Notes on some species of *Anthemis (Compositae, Anthemideae)* in Cyprus

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Introduction

Anthemis (Compositae), with its c. 210 species (Bremer 1994), is one of the largest genera in the tribe *Anthemideae*. It is represented in Cyprus by ten species (Meikle 1985) belonging to two subgenera and five sections. Two species, *A. plutonia* and *A. tricolor*, are found only in Cyprus, while the other species show wider distributional ranges.

The first named author, who specialized in the biosystematics of N.W. African *Anthemis* (Oberprieler 1998) at that time, welcomed the opportunity to get aquainted with some eastern Mediterranean representatives of the genus that was provided by the second author's participation in the fourth OPTIMA expedition Iter Mediterraneum IV to Cyprus in April 1991.

Material and methods

The present study is based primarily on the abundant plant material collected during Iter Mediterraneum IV, and on additional specimens conserved in the herbaria of the Botanical Museum Berlin-Dahlem (B), the Forestry Department of the Ministry of Agriculture and Natural Recources in Nikosia (CYP), the Royal Botanic Gardens Kew (K), and the private collections of D. Lange (Stuttgart) and the authors.

Specimens collected during the OPTIMA expedition are cited with their Iter Mediterraneum IV locality number, followed either by the official collection number or, if there is none, by Vogt's personal collection number. All such specimens are present both in B and Vogt's personal herbarium. Duplicates of officially numbered specimens are deposited in PAL, SEV, G, and several other herbaria.

Plants used for karyological studies were raised in the Berlin Botanic Garden, and vouchers of cultivated plants were deposited in B.

Root tips were pretreated with hydroxyquinoline (0.002 molar aqueous solution) for 4 hours, fixed in 96 % ethanol : glacial acetic acid (3 : 1) and refrigerated. Hydrolysis was performed in 1-2n hydrochloric acid for 10-15 min at 60°C. For chromosome staining, root tips were squashed in aceto-orcein.

Studies on haploid chromosome numbers were carried out on young flower buds fixed in the field in 96 % ethanol : glacial acetic acid (3 : 1). The anthers were stained in cold aceto-orcein.

Multivariate analysis of morphological and phytochemical variation in *Anthemis plutonia* and *A. tricolor* was carried out using the SPSS for Windows program package. For morphological leaf characters three representative rosette leaves per plant were softened in boiling water, carefully flattened, measured, and the results averaged for each specimen.

Isolation of essential oils was performed using 0.3-3.1 g of capitula from different plants of each population, which were hydrodistilled in a "Karlsruher" apparatus for 90 min using n-hexane (1 ml) as a solvent.

Gas chromatography was carried out using a Perkin Elmer F22 chromatography apparatus with a split-injection system and a 30 m × 0.32 mm fused-silica capillary column coated with 0.25 µm DB-Wax. Nitrogen flow rate was 1 ml/min and oven temperature was constant at 70°C for 8 min and then increased to 180°C with a rate of 2°C/min. Injector and detector temperature was 180°C, injection split ratio was 1:30. Compound contents were given in peak area percentages using a Varian 4270 integrator (method 0).

Results

1. *Anthemis tricolor* Boiss. and *A. plutonia* Meikle

These two closely related species of *Anthemis* sect. *Anthemis* are endemic to Cyprus and show a distinct edaphic vicariance. According to Meikle (1985) they can be reliably distinguished by differences in cauline leaf dissection, pappus developement and indumentum features. *Anthemis tricolor* occurs from sea level to c. 1000 m altitude. It flowers from February until May and prefers dry, rocky or stony ground, usually on chalk or limestone, in all parts of the island.

A. plutonia grows at higher elevations (250-1950 m) and flowers later, from March until July. Its distributional range is restricted to the igneous areas of the Troodos Range, with an isolated outpost on Stavrovouni mountain.

Chromosome numbers

The cytology of *Anthemis tricolor* and *A. plutonia* had not yet been studied. All investigated populations yielded chromosome numbers of n = 9 or 2n = 18. No peculiarities in meiosis were detected. Chromosomes formed nine regular bivalents during diakinesis and metaphase of meiosis.

Anthemis tricolor Boiss. (Fig. 1A-B).

n = 9. **Larnaka:** Cape Greco, *5-144* (Fig. 1A).
n = 9. **Limassol:** Vouni, *Vogt 15-8396* (Fig. 1B).

Anthemis plutonia Meikle var. ***plutonia*** (Fig. 1C-D).

n = 9. **Larnaka:** Lefkara-Vavatsinia, *19-766*.
n = 9. **Paphos:** Mount Tripylos, *Vogt 21-8531* (Fig. 1C).
n = 9. **Paphos:** Stavros tis Psokas, *Vogt 22-8533* (Fig. 1D).
n = 9. **Paphos:** Mount Chionistra, *Vogt 37-8977*.

