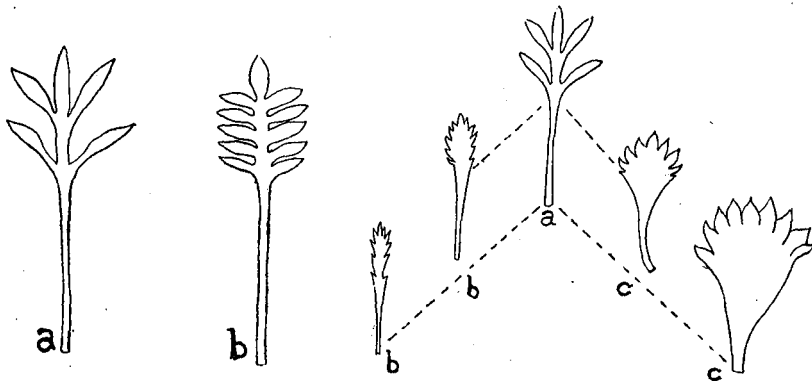


Fig. 1.—a, leaf of *T. pallidum*, type; b, leaf of *T. pulverulentum*, type.

Fig. 2.—Variations in leaf shape of *T. pallidum*; a, ssp. *pallidum*; b, b, ssp. *virescens*; c, c, ssp. *spatulifolium*.



CORRECCIONES A LA PARTE PRIMERA DE LA «REVISION
DEL GENERO ARMERIA WILLD, CON ESPECIAL REFERENCIA A LOS GRUPOS IBERICOS», por F. Bernis

PÁGINA	GRUPO	DICE	DEBE DECIR
234	var. <i>tingitana</i>	lám. XI.IV, fig. 1 y 2	lám. 28, fig. A y B
237	» <i>chamaeropicola</i>	» LVI, fig. 1	» 30, fig. A
238	» <i>amplifoliata</i>	» XLVI, fig. 2	» 30, fig. B
238	» <i>simplex</i>	» XLVII, fig. 1	» 31, fig. A
241	» <i>choulettiana</i>	» XLVII, fig. 2	» 31, fig. B
244	» <i>rumelica</i>	» LXI, fig. 2 sin.	» 53, fig. B. sin.
246	» <i>cantescens</i>	» LXI, fig. 2 dext.	» 53, fig. B. dext.
247	» <i>majellensis</i>	» LXI, fig. 1	» 53, fig. A
249	» <i>Malivaudii</i>	» LXII, fig. 2	» 54, fig. B