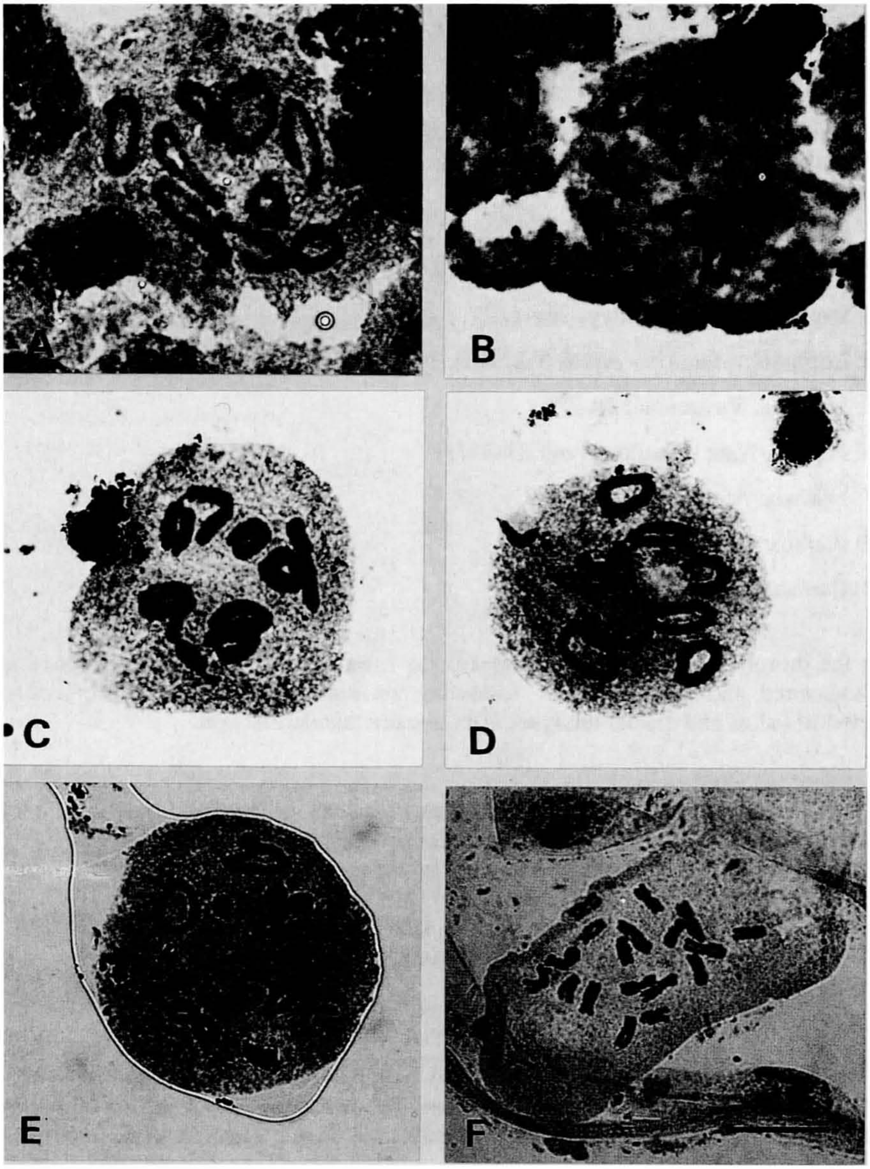

Fig. 1. PMC meiosis of: **A,** *Anthemis tricolor*, $n = 9$ (Cape Greco, *5-144*); **B,** *A. tricolor*, $n = 9$ (Vouni, *Vogt 15-8396*); **C,** *A. plutonia* var. *plutonia*, $n = 9$ (Mount Tripylos, *Vogt 21-8531*); **D,** *A. plutonia* var. *plutonia*, $n = 9$ (Stavros tis Psokas, *Vogt 22-8533*); **E,** *Anthemis plutonia* var. *artemisioides*, $n = 9$ (Stavrovouni, *12-428*). **F,** *A. pseudocotula*, $2n = 18$, root-tip mitosis (Paphos harbour, *Vogt 9000*). — Scale bar = 10 µm.

Anthemis plutonia var. ***artemisioides*** (Holmboe) Oberprieler & Vogt (Fig. 1E).

$n = 9$. **Larnaka:** Stavrovouni, *12-428*.

$2n = 18$. **Larnaka:**Stavrovouni, *Vogt 9009*.

Morphological and phytochemical variation

For morphological and phytochemical analyses the following nine populations of *Anthemis tricolor* and *A. plutonia* were selected (Fig. 2):

pop-1: Larnaka: Stavrovouni, *Vogt 9009*.

pop-2: Paphos: Stavros tis Psokas, *Vogt 22-8533*.

pop-3: Paphos: Ezoussas valley, *26a-1197*.

pop-4: Limassol: Mandria - Ayios Nikolaus, *34-1602*.

pop-5: Larnaka: Vavatsinia, *20-776*.

pop-6: Paphos: Nata - Axylon, *Vogt 23-8571*.

pop-7: Nikosia: Alona, *Vogt 33-8879*.

pop-8: Paphos; Kidhasi, *Vogt 35-8952*.

pop-9: Larnaka; Kato Lefkara, *17-749*.

For the morphological analysis 69 specimens from the 9 populations mentioned above were measured and scored for the following six leaf characters. Measurements were subjected to factor and cluster analyses after z-score standardisation.

1) PETIO: petiole length expressed as leaf length / distance from leaf base to first lobe
2) LAMIN: distance from first leaf lobe to leaf tip / leaf width
3) RHACH: width of leaf rhachis between first and second pair of leaf lobes
4) LOBEW: width of primary leaf lobe
5) NUMB1: Number of primary lobes on one side of the leaf, terminal lobe excluded
6) NUMB2: Number of secundary lobes on one side of first primary leaf lobe, terminal lobe excluded

For processing of phytochemical data 36 essential oil compounds were used, each having a concentration of more than 1% in the essential oils of at least one of the population samples. Compounds with concentrations lower than 1% in all samples were discarded.

Principal components analysis (PCA) based on morphological data yielded two components with eigenvalues higher than 1, accounting for 70.5 % of the total variance (Fig. 3). This, together with the high loadings of characters on the first principal component (PC 1), indicates a strong correlation of variables. PC 1, which accounts for 52.9 % of the total variance, is dominated by the variables PETIO, RHACH, LOBEW, NUMB1 and NUMB2.

The only variable with a considerable loading on PC 2 is LAMIN, causing the removal of three outliers. Since PC 2 accounts only for the comparatively small amount of 17.6 % of the total variance, variation displayed on this axis plays only a secondary role compared to variation on PC 1.

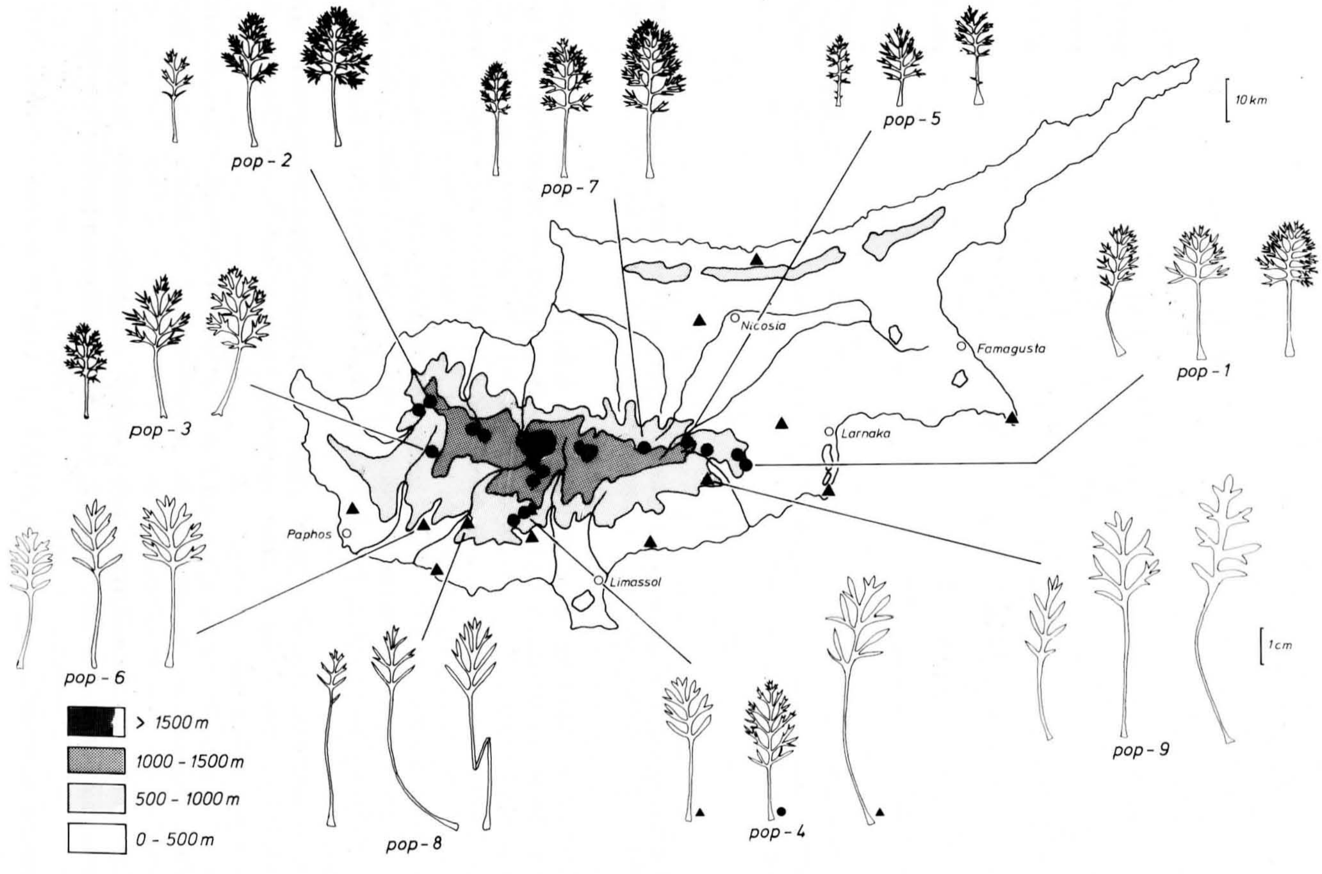

Fig. 2. Map of Cyprus showing the distributional range of *Anthemis tricolor* (triangles) and *A. plutonia* (circles) according to revised material. Three representative leaves of the investigated populations (pop-1 to pop-9) are illustrated.

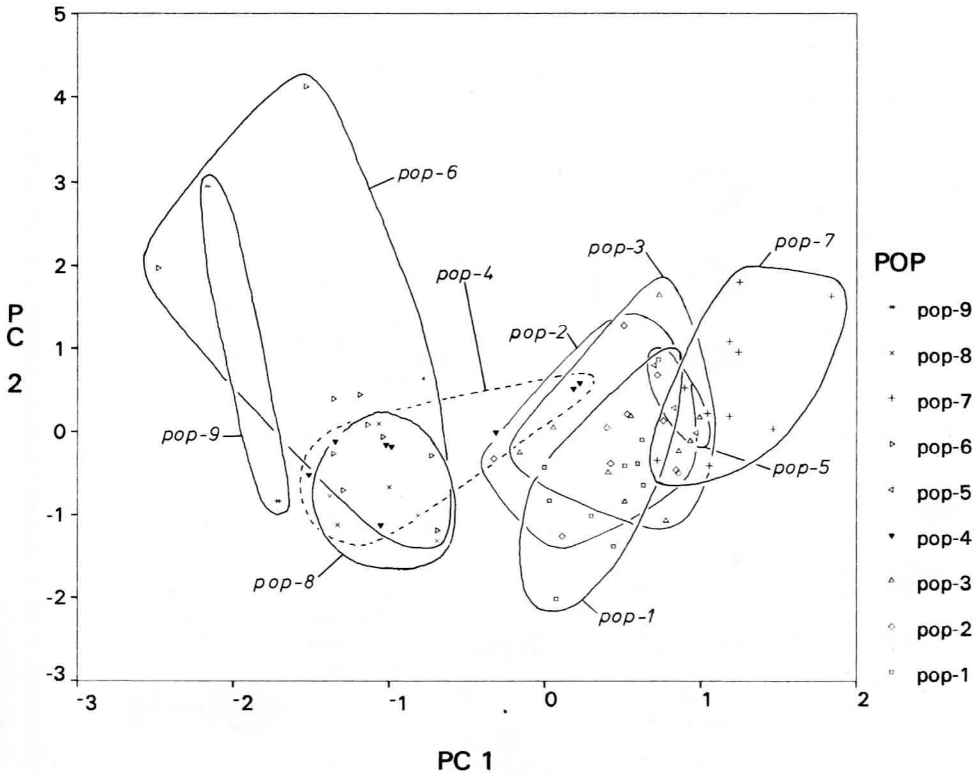

Fig. 3. Resulting ordination of investigated specimens of populations 1-9 after principal components analysis (PCA) of morphological data. PC 1 accounts for 52.9 %, PC 2 for 17.6 % of the total variance.

With respect to the factor scores on this rather dominating axis PC 1 the specimens investigated form two distinct clusters: the first with factor scores higher than - 0.5 and members of populations 1, 2, 3, 5, and 7, and the second with factor scores lower than -0.5 and members of populations 6, 8, and 9. Population 4 connects the two groups by having members of both. Information on variable loadings shows that the first group has more strongly dissected leaves than the second group, with shorter petioles and more slender rhachises and primary leaf lobes, corresponding to the description of *Anthemis plutonia* in Meikle (1985); the second group morphologically approaches *A. tricolor*. Population 4 seems to contain both taxa.

Principal component analysis of chemical data yielded eight principal components with eigenvalues higher than 1, the first two accounting for only 52.4 %, the first three for 69.1 % of the total variance.

Correlations between chemical variables thus appear to be weaker than between morphological characters. Nevertheless, the arrangement of populations in the three-dimensional factor space of principal components PC1 to PC 3 (Fig. 4) shows a clear correlation between morphological and chemical groupings, which supports the assumption that the two species involved also show differences in their essential oil spectra.

Populations 6, 8, and 9, representing typical specimens of *Anthemis tricolor*, form a clear cluster on the negative side of PC 1 and are set apart from all other populations; populations 5 and 7 form a more remote group; and populations 1, 2, 3, and 4, a rather transitional cluster.

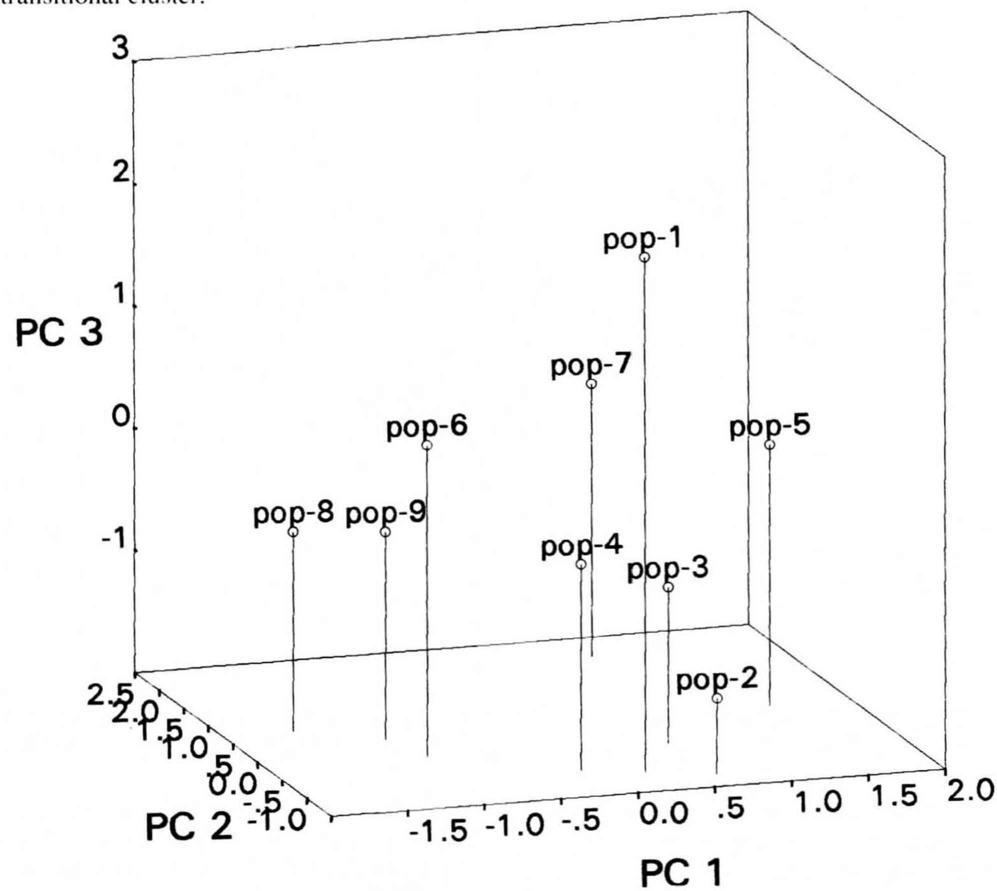

Fig. 4. Resulting ordination of investigated populations (pop-1 to pop-9) after principal components analysis (PCA) of chemical data. PC 1 accounts for 28.2 %, PC 2 for 24.2 %, and PC 3 for 16.7 % of the total variance.

The position of population 5 and, especially, population 7 in the chemical analysis seems to be in agreement with their positions in the PCA of morphological data where their members were also found to form the extreme of the cluster of populations representing *Anthemis plutonia*.

This striking correspondence between the two analyses can perhaps be explained by the effect of altitude. Population 7 was collected at 940 m, population 5 at 770 m, and populations 2 and 3 at lower altitudes of 450-750 m. These lowermost populations, in particular, skirt the altitudinal range of *A. tricolor* which they also approach in morphological and chemical respects, leading to an altitudinal cline in the variation of these variables within *A. plutonia*.

A parallel cline can be deduced from Meikle's (1985) note on the size variation of ray florets in *Anthemis plutonia*: "forms especially from very high altitudes, are destitute of ligules; most plants have very small ligules, and a few from the lowest limits of distribution, have ligules almost, but not quite, as large as in *A. tricolor*".

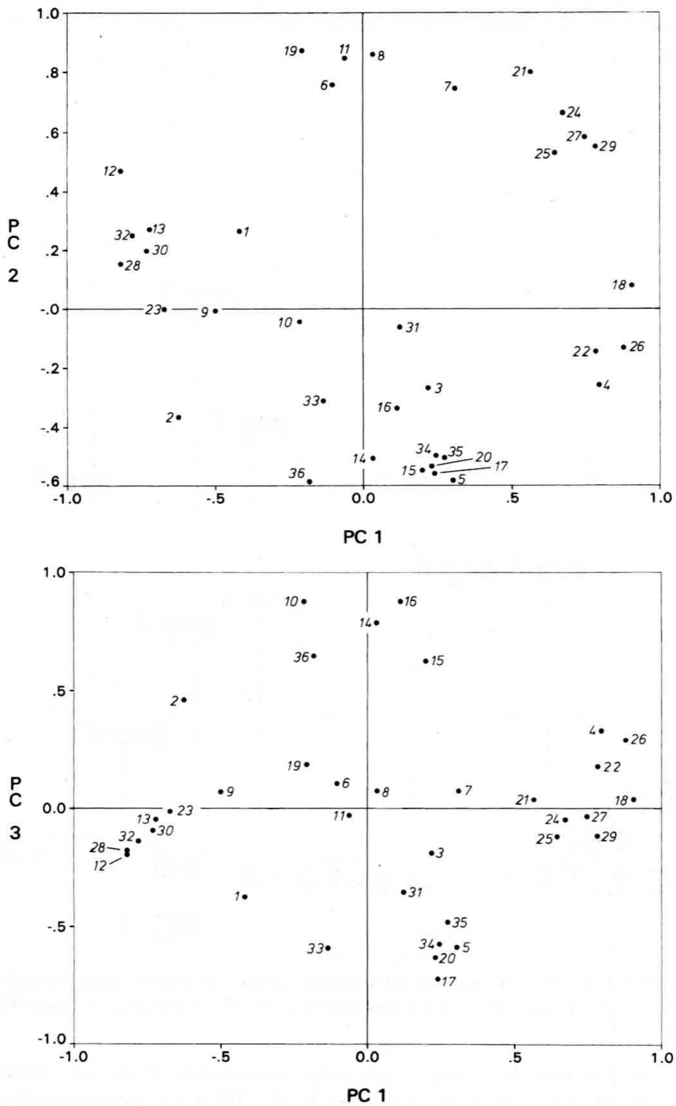

Fig. 5. Resulting variable loadings on PC 1 to PC 3 of principal component analysis (PCA) of chemical data. PC I accounts for 28.2 %, PC II for 24.2 %, and PC III for 16.7 % of the total variance. Variable numbers correspond to peak numbers in Fig. 6.

The main aim of morphological and chemical analyses was to clarify the status of the rayless *Anthemis plutonia* resembling plants of population 1 from the Stavrovouni area where they grow at the relatively low altitude of around 500 m. This contradicts the statement of Meikle (1985) mentioned above, who found rayless plants of *A. plutonia* to grow especially in very high altitudes. Analysis of morphological data (leaf characters) clearly indicate the placement of this population within *A. plutonia* (Fig. 3).

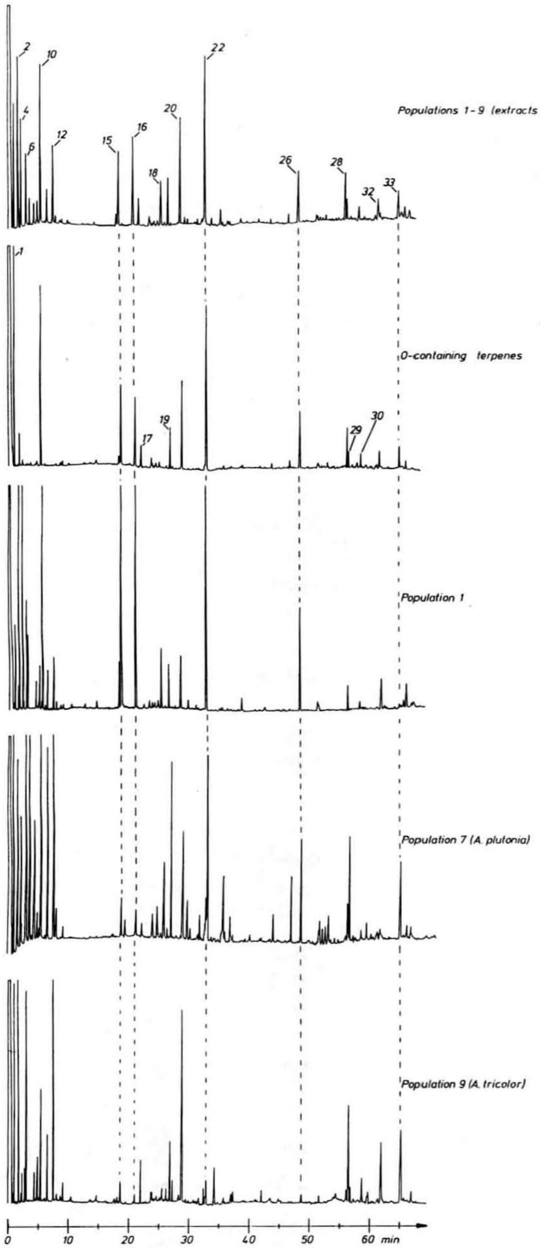

Fig. 6. Results of gas chromatography of isolated essential oils: **A,** analysis of combined extracts of populations 1-9; **B,** analysis of combined extracts of populations 1-9 after removal of apolar components; **C-E,** analyses of extracts of population 1, 7, and 9.

A comprehensive morphological comparison concerning characters of involucral bracts, receptacular scales, and tubular flowers between the type specimen of *Anthemis tricolor* var. *artemisioides* Holmboe (Chionistra, 24 Jun 1905, *Holmboe 984*, O!) which is included in *A. plutonia* by Meikle (1985) and Stavrovouni population shows that there are no major differences detectable.

Principal component analysis of chemical data, however, shows the Stavrovouni population to be placed amongst the populations with intermediate chemotype (pop-2 to pop-4) on the first two principal components, but clearly set apart from the populations on PC 3 (Fig. 4).

Considering loadings of variables on that axis (Fig. 5), the remote position is especially due to compounds 10, 14, 15, and 16. Corresponding peak area percentages accordingly show their maximum values in the oil from this population, namely 16.0 % in compound 10 (versus 1.0-6.5 % in populations 2, 3, 4, 5, and 7 and 4.0-6.5 % in populations 6, 8, and 9), 1.7% in compound 14 (versus 0-0.2 % and 0-0.4 %, respectively), 12.4% in compound 15 (versus 0.5-4.1 % and 0-1.4 %, respectively), and 11.1 % in compound 16 (versus 0.3-4.0 % and 0.1-6.1 %, respectively).

No additional investigation of the chemical structures of these compounds was not carried out, but it can be shown (Fig. 6) that all of them are O-containing compounds (number 10 presumably 1,8-cineol and number 16 presumably camphor). This may account for the characteristic and deviating scent of plants from the Stavrovouni area noticed by some of the excursion participants, and may indicate the genetic independence of this population.

The results of our analyses may indicate that the clinal variations in morphological and chemical respects exhibited by *Anthemis plutonia* are due to actual or past interbreeding and introgressive hybridisation between an originally rayless *A. plutonia* with *A. tricolor*, in the altitudinal range of joint occurrence of the two species. This overlapping zone extends from about 450 m up to at least 850 m where we found population 4 to contain *A. tricolor* individuals.

If we take the occurrence of ray florets as an indication of genetic influence of *Anthemis tricolor* this zone might be enlarged up to at least 940 m, as we found all plants of population 7 to have small ray florets. We have to keep in mind that, due to methodical circumstances (amalgamation of individuals into one sample), it is impossible to decide whether the intermediate position of pop-4 in the chemical analysis is a result of the realization of intermediate chemotypes in each plant investigated or an amalgamation effect.

Therefore, our data cannot prove that hybridization between *A. tricolor* and *A. plutonia* actually occurs but it seems to offer a very reasonable explanation of the observed pattern of variation.

Information on the ecological preferences of the two species, with *Anthemis plutonia* growing on volcanic rocks and *A. tricolor* mostly on chalk and limestone, encourages us to consider the Stavrovouni population, which also grows on volcanic soil, to be a remnant population of the originally rayless *A. plutonia* (thus typical *A. tricolor* var. *artemisioides* Holmboe) which, due to hybridization with *A. tricolor* leading to *A. plutonia* plants with ray florets, is now restricted to the higher altitudes of the Troodos massif.

Holmboe's taxon thus seems to us not to be a mere rayless variant of *A. plutonia*. We therefore propose not to include this taxon in the synonymy of *A. plutonia* but to taxonomically acknowledge it at least on the level of a variety, giving rise to the following new combination:

Anthemis plutonia var. ***artemisioides*** (Holmboe) Oberprieler & Vogt, **comb. nov.**
• *A. tricolor* var. *artemisioides* Holmboe 181 (1914) in Bergens Mus. Skr., ser. 2, 1(2): — Type: Chionistra, 24 Jun 1905, *Holmboe 984* (O!).

Specimens studied

Anthemis tricolor. — **Larnaka:** between beach of Meneou and Cape Kiti, gravel beach, 13 Apr 1991, *Vogt 9-9037* (B; Herb. Vogt); Cape Greco, limestone rocks (lower Miocene) and sand, 10-20 m, 12 Apr 1991, *5-144* (B); Ayia Anna, dry slopes, palaeogene limestone and marl, c. 150 m, 15 Apr 1991, *13-505* (B); Kato Lefkara, track to Vavla, marles and limestone, garrigue and meadows, 520 m, 18 Apr 1991, *17-749* (B); near salt-lake S.E. of Kiti, S.W. of Larnaka, 20 Feb 1984, *Hansen* (K). **Limassol:** Vouni, roadside, limestone and marl, 480 m, 17 Apr 1991, *Vogt 15-8396* (B; Herb. Vogt); Amathus, stony slopes, edge of agricultural land, walls, garrigue, marl and limestone, 10-40 m, 14 Apr 1991, *11-352* (B); Mandria and Ayios Nikolaos, roadsides and garrigue, gabbro and limestone, 27 Apr 1991, *34-1602* (B). **Nikosia:** between Nikosia and Kokkinotremithia, in garrigue on limestone, 250 m, 4 Mar 1990, *Christodoulou* (CYP N° 743). **Paphos:** Kidhasi, valley of Dhiarizos, river bank and meadows, 27 Apr 1991 (*Vogt 35-8952*) (B; Herb. Vogt); between Nata and Axylon, garrigue, limestone and marl-limestone, 350-400 m, 22 Apr 1991, *Vogt 23-8571* (B; Herb. Vogt); S. E. of Paphos, Petra tou Romiou, Strandvegetation, Felstriften, 18 Apr 1992, *Lange 5658* (Herb. Lange); ibid., 3 Apr 1993, *Lange 5929* (Herb. Lange); N. E. of Paphos, zwischen Kili und Kloster Ayios Neophytos, Phrygana, Weinfelder, 17 Apr 1992, *Lange 6531* (Herb. Lange). **N. Cyprus:** Buffavento, am Bergfuß, 4 Apr 1990, *Lang* (B).

Anthemis plutonia var. *plutonia*. — **Larnaka:** road from Lefkara to Vavatsinia, 4-5 km before Vavatsinia, volcanic rocks, 750 m, 18 Apr 1991, *19-766* (B); Vavatsinia, road to Lythrodhonda, roadside, volcanic rocks, 770 m, 19 Apr 1991, *20-776* (B). **Limassol:** between Mandria and Ayios Nikolaus, roadsides and garrigue, gabbro and limestone, 27 Apr 1991, *34-1582* (B); ibid., *34-1602*; N. W. of Limassol, Troodos-Gebirge, N Pano Platres, zwischen Kryos Potamos und Caledonian Waterfalls, 1400-1600 m, 7 Jun 1988, *Lange 4313* (Herb. Lange); N. W. of Limassol, Troodos-Gebirge, zwischen Pano Platres und Troodos, 1300-1700 m, 7 Jun 1988, *Lange 4296* (Herb. Lange). **Nikosia:** N. E. of Pano Platres, zwischen Stavros tis Ayiasmati (Platanistasa) und Lagoudhera, Phrygana, *Pinus brutia*-Wälder, 23 Apr 1993, *Lange 6177* (Herb. Lange); Alona, steep slopes, garrigue, diabase, 940 m, 26 Apr 1991, *Vogt 33-8879* (B; Herb. Vogt). **Paphos:** surroundings of Stavros tis Psokas, *Pinus brutia* forest on volcanic rocks, 750 m, 21 Apr 1991, *Vogt 22-8532* (B; Herb. Vogt); ibid., *Vogt 22-8532* (B; Herb. Vogt); Mount Tripylos and Cedar valley, forest with *Cedrus brevifolia* and *Quercus alnifolia*, 1080-1360 m, 20 Apr 1991, *Vogt 21-8531* (B; Herb. Vogt); junction of the track to Ayia (Panayi), valley of Ezoussas, vulcanic rocks, c. 450 m, 23 Apr 1991, *26-1197* (B); Tripylos, igneous mountainside, 1350 m, 3 May 1990, *Christodoulou* (CYP N° 853).

Anthemis plutonia var. *artemisioides*. — **Larnaka:** Stavrovouni, reforestation area, diabase, basalt and gabbro, 450-800 m, 15 Apr 1991, *12-428* (B); ibid., *12-443* (B); ibid., road embankment at c. 500 m, 3 May 1991, *Vogt 9009* (B; Herb. Vogt). **Paphos:** summit of Mt Chionistra, volcanic rocks and thin forest, 1950 m, 28 Apr 1991, *Vogt 8977* (Herb. Vogt).

2. *Anthemis pseudocotula* Boiss.

All the excursion's official collections of *Anthemis* sect. *Maruta* proved to represent *A. pseudocotula* Boiss., which ranges from the E. Mediterranean area to Iraq and Iran. As Eig (1938) and subsequently Yavin (1970) pointed out, the corona length of the persistent achenes in Palestine shows a considerable amount of variation with a gradual transition from achenes with an abaxial auricle half as long as the body of the achene to achenes lacking a corona. Meikle (1975) considered this species to be very uniform in Cyprus and placed all examined specimens under *A. pseudocotula* subsp. *rotata* (Boiss.) Eig, defined by Eig (1938) and Yavin (1970) by its achenes devoid of an adaxial auricle. In contrast, we found the Cyprian plant material collected during the OPTIMA excursion to represent different forms of both accepted subspecies of *A. pseudocotula: Vogt 9000* from the Paphos harbour area possesses achenes with auricles half as long as the rest of the achenes' body and must therefore be assigned to *A. pseudocotula* (subsp. *pseudocotula*) var. *massadensis* Yavin, described from the Judean Desert; *Vogt 8568* possesses achenes devoid of an auricle but with its apex slanting from the abaxial to the adaxial side, and therefore corresponds with *A. pseudocotula* subsp. *rotata* (Boiss.) Eig; while the achenes of *Vogt 9033* have the bald and rounded apices typical for *A. pseudocotula* (subsp. *rotata*) var. *rotundata* Eig; *A. pseudocotula* is therefore represented in Cyprus by at least three of the varieties and two of the subspecies accepted by Eig (1938) and Yavin (1970). As Yavin (1970) pointed out when studying populations of *A. pseudocotula* in Palestina, the different achene types occur even within the same population. Therefore, the taxonomic acknowledgement of these types on a higher taxonomic level than forma seems questionable. Pending a biosystematic study of this species on a larger geographic scale, all Cyprian specimens are assigned to a not further subdivided *A. pseudocotula*.

Chromosome numbers. — No Cyprian material of *Anthemis pseudocotula* had previously been studied. Reports from other regions of the distributional range of this species were given by Yavin (1970: Israel) and Brullo & al. (1990: Libya).

Plants from two populations yielded $n = 9$ and $2n = 18$ chromosomes, respectively. No peculiarities in meiosis were detected, the chromosomes during diakinesis and metaphase being arranged in nine regular bivalents.

The diploid complement (Fig. 1F, Fig. 7) comprises five pairs of ± metacentric chromosomes, two pairs with a submetacentric position of the centromer and two pairs of subtelocentric chromosomes ($2n = 18 = 10m + 4sm + 2st\text{-}sat + 2st$).

The karyotype asymmetry index (AsI %, calculated by the formula: long arms in chromosome set / chromosome length in its set × 100) was found to be 60.8 %, and the ratio longest pair / shortest pair was 1.4, indicating a very symmetrical karyotype. In all examined mitotic plates one additional B-chromosome was found.

$n = 9$. **Limassol:** Kambou - Souni, *14-549*.

$2n = 18 + 1B$. **Paphos:** Paphos-Habour *Vogt 9000* (Fig. 1F, Fig. 7).

Specimens studied

Larnaka: salt lake near Larnaka, 1-2 m, 13 Apr 1991, *Vogt 6-8057-2* (B; Herb. Vogt); Pervolia, roadsides and fallow land in the village, c. 10 m, 10 Apr 1991, *Vogt 9033* (B; Herb. Vogt). **Limassol:** W Limassol, zwischen Evdhimou- und Pissouri-Beach, Strandvegetation, Phrygana, 4 Apr 1993, *Lange 5947* (Herb. Lange); between Kambou and Souni, garrigue, limestone and marl, 280 m, 17 Apr 1991, *14-549* (B). **Paphos:** junction of the track to Ayia (Panayi), valley of Ezoussas, volcanic rocks, c. 450

m, 23 Apr 1991, *26A-1198* (B); between Nata and Axylon, garrigue, limestone and marl-limestone, 350-400 m, 22 Apr 1991, *Vogt 23-8568* (B; Herb. Vogt); between Paphos harbour and the lighthouse, 34°45'N, 32°24'E, sandy plains and limestone rocks, 3-20 m, 2 May 1991, *Vogt 9000* (B; Herb. Vogt).

3. *Anthemis cotula* L.

This species of *Anthemis* sect. *Maruta* is widespread in Europe and the Mediterranean region, and introduced as a weed in many countries of the temperate parts of the world.

According to specimens cited in Meikle (1985: 916), *Anthemis cotula* is common all over the island on roadsides, cultivated and fallow land, and occurs occasionally also in natural habitats.

Specimens studied

Larnaka: Larnaka salt-lake, salt-marsh, 0 m, 20 Apr 1989, *Christodoulou* (CYP N° 460). **Paphos:** Kidhasi, valley of Dhiarizos, river bank and meadows, 27 Apr 1991, *Vogt 35-8953* (B; Herb. Vogt).

4. *Anthemis rigida* Boiss. ex Heldr.

The discoid *Anthemis rigida* (*Anthemis sect. Anthemis*) ranges from Greece, Crete and the Aegean Islands to W. and S. Turkey. It is restricted to sandy or stony ground near the sea from sea-level to 150 m. In Crete it is known to ascend to even higher altitudes around 500-1000 m.

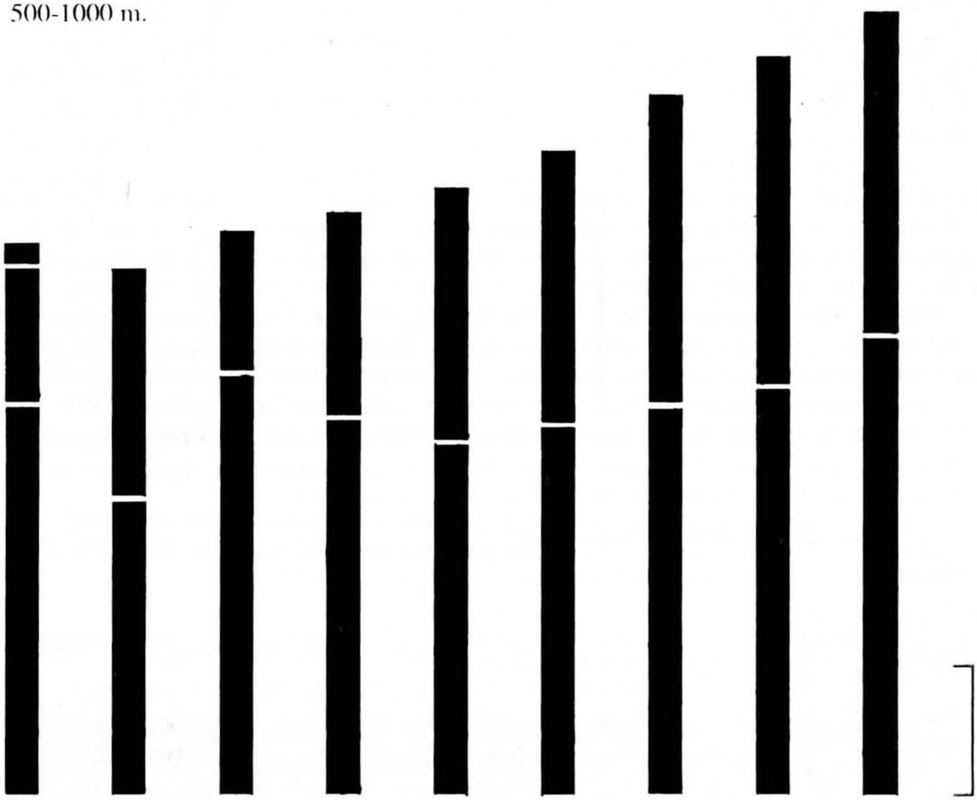

Fig. 7. Idiogram of *Anthemis pseudocotula (Vogt 9000)* — Scale bar = 1µm.

Specimens studied

Larnaka: Perivolia, beach and sandy rubble piles, 0-5 m, 10 Apr 1991, *1-2* (B); Cape Greco, limestone rocks (lower Miocene) and sand, 10-20 m, 12 Apr 1991, *Vogt 5-8044* (B; Herb. Vogt). **Paphos:** beach of "Petra-tou-Romiou", sand and rocks, 0-5 m, 27 Apr 1991, *Vogt 36-8971* (B; Herb. Vogt); sandy plains and limestone rocks between Paphos-Harbour and the lighthouse, 34°45'N, 32°24'E, 3-20 m, 02 May 1991, *Vogt* 8999 (B; Herb. Vogt); Mouti tis Sotiras (Akamas), pathside, 150 m, 21 Feb 1989, *Christodoulou* (CYP N° 198).

5. *Anthemis tomentosa* L.

As noted by Meikle (1985: 919), the mention of a member of the *Anthemis tomentosa* group (*A.* sect. *Anthemis*) for Cyprus dates back to the report of *A. peregrina* L. in Unger & Kotschy (1865: 237), where that species is stated to be rather common on the island ("In Cypern nicht selten"). The absence of a precise localisation in Unger & Kotschy (1865), along with the absence of this species in the collections of subsequent botanists visting Cyprus, led Meikle (1985) to question its occurrence on the island. Most recently, Della & Iatrou (1995) confirmed the presence of *A. peregrina* in Cyprus in a paper on floristic novelties.

During OPTIMA's Iter Mediterraneum IV, one of us (R. V.) had the opportunity to visit to the Herbarium of the Forest Department of the Ministry of Agriculture and Natural Recources in Nikosia and have a look to the *Anthemis* specimens deposited there, which included a specimen from W. Cyprus provisionally labelled as *Anthemis peregrina* L., which was obtained on loan to Berlin. Additional specimens, some of them cited in the study of Della & Iatrou (1995), were found in the herbarium of the Royal Botanic Gardens Kew.

The *Anthemis tomentosa* group was recently revised by Georgiou (1990), who recognized four distinct species (*A. tomentosa* L., *A. peregrina* L., *A. werneri* Stoj. & Acht., and *A. scopulorum* Rech. f.) within this asseamblage of closely related taxa. Using her key, the specimens in question could be easily identified as *A. tomentosa* L. f. *tomentosa*, not *A. peregrina*. Following Georgiou (1990), the former taxon is restricted to the coasts of E. Greece, the Aegean area, and W. Turkey, while the latter is confined to the coasts of the Ionian and East Aegean Sea. The present specimen-based indication of *A. tomentosa* for Cyprus, together with a report in the Flora of Turkey (Davis 1975: 203) for the region around Antalya in S. Anatolia, shifts eastwards the border area of this species.

Because a detailed description of *Anthemis tomentosa* is missing in Meikle (1985), it is given below, based exclusively on Cyprian plant material, following the style of Meikle's *Flora*.

Anthemis tomentosa L., Sp. Pl.: 893 (1753). — Lectotype (designated by Georgiou 1990): Herb. Clifford: 415 N° 3 (BM, photo!).

Procumbent annual. Stems whitish tomentose, 10-30 cm long, usually much branched. Basal leaves 1.5-2 cm long, 0.5-0.8 cm wide, bipinnatisect, leavebase with teeth, whitish tomentose, ultimate segments lanceolate and obtuse. Middle cauline leaves 1.0-1.5 cm long, 0.5-0.8 cm wide, pinnatipartite to bipinnatipartite, sessile, leavebase with teeth, whitish tomentose. Upper cauline leaves 0.5-1.4 cm long, 0.1-0.6 cm wide, sessile, entire to pinnatisect. Peduncles 2-6 cm long. Involucre 8-12 in diametre. Phyllaries imbricate in 3 series, the outermost narrow triangular, around 3.5 mm long and 1 mm wide, acuminate, densly tomentose on the outer surface, with a very narrow brown hyaline margin, the middle ones ovate, around 4 mm long and 2 mm wide, acuminate, densly tomentose on the outer surface, the innermost elliptical to obovate, around 5 mm long and 2 mm wide, acuminate, with a broad hyaline membranous margin, abaxially densly tomentose only in the upper half. Receptacle conical, covered all over with receptacular scales. Receptacular scales elliptical to obovate, around 3 mm long and up to 1.3 mm wide, hyaline-membranous, with a distinct midrib and apically erose margin, abruptly acuminate. Ray-florets sterile, white, up to 10 mm long and 3.5 mm wide, tube around 3.5 mm long. Tubular florets yellow, around 4 mm long. Achenes obconical, up to 2 mm long, obscurely 4-angled, with a lop-sided apex and an adaxial, erose corona about 0.1 mm long.

Habitat. — Sandy and stony grounds near the sea, sea-level, fl. April.

Distribution. — Greece, W. and S. Turkey.

Note. — Following Georgiou (1990) *Anthemis peregrina* L. differs from *A. tomentosa* L. by being less densely tomentose and having more strongly dissected leaves with oblong-linear and cuspidate ultimate segments.

Specimens studied

Paphos: Paphos, Umgebung der "Königsgräber", Felstriften, Ruderalvegetation, 14 Apr 1993, *Lange 6053* (Herb. Lange); Pharos, near Kato Paphos, sandy seashore, sea-level, 22 Apr 1989, *Christodoulou* (CYP N° 477); ibid., 6 May 1990, *Christodoulou 856* (K); ibid., about sea-level, roadside, 2 Apr 1989, *Christodoulou 418* (K); ibid., sea level, on sand by the sea, 1 Apr 1979, *Kyriakou 1856* (K)..

6. *Anthemis amblyolepis* Eig and ***Anthemis palaestina*** (Reut. ex Kotschy) Boiss.

These E. Mediterranean species of *Anthemis* subg. *Cota* are closely related and often regarded as subspecies, e.g. in Feinbrun-Dothan (1978: 336). As stated by Meikle (1985) *A. amblyolepis* is much less common on Cyprus than *A. palaestina*. This observation is confirmed by our collections listed below.

All the excursion's official collections belonging to *Anthemis* subg. *Cota* turned out to represent *A. palaestina*. Only one plant collected by the second author showed the truncate receptacular scales typical of *A. amblyolepis*.

Specimens studied

Anthemis amblyolepis — **Limassol:** Curium, rocky ground by the sea, 0 m, 5 Apr 1989, *Christodoulou* (CYP N° 432). **Paphos:** Kidhasi, valley of Dhiarizos, river bank and meadows, 27 Apr 1991, *Vogt 35-8951* (B; Herb. Vogt).

Anthemis palaestina — **Larnaka:** Kato Lefkara, track to Vavla, marles and limestone, garrigue and meadows, 520 m, 18 Apr 1991, *Vogt 17-8461* (B; Herb. Vogt); Stavrovouni, reforestation area, diabase, basalt and gabbro, 450-800 m, 15 Apr 1991, *Vogt 12-9035* (B; Herb. Vogt); Pervolia, roadsides and fallow land in the village, c. 10 m, 10 Apr 1991, *Vogt 9036* (B; Herb. Vogt). **Limassol:** between Kambou and Souni, garrigue, limestone and marl, 280 m, 17 Apr 1991, *Vogt 14-9034* (B; Herb. Vogt); between Mandria and Ayios Nikolaos, roadsides and garrigue, gabbro and limestone, 27 Apr 1991, *34-1601* (B). **Nikosia:** Klirou junction, field margin, 250 m, 2 Mar 1989, *Christodoulou* (CYP N° 235). **Paphos:** between Nata and Axylon, garrigue, limestone and marl-limestone, 350-400 m, 22 Apr 1991, *Vogt 23-8569* (B; Herb. Vogt); Pano Panayia, limestone, garrigue and meadows, 820 m, 22 Apr 1991, *Vogt 25-9030* (B; Herb. Vogt); near Dhrouschia and Inia, west of mount Lara, meadows and big rocks of triasic sandstones, 550 m, 24 Apr 1991, *29-1366* (B).

